

# Computer algebra independent integration tests

4-Trig-functions/4.2-Cosine/4.2.7-d-trig- $\hat{m}$ -a+b-c-cos- $\hat{n}$ - $\hat{p}$

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## Contents

<b>1</b>	<b>Introduction</b>	<b>3</b>
1.1	Listing of CAS systems tested . . . . .	3
1.2	Results . . . . .	3
1.3	Performance . . . . .	5
1.4	list of integrals that has no closed form antiderivative . . . . .	6
1.5	list of integrals solved by CAS but has no known antiderivative . . . . .	6
1.6	list of integrals solved by CAS but failed verification . . . . .	6
1.7	Timing . . . . .	7
1.8	Verification . . . . .	7
1.9	Important notes about some of the results . . . . .	7
1.10	Design of the test system . . . . .	8
<b>2</b>	<b>detailed summary tables of results</b>	<b>11</b>
2.1	List of integrals sorted by grade for each CAS . . . . .	11
2.2	Detailed conclusion table per each integral for all CAS systems . . . . .	12
2.3	Detailed conclusion table specific for Rubi results . . . . .	26
<b>3</b>	<b>Listing of integrals</b>	<b>31</b>
3.1	$\int \frac{\sin^6(x)}{a-a \cos^2(x)} dx$ . . . . .	31
3.2	$\int \frac{\sin^5(x)}{a-a \cos^2(x)} dx$ . . . . .	34
3.3	$\int \frac{\sin^4(x)}{a-a \cos^2(x)} dx$ . . . . .	37
3.4	$\int \frac{\sin^3(x)}{a-a \cos^2(x)} dx$ . . . . .	40
3.5	$\int \frac{\sin^2(x)}{a-a \cos^2(x)} dx$ . . . . .	43
3.6	$\int \frac{\sin(x)}{a-a \cos^2(x)} dx$ . . . . .	45
3.7	$\int \frac{\csc(x)}{a-a \cos^2(x)} dx$ . . . . .	48
3.8	$\int \frac{\csc^2(x)}{a-a \cos^2(x)} dx$ . . . . .	51
3.9	$\int \frac{\csc^3(x)}{a-a \cos^2(x)} dx$ . . . . .	54
3.10	$\int \frac{\sin^7(x)}{a+b \cos^2(x)} dx$ . . . . .	57
3.11	$\int \frac{\sin^5(x)}{a+b \cos^2(x)} dx$ . . . . .	60
3.12	$\int \frac{\sin^3(x)}{a+b \cos^2(x)} dx$ . . . . .	63

3.13	$\int \frac{\sin(x)}{a+b \cos^2(x)} dx$	66
3.14	$\int \frac{\csc(x)}{a+b \cos^2(x)} dx$	69
3.15	$\int \frac{\csc^3(x)}{a+b \cos^2(x)} dx$	72
3.16	$\int \frac{\csc^5(x)}{a+b \cos^2(x)} dx$	75
3.17	$\int \frac{\sin^6(x)}{a+b \cos^2(x)} dx$	79
3.18	$\int \frac{\sin^4(x)}{a+b \cos^2(x)} dx$	83
3.19	$\int \frac{\sin^2(x)}{a+b \cos^2(x)} dx$	86
3.20	$\int \frac{1}{a+b \cos^2(x)} dx$	89
3.21	$\int \frac{\csc^2(x)}{a+b \cos^2(x)} dx$	92
3.22	$\int \frac{\csc^4(x)}{a+b \cos^2(x)} dx$	95
3.23	$\int \frac{\csc^6(x)}{a+b \cos^2(x)} dx$	98
3.24	$\int \frac{\sin(x)}{4-3 \cos^3(x)} dx$	101
3.25	$\int \frac{1}{1-\cos^2(x)} dx$	105
3.26	$\int \frac{1}{(1-\cos^2(x))^2} dx$	108
3.27	$\int \frac{1}{(1-\cos^2(x))^3} dx$	111
3.28	$\int \frac{\cos^7(x)}{a+b \cos^2(x)} dx$	114
3.29	$\int \frac{\cos^5(x)}{a+b \cos^2(x)} dx$	117
3.30	$\int \frac{\cos^3(x)}{a+b \cos^2(x)} dx$	120
3.31	$\int \frac{\cos(x)}{a+b \cos^2(x)} dx$	123
3.32	$\int \frac{\sec(x)}{a+b \cos^2(x)} dx$	126
3.33	$\int \frac{\sec^3(x)}{a+b \cos^2(x)} dx$	129
3.34	$\int \frac{\sec^5(x)}{a+b \cos^2(x)} dx$	132
3.35	$\int \frac{\cos^6(x)}{a+b \cos^2(x)} dx$	136
3.36	$\int \frac{\cos^4(x)}{a+b \cos^2(x)} dx$	140
3.37	$\int \frac{\cos^2(x)}{a+b \cos^2(x)} dx$	143
3.38	$\int \frac{1}{a+b \cos^2(x)} dx$	146
3.39	$\int \frac{\sec^2(x)}{a+b \cos^2(x)} dx$	149
3.40	$\int \frac{\sec^4(x)}{a+b \cos^2(x)} dx$	152
3.41	$\int \frac{\sec^6(x)}{a+b \cos^2(x)} dx$	155
3.42	$\int \frac{1}{(a+b \cos^2(x))^2} dx$	158
3.43	$\int \frac{1}{(a+b \cos^2(x))^3} dx$	161
3.44	$\int \frac{1}{1+\cos^2(x)} dx$	165
3.45	$\int \frac{1}{(1+\cos^2(x))^2} dx$	168
3.46	$\int \frac{1}{(1+\cos^2(x))^3} dx$	171
3.47	$\int \sqrt{1-\cos^2(x)} dx$	175
3.48	$\int \sqrt{-1+\cos^2(x)} dx$	178
3.49	$\int (1-\cos^2(x))^{3/2} dx$	181
3.50	$\int (-1+\cos^2(x))^{3/2} dx$	184

3.51	$\int \frac{1}{\sqrt{1-\cos^2(x)}} dx$	187
3.52	$\int \frac{1}{\sqrt{-1+\cos^2(x)}} dx$	190
3.53	$\int \frac{1}{(1-\cos^2(x))^{3/2}} dx$	193
3.54	$\int \frac{1}{(-1+\cos^2(x))^{3/2}} dx$	196
3.55	$\int \sqrt{1+\cos^2(x)} dx$	199
3.56	$\int \sqrt{-1-\cos^2(x)} dx$	201
3.57	$\int \sqrt{a+b\cos^2(x)} dx$	204
3.58	$\int (1+\cos^2(x))^{3/2} dx$	207
3.59	$\int (-1-\cos^2(x))^{3/2} dx$	210
3.60	$\int (a+b\cos^2(x))^{3/2} dx$	213
3.61	$\int \frac{1}{\sqrt{1+\cos^2(x)}} dx$	216
3.62	$\int \frac{1}{\sqrt{-1-\cos^2(x)}} dx$	218
3.63	$\int \frac{1}{\sqrt{a+b\cos^2(x)}} dx$	221
3.64	$\int \frac{1}{(1+\cos^2(x))^{3/2}} dx$	224
3.65	$\int \frac{1}{(-1-\cos^2(x))^{3/2}} dx$	227
3.66	$\int \frac{1}{(a+b\cos^2(x))^{3/2}} dx$	230
3.67	$\int \frac{\cos(x)}{\sqrt{1+\cos^2(x)}} dx$	233
3.68	$\int \frac{\cos(5+3x)}{\sqrt{3+\cos^2(5+3x)}} dx$	236
3.69	$\int \frac{\cos(x)}{\sqrt{4-\cos^2(x)}} dx$	239
3.70	$\int \frac{1}{a+b\cos^4(x)} dx$	242
3.71	$\int \frac{1}{a-b\cos^4(x)} dx$	248
3.72	$\int \frac{1}{1+\cos^4(x)} dx$	251
3.73	$\int \frac{1}{1-\cos^4(x)} dx$	255
3.74	$\int \frac{1}{a+b\cos^5(x)} dx$	258
3.75	$\int \frac{1}{a+b\cos^6(x)} dx$	261
3.76	$\int \frac{1}{a+b\cos^8(x)} dx$	264
3.77	$\int \frac{1}{a-b\cos^5(x)} dx$	267
3.78	$\int \frac{1}{a-b\cos^6(x)} dx$	270
3.79	$\int \frac{1}{a-b\cos^8(x)} dx$	273
3.80	$\int \frac{1}{1+\cos^5(x)} dx$	276
3.81	$\int \frac{1}{1+\cos^6(x)} dx$	280
3.82	$\int \frac{1}{1+\cos^8(x)} dx$	283
3.83	$\int \frac{1}{1-\cos^5(x)} dx$	286
3.84	$\int \frac{1}{1-\cos^6(x)} dx$	290
3.85	$\int \frac{1}{1-\cos^8(x)} dx$	294
3.86	$\int \frac{\tan(x)}{1+\cos^2(x)} dx$	297
3.87	$\int \sqrt{a+b\cos^2(x)} \tan(x) dx$	300
3.88	$\int \sqrt{1-\cos^2(x)} \tan(x) dx$	303
3.89	$\int \frac{\tan(x)}{\sqrt{a+b\cos^2(x)}} dx$	306
3.90	$\int \frac{\tan(x)}{\sqrt{1+\cos^2(x)}} dx$	309

3.91	$\int \frac{\tan(x)}{\sqrt{1-\cos^2(x)}} dx$	312
3.92	$\int \frac{\tan^3(x)}{a+b \cos^3(x)} dx$	315
3.93	$\int \sqrt{a+b \cos^3(x)} \tan(x) dx$	319
3.94	$\int \frac{\tan(x)}{\sqrt{a+b \cos^3(x)}} dx$	322
3.95	$\int \sqrt{a+b \cos^4(x)} \tan(x) dx$	325
3.96	$\int \frac{\tan(x)}{\sqrt{a+b \cos^4(x)}} dx$	328
3.97	$\int \sqrt{a+b \cos^n(x)} \tan(x) dx$	331
3.98	$\int \frac{\tan(x)}{\sqrt{a+b \cos^n(x)}} dx$	334
<b>4</b>	<b>Listing of Grading functions</b>	<b>337</b>

# Chapter 1

## Introduction

This report gives the result of running the computer algebra independent integration problems. The listing of the problems are maintained by and can be downloaded from <https://rulebasedintegration.org>

The number of integrals in this report is [ 98 ]. This is test number [ 95 ].

### 1.1 Listing of CAS systems tested

The following systems were tested at this time.

1. Mathematica 12.1 (64 bit) on windows 10.
2. Rubi 4.16.1 in Mathematica 12 on windows 10.
3. Maple 2020 (64 bit) on windows 10.
4. Maxima 5.43 on Linux. (via sagemath 8.9)
5. Fricas 1.3.6 on Linux (via sagemath 9.0)
6. Sympy 1.5 under Python 3.7.3 using Anaconda distribution.
7. Giac/Xcas 1.5 on Linux. (via sagemath 8.9)

Maxima, Fricas and Giac/Xcas were called from inside SageMath. This was done using SageMath integrate command by changing the name of the algorithm to use the different CAS systems.

Sympy was called directly using Python.

### 1.2 Results

Important note: A number of problems in this test suite have no antiderivative in closed form. This means the antiderivative of these integrals can not be expressed in terms of elementary, special functions or Hypergeometric2F1 functions. RootSum and RootOf are not allowed.

If a CAS returns the above integral unevaluated within the time limit, then the result is counted as passed and assigned an A grade.

However, if CAS times out, then it is assigned an F grade even if the integral is not integrable, as this implies CAS could not determine that the integral is not integrable in the time limit.

If a CAS returns an antiderivative to such an integral, it is assigned an A grade automatically and this special result is listed in the introduction section of each individual test report to make it easy to identify as this can be important result to investigate.

The results given in in the table below reflects the above.

System	solved	Failed
Rubi	% 100. ( 98 )	% 0. ( 0 )
Mathematica	% 100. ( 98 )	% 0. ( 0 )
Maple	% 100. ( 98 )	% 0. ( 0 )
Maxima	% 32.65 ( 32 )	% 67.35 ( 66 )
Fricas	% 71.43 ( 70 )	% 28.57 ( 28 )
Sympy	% 15.31 ( 15 )	% 84.69 ( 83 )
Giac	% 68.37 ( 67 )	% 31.63 ( 31 )

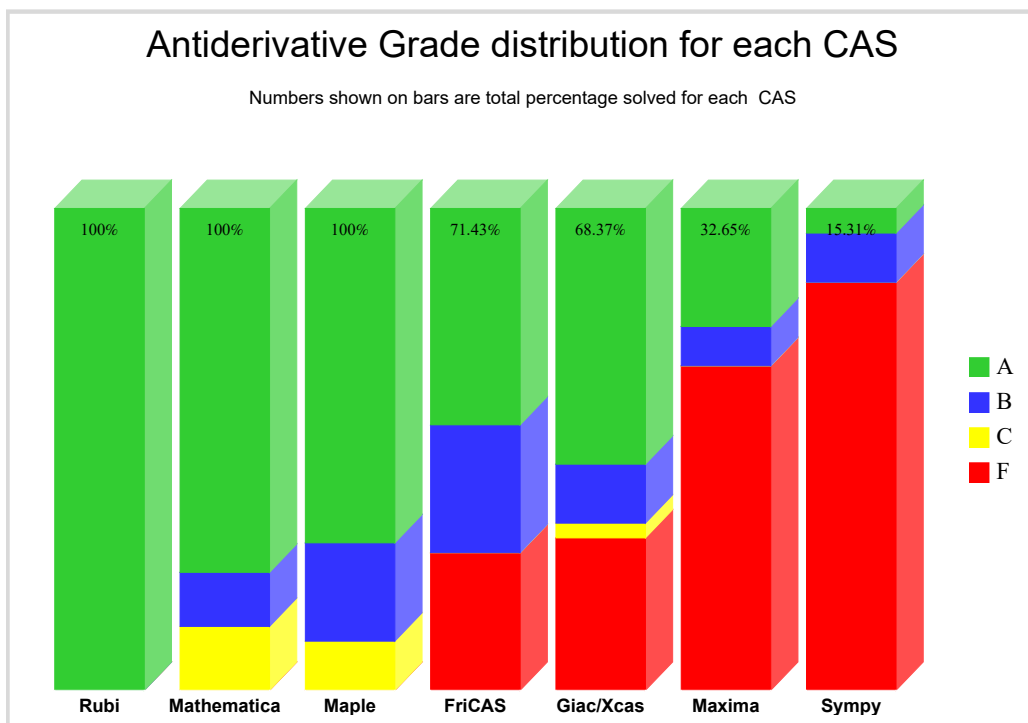
The table below gives additional break down of the grading of quality of the antiderivatives generated by each CAS. The grading is given using the letters A,B,C and F with A being the best quality. The grading is accomplished by comparing the antiderivative generated with the optimal antiderivatives included in the test suite. The following table describes the meaning of these grades.

grade	description
A	Integral was solved and antiderivative is optimal in quality and leaf size.
B	Integral was solved and antiderivative is optimal in quality but leaf size is larger than twice the optimal antiderivatives leaf size.
C	Integral was solved and antiderivative is non-optimal in quality. This can be due to one or more of the following reasons <ol style="list-style-type: none"> <li>1. antiderivative contains a hypergeometric function and the optimal antiderivative does not.</li> <li>2. antiderivative contains a special function and the optimal antiderivative does not.</li> <li>3. antiderivative contains the imaginary unit and the optimal antiderivative does not.</li> </ol>
F	Integral was not solved. Either the integral was returned unevaluated within the time limit, or it timed out, or CAS hanged or crashed or an exception was raised.

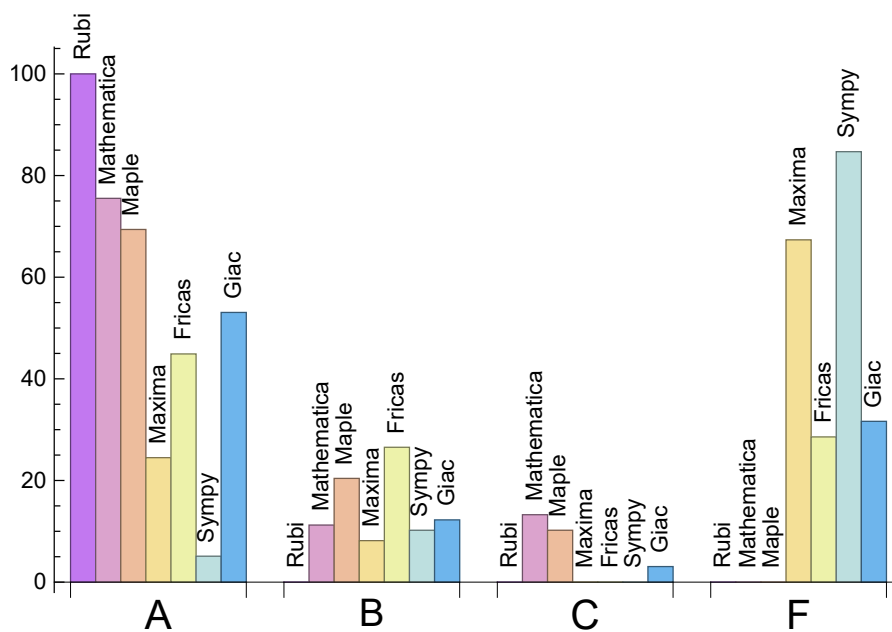
Grading is implemented for all CAS systems. Based on the above, the following table summarizes the grading for this test suite.

System	% A grade	% B grade	% C grade	% F grade
Rubi	100.	0.	0.	0.
Mathematica	75.51	11.22	13.27	0.
Maple	69.39	20.41	10.2	0.
Maxima	24.49	8.16	0.	67.35
Fricas	44.9	26.53	0.	28.57
Sympy	5.1	10.2	0.	84.69
Giac	53.06	12.24	3.06	31.63

The following is a Bar chart illustration of the data in the above table.



The figure below compares the CAS systems for each grade level.



### 1.3 Performance

The table below summarizes the performance of each CAS system in terms of CPU time and leaf size of results.

System	Mean time (sec)	Mean size	Normalized mean	Median size	Normalized median
Rubi	0.11	71.99	1.	41.5	1.
Mathematica	0.13	67.76	1.19	45.	1.
Maple	0.2	97.41	1.37	49.5	1.07
Maxima	1.33	57.88	2.41	27.	1.32
Fricas	2.3	384.33	7.57	249.5	6.99
Sympy	7.17	127.8	4.34	78.	3.35
Giac	1.18	76.12	1.84	61.	1.67

## 1.4 list of integrals that has no closed form antiderivative

{

## 1.5 list of integrals solved by CAS but has no known antiderivative

Rubi {

Mathematica {

Maple {

Maxima {

Fricas {

Sympy {

Giac {

## 1.6 list of integrals solved by CAS but failed verification

The following are integrals solved by CAS but the verification phase failed to verify the anti-derivative produced is correct. This does not mean necessarily that the anti-derivative is wrong, as additional methods of verification might be needed, or more time is needed (3 minutes time limit was used). These integrals are listed here to make it easier to do further investigation to determine why it was not possible to verify the result produced.

Rubi {

Mathematica {74, 76, 77, 79}

Maple Verification phase not implemented yet.

Maxima Verification phase not implemented yet.

Fricas Verification phase not implemented yet.

Sympy Verification phase not implemented yet.

Giac Verification phase not implemented yet.



## 1.7 Timing

The command `AboluteTiming[]` was used in Mathematica to obtain the elapsed time for each integrate call. In Maple, the command `Usage` was used as in the following example

```
cpu_time := Usage(assign ('result_of _int',int(expr,x)),output='realtime')
```

For all other CAS systems, the elapsed time to complete each integral was found by taking the difference between the time after the call has completed from the time before the call was made. This was done using Python's `time.time()` call.

All elapsed times shown are in seconds. A time limit of 3 minutes was used for each integral. If the integrate command did not complete within this time limit, the integral was aborted and considered to have failed and assigned an F grade. The time used by failed integrals due to time out is not counted in the final statistics.

## 1.8 Verification

A verification phase was applied on the result of integration for Rubi and Mathematica. Future version of this report will implement verification for the other CAS systems. For the integrals whose result was not run through a verification phase, it is assumed that the antiderivative produced was correct.

Verification phase has 3 minutes time out. An integral whose result was not verified could still be correct. Further investigation is needed on those integrals which failed verifications. Such integrals are marked in the summary table below and also in each integral separate section so they are easy to identify and locate.

## 1.9 Important notes about some of the results

### 1.9.1 Important note about Maxima results

Since these integrals are run in a batch mode, using an automated script, and by using `sagemath` (SageMath uses Maxima), then any integral where Maxima needs an interactive response from the user to answer a question during evaluation of the integral in order to complete the integration, will fail and is counted as failed.

The exception raised is `ValueError`. Therefore Maxima result below is lower than what could result if Maxima was run directly and each question Maxima asks was answered correctly.

The percentage of such failures were not counted for each test file, but for an example, for the Timofeev test file, there were about 30 such integrals out of total 705, or about 4 percent. This pecentage can be higher or lower depending on the specific input test file.

Such integrals can be indentified by looking at the output of the integration in each section for Maxima. If the output was an exception `ValueError` then this is most likely due to this reason.

Maxima integrate was run using SageMath with the following settings set by default

```
'besselexpand : true'
'display2d : false'
'domain : complex'
'keepfloat : true'
'load(to_poly_solve)'
'load(simplify_sum)'
'load(abs_integrate)' 'load(diag)'
```

SageMath loading of Maxima `abs_integrate` was found to cause some problem. So the following code was added to disable this effect.

```
from sage.interfaces.maxima_lib import maxima_lib
maxima_lib.set('extra_definite_integration_methods', '[]')
maxima_lib.set('extra_integration_methods', '[]')
```

See <https://ask.sagemath.org/question/43088/integrate-results-that-are-different-from-using-maxima/> for reference.

## 1.9.2 Important note about FriCAS and Giac/X-CAS results

There are Few integrals which failed due to SageMath not able to translate the result back to SageMath syntax and not because these CAS system were not able to do the integrations.

These will fail With error Exception raised: NotImplementedError

The number of such cases seems to be very small. About 1 or 2 percent of all integrals.

Hopefully the next version of SageMath will have complete translation of FriCAS and XCAS syntax and I will re-run all the tests again when this happens.

## 1.9.3 Important note about finding leaf size of antiderivative

For Mathematica, Rubi and Maple, the builtin system function LeafSize is used to find the leaf size of each antiderivative.

The other CAS systems (SageMath and Sympy) do not have special builtin function for this purpose at this time. Therefore the leaf size is determined as follows.

For Fricas, Giac and Maxima (all called via sagemath) the following code is used

#see <https://stackoverflow.com/questions/25202346/how-to-obtain-leaf-count-expression-size-in->

```
def tree(expr):
    if expr.operator() is None:
        return expr
    else:
        return [expr.operator()+map(tree, expr.operands())
```

```
try:
    # 1.35 is a fudge factor since this estimate of leaf count is bit lower than
    #what it should be compared to Mathematica's
    leafCount = round(1.35*len(flatten(tree(anti))))
except Exception as ee:
    leafCount =1
```

For Sympy, called directly from Python, the following code is used

```
try:
    # 1.7 is a fudge factor since it is low side from actual leaf count
    leafCount = round(1.7*count_ops(anti))

except Exception as ee:
    leafCount =1
```

When these cas systems have a builtin function to find the leaf size of expressions, it will be used instead, and these tests run again.

## 1.10 Design of the test system

The following diagram gives a high level view of the current test build system.



One record (line) per one integral result. The line is CSV comma separated. It contains 13 fields. This is description of each record (line)

1. integer, the problem number.
2. integer. 0 or 1 for failed or passed. (this is not the grade field)
3. integer. Leaf size of result.
4. integer. Leaf size of the optimal antiderivative.
5. number. CPU time used to solve this integral. 0 if failed.
6. string. The integral in Latex format
7. string. The input used in CAS own syntax.
8. string. The result (antiderivative) produced by CAS in Latex format
9. string. The optimal antiderivative in Latex format.
10. integer. 0 or 1. Indicates if problem has known antiderivative or not
11. String. The result (antiderivative) in CAS own syntax.
12. String. The grade of the antiderivative. Can be "A", "B", "C", or "F"
13. String. The optimal antiderivative in CAS own syntax.

### High level overview of the CAS independent integration test build system

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# Chapter 2

## detailed summary tables of results

### 2.1 List of integrals sorted by grade for each CAS

#### 2.1.1 Rubi

A grade: { 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98 }

B grade: { }

C grade: { }

F grade: { }

#### 2.1.2 Mathematica

A grade: { 1, 2, 3, 4, 5, 8, 10, 13, 14, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 71, 73, 81, 85, 86, 87, 89, 90, 93, 94, 95, 96, 97, 98 }

B grade: { 6, 7, 9, 11, 12, 15, 16, 33, 34, 88, 91 }

C grade: { 70, 72, 74, 75, 76, 77, 78, 79, 80, 82, 83, 84, 92 }

F grade: { }

#### 2.1.3 Maple

A grade: { 1, 2, 3, 4, 6, 8, 11, 12, 13, 14, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 53, 54, 57, 59, 60, 62, 63, 65, 66, 71, 72, 73, 81, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98 }

B grade: { 7, 9, 10, 15, 16, 17, 18, 34, 52, 55, 56, 58, 61, 64, 67, 68, 69, 70, 84, 85 }

C grade: { 5, 74, 75, 76, 77, 78, 79, 80, 82, 83 }

F grade: { }

#### 2.1.4 Maxima

A grade: { 1, 2, 3, 4, 5, 8, 9, 24, 25, 26, 27, 44, 45, 46, 47, 48, 49, 52, 67, 68, 69, 73, 81, 86 }

B grade: { 6, 7, 51, 53, 54, 88, 90, 91 }

C grade: { }

F grade: { 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 50, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 70, 71, 72, 74, 75, 76, 77, 78, 79, 80, 82, 83, 84, 85, 87, 89, 92, 93, 94, 95, 96, 97, 98 }

## 2.1.5 FriCAS

A grade: { 1, 2, 3, 4, 5, 8, 10, 11, 12, 13, 14, 17, 18, 19, 24, 28, 29, 30, 32, 33, 34, 35, 36, 37, 44, 45, 46, 47, 48, 49, 50, 51, 53, 73, 86, 87, 88, 89, 90, 93, 95, 96, 97, 98 }

B grade: { 6, 7, 9, 15, 16, 20, 21, 22, 23, 25, 26, 27, 31, 38, 39, 40, 41, 42, 43, 67, 68, 69, 70, 71, 81, 91 }

C grade: { }

F grade: { 52, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 72, 74, 75, 76, 77, 78, 79, 80, 82, 83, 84, 85, 92, 94 }

## 2.1.6 Sympy

A grade: { 5, 13, 24, 44, 73 }

B grade: { 1, 2, 3, 4, 6, 25, 26, 27, 45, 46 }

C grade: { }

F grade: { 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98 }

## 2.1.7 Giac

A grade: { 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 17, 18, 19, 20, 21, 22, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 67, 68, 69, 73, 86, 87, 89, 92, 93, 94, 95, 96 }

B grade: { 6, 7, 15, 16, 23, 47, 49, 53, 81, 88, 90, 91 }

C grade: { 48, 50, 54 }

F grade: { 24, 51, 52, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 70, 71, 72, 74, 75, 76, 77, 78, 79, 80, 82, 83, 84, 85, 97, 98 }

## 2.2 Detailed conclusion table per each integral for all CAS systems

Detailed conclusion table per each integral is given by table below. The elapsed time is in seconds. For failed result it is given as F(-1) if the failure was due to timeout. It is given as F(-2) if the failure was due to an exception being raised, which could indicate a bug in the system. If the failure was due to integral not being evaluated within the time limit, then it is given just an F.

In this table, the column **normalized size** is defined as  $\frac{\text{antiderivative leaf size}}{\text{optimal antiderivative leaf size}}$

Problem 1	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	B	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	33	33	26	42	50	62	473	42
normalized size	1	1.	0.79	1.27	1.52	1.88	14.33	1.27
time (sec)	N/A	0.052	0.004	0.083	1.424	1.891	16.231	1.153

Problem 2	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	B	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	19	19	19	16	19	39	162	19
normalized size	1	1.	1.	0.84	1.	2.05	8.53	1.
time (sec)	N/A	0.045	0.003	0.018	0.946	1.734	18.335	1.118

Problem 3	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	B	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	20	20	18	25	28	38	153	30
normalized size	1	1.	0.9	1.25	1.4	1.9	7.65	1.5
time (sec)	N/A	0.045	0.003	0.022	1.452	1.745	4.435	1.133

Problem 4	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	B	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	7	7	7	8	9	15	36	9
normalized size	1	1.	1.	1.14	1.29	2.14	5.14	1.29
time (sec)	N/A	0.041	0.002	0.015	0.946	1.853	2.009	1.123

Problem 5	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	C	A	A	A	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	5	5	5	8	7	7	2	7
normalized size	1	1.	1.	1.6	1.4	1.4	0.4	1.4
time (sec)	N/A	0.04	0.001	0.022	1.414	1.916	0.998	1.171

Problem 6	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	B	A	B	B	B	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	8	8	21	9	28	77	19	31
normalized size	1	1.	2.62	1.12	3.5	9.62	2.38	3.88
time (sec)	N/A	0.025	0.007	0.014	0.952	2.012	0.264	1.165

Problem 7	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	B	B	B	B	F	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	22	22	51	44	50	153	0	51
normalized size	1	1.	2.32	2.	2.27	6.95	0.	2.32
time (sec)	N/A	0.044	0.008	0.034	0.949	1.892	0.	1.16

Problem 8	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	19	19	21	18	23	76	0	23
normalized size	1	1.	1.11	0.95	1.21	4.	0.	1.21
time (sec)	N/A	0.048	0.003	0.03	0.942	1.825	0.	1.175

Problem 9	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	B	B	A	B	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	35	35	75	66	69	232	0	63
normalized size	1	1.	2.14	1.89	1.97	6.63	0.	1.8
time (sec)	N/A	0.055	0.006	0.037	0.952	1.97	0.	1.129

Problem 10	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	78	78	143	138	0	547	0	134
normalized size	1	1.	1.83	1.77	0.	7.01	0.	1.72
time (sec)	N/A	0.09	0.243	0.024	0.	2.087	0.	1.142

Problem 11	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	B	A	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	54	54	116	86	0	383	0	80
normalized size	1	1.	2.15	1.59	0.	7.09	0.	1.48
time (sec)	N/A	0.073	0.168	0.019	0.	1.777	0.	1.127

Problem 12	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	B	A	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	36	36	90	46	0	248	0	41
normalized size	1	1.	2.5	1.28	0.	6.89	0.	1.14
time (sec)	N/A	0.053	0.161	0.017	0.	1.745	0.	1.128

Problem 13	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	A	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	26	26	26	18	0	181	87	23
normalized size	1	1.	1.	0.69	0.	6.96	3.35	0.88
time (sec)	N/A	0.027	0.019	0.012	0.	1.671	1.947	1.123

Problem 14	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	42	42	50	56	0	329	0	68
normalized size	1	1.	1.19	1.33	0.	7.83	0.	1.62
time (sec)	N/A	0.049	0.047	0.036	0.	1.782	0.	1.201

Problem 15	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	B	B	F(-2)	B	F	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	62	62	140	111	0	713	0	139
normalized size	1	1.	2.26	1.79	0.	11.5	0.	2.24
time (sec)	N/A	0.086	0.508	0.041	0.	2.121	0.	1.157



Problem 16	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	B	B	F(-2)	B	F(-1)	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	94	94	204	205	0	1490	0	240
normalized size	1	1.	2.17	2.18	0.	15.85	0.	2.55
time (sec)	N/A	0.138	1.232	0.049	0.	2.499	0.	1.159

Problem 17	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	88	88	77	194	0	702	0	161
normalized size	1	1.	0.88	2.2	0.	7.98	0.	1.83
time (sec)	N/A	0.181	0.188	0.033	0.	1.933	0.	1.19

Problem 18	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	60	60	52	105	0	541	0	108
normalized size	1	1.	0.87	1.75	0.	9.02	0.	1.8
time (sec)	N/A	0.105	0.098	0.025	0.	1.9	0.	1.153

Problem 19	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	40	40	37	54	0	435	0	68
normalized size	1	1.	0.92	1.35	0.	10.88	0.	1.7
time (sec)	N/A	0.059	0.065	0.023	0.	1.976	0.	1.204

Problem 20	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	B	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	30	30	29	21	0	406	0	50
normalized size	1	1.	0.97	0.7	0.	13.53	0.	1.67
time (sec)	N/A	0.019	0.057	0.014	0.	1.803	0.	1.136

Problem 21	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	B	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	41	41	40	39	0	571	0	74
normalized size	1	1.	0.98	0.95	0.	13.93	0.	1.8
time (sec)	N/A	0.056	0.089	0.03	0.	1.911	0.	1.177

Problem 22	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	B	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	61	61	59	65	0	936	0	122
normalized size	1	1.	0.97	1.07	0.	15.34	0.	2.
time (sec)	N/A	0.08	0.2	0.038	0.	1.98	0.	1.217

Problem 23	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	B	F(-1)	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	89	89	90	106	0	1446	0	211
normalized size	1	1.	1.01	1.19	0.	16.25	0.	2.37
time (sec)	N/A	0.102	0.381	0.042	0.	2.043	0.	1.21

Problem 24	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	A	F(-2)
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	98	98	79	80	120	251	85	0
normalized size	1	1.	0.81	0.82	1.22	2.56	0.87	0.
time (sec)	N/A	0.09	0.098	0.017	1.439	1.753	3.141	0.

Problem 25	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	B	B	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	4	4	4	7	8	22	14	8
normalized size	1	1.	1.	1.75	2.	5.5	3.5	2.
time (sec)	N/A	0.014	0.002	0.014	0.957	1.593	0.597	1.179

Problem 26	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	B	B	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	13	13	17	14	19	73	34	19
normalized size	1	1.	1.31	1.08	1.46	5.62	2.62	1.46
time (sec)	N/A	0.015	0.003	0.017	0.963	1.539	2.429	1.217

Problem 27	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	B	B	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	21	21	27	20	27	112	54	27
normalized size	1	1.	1.29	0.95	1.29	5.33	2.57	1.29
time (sec)	N/A	0.017	0.004	0.017	0.952	1.589	9.119	1.164

Problem 28	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	78	78	111	78	0	597	0	130
normalized size	1	1.	1.42	1.	0.	7.65	0.	1.67
time (sec)	N/A	0.084	0.385	0.02	0.	1.911	0.	1.164

Problem 29	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	56	56	86	50	0	441	0	88
normalized size	1	1.	1.54	0.89	0.	7.88	0.	1.57
time (sec)	N/A	0.071	0.185	0.015	0.	1.871	0.	1.169

Problem 30	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	38	38	38	33	0	319	0	55
normalized size	1	1.	1.	0.87	0.	8.39	0.	1.45
time (sec)	N/A	0.055	0.029	0.013	0.	1.878	0.	1.157

Problem 31	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	B	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	29	29	29	21	0	228	0	42
normalized size	1	1.	1.	0.72	0.	7.86	0.	1.45
time (sec)	N/A	0.031	0.011	0.011	0.	1.783	0.	1.126

Problem 32	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	41	41	38	47	0	329	0	77
normalized size	1	1.	0.93	1.15	0.	8.02	0.	1.88
time (sec)	N/A	0.052	0.056	0.028	0.	1.878	0.	1.188

Problem 33	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	B	A	F(-2)	A	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	59	59	152	92	0	536	0	115
normalized size	1	1.	2.58	1.56	0.	9.08	0.	1.95
time (sec)	N/A	0.098	0.361	0.039	0.	1.997	0.	1.22

Problem 34	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	B	B	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	90	90	215	165	0	709	0	171
normalized size	1	1.	2.39	1.83	0.	7.88	0.	1.9
time (sec)	N/A	0.166	1.098	0.042	0.	2.135	0.	1.172

Problem 35	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	87	87	76	122	0	666	0	140
normalized size	1	1.	0.87	1.4	0.	7.66	0.	1.61
time (sec)	N/A	0.196	0.213	0.022	0.	1.944	0.	1.162

Problem 36	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	60	60	52	60	0	533	0	97
normalized size	1	1.	0.87	1.	0.	8.88	0.	1.62
time (sec)	N/A	0.098	0.121	0.02	0.	1.891	0.	1.174

Problem 37	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	38	38	36	32	0	447	0	65
normalized size	1	1.	0.95	0.84	0.	11.76	0.	1.71
time (sec)	N/A	0.06	0.079	0.017	0.	1.837	0.	1.184

Problem 38	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	B	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	30	30	29	21	0	406	0	50
normalized size	1	1.	0.97	0.7	0.	13.53	0.	1.67
time (sec)	N/A	0.019	0.048	0.001	0.	2.199	0.	1.177

Problem 39	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	B	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	37	37	38	33	0	543	0	49
normalized size	1	1.	1.03	0.89	0.	14.68	0.	1.32
time (sec)	N/A	0.061	0.074	0.028	0.	1.928	0.	1.124

Problem 40	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	B	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	56	56	55	51	0	672	0	96
normalized size	1	1.	0.98	0.91	0.	12.	0.	1.71
time (sec)	N/A	0.086	0.135	0.03	0.	1.893	0.	1.191

Problem 41	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	B	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	79	79	80	80	0	832	0	140
normalized size	1	1.	1.01	1.01	0.	10.53	0.	1.77
time (sec)	N/A	0.101	0.319	0.034	0.	1.848	0.	1.183

Problem 42	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	B	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	65	65	70	81	0	774	0	93
normalized size	1	1.	1.08	1.25	0.	11.91	0.	1.43
time (sec)	N/A	0.049	0.222	0.02	0.	1.91	0.	1.162

Problem 43	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	B	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	107	107	106	175	0	1381	0	201
normalized size	1	1.	0.99	1.64	0.	12.91	0.	1.88
time (sec)	N/A	0.117	0.615	0.022	0.	2.189	0.	1.151

Problem 44	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	A	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	34	34	15	14	18	99	63	62
normalized size	1	1.	0.44	0.41	0.53	2.91	1.85	1.82
time (sec)	N/A	0.013	0.024	0.011	1.484	1.617	1.075	1.186

Problem 45	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	B	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	55	55	35	27	35	178	218	80
normalized size	1	1.	0.64	0.49	0.64	3.24	3.96	1.45
time (sec)	N/A	0.026	0.076	0.017	1.492	1.661	7.46	1.195

Problem 46	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	B	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	71	71	51	35	55	251	439	92
normalized size	1	1.	0.72	0.49	0.77	3.54	6.18	1.3
time (sec)	N/A	0.052	0.123	0.016	1.458	1.635	34.938	1.227

Problem 47	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	F	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	12	12	12	13	14	12	0	32
normalized size	1	1.	1.	1.08	1.17	1.	0.	2.67
time (sec)	N/A	0.016	0.006	0.463	1.445	1.9	0.	1.271

Problem 48	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	F	C
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	14	14	14	14	16	4	0	38
normalized size	1	1.	1.	1.	1.14	0.29	0.	2.71
time (sec)	N/A	0.016	0.005	0.231	1.457	1.779	0.	1.178

Problem 49	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	F(-1)	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	29	29	23	19	15	31	0	61
normalized size	1	1.	0.79	0.66	0.52	1.07	0.	2.1
time (sec)	N/A	0.022	0.026	0.756	1.636	1.724	0.	1.213

Problem 50	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F	A	F(-1)	C
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	33	33	25	21	0	4	0	74
normalized size	1	1.	0.76	0.64	0.	0.12	0.	2.24
time (sec)	N/A	0.025	0.026	0.464	0.	1.548	0.	1.244

Problem 51	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	B	A	F	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	15	15	28	14	47	77	0	0
normalized size	1	1.	1.87	0.93	3.13	5.13	0.	0.
time (sec)	N/A	0.02	0.015	0.336	1.64	1.612	0.	0.

Problem 52	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	A	F(-2)	F	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	17	17	30	34	23	0	0	0
normalized size	1	1.	1.76	2.	1.35	0.	0.	0.
time (sec)	N/A	0.018	0.01	0.233	1.584	0.	0.	0.

Problem 53	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	B	A	F(-1)	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	32	32	51	37	405	150	0	105
normalized size	1	1.	1.59	1.16	12.66	4.69	0.	3.28
time (sec)	N/A	0.027	0.044	0.812	1.638	1.61	0.	1.275

Problem 54	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	B	F(-2)	F(-1)	C
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	36	36	53	51	383	0	0	122
normalized size	1	1.	1.47	1.42	10.64	0.	0.	3.39
time (sec)	N/A	0.026	0.03	0.499	1.671	0.	0.	1.296

Problem 55	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	F	F	F	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	9	9	11	41	0	0	0	0
normalized size	1	1.	1.22	4.56	0.	0.	0.	0.
time (sec)	N/A	0.008	0.021	0.747	0.	0.	0.	0.

Problem 56	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	F	F	F	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	32	32	34	75	0	0	0	0
normalized size	1	1.	1.06	2.34	0.	0.	0.	0.
time (sec)	N/A	0.022	0.038	1.302	0.	0.	0.	0.

Problem 57	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F	F	F	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	42	42	46	49	0	0	0	0
normalized size	1	1.	1.1	1.17	0.	0.	0.	0.
time (sec)	N/A	0.035	0.072	0.336	0.	0.	0.	0.

Problem 58	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	F	F	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	43	43	39	101	0	0	0	0
normalized size	1	1.	0.91	2.35	0.	0.	0.	0.
time (sec)	N/A	0.054	0.048	1.055	0.	0.	0.	0.

Problem 59	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F	F	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	89	89	66	110	0	0	0	0
normalized size	1	1.	0.74	1.24	0.	0.	0.	0.
time (sec)	N/A	0.094	0.068	1.364	0.	0.	0.	0.

Problem 60	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F	F	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	121	121	123	192	0	0	0	0
normalized size	1	1.	1.02	1.59	0.	0.	0.	0.
time (sec)	N/A	0.162	0.452	0.783	0.	0.	0.	0.

Problem 61	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	F	F	F	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	9	9	11	41	0	0	0	0
normalized size	1	1.	1.22	4.56	0.	0.	0.	0.
time (sec)	N/A	0.008	0.033	0.683	0.	0.	0.	0.

Problem 62	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F	F	F	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	32	32	33	62	0	0	0	0
normalized size	1	1.	1.03	1.94	0.	0.	0.	0.
time (sec)	N/A	0.018	0.04	0.943	0.	0.	0.	0.

Problem 63	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F	F	F	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	42	42	46	48	0	0	0	0
normalized size	1	1.	1.1	1.14	0.	0.	0.	0.
time (sec)	N/A	0.029	0.064	0.37	0.	0.	0.	0.

Problem 64	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	F	F	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	32	32	35	70	0	0	0	0
normalized size	1	1.	1.09	2.19	0.	0.	0.	0.
time (sec)	N/A	0.018	0.06	1.058	0.	0.	0.	0.

Problem 65	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F	F	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	56	56	43	101	0	0	0	0
normalized size	1	1.	0.77	1.8	0.	0.	0.	0.
time (sec)	N/A	0.033	0.041	1.184	0.	0.	0.	0.

Problem 66	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F	F	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	78	78	75	73	0	0	0	0
normalized size	1	1.	0.96	0.94	0.	0.	0.	0.
time (sec)	N/A	0.047	0.175	0.798	0.	0.	0.	0.

Problem 67	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	A	B	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	9	9	9	33	11	162	0	11
normalized size	1	1.	1.	3.67	1.22	18.	0.	1.22
time (sec)	N/A	0.021	0.007	0.377	1.427	1.716	0.	1.334

Problem 68	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	A	B	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	15	15	15	57	15	248	0	15
normalized size	1	1.	1.	3.8	1.	16.53	0.	1.
time (sec)	N/A	0.027	0.024	0.484	1.453	1.729	0.	1.416

Problem 69	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	A	B	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	9	9	9	53	11	119	0	22
normalized size	1	1.	1.	5.89	1.22	13.22	0.	2.44
time (sec)	N/A	0.026	0.009	0.897	1.522	1.669	0.	1.234

Problem 70	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	B	F	B	F(-1)	F(-2)
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	487	487	121	3348	0	1796	0	0
normalized size	1	1.	0.25	6.87	0.	3.69	0.	0.
time (sec)	N/A	1.101	0.222	0.153	0.	2.445	0.	0.

Problem 71	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F	B	F(-1)	F(-2)
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	101	101	109	64	0	1774	0	0
normalized size	1	1.	1.08	0.63	0.	17.56	0.	0.
time (sec)	N/A	0.116	0.189	0.035	0.	2.525	0.	0.



Problem 72	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	A	F	F(-1)	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	292	292	45	227	0	0	0	0
normalized size	1	1.	0.15	0.78	0.	0.	0.	0.
time (sec)	N/A	0.191	0.07	0.099	0.	0.	0.	0.

Problem 73	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	A	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	45	45	24	21	27	135	78	72
normalized size	1	1.	0.53	0.47	0.6	3.	1.73	1.6
time (sec)	N/A	0.018	0.054	0.02	1.455	2.184	4.633	1.238

Problem 74	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	C	F	F(-2)	F(-1)	F
verified	N/A	Yes	NO	TBD	TBD	TBD	TBD	TBD
size	494	494	130	150	0	0	0	0
normalized size	1	1.	0.26	0.3	0.	0.	0.	0.
time (sec)	N/A	0.918	0.204	0.027	0.	0.	0.	0.

Problem 75	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	C	F	F(-1)	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	171	171	146	60	0	0	0	0
normalized size	1	1.	0.85	0.35	0.	0.	0.	0.
time (sec)	N/A	0.238	0.225	0.152	0.	0.	0.	0.

Problem 76	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	C	F	F(-1)	F(-1)	F
verified	N/A	Yes	NO	TBD	TBD	TBD	TBD	TBD
size	245	245	172	76	0	0	0	0
normalized size	1	1.	0.7	0.31	0.	0.	0.	0.
time (sec)	N/A	0.486	0.26	0.091	0.	0.	0.	0.

Problem 77	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	C	F	F(-2)	F(-1)	F
verified	N/A	Yes	NO	TBD	TBD	TBD	TBD	TBD
size	494	494	130	148	0	0	0	0
normalized size	1	1.	0.26	0.3	0.	0.	0.	0.
time (sec)	N/A	0.589	0.18	0.027	0.	0.	0.	0.

Problem 78	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	C	F	F(-1)	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	175	175	146	62	0	0	0	0
normalized size	1	1.	0.83	0.35	0.	0.	0.	0.
time (sec)	N/A	0.249	0.176	0.121	0.	0.	0.	0.

Problem 79	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	C	F	F(-1)	F(-1)	F
verified	N/A	Yes	NO	TBD	TBD	TBD	TBD	TBD
size	213	213	172	78	0	0	0	0
normalized size	1	1.	0.81	0.37	0.	0.	0.	0.
time (sec)	N/A	0.216	0.209	0.089	0.	0.	0.	0.

Problem 80	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	C	F	F(-1)	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	223	223	378	62	0	0	0	0
normalized size	1	1.	1.7	0.28	0.	0.	0.	0.
time (sec)	N/A	0.562	0.123	0.023	0.	0.	0.	0.

Problem 81	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	B	F(-1)	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	83	103	79	73	97	463	0	250
normalized size	1	1.24	0.95	0.88	1.17	5.58	0.	3.01
time (sec)	N/A	0.104	0.16	0.02	1.431	1.675	0.	1.172

Problem 82	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	C	F	F(-1)	F(-1)	F(-2)
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	129	129	141	67	0	0	0	0
normalized size	1	1.	1.09	0.52	0.	0.	0.	0.
time (sec)	N/A	0.18	0.142	0.02	0.	0.	0.	0.

Problem 83	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	C	F	F(-1)	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	205	205	378	62	0	0	0	0
normalized size	1	1.	1.84	0.3	0.	0.	0.	0.
time (sec)	N/A	0.473	0.119	0.02	0.	0.	0.	0.

Problem 84	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	B	F	F(-1)	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	71	71	117	233	0	0	0	0
normalized size	1	1.	1.65	3.28	0.	0.	0.	0.
time (sec)	N/A	0.119	0.265	0.092	0.	0.	0.	0.

Problem 85	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	B	F(-1)	F(-1)	F(-1)	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	89	89	64	246	0	0	0	0
normalized size	1	1.	0.72	2.76	0.	0.	0.	0.
time (sec)	N/A	0.077	0.145	0.034	0.	0.	0.	0.

Problem 86	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	A	A	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	17	17	17	16	26	59	0	23
normalized size	1	1.	1.	0.94	1.53	3.47	0.	1.35
time (sec)	N/A	0.029	0.008	0.032	0.934	2.249	0.	1.184

Problem 87	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	40	40	40	43	0	243	0	51
normalized size	1	1.	1.	1.08	0.	6.08	0.	1.27
time (sec)	N/A	0.063	0.026	0.018	0.	3.372	0.	1.145

Problem 88	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	B	A	B	A	F	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	20	20	47	17	63	72	0	61
normalized size	1	1.	2.35	0.85	3.15	3.6	0.	3.05
time (sec)	N/A	0.051	0.029	0.413	1.498	1.688	0.	1.156

Problem 89	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	25	25	25	30	0	184	0	32
normalized size	1	1.	1.	1.2	0.	7.36	0.	1.28
time (sec)	N/A	0.06	0.012	0.02	0.	2.122	0.	1.155

Problem 90	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	B	A	F	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	11	11	11	10	81	51	0	36
normalized size	1	1.	1.	0.91	7.36	4.64	0.	3.27
time (sec)	N/A	0.035	0.01	0.019	1.457	1.872	0.	1.164

Problem 91	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	B	A	B	B	F	B
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	9	9	44	8	53	59	0	45
normalized size	1	1.	4.89	0.89	5.89	6.56	0.	5.
time (sec)	N/A	0.053	0.021	0.21	1.469	1.701	0.	1.171

Problem 92	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	C	A	F(-2)	F(-1)	F(-1)	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	153	153	217	125	0	0	0	193
normalized size	1	1.	1.42	0.82	0.	0.	0.	1.26
time (sec)	N/A	0.197	0.259	0.032	0.	0.	0.	1.204

Problem 93	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	45	45	45	34	0	340	0	51
normalized size	1	1.	1.	0.76	0.	7.56	0.	1.13
time (sec)	N/A	0.073	0.025	0.179	0.	26.956	0.	1.173

Problem 94	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	F(-2)	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	28	28	28	21	0	0	0	32
normalized size	1	1.	1.	0.75	0.	0.	0.	1.14
time (sec)	N/A	0.067	0.016	0.03	0.	0.	0.	1.174

Problem 95	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	45	45	45	44	0	259	0	51
normalized size	1	1.	1.	0.98	0.	5.76	0.	1.13
time (sec)	N/A	0.077	0.031	0.032	0.	3.212	0.	1.157

Problem 96	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F	A	F	A
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	28	28	28	31	0	189	0	32
normalized size	1	1.	1.	1.11	0.	6.75	0.	1.14
time (sec)	N/A	0.071	0.016	0.033	0.	2.885	0.	1.151

Problem 97	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	47	47	46	39	0	254	0	0
normalized size	1	1.	0.98	0.83	0.	5.4	0.	0.
time (sec)	N/A	0.079	0.03	0.02	0.	2.102	0.	0.

Problem 98	Optimal	Rubi	Mathematica	Maple	Maxima	Fricas	Sympy	Giac
grade	A	A	A	A	F(-2)	A	F	F
verified	N/A	Yes	Yes	TBD	TBD	TBD	TBD	TBD
size	29	29	29	24	0	192	0	0
normalized size	1	1.	1.	0.83	0.	6.62	0.	0.
time (sec)	N/A	0.077	0.015	0.02	0.	1.965	0.	0.

## 2.3 Detailed conclusion table specific for Rubi results

The following table is specific to Rubi. It gives additional statistics for each integral. the column **steps** is the number of steps used by Rubi to obtain the antiderivative. The **rules** column is the number of unique rules used. The **integrand size** column is the leaf size of

the integrand. Finally the ratio  $\frac{\text{number of rules}}{\text{integrand size}}$  is given. The larger this ratio is, the harder the integral was to solve. In this test, problem number [72] had the largest ratio of [ 0.75 ]

Table 2.1: Rubi specific breakdown of results for each integral

#	grade	number of steps used	number of unique rules	normalized antiderivative leaf size	integrand leaf size	$\frac{\text{number of rules}}{\text{integrand leaf size}}$
1	A	4	3	1.	16	0.188
2	A	3	2	1.	16	0.125
3	A	3	3	1.	16	0.188
4	A	2	2	1.	16	0.125
5	A	2	2	1.	16	0.125
6	A	2	2	1.	14	0.143
7	A	3	3	1.	14	0.214
8	A	3	2	1.	16	0.125
9	A	4	3	1.	16	0.188
10	A	4	3	1.	15	0.2
11	A	4	3	1.	15	0.2
12	A	3	3	1.	15	0.2
13	A	2	2	1.	13	0.154
14	A	4	4	1.	13	0.308
15	A	5	5	1.	15	0.333
16	A	6	6	1.	15	0.4
17	A	6	6	1.	15	0.4
18	A	5	5	1.	15	0.333
19	A	4	4	1.	15	0.267
20	A	2	2	1.	10	0.2
21	A	3	3	1.	15	0.2
22	A	4	3	1.	15	0.2
23	A	4	3	1.	15	0.2
24	A	7	7	1.	13	0.538
25	A	3	3	1.	10	0.3
26	A	3	2	1.	10	0.2
27	A	3	2	1.	10	0.2
28	A	4	3	1.	15	0.2
29	A	4	3	1.	15	0.2
30	A	3	3	1.	15	0.2
31	A	2	2	1.	13	0.154
32	A	4	4	1.	13	0.308
33	A	5	5	1.	15	0.333
34	A	6	6	1.	15	0.4
35	A	6	6	1.	15	0.4
36	A	5	5	1.	15	0.333
37	A	3	3	1.	15	0.2
38	A	2	2	1.	10	0.2
39	A	3	3	1.	15	0.2
40	A	4	3	1.	15	0.2
41	A	4	3	1.	15	0.2

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Table 2.1 – continued from previous page

#	grade	number of steps used	number of unique rules	normalized antiderivative leaf size	integrand leaf size	$\frac{\text{number of rules}}{\text{integrand leaf size}}$
42	A	4	4	1.	10	0.4
43	A	5	5	1.	10	0.5
44	A	2	2	1.	8	0.25
45	A	4	4	1.	8	0.5
46	A	5	5	1.	8	0.625
47	A	3	3	1.	12	0.25
48	A	3	3	1.	10	0.3
49	A	4	4	1.	12	0.333
50	A	4	4	1.	10	0.4
51	A	3	3	1.	12	0.25
52	A	3	3	1.	10	0.3
53	A	4	4	1.	12	0.333
54	A	4	4	1.	10	0.4
55	A	1	1	1.	10	0.1
56	A	2	2	1.	12	0.167
57	A	2	2	1.	12	0.167
58	A	4	4	1.	10	0.4
59	A	6	6	1.	12	0.5
60	A	6	6	1.	12	0.5
61	A	1	1	1.	10	0.1
62	A	2	2	1.	12	0.167
63	A	2	2	1.	12	0.167
64	A	3	3	1.	10	0.3
65	A	4	4	1.	12	0.333
66	A	4	4	1.	12	0.333
67	A	2	2	1.	13	0.154
68	A	2	2	1.	21	0.095
69	A	2	2	1.	15	0.133
70	A	10	6	1.	10	0.6
71	A	4	3	1.	11	0.273
72	A	10	6	1.	8	0.75
73	A	3	3	1.	10	0.3
74	A	12	3	1.	10	0.3
75	A	7	3	1.	10	0.3
76	A	9	3	1.	10	0.3
77	A	12	3	1.	11	0.273
78	A	7	3	1.	11	0.273
79	A	9	3	1.	11	0.273
80	A	11	5	1.	8	0.625
81	A	7	3	1.24	8	0.375
82	A	9	3	1.	8	0.375
83	A	11	5	1.	10	0.5
84	A	8	6	1.	10	0.6
85	A	10	6	1.	10	0.6

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Table 2.1 – continued from previous page

#	grade	number of steps used	number of unique rules	normalized antiderivative leaf size	integrand leaf size	$\frac{\text{number of rules}}{\text{integrand leaf size}}$
86	A	4	4	1.	11	0.364
87	A	4	4	1.	15	0.267
88	A	5	5	1.	15	0.333
89	A	3	3	1.	15	0.2
90	A	3	3	1.	13	0.231
91	A	4	4	1.	15	0.267
92	A	11	10	1.	15	0.667
93	A	5	5	1.	15	0.333
94	A	4	4	1.	15	0.267
95	A	5	5	1.	15	0.333
96	A	4	4	1.	15	0.267
97	A	5	5	1.	15	0.333
98	A	4	4	1.	15	0.267





# Chapter 3

## Listing of integrals

### 3.1

$$\int \frac{\sin^6(x)}{a - a \cos^2(x)} dx$$

Optimal. Leaf size=33

$$\frac{3x}{8a} - \frac{\sin^3(x) \cos(x)}{4a} - \frac{3 \sin(x) \cos(x)}{8a}$$

[Out] (3\*x)/(8\*a) - (3\*Cos[x]\*Sin[x])/(8\*a) - (Cos[x]\*Sin[x]^3)/(4\*a)

---

**Rubi [A]** time = 0.0524986, antiderivative size = 33, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 3, integrand size = 16,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.188$ , Rules used = {3175, 2635, 8}

$$\frac{3x}{8a} - \frac{\sin^3(x) \cos(x)}{4a} - \frac{3 \sin(x) \cos(x)}{8a}$$

Antiderivative was successfully verified.

[In] Int[Sin[x]^6/(a - a\*cos[x]^2), x]

[Out] (3\*x)/(8\*a) - (3\*Cos[x]\*Sin[x])/(8\*a) - (Cos[x]\*Sin[x]^3)/(4\*a)

### Rule 3175

Int[(u\_)\*((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^(p\_), x\_Symbol] := Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

### Rule 2635

Int[((b\_)\*sin[(c\_) + (d\_)\*(x\_)])^(n\_), x\_Symbol] := -Simp[(b\*cos[c + d\*x])\*(b\*sin[c + d\*x])^(n - 1))/(d\*n), x] + Dist[(b^2\*(n - 1))/n, Int[(b\*sin[c + d\*x])^(n - 2), x], x] /; FreeQ[{b, c, d}, x] && GtQ[n, 1] && IntegerQ[2\*n]

### Rule 8

Int[a\_, x\_Symbol] := Simp[a\*x, x] /; FreeQ[a, x]

### Rubi steps

$$\begin{aligned}
\int \frac{\sin^6(x)}{a - a \cos^2(x)} dx &= \frac{\int \sin^4(x) dx}{a} \\
&= -\frac{\cos(x) \sin^3(x)}{4a} + \frac{3 \int \sin^2(x) dx}{4a} \\
&= -\frac{3 \cos(x) \sin(x)}{8a} - \frac{\cos(x) \sin^3(x)}{4a} + \frac{3 \int 1 dx}{8a} \\
&= \frac{3x}{8a} - \frac{3 \cos(x) \sin(x)}{8a} - \frac{\cos(x) \sin^3(x)}{4a}
\end{aligned}$$

**Mathematica [A]** time = 0.0042435, size = 26, normalized size = 0.79

$$\frac{\frac{3x}{8} - \frac{1}{4} \sin(2x) + \frac{1}{32} \sin(4x)}{a}$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]^6/(a - a\*Cos[x]^2),x]

[Out] ((3\*x)/8 - Sin[2\*x]/4 + Sin[4\*x]/32)/a

**Maple [A]** time = 0.083, size = 42, normalized size = 1.3

$$-\frac{5 (\tan(x))^3}{8 a ((\tan(x))^2 + 1)^2} - \frac{3 \tan(x)}{8 a ((\tan(x))^2 + 1)^2} + \frac{3 \arctan(\tan(x))}{8 a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sin(x)^6/(a-a\*cos(x)^2),x)

[Out] -5/8/a/(tan(x)^2+1)^2\*tan(x)^3-3/8/a/(tan(x)^2+1)^2\*tan(x)+3/8/a\*arctan(tan(x))

**Maxima [A]** time = 1.42433, size = 50, normalized size = 1.52

$$-\frac{5 \tan(x)^3 + 3 \tan(x)}{8 (a \tan(x)^4 + 2 a \tan(x)^2 + a)} + \frac{3 x}{8 a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^6/(a-a\*cos(x)^2),x, algorithm="maxima")

[Out] -1/8\*(5\*tan(x)^3 + 3\*tan(x))/(a\*tan(x)^4 + 2\*a\*tan(x)^2 + a) + 3/8\*x/a

**Fricas [A]** time = 1.89114, size = 62, normalized size = 1.88

$$\frac{(2 \cos(x)^3 - 5 \cos(x)) \sin(x) + 3 x}{8 a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^6/(a-a\*cos(x)^2),x, algorithm="fricas")

[Out] 1/8\*((2\*cos(x)^3 - 5\*cos(x))\*sin(x) + 3\*x)/a

**Sympy [B]** time = 16.2315, size = 473, normalized size = 14.33

$$\frac{3x \tan^8\left(\frac{x}{2}\right)}{8a \tan^8\left(\frac{x}{2}\right) + 32a \tan^6\left(\frac{x}{2}\right) + 48a \tan^4\left(\frac{x}{2}\right) + 32a \tan^2\left(\frac{x}{2}\right) + 8a} + \frac{12x \tan^6\left(\frac{x}{2}\right)}{8a \tan^8\left(\frac{x}{2}\right) + 32a \tan^6\left(\frac{x}{2}\right) + 48a \tan^4\left(\frac{x}{2}\right) + 32a \tan^2\left(\frac{x}{2}\right) + 8a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)\*\*6/(a-a\*cos(x)\*\*2),x)

[Out] 3\*x\*tan(x/2)\*\*8/(8\*a\*tan(x/2)\*\*8 + 32\*a\*tan(x/2)\*\*6 + 48\*a\*tan(x/2)\*\*4 + 32\*a\*tan(x/2)\*\*2 + 8\*a) + 12\*x\*tan(x/2)\*\*6/(8\*a\*tan(x/2)\*\*8 + 32\*a\*tan(x/2)\*\*6 + 48\*a\*tan(x/2)\*\*4 + 32\*a\*tan(x/2)\*\*2 + 8\*a) + 18\*x\*tan(x/2)\*\*4/(8\*a\*tan(x/2)\*\*8 + 32\*a\*tan(x/2)\*\*6 + 48\*a\*tan(x/2)\*\*4 + 32\*a\*tan(x/2)\*\*2 + 8\*a) + 12\*x\*tan(x/2)\*\*2/(8\*a\*tan(x/2)\*\*8 + 32\*a\*tan(x/2)\*\*6 + 48\*a\*tan(x/2)\*\*4 + 32\*a\*tan(x/2)\*\*2 + 8\*a) + 3\*x/(8\*a\*tan(x/2)\*\*8 + 32\*a\*tan(x/2)\*\*6 + 48\*a\*tan(x/2)\*\*4 + 32\*a\*tan(x/2)\*\*2 + 8\*a) + 6\*tan(x/2)\*\*7/(8\*a\*tan(x/2)\*\*8 + 32\*a\*tan(x/2)\*\*6 + 48\*a\*tan(x/2)\*\*4 + 32\*a\*tan(x/2)\*\*2 + 8\*a) + 22\*tan(x/2)\*\*5/(8\*a\*tan(x/2)\*\*8 + 32\*a\*tan(x/2)\*\*6 + 48\*a\*tan(x/2)\*\*4 + 32\*a\*tan(x/2)\*\*2 + 8\*a) - 22\*tan(x/2)\*\*3/(8\*a\*tan(x/2)\*\*8 + 32\*a\*tan(x/2)\*\*6 + 48\*a\*tan(x/2)\*\*4 + 32\*a\*tan(x/2)\*\*2 + 8\*a) - 6\*tan(x/2)/(8\*a\*tan(x/2)\*\*8 + 32\*a\*tan(x/2)\*\*6 + 48\*a\*tan(x/2)\*\*4 + 32\*a\*tan(x/2)\*\*2 + 8\*a)

**Giac [A]** time = 1.1531, size = 42, normalized size = 1.27

$$\frac{3x}{8a} - \frac{5 \tan(x)^3 + 3 \tan(x)}{8(\tan(x)^2 + 1)^2 a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^6/(a-a\*cos(x)^2),x, algorithm="giac")

[Out] 3/8\*x/a - 1/8\*(5\*tan(x)^3 + 3\*tan(x))/((tan(x)^2 + 1)^2\*a)

$$3.2 \quad \int \frac{\sin^5(x)}{a - a \cos^2(x)} dx$$

**Optimal.** Leaf size=19

$$\frac{\cos^3(x)}{3a} - \frac{\cos(x)}{a}$$

[Out] -(Cos[x]/a) + Cos[x]^3/(3\*a)

**Rubi [A]** time = 0.0451872, antiderivative size = 19, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 2, integrand size = 16,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.125$ , Rules used = {3175, 2633}

$$\frac{\cos^3(x)}{3a} - \frac{\cos(x)}{a}$$

Antiderivative was successfully verified.

[In] Int[Sin[x]^5/(a - a\*Cos[x]^2),x]

[Out] -(Cos[x]/a) + Cos[x]^3/(3\*a)

#### Rule 3175

Int[(u\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^p, x\_Symbol] :> Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

#### Rule 2633

Int[sin[(c\_.) + (d\_.)\*(x\_.)]^n, x\_Symbol] :> -Dist[d^(-1), Subst[Int[Expand[(1 - x^2)^((n - 1)/2), x], x], x, Cos[c + d\*x]], x] /; FreeQ[{c, d}, x] && IGtQ[(n - 1)/2, 0]

#### Rubi steps

$$\begin{aligned} \int \frac{\sin^5(x)}{a - a \cos^2(x)} dx &= \frac{\int \sin^3(x) dx}{a} \\ &= -\frac{\text{Subst}\left(\int (1 - x^2) dx, x, \cos(x)\right)}{a} \\ &= -\frac{\cos(x)}{a} + \frac{\cos^3(x)}{3a} \end{aligned}$$

**Mathematica [A]** time = 0.0031018, size = 19, normalized size = 1.

$$\frac{1}{12} \cos(3x) - \frac{3 \cos(x)}{4}$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]^5/(a - a\*Cos[x]^2),x]

[Out]  $((-3*\text{Cos}[x])/4 + \text{Cos}[3*x]/12)/a$

**Maple [A]** time = 0.018, size = 16, normalized size = 0.8

$$\frac{1}{a} \left( \frac{(\cos(x))^3}{3} - \cos(x) \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(sin(x)^5/(a-a*cos(x)^2), x)`

[Out]  $1/a*(1/3*\cos(x)^3-\cos(x))$

**Maxima [A]** time = 0.946388, size = 19, normalized size = 1.

$$\frac{\cos(x)^3 - 3 \cos(x)}{3a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)^5/(a-a*cos(x)^2), x, algorithm="maxima")`

[Out]  $1/3*(\cos(x)^3 - 3*\cos(x))/a$

**Fricas [A]** time = 1.73446, size = 39, normalized size = 2.05

$$\frac{\cos(x)^3 - 3 \cos(x)}{3a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)^5/(a-a*cos(x)^2), x, algorithm="fricas")`

[Out]  $1/3*(\cos(x)^3 - 3*\cos(x))/a$

**Sympy [B]** time = 18.3349, size = 162, normalized size = 8.53

$$\frac{14 \tan^6\left(\frac{x}{2}\right)}{15a \tan^6\left(\frac{x}{2}\right) + 45a \tan^4\left(\frac{x}{2}\right) + 45a \tan^2\left(\frac{x}{2}\right) + 15a} + \frac{42 \tan^4\left(\frac{x}{2}\right)}{15a \tan^6\left(\frac{x}{2}\right) + 45a \tan^4\left(\frac{x}{2}\right) + 45a \tan^2\left(\frac{x}{2}\right) + 15a} - \frac{18 \tan^2\left(\frac{x}{2}\right)}{15a \tan^6\left(\frac{x}{2}\right) + 45a \tan^4\left(\frac{x}{2}\right) + 45a \tan^2\left(\frac{x}{2}\right) + 15a} - \frac{6}{15a \tan^6\left(\frac{x}{2}\right) + 45a \tan^4\left(\frac{x}{2}\right) + 45a \tan^2\left(\frac{x}{2}\right) + 15a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)**5/(a-a*cos(x)**2), x)`

[Out]  $14*\tan(x/2)**6/(15*a*\tan(x/2)**6 + 45*a*\tan(x/2)**4 + 45*a*\tan(x/2)**2 + 15*a) + 42*\tan(x/2)**4/(15*a*\tan(x/2)**6 + 45*a*\tan(x/2)**4 + 45*a*\tan(x/2)**2 + 15*a) - 18*\tan(x/2)**2/(15*a*\tan(x/2)**6 + 45*a*\tan(x/2)**4 + 45*a*\tan(x/2)**2 + 15*a) - 6/(15*a*\tan(x/2)**6 + 45*a*\tan(x/2)**4 + 45*a*\tan(x/2)**2 + 15*a)$

+ 15\*a)

---

**Giac [A]** time = 1.11841, size = 19, normalized size = 1.

$$\frac{\cos(x)^3 - 3 \cos(x)}{3a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^5/(a-a\*cos(x)^2),x, algorithm="giac")

[Out] 1/3\*(cos(x)^3 - 3\*cos(x))/a

### 3.3 $\int \frac{\sin^4(x)}{a - a \cos^2(x)} dx$

**Optimal.** Leaf size=20

$$\frac{x}{2a} - \frac{\sin(x) \cos(x)}{2a}$$

[Out] x/(2\*a) - (Cos[x]\*Sin[x])/(2\*a)

**Rubi [A]** time = 0.0452092, antiderivative size = 20, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 16,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.188$ , Rules used = {3175, 2635, 8}

$$\frac{x}{2a} - \frac{\sin(x) \cos(x)}{2a}$$

Antiderivative was successfully verified.

[In] Int[Sin[x]^4/(a - a\*Cos[x]^2),x]

[Out] x/(2\*a) - (Cos[x]\*Sin[x])/(2\*a)

#### Rule 3175

Int[(u\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_), x\_Symbol] :> Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

#### Rule 2635

Int[((b\_.)\*sin[(c\_.) + (d\_.)\*(x\_)])^(n\_), x\_Symbol] :> -Simp[(b\*Cos[c + d\*x]^(n-1))/(d\*n), x] + Dist[(b^2\*(n-1))/n, Int[(b\*Sin[c + d\*x])^(n-2), x], x] /; FreeQ[{b, c, d}, x] && GtQ[n, 1] && IntegerQ[2\*n]

#### Rule 8

Int[a\_, x\_Symbol] :> Simp[a\*x, x] /; FreeQ[a, x]

#### Rubi steps

$$\begin{aligned} \int \frac{\sin^4(x)}{a - a \cos^2(x)} dx &= \frac{\int \sin^2(x) dx}{a} \\ &= -\frac{\cos(x) \sin(x)}{2a} + \frac{\int 1 dx}{2a} \\ &= \frac{x}{2a} - \frac{\cos(x) \sin(x)}{2a} \end{aligned}$$

**Mathematica [A]** time = 0.0027754, size = 18, normalized size = 0.9

$$\frac{x}{2} - \frac{1}{4} \frac{\sin(2x)}{a}$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]^4/(a - a\*Cos[x]^2),x]

[Out] (x/2 - Sin[2\*x]/4)/a

**Maple [A]** time = 0.022, size = 25, normalized size = 1.3

$$-\frac{\tan(x)}{2a((\tan(x))^2+1)} + \frac{\arctan(\tan(x))}{2a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sin(x)^4/(a-a\*cos(x)^2),x)

[Out] -1/2/a\*tan(x)/(tan(x)^2+1)+1/2/a\*arctan(tan(x))

**Maxima [A]** time = 1.45167, size = 28, normalized size = 1.4

$$\frac{x}{2a} - \frac{\tan(x)}{2(a\tan(x)^2+a)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^4/(a-a\*cos(x)^2),x, algorithm="maxima")

[Out] 1/2\*x/a - 1/2\*tan(x)/(a\*tan(x)^2 + a)

**Fricas [A]** time = 1.7447, size = 38, normalized size = 1.9

$$\frac{\cos(x)\sin(x) - x}{2a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^4/(a-a\*cos(x)^2),x, algorithm="fricas")

[Out] -1/2\*(cos(x)\*sin(x) - x)/a

**Sympy [B]** time = 4.43492, size = 153, normalized size = 7.65

$$\frac{x \tan^4\left(\frac{x}{2}\right)}{2a \tan^4\left(\frac{x}{2}\right) + 4a \tan^2\left(\frac{x}{2}\right) + 2a} + \frac{2x \tan^2\left(\frac{x}{2}\right)}{2a \tan^4\left(\frac{x}{2}\right) + 4a \tan^2\left(\frac{x}{2}\right) + 2a} + \frac{x}{2a \tan^4\left(\frac{x}{2}\right) + 4a \tan^2\left(\frac{x}{2}\right) + 2a} + \frac{2 \tan^3\left(\frac{x}{2}\right)}{2a \tan^4\left(\frac{x}{2}\right) + 4a \tan^2\left(\frac{x}{2}\right) + 2a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)\*\*4/(a-a\*cos(x)\*\*2),x)



```
[Out] x*tan(x/2)**4/(2*a*tan(x/2)**4 + 4*a*tan(x/2)**2 + 2*a) + 2*x*tan(x/2)**2/(
2*a*tan(x/2)**4 + 4*a*tan(x/2)**2 + 2*a) + x/(2*a*tan(x/2)**4 + 4*a*tan(x/2)
)**2 + 2*a) + 2*tan(x/2)**3/(2*a*tan(x/2)**4 + 4*a*tan(x/2)**2 + 2*a) - 2*t
an(x/2)/(2*a*tan(x/2)**4 + 4*a*tan(x/2)**2 + 2*a)
```

**Giac [A]** time = 1.13313, size = 30, normalized size = 1.5

$$\frac{x}{2a} - \frac{\tan(x)}{2(\tan(x)^2 + 1)a}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(sin(x)^4/(a-a*cos(x)^2),x, algorithm="giac")
```

```
[Out] 1/2*x/a - 1/2*tan(x)/((tan(x)^2 + 1)*a)
```

$$3.4 \quad \int \frac{\sin^3(x)}{a - a \cos^2(x)} dx$$

**Optimal.** Leaf size=7

$$-\frac{\cos(x)}{a}$$

[Out] -(Cos[x]/a)

**Rubi [A]** time = 0.0413498, antiderivative size = 7, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 16,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.125$ , Rules used = {3175, 2638}

$$-\frac{\cos(x)}{a}$$

Antiderivative was successfully verified.

[In] Int[Sin[x]^3/(a - a\*Cos[x]^2),x]

[Out] -(Cos[x]/a)

#### Rule 3175

Int[(u\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^p, x\_Symbol] := Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

#### Rule 2638

Int[sin[(c\_.) + (d\_.)\*(x\_)], x\_Symbol] := -Simp[Cos[c + d\*x]/d, x] /; FreeQ[{c, d}, x]

#### Rubi steps

$$\begin{aligned} \int \frac{\sin^3(x)}{a - a \cos^2(x)} dx &= \frac{\int \sin(x) dx}{a} \\ &= -\frac{\cos(x)}{a} \end{aligned}$$

**Mathematica [A]** time = 0.0020658, size = 7, normalized size = 1.

$$-\frac{\cos(x)}{a}$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]^3/(a - a\*Cos[x]^2),x]

[Out] -(Cos[x]/a)

**Maple [A]** time = 0.015, size = 8, normalized size = 1.1

$$-\frac{\cos(x)}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sin(x)^3/(a-a\*cos(x)^2),x)

[Out] -cos(x)/a

---

**Maxima [A]** time = 0.945899, size = 9, normalized size = 1.29

$$-\frac{\cos(x)}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^3/(a-a\*cos(x)^2),x, algorithm="maxima")

[Out] -cos(x)/a

---

**Fricas [A]** time = 1.85319, size = 15, normalized size = 2.14

$$-\frac{\cos(x)}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^3/(a-a\*cos(x)^2),x, algorithm="fricas")

[Out] -cos(x)/a

---

**Sympy [B]** time = 2.00868, size = 36, normalized size = 5.14

$$\frac{2 \tan^2\left(\frac{x}{2}\right)}{3a \tan^2\left(\frac{x}{2}\right) + 3a} - \frac{4}{3a \tan^2\left(\frac{x}{2}\right) + 3a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)\*\*3/(a-a\*cos(x)\*\*2),x)

[Out] 2\*tan(x/2)\*\*2/(3\*a\*tan(x/2)\*\*2 + 3\*a) - 4/(3\*a\*tan(x/2)\*\*2 + 3\*a)

---

**Giac [A]** time = 1.12301, size = 9, normalized size = 1.29

$$-\frac{\cos(x)}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(sin(x)^3/(a-a*cos(x)^2),x, algorithm="giac")
```

```
[Out] -cos(x)/a
```

$$3.5 \quad \int \frac{\sin^2(x)}{a - a \cos^2(x)} dx$$

**Optimal.** Leaf size=5

$$\frac{x}{a}$$

[Out] x/a

**Rubi [A]** time = 0.0402654, antiderivative size = 5, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 16,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.125$ , Rules used = {3175, 8}

$$\frac{x}{a}$$

Antiderivative was successfully verified.

[In] Int[Sin[x]^2/(a - a\*Cos[x]^2),x]

[Out] x/a

**Rule 3175**

Int[(u\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_), x\_Symbol] :> Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

**Rule 8**

Int[a\_, x\_Symbol] :> Simp[a\*x, x] /; FreeQ[a, x]

**Rubi steps**

$$\int \frac{\sin^2(x)}{a - a \cos^2(x)} dx = \frac{\int 1 dx}{a} = \frac{x}{a}$$

**Mathematica [A]** time = 0.0007132, size = 5, normalized size = 1.

$$\frac{x}{a}$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]^2/(a - a\*Cos[x]^2),x]

[Out] x/a

**Maple [C]** time = 0.022, size = 8, normalized size = 1.6

$$\frac{\arctan(\tan(x))}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(sin(x)^2/(a-a*cos(x)^2),x)`

[Out] `1/a*arctan(tan(x))`

---

**Maxima [A]** time = 1.41437, size = 7, normalized size = 1.4

$$\frac{x}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)^2/(a-a*cos(x)^2),x, algorithm="maxima")`

[Out] `x/a`

---

**Fricas [A]** time = 1.91557, size = 7, normalized size = 1.4

$$\frac{x}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)^2/(a-a*cos(x)^2),x, algorithm="fricas")`

[Out] `x/a`

---

**Sympy [A]** time = 0.998404, size = 2, normalized size = 0.4

$$\frac{x}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)**2/(a-a*cos(x)**2),x)`

[Out] `x/a`

---

**Giac [A]** time = 1.17127, size = 7, normalized size = 1.4

$$\frac{x}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)^2/(a-a*cos(x)^2),x, algorithm="giac")`

[Out] `x/a`

$$3.6 \quad \int \frac{\sin(x)}{a - a \cos^2(x)} dx$$

**Optimal.** Leaf size=8

$$-\frac{\tanh^{-1}(\cos(x))}{a}$$

[Out] -(ArcTanh[Cos[x]]/a)

**Rubi [A]** time = 0.0249527, antiderivative size = 8, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 14,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.143$ , Rules used = {3175, 3770}

$$-\frac{\tanh^{-1}(\cos(x))}{a}$$

Antiderivative was successfully verified.

[In] Int[Sin[x]/(a - a\*Cos[x]^2),x]

[Out] -(ArcTanh[Cos[x]]/a)

#### Rule 3175

Int[(u\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_), x\_Symbol] :=> Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

#### Rule 3770

Int[csc[(c\_.) + (d\_.)\*(x\_)], x\_Symbol] :=> -Simp[ArcTanh[Cos[c + d\*x]]/d, x] /; FreeQ[{c, d}, x]

#### Rubi steps

$$\begin{aligned} \int \frac{\sin(x)}{a - a \cos^2(x)} dx &= \frac{\int \csc(x) dx}{a} \\ &= -\frac{\tanh^{-1}(\cos(x))}{a} \end{aligned}$$

**Mathematica [B]** time = 0.0067421, size = 21, normalized size = 2.62

$$\frac{\log\left(\sin\left(\frac{x}{2}\right)\right) - \log\left(\cos\left(\frac{x}{2}\right)\right)}{a}$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]/(a - a\*Cos[x]^2),x]

[Out] (-Log[Cos[x/2]] + Log[Sin[x/2]])/a

**Maple [A]** time = 0.014, size = 9, normalized size = 1.1

$$-\frac{\operatorname{Artanh}(\cos(x))}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(sin(x)/(a-a*cos(x)^2),x)`

[Out] `-arctanh(cos(x))/a`

---

**Maxima [B]** time = 0.952486, size = 28, normalized size = 3.5

$$-\frac{\log(\cos(x)+1)}{2a} + \frac{\log(\cos(x)-1)}{2a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)/(a-a*cos(x)^2),x, algorithm="maxima")`

[Out] `-1/2*log(cos(x) + 1)/a + 1/2*log(cos(x) - 1)/a`

---

**Fricas [B]** time = 2.01169, size = 77, normalized size = 9.62

$$-\frac{\log\left(\frac{1}{2}\cos(x) + \frac{1}{2}\right) - \log\left(-\frac{1}{2}\cos(x) + \frac{1}{2}\right)}{2a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)/(a-a*cos(x)^2),x, algorithm="fricas")`

[Out] `-1/2*(log(1/2*cos(x) + 1/2) - log(-1/2*cos(x) + 1/2))/a`

---

**Sympy [B]** time = 0.264378, size = 19, normalized size = 2.38

$$\frac{\log(\cos(x)-1)}{2a} - \frac{\log(\cos(x)+1)}{2a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)/(a-a*cos(x)**2),x)`

[Out] `log(cos(x) - 1)/(2*a) - log(cos(x) + 1)/(2*a)`

---

**Giac [B]** time = 1.16478, size = 31, normalized size = 3.88

$$-\frac{\log(\cos(x)+1)}{2a} + \frac{\log(-\cos(x)+1)}{2a}$$

Verification of antiderivative is not currently implemented for this CAS.



```
[In] integrate(sin(x)/(a-a*cos(x)^2),x, algorithm="giac")
```

```
[Out] -1/2*log(cos(x) + 1)/a + 1/2*log(-cos(x) + 1)/a
```

$$3.7 \quad \int \frac{\csc(x)}{a - a \cos^2(x)} dx$$

**Optimal.** Leaf size=22

$$-\frac{\tanh^{-1}(\cos(x))}{2a} - \frac{\cot(x) \csc(x)}{2a}$$

[Out] -ArcTanh[Cos[x]]/(2\*a) - (Cot[x]\*Csc[x])/(2\*a)

**Rubi [A]** time = 0.0439701, antiderivative size = 22, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 14,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.214$ , Rules used = {3175, 3768, 3770}

$$-\frac{\tanh^{-1}(\cos(x))}{2a} - \frac{\cot(x) \csc(x)}{2a}$$

Antiderivative was successfully verified.

[In] Int[Csc[x]/(a - a\*Cos[x]^2), x]

[Out] -ArcTanh[Cos[x]]/(2\*a) - (Cot[x]\*Csc[x])/(2\*a)

#### Rule 3175

Int[(u\_)\*((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^p], x\_Symbol] := Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

#### Rule 3768

Int[(csc[(c\_) + (d\_)\*(x\_)]\*(b\_))^(n\_), x\_Symbol] := -Simp[(b\*Csc[c + d\*x]^(n-1))/(d\*(n-1)), x] + Dist[(b^2\*(n-2))/(n-1), Int[(b\*Csc[c + d\*x]^(n-2)), x], x] /; FreeQ[{b, c, d}, x] && GtQ[n, 1] && IntegerQ[2\*n]

#### Rule 3770

Int[csc[(c\_) + (d\_)\*(x\_)], x\_Symbol] := -Simp[ArcTanh[Cos[c + d\*x]]/d, x] /; FreeQ[{c, d}, x]

#### Rubi steps

$$\begin{aligned} \int \frac{\csc(x)}{a - a \cos^2(x)} dx &= \frac{\int \csc^3(x) dx}{a} \\ &= -\frac{\cot(x) \csc(x)}{2a} + \frac{\int \csc(x) dx}{2a} \\ &= -\frac{\tanh^{-1}(\cos(x))}{2a} - \frac{\cot(x) \csc(x)}{2a} \end{aligned}$$

**Mathematica [B]** time = 0.0079475, size = 51, normalized size = 2.32

$$\frac{-\frac{1}{8} \csc^2\left(\frac{x}{2}\right) + \frac{1}{8} \sec^2\left(\frac{x}{2}\right) + \frac{1}{2} \log\left(\sin\left(\frac{x}{2}\right)\right) - \frac{1}{2} \log\left(\cos\left(\frac{x}{2}\right)\right)}{a}$$

Antiderivative was successfully verified.

[In] Integrate[Csc[x]/(a - a\*Cos[x]^2), x]

[Out] (-Csc[x/2]^2/8 - Log[Cos[x/2]]/2 + Log[Sin[x/2]]/2 + Sec[x/2]^2/8)/a

**Maple [B]** time = 0.034, size = 44, normalized size = 2.

$$\frac{1}{4a(1 + \cos(x))} - \frac{\ln(1 + \cos(x))}{4a} + \frac{1}{4a(\cos(x) - 1)} + \frac{\ln(\cos(x) - 1)}{4a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(csc(x)/(a-a\*cos(x)^2), x)

[Out] 1/4/a/(1+cos(x))-1/4/a\*ln(1+cos(x))+1/4/a/(cos(x)-1)+1/4/a\*ln(cos(x)-1)

**Maxima [B]** time = 0.948883, size = 50, normalized size = 2.27

$$\frac{\cos(x)}{2(a \cos(x)^2 - a)} - \frac{\log(\cos(x) + 1)}{4a} + \frac{\log(\cos(x) - 1)}{4a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)/(a-a\*cos(x)^2), x, algorithm="maxima")

[Out] 1/2\*cos(x)/(a\*cos(x)^2 - a) - 1/4\*log(cos(x) + 1)/a + 1/4\*log(cos(x) - 1)/a

**Fricas [B]** time = 1.89224, size = 153, normalized size = 6.95

$$\frac{(\cos(x)^2 - 1) \log\left(\frac{1}{2} \cos(x) + \frac{1}{2}\right) - (\cos(x)^2 - 1) \log\left(-\frac{1}{2} \cos(x) + \frac{1}{2}\right) - 2 \cos(x)}{4(a \cos(x)^2 - a)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)/(a-a\*cos(x)^2), x, algorithm="fricas")

[Out] -1/4\*((cos(x)^2 - 1)\*log(1/2\*cos(x) + 1/2) - (cos(x)^2 - 1)\*log(-1/2\*cos(x) + 1/2) - 2\*cos(x))/(a\*cos(x)^2 - a)

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\frac{\int \frac{\csc(x)}{\cos^2(x)-1} dx}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)/(a-a\*cos(x)\*\*2), x)

[Out] `-Integral(csc(x)/(cos(x)**2 - 1), x)/a`

---

**Giac [B]** time = 1.15986, size = 51, normalized size = 2.32

$$-\frac{\log(\cos(x) + 1)}{4a} + \frac{\log(-\cos(x) + 1)}{4a} + \frac{\cos(x)}{2(\cos(x)^2 - 1)a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(csc(x)/(a-a*cos(x)^2),x, algorithm="giac")`

[Out] `-1/4*log(cos(x) + 1)/a + 1/4*log(-cos(x) + 1)/a + 1/2*cos(x)/((cos(x)^2 - 1)*a)`

$$3.8 \quad \int \frac{\csc^2(x)}{a - a \cos^2(x)} dx$$

**Optimal.** Leaf size=19

$$-\frac{\cot^3(x)}{3a} - \frac{\cot(x)}{a}$$

[Out] -(Cot[x]/a) - Cot[x]^3/(3\*a)

**Rubi [A]** time = 0.0477914, antiderivative size = 19, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 2, integrand size = 16,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.125$ , Rules used = {3175, 3767}

$$-\frac{\cot^3(x)}{3a} - \frac{\cot(x)}{a}$$

Antiderivative was successfully verified.

[In] Int[Csc[x]^2/(a - a\*Cos[x]^2), x]

[Out] -(Cot[x]/a) - Cot[x]^3/(3\*a)

#### Rule 3175

Int[(u\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_), x\_Symbol] :> Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

#### Rule 3767

Int[csc[(c\_.) + (d\_.)\*(x\_)]^(n\_), x\_Symbol] :> -Dist[d^(-1), Subst[Int[ExpandIntegrand[(1 + x^2)^(n/2 - 1), x], x], x, Cot[c + d\*x]], x] /; FreeQ[{c, d}, x] && IGtQ[n/2, 0]

#### Rubi steps

$$\begin{aligned} \int \frac{\csc^2(x)}{a - a \cos^2(x)} dx &= \frac{\int \csc^4(x) dx}{a} \\ &= -\frac{\text{Subst}\left(\int (1 + x^2) dx, x, \cot(x)\right)}{a} \\ &= -\frac{\cot(x)}{a} - \frac{\cot^3(x)}{3a} \end{aligned}$$

**Mathematica [A]** time = 0.0032647, size = 21, normalized size = 1.11

$$\frac{-\frac{2 \cot(x)}{3} - \frac{1}{3} \cot(x) \csc^2(x)}{a}$$

Antiderivative was successfully verified.

[In] Integrate[Csc[x]^2/(a - a\*Cos[x]^2), x]

[Out]  $((-2*\text{Cot}[x])/3 - (\text{Cot}[x]*\text{Csc}[x]^2)/3)/a$

---

**Maple [A]** time = 0.03, size = 18, normalized size = 1.

$$\frac{1}{a} \left( -\frac{1}{3 (\tan(x))^3} - (\tan(x))^{-1} \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(csc(x)^2/(a-a*cos(x)^2),x)`

[Out]  $1/a*(-1/3/\tan(x)^3-1/\tan(x))$

---

**Maxima [A]** time = 0.941513, size = 23, normalized size = 1.21

$$-\frac{3 \tan(x)^2 + 1}{3 a \tan(x)^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(csc(x)^2/(a-a*cos(x)^2),x, algorithm="maxima")`

[Out]  $-1/3*(3*\tan(x)^2 + 1)/(a*\tan(x)^3)$

---

**Fricas [A]** time = 1.82509, size = 76, normalized size = 4.

$$-\frac{2 \cos(x)^3 - 3 \cos(x)}{3 (a \cos(x)^2 - a) \sin(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(csc(x)^2/(a-a*cos(x)^2),x, algorithm="fricas")`

[Out]  $-1/3*(2*\cos(x)^3 - 3*\cos(x))/((a*\cos(x)^2 - a)*\sin(x))$

---

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$-\frac{\int \frac{\csc^2(x)}{\cos^2(x)-1} dx}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(csc(x)**2/(a-a*cos(x)**2),x)`

[Out]  $-\text{Integral}(\csc(x)**2/(\cos(x)**2 - 1), x)/a$

---

**Giac [A]** time = 1.17476, size = 23, normalized size = 1.21

$$-\frac{3 \tan(x)^2 + 1}{3 a \tan(x)^3}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(csc(x)^2/(a-a*cos(x)^2),x, algorithm="giac")
```

```
[Out] -1/3*(3*tan(x)^2 + 1)/(a*tan(x)^3)
```

### 3.9 $\int \frac{\csc^3(x)}{a - a \cos^2(x)} dx$

**Optimal.** Leaf size=35

$$-\frac{3 \tanh^{-1}(\cos(x))}{8a} - \frac{\cot(x) \csc^3(x)}{4a} - \frac{3 \cot(x) \csc(x)}{8a}$$

[Out]  $(-3*\text{ArcTanh}[\text{Cos}[x]])/(8*a) - (3*\text{Cot}[x]*\text{Csc}[x])/(8*a) - (\text{Cot}[x]*\text{Csc}[x]^3)/(4*a)$

**Rubi [A]** time = 0.0551938, antiderivative size = 35, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 3, integrand size = 16,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.188$ , Rules used = {3175, 3768, 3770}

$$-\frac{3 \tanh^{-1}(\cos(x))}{8a} - \frac{\cot(x) \csc^3(x)}{4a} - \frac{3 \cot(x) \csc(x)}{8a}$$

Antiderivative was successfully verified.

[In]  $\text{Int}[\text{Csc}[x]^3/(a - a*\text{Cos}[x]^2), x]$

[Out]  $(-3*\text{ArcTanh}[\text{Cos}[x]])/(8*a) - (3*\text{Cot}[x]*\text{Csc}[x])/(8*a) - (\text{Cot}[x]*\text{Csc}[x]^3)/(4*a)$

#### Rule 3175

$\text{Int}[(u_.)*((a_.) + (b_.)*\sin[(e_.) + (f_.)*(x_)]^2)^{(p_)}, x\_Symbol] \rightarrow \text{Dist}[a^p, \text{Int}[\text{ActivateTrig}[u*\cos[e + f*x]^{(2*p)}], x], x] /; \text{FreeQ}\{a, b, e, f, p\}, x] \ \&\& \ \text{EqQ}[a + b, 0] \ \&\& \ \text{IntegerQ}[p]$

#### Rule 3768

$\text{Int}[(\csc[(c_.) + (d_.)*(x_)]*(b_.)^{(n_)}), x\_Symbol] \rightarrow -\text{Simp}[(b*\text{Cos}[c + d*x])*(b*\text{Csc}[c + d*x])^{(n-1)})/(d*(n-1)), x] + \text{Dist}[(b^2*(n-2))/(n-1), \text{Int}[(b*\text{Csc}[c + d*x])^{(n-2)}, x], x] /; \text{FreeQ}\{b, c, d\}, x] \ \&\& \ \text{GtQ}[n, 1] \ \&\& \ \text{IntegerQ}[2*n]$

#### Rule 3770

$\text{Int}[\csc[(c_.) + (d_.)*(x_)], x\_Symbol] \rightarrow -\text{Simp}[\text{ArcTanh}[\text{Cos}[c + d*x]]/d, x] /; \text{FreeQ}\{c, d\}, x]$

#### Rubi steps

$$\begin{aligned} \int \frac{\csc^3(x)}{a - a \cos^2(x)} dx &= \frac{\int \csc^5(x) dx}{a} \\ &= -\frac{\cot(x) \csc^3(x)}{4a} + \frac{3 \int \csc^3(x) dx}{4a} \\ &= -\frac{3 \cot(x) \csc(x)}{8a} - \frac{\cot(x) \csc^3(x)}{4a} + \frac{3 \int \csc(x) dx}{8a} \\ &= -\frac{3 \tanh^{-1}(\cos(x))}{8a} - \frac{3 \cot(x) \csc(x)}{8a} - \frac{\cot(x) \csc^3(x)}{4a} \end{aligned}$$



**Mathematica [B]** time = 0.0062478, size = 75, normalized size = 2.14

$$\frac{-\frac{1}{64} \csc^4\left(\frac{x}{2}\right) - \frac{3}{32} \csc^2\left(\frac{x}{2}\right) + \frac{1}{64} \sec^4\left(\frac{x}{2}\right) + \frac{3}{32} \sec^2\left(\frac{x}{2}\right) + \frac{3}{8} \log\left(\sin\left(\frac{x}{2}\right)\right) - \frac{3}{8} \log\left(\cos\left(\frac{x}{2}\right)\right)}{a}$$

Antiderivative was successfully verified.

[In] Integrate[Csc[x]^3/(a - a\*Cos[x]^2), x]

[Out] ((-3\*Csc[x/2]^2)/32 - Csc[x/2]^4/64 - (3\*Log[Cos[x/2]])/8 + (3\*Log[Sin[x/2]])/8 + (3\*Sec[x/2]^2)/32 + Sec[x/2]^4/64)/a

**Maple [B]** time = 0.037, size = 66, normalized size = 1.9

$$\frac{1}{16a(1+\cos(x))^2} + \frac{3}{16a(1+\cos(x))} - \frac{3\ln(1+\cos(x))}{16a} - \frac{1}{16a(\cos(x)-1)^2} + \frac{3}{16a(\cos(x)-1)} + \frac{3\ln(\cos(x)-1)}{16a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(csc(x)^3/(a-a\*cos(x)^2), x)

[Out] 1/16/a/(1+cos(x))^2+3/16/a/(1+cos(x))-3/16/a\*ln(1+cos(x))-1/16/a/(cos(x)-1)^2+3/16/a/(cos(x)-1)+3/16/a\*ln(cos(x)-1)

**Maxima [A]** time = 0.95155, size = 69, normalized size = 1.97

$$\frac{3\cos(x)^3 - 5\cos(x)}{8(a\cos(x)^4 - 2a\cos(x)^2 + a)} - \frac{3\log(\cos(x) + 1)}{16a} + \frac{3\log(\cos(x) - 1)}{16a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^3/(a-a\*cos(x)^2), x, algorithm="maxima")

[Out] 1/8\*(3\*cos(x)^3 - 5\*cos(x))/(a\*cos(x)^4 - 2\*a\*cos(x)^2 + a) - 3/16\*log(cos(x) + 1)/a + 3/16\*log(cos(x) - 1)/a

**Fricas [B]** time = 1.97039, size = 232, normalized size = 6.63

$$\frac{6\cos(x)^3 - 3(\cos(x)^4 - 2\cos(x)^2 + 1)\log\left(\frac{1}{2}\cos(x) + \frac{1}{2}\right) + 3(\cos(x)^4 - 2\cos(x)^2 + 1)\log\left(-\frac{1}{2}\cos(x) + \frac{1}{2}\right) - 10\cos(x)}{16(a\cos(x)^4 - 2a\cos(x)^2 + a)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^3/(a-a\*cos(x)^2), x, algorithm="fricas")

[Out] 1/16\*(6\*cos(x)^3 - 3\*(cos(x)^4 - 2\*cos(x)^2 + 1)\*log(1/2\*cos(x) + 1/2) + 3\*(cos(x)^4 - 2\*cos(x)^2 + 1)\*log(-1/2\*cos(x) + 1/2) - 10\*cos(x))/(a\*cos(x)^4 - 2\*a\*cos(x)^2 + a)

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$-\frac{\int \frac{\csc^3(x)}{\cos^2(x)-1} dx}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)\*\*3/(a-a\*cos(x)\*\*2),x)

[Out] -Integral(csc(x)\*\*3/(cos(x)\*\*2 - 1), x)/a

**Giac [A]** time = 1.12851, size = 63, normalized size = 1.8

$$-\frac{3 \log(\cos(x) + 1)}{16 a} + \frac{3 \log(-\cos(x) + 1)}{16 a} + \frac{3 \cos(x)^3 - 5 \cos(x)}{8 (\cos(x)^2 - 1)^2 a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^3/(a-a\*cos(x)^2),x, algorithm="giac")

[Out] -3/16\*log(cos(x) + 1)/a + 3/16\*log(-cos(x) + 1)/a + 1/8\*(3\*cos(x)^3 - 5\*cos(x))/((cos(x)^2 - 1)^2\*a)

### 3.10 $\int \frac{\sin^7(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=78

$$\frac{(a^2 + 3ab + 3b^2) \cos(x)}{b^3} - \frac{(a + 3b) \cos^3(x)}{3b^2} - \frac{(a + b)^3 \tan^{-1}\left(\frac{\sqrt{b} \cos(x)}{\sqrt{a}}\right)}{\sqrt{ab}^{7/2}} + \frac{\cos^5(x)}{5b}$$

[Out] -(((a + b)^3\*ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]]/(Sqrt[a]\*b^(7/2)))) + ((a^2 + 3\*a\*b + 3\*b^2)\*Cos[x])/b^3 - ((a + 3\*b)\*Cos[x]^3)/(3\*b^2) + Cos[x]^5/(5\*b)

**Rubi [A]** time = 0.0903888, antiderivative size = 78, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3190, 390, 205}

$$\frac{(a^2 + 3ab + 3b^2) \cos(x)}{b^3} - \frac{(a + 3b) \cos^3(x)}{3b^2} - \frac{(a + b)^3 \tan^{-1}\left(\frac{\sqrt{b} \cos(x)}{\sqrt{a}}\right)}{\sqrt{ab}^{7/2}} + \frac{\cos^5(x)}{5b}$$

Antiderivative was successfully verified.

[In] Int[Sin[x]^7/(a + b\*Cos[x]^2), x]

[Out] -(((a + b)^3\*ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]]/(Sqrt[a]\*b^(7/2)))) + ((a^2 + 3\*a\*b + 3\*b^2)\*Cos[x])/b^3 - ((a + 3\*b)\*Cos[x]^3)/(3\*b^2) + Cos[x]^5/(5\*b)

#### Rule 3190

Int[cos[(e\_.) + (f\_.)\*(x\_)]^(m\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_.), x\_Symbol] :> With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b\*ff^2\*x^2)^p, x], x, Sin[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 390

Int[((a\_) + (b\_.)\*(x\_)^(n\_))^(p\_)\*((c\_) + (d\_.)\*(x\_)^(n\_))^(q\_), x\_Symbol] :> Int[PolynomialDivide[(a + b\*x^n)^p, (c + d\*x^n)^(-q), x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0] && IGtQ[n, 0] && IGtQ[p, 0] && ILtQ[q, 0] && GeQ[p, -q]

#### Rule 205

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

#### Rubi steps

$$\begin{aligned}
\int \frac{\sin^7(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{(1-x^2)^3}{a + bx^2} dx, x, \cos(x) \right) \\
&= -\text{Subst} \left( \int \left( -\frac{a^2 + 3ab + 3b^2}{b^3} + \frac{(a+3b)x^2}{b^2} - \frac{x^4}{b} + \frac{a^3 + 3a^2b + 3ab^2 + b^3}{b^3(a+bx^2)} \right) dx, x, \cos(x) \right) \\
&= \frac{(a^2 + 3ab + 3b^2) \cos(x)}{b^3} - \frac{(a+3b) \cos^3(x)}{3b^2} + \frac{\cos^5(x)}{5b} - \frac{(a+b)^3 \text{Subst} \left( \int \frac{1}{a+bx^2} dx, x, \cos(x) \right)}{b^3} \\
&= -\frac{(a+b)^3 \tan^{-1} \left( \frac{\sqrt{b} \cos(x)}{\sqrt{a}} \right)}{\sqrt{ab}^{7/2}} + \frac{(a^2 + 3ab + 3b^2) \cos(x)}{b^3} - \frac{(a+3b) \cos^3(x)}{3b^2} + \frac{\cos^5(x)}{5b}
\end{aligned}$$

**Mathematica [A]** time = 0.24336, size = 143, normalized size = 1.83

$$\frac{(8a^2 + 22ab + 19b^2) \cos(x)}{8b^3} - \frac{(4a + 9b) \cos(3x)}{48b^2} - \frac{(a+b)^3 \tan^{-1} \left( \frac{\sqrt{b} - \sqrt{a+b} \tan(\frac{x}{2})}{\sqrt{a}} \right)}{\sqrt{ab}^{7/2}} - \frac{(a+b)^3 \tan^{-1} \left( \frac{\sqrt{a+b} \tan(\frac{x}{2}) + \sqrt{b}}{\sqrt{a}} \right)}{\sqrt{ab}^{7/2}} + \dots$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]^7/(a + b\*Cos[x]^2), x]

[Out] -(((a + b)^3\*ArcTan[(Sqrt[b] - Sqrt[a + b]\*Tan[x/2])/Sqrt[a]])/(Sqrt[a]\*b^(7/2))) - ((a + b)^3\*ArcTan[(Sqrt[b] + Sqrt[a + b]\*Tan[x/2])/Sqrt[a]])/(Sqrt[a]\*b^(7/2)) + ((8\*a^2 + 22\*a\*b + 19\*b^2)\*Cos[x])/(8\*b^3) - ((4\*a + 9\*b)\*Cos[3\*x])/(48\*b^2) + Cos[5\*x]/(80\*b)

**Maple [B]** time = 0.024, size = 138, normalized size = 1.8

$$\frac{(\cos(x))^5}{5b} - \frac{(\cos(x))^3 a}{3b^2} - \frac{(\cos(x))^3}{b} + \frac{a^2 \cos(x)}{b^3} + 3 \frac{a \cos(x)}{b^2} + 3 \frac{\cos(x)}{b} - \frac{a^3}{b^3} \arctan \left( b \cos(x) \frac{1}{\sqrt{ab}} \right) \frac{1}{\sqrt{ab}} - 3 \frac{a^2}{b^2 \sqrt{ab}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sin(x)^7/(a+b\*cos(x)^2), x)

[Out] 1/5\*cos(x)^5/b-1/3/b^2\*cos(x)^3\*a-cos(x)^3/b+1/b^3\*a^2\*cos(x)+3/b^2\*a\*cos(x)+3\*cos(x)/b-1/b^3/(a\*b)^(1/2)\*arctan(b\*cos(x)/(a\*b)^(1/2))\*a^3-3/b^2/(a\*b)^(1/2)\*arctan(b\*cos(x)/(a\*b)^(1/2))\*a^2-3/b/(a\*b)^(1/2)\*arctan(b\*cos(x)/(a\*b)^(1/2))\*a-1/(a\*b)^(1/2)\*arctan(b\*cos(x)/(a\*b)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^7/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError

---

**Fricas [A]** time = 2.08668, size = 547, normalized size = 7.01

$$\frac{6ab^3 \cos(x)^5 - 10(a^2b^2 + 3ab^3) \cos(x)^3 - 15(a^3 + 3a^2b + 3ab^2 + b^3) \sqrt{-ab} \log\left(-\frac{b \cos(x)^2 + 2\sqrt{-ab} \cos(x) - a}{b \cos(x)^2 + a}\right) + 30(a^3b}{30ab^4}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^7/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/30\*(6\*a\*b^3\*cos(x)^5 - 10\*(a^2\*b^2 + 3\*a\*b^3)\*cos(x)^3 - 15\*(a^3 + 3\*a^2\*b + 3\*a\*b^2 + b^3)\*sqrt(-a\*b)\*log(-(b\*cos(x)^2 + 2\*sqrt(-a\*b)\*cos(x) - a)/(b\*cos(x)^2 + a)) + 30\*(a^3\*b + 3\*a^2\*b^2 + 3\*a\*b^3)\*cos(x))/(a\*b^4), 1/15\*(3\*a\*b^3\*cos(x)^5 - 5\*(a^2\*b^2 + 3\*a\*b^3)\*cos(x)^3 - 15\*(a^3 + 3\*a^2\*b + 3\*a\*b^2 + b^3)\*sqrt(a\*b)\*arctan(sqrt(a\*b)\*cos(x)/a) + 15\*(a^3\*b + 3\*a^2\*b^2 + 3\*a\*b^3)\*cos(x))/(a\*b^4)]

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)\*\*7/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

---

**Giac [A]** time = 1.14163, size = 134, normalized size = 1.72

$$-\frac{(a^3 + 3a^2b + 3ab^2 + b^3) \arctan\left(\frac{b \cos(x)}{\sqrt{ab}}\right)}{\sqrt{abb^3}} + \frac{3b^4 \cos(x)^5 - 5ab^3 \cos(x)^3 - 15b^4 \cos(x)^3 + 15a^2b^2 \cos(x) + 45ab^3 \cos(x)}{15b^5}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^7/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] -(a^3 + 3\*a^2\*b + 3\*a\*b^2 + b^3)\*arctan(b\*cos(x)/sqrt(a\*b))/(sqrt(a\*b)\*b^3) + 1/15\*(3\*b^4\*cos(x)^5 - 5\*a\*b^3\*cos(x)^3 - 15\*b^4\*cos(x)^3 + 15\*a^2\*b^2\*cos(x) + 45\*a\*b^3\*cos(x) + 45\*b^4\*cos(x))/b^5

$$3.11 \quad \int \frac{\sin^5(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=54

$$\frac{(a+2b)\cos(x)}{b^2} - \frac{(a+b)^2 \tan^{-1}\left(\frac{\sqrt{b}\cos(x)}{\sqrt{a}}\right)}{\sqrt{ab}^{5/2}} - \frac{\cos^3(x)}{3b}$$

[Out] -(((a + b)^2\*ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]])/(Sqrt[a]\*b^(5/2))) + ((a + 2\*b)\*Cos[x])/b^2 - Cos[x]^3/(3\*b)

**Rubi [A]** time = 0.0726949, antiderivative size = 54, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3190, 390, 205}

$$\frac{(a+2b)\cos(x)}{b^2} - \frac{(a+b)^2 \tan^{-1}\left(\frac{\sqrt{b}\cos(x)}{\sqrt{a}}\right)}{\sqrt{ab}^{5/2}} - \frac{\cos^3(x)}{3b}$$

Antiderivative was successfully verified.

[In] Int[Sin[x]^5/(a + b\*Cos[x]^2), x]

[Out] -(((a + b)^2\*ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]])/(Sqrt[a]\*b^(5/2))) + ((a + 2\*b)\*Cos[x])/b^2 - Cos[x]^3/(3\*b)

#### Rule 3190

```
Int[cos[(e_.) + (f_.)*(x_.)]^(m_.)*((a_.) + (b_.)*sin[(e_.) + (f_.)*(x_.)]^2)^(p_.), x_Symbol]
:> With[{ff = FreeFactors[Sin[e + f*x], x]}, Dist[ff/f, Subst[Int[(1 - ff^2*x^2)^((m - 1)/2)*(a + b*ff^2*x^2)^p, x], x, Sin[e + f*x]/ff], x]
/; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]
```

#### Rule 390

```
Int[((a_.) + (b_.)*(x_)^(n_))^(p_)*((c_.) + (d_.)*(x_)^(n_))^(q_), x_Symbol]
:> Int[PolynomialDivide[(a + b*x^n)^p, (c + d*x^n)^(-q), x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b*c - a*d, 0] && IGtQ[n, 0] && IGtQ[p, 0] && ILtQ[q, 0] && GeQ[p, -q]
```

#### Rule 205

```
Int[((a_.) + (b_.)*(x_)^2)^(-1), x_Symbol]
:> Simp[(Rt[a/b, 2]*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]
```

#### Rubi steps

$$\begin{aligned}
\int \frac{\sin^5(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{(1-x^2)^2}{a+bx^2} dx, x, \cos(x) \right) \\
&= -\text{Subst} \left( \int \left( -\frac{a+2b}{b^2} + \frac{x^2}{b} + \frac{a^2+2ab+b^2}{b^2(a+bx^2)} \right) dx, x, \cos(x) \right) \\
&= \frac{(a+2b)\cos(x)}{b^2} - \frac{\cos^3(x)}{3b} - \frac{(a+b)^2 \text{Subst} \left( \int \frac{1}{a+bx^2} dx, x, \cos(x) \right)}{b^2} \\
&= -\frac{(a+b)^2 \tan^{-1} \left( \frac{\sqrt{b}\cos(x)}{\sqrt{a}} \right)}{\sqrt{ab}^{5/2}} + \frac{(a+2b)\cos(x)}{b^2} - \frac{\cos^3(x)}{3b}
\end{aligned}$$

**Mathematica [B]** time = 0.16841, size = 116, normalized size = 2.15

$$\frac{3\sqrt{b}(4a+7b)\cos(x) - \frac{12(a+b)^2 \tan^{-1} \left( \frac{\sqrt{b}-\sqrt{a+b}\tan\left(\frac{x}{2}\right)}{\sqrt{a}} \right)}{\sqrt{a}} - \frac{12(a+b)^2 \tan^{-1} \left( \frac{\sqrt{a+b}\tan\left(\frac{x}{2}\right)+\sqrt{b}}{\sqrt{a}} \right)}{\sqrt{a}} - b^{3/2}\cos(3x)}{12b^{5/2}}$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]^5/(a + b\*Cos[x]^2), x]

[Out]  $\left( (-12(a+b)^2 \text{ArcTan}[\frac{\sqrt{b}-\sqrt{a+b}\tan(x/2)}{\sqrt{a}}])/\sqrt{a} \right)/\sqrt{a} - \left( 12(a+b)^2 \text{ArcTan}[\frac{\sqrt{b}+\sqrt{a+b}\tan(x/2)}{\sqrt{a}}])/\sqrt{a} \right)/\sqrt{a} + 3\sqrt{b}(4a+7b)\cos(x) - b^{3/2}\cos(3x) / (12b^{5/2})$

**Maple [A]** time = 0.019, size = 86, normalized size = 1.6

$$-\frac{(\cos(x))^3}{3b} + \frac{a\cos(x)}{b^2} + 2\frac{\cos(x)}{b} - \frac{a^2}{b^2} \arctan\left(b\cos(x)\frac{1}{\sqrt{ab}}\right)\frac{1}{\sqrt{ab}} - 2\frac{a}{b\sqrt{ab}} \arctan\left(\frac{b\cos(x)}{\sqrt{ab}}\right) - \arctan\left(b\cos(x)\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sin(x)^5/(a+b\*cos(x)^2), x)

[Out]  $-1/3*\cos(x)^3/b+1/b^2*a*\cos(x)+2*\cos(x)/b-1/b^2/(a*b)^{(1/2)}*\arctan(b*\cos(x)/(a*b)^{(1/2)})*a^2-2/b/(a*b)^{(1/2)}*\arctan(b*\cos(x)/(a*b)^{(1/2)})*a-1/(a*b)^{(1/2)}*\arctan(b*\cos(x)/(a*b)^{(1/2)})$

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^5/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError

---

**Fricas [A]** time = 1.77727, size = 383, normalized size = 7.09

$$\left[ \frac{2ab^2 \cos(x)^3 + 3(a^2 + 2ab + b^2)\sqrt{-ab} \log\left(\frac{-b \cos(x)^2 + 2\sqrt{-ab} \cos(x) - a}{b \cos(x)^2 + a}\right) - 6(a^2b + 2ab^2) \cos(x)}{6ab^3}, \frac{ab^2 \cos(x)^3 + 3(a^2 + 2ab + b^2)\sqrt{ab} \arctan\left(\frac{b \cos(x)}{a}\right) - 6(a^2b + 2ab^2) \cos(x)}{3b^3} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^5/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [-1/6\*(2\*a\*b^2\*cos(x)^3 + 3\*(a^2 + 2\*a\*b + b^2)\*sqrt(-a\*b)\*log(-(b\*cos(x)^2 + 2\*sqrt(-a\*b)\*cos(x) - a)/(b\*cos(x)^2 + a)) - 6\*(a^2\*b + 2\*a\*b^2)\*cos(x))/(a\*b^3), -1/3\*(a\*b^2\*cos(x)^3 + 3\*(a^2 + 2\*a\*b + b^2)\*sqrt(a\*b)\*arctan(sqrt(a\*b)\*cos(x)/a) - 3\*(a^2\*b + 2\*a\*b^2)\*cos(x))/(a\*b^3)]

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)\*\*5/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

---

**Giac [A]** time = 1.12684, size = 80, normalized size = 1.48

$$\frac{(a^2 + 2ab + b^2) \arctan\left(\frac{b \cos(x)}{\sqrt{ab}}\right)}{\sqrt{abb^2}} - \frac{b^2 \cos(x)^3 - 3ab \cos(x) - 6b^2 \cos(x)}{3b^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^5/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] -(a^2 + 2\*a\*b + b^2)\*arctan(b\*cos(x)/sqrt(a\*b))/(sqrt(a\*b)\*b^2) - 1/3\*(b^2\*cos(x)^3 - 3\*a\*b\*cos(x) - 6\*b^2\*cos(x))/b^3



$$3.12 \quad \int \frac{\sin^3(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=36

$$\frac{\cos(x)}{b} - \frac{(a+b) \tan^{-1}\left(\frac{\sqrt{b} \cos(x)}{\sqrt{a}}\right)}{\sqrt{ab}^{3/2}}$$

[Out] -(((a + b)\*ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]])/(Sqrt[a]\*b^(3/2))) + Cos[x]/b

**Rubi [A]** time = 0.0531164, antiderivative size = 36, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3190, 388, 205}

$$\frac{\cos(x)}{b} - \frac{(a+b) \tan^{-1}\left(\frac{\sqrt{b} \cos(x)}{\sqrt{a}}\right)}{\sqrt{ab}^{3/2}}$$

Antiderivative was successfully verified.

[In] Int[Sin[x]^3/(a + b\*cos[x]^2), x]

[Out] -(((a + b)\*ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]])/(Sqrt[a]\*b^(3/2))) + Cos[x]/b

#### Rule 3190

Int[cos[(e\_.) + (f\_.)\*(x\_)]^(m\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_.), x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b\*ff^2\*x^2)^p, x], x, Sin[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 388

Int[((a\_) + (b\_.)\*(x\_)^(n\_))^(p\_)\*((c\_) + (d\_.)\*(x\_)^(n\_)), x\_Symbol] := Simp[(d\*x\*(a + b\*x^n)^(p + 1))/(b\*(n\*(p + 1) + 1)), x] - Dist[(a\*d - b\*c\*(n\*(p + 1) + 1))/(b\*(n\*(p + 1) + 1)), Int[(a + b\*x^n)^p, x], x] /; FreeQ[{a, b, c, d, n}, x] && NeQ[b\*c - a\*d, 0] && NeQ[n\*(p + 1) + 1, 0]

#### Rule 205

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

#### Rubi steps

$$\begin{aligned} \int \frac{\sin^3(x)}{a+b \cos^2(x)} dx &= -\text{Subst}\left(\int \frac{1-x^2}{a+bx^2} dx, x, \cos(x)\right) \\ &= \frac{\cos(x)}{b} - \frac{(a+b) \text{Subst}\left(\int \frac{1}{a+bx^2} dx, x, \cos(x)\right)}{b} \\ &= -\frac{(a+b) \tan^{-1}\left(\frac{\sqrt{b} \cos(x)}{\sqrt{a}}\right)}{\sqrt{ab}^{3/2}} + \frac{\cos(x)}{b} \end{aligned}$$

**Mathematica [B]** time = 0.161007, size = 90, normalized size = 2.5

$$\frac{\sqrt{a}\sqrt{b}\cos(x) - (a+b)\tan^{-1}\left(\frac{\sqrt{b}-\sqrt{a+b}\tan\left(\frac{x}{2}\right)}{\sqrt{a}}\right) - (a+b)\tan^{-1}\left(\frac{\sqrt{a+b}\tan\left(\frac{x}{2}\right)+\sqrt{b}}{\sqrt{a}}\right)}{\sqrt{ab}^{3/2}}$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]^3/(a + b\*Cos[x]^2),x]

[Out] (-((a + b)\*ArcTan[(Sqrt[b] - Sqrt[a + b]\*Tan[x/2])/Sqrt[a]]) - (a + b)\*ArcTan[(Sqrt[b] + Sqrt[a + b]\*Tan[x/2])/Sqrt[a]] + Sqrt[a]\*Sqrt[b]\*Cos[x])/(Sqrt[a]\*b^(3/2))

**Maple [A]** time = 0.017, size = 46, normalized size = 1.3

$$\frac{\cos(x)}{b} - \frac{a}{b} \arctan\left(b \cos(x) \frac{1}{\sqrt{ab}}\right) \frac{1}{\sqrt{ab}} - \arctan\left(b \cos(x) \frac{1}{\sqrt{ab}}\right) \frac{1}{\sqrt{ab}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sin(x)^3/(a+b\*cos(x)^2),x)

[Out] cos(x)/b-1/b/(a\*b)^(1/2)\*arctan(b\*cos(x)/(a\*b)^(1/2))\*a-1/(a\*b)^(1/2)\*arctan(b\*cos(x)/(a\*b)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^3/(a+b\*cos(x)^2),x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.74506, size = 248, normalized size = 6.89

$$\left[ \frac{2ab\cos(x) - \sqrt{-ab}(a+b)\log\left(-\frac{b\cos(x)^2+2\sqrt{-ab}\cos(x)-a}{b\cos(x)^2+a}\right)}{2ab^2}, \frac{ab\cos(x) - \sqrt{ab}(a+b)\arctan\left(\frac{\sqrt{ab}\cos(x)}{a}\right)}{ab^2} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^3/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/2\*(2\*a\*b\*cos(x) - sqrt(-a\*b)\*(a + b)\*log(-(b\*cos(x)^2 + 2\*sqrt(-a\*b)\*cos(x) - a)/(b\*cos(x)^2 + a)))/(a\*b^2), (a\*b\*cos(x) - sqrt(a\*b)\*(a + b)\*arctan(sqrt(a\*b)\*cos(x)/a))/(a\*b^2)]

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)\*\*3/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

---

**Giac [A]** time = 1.12843, size = 41, normalized size = 1.14

$$-\frac{(a+b)\arctan\left(\frac{b\cos(x)}{\sqrt{ab}}\right)}{\sqrt{abb}} + \frac{\cos(x)}{b}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^3/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] -(a + b)\*arctan(b\*cos(x)/sqrt(a\*b))/(sqrt(a\*b)\*b) + cos(x)/b

### 3.13 $\int \frac{\sin(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=26

$$-\frac{\tan^{-1}\left(\frac{\sqrt{b}\cos(x)}{\sqrt{a}}\right)}{\sqrt{a}\sqrt{b}}$$

[Out] -(ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]]/(Sqrt[a]\*Sqrt[b]))

**Rubi [A]** time = 0.0272752, antiderivative size = 26, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 13,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.154$ , Rules used = {3190, 205}

$$-\frac{\tan^{-1}\left(\frac{\sqrt{b}\cos(x)}{\sqrt{a}}\right)}{\sqrt{a}\sqrt{b}}$$

Antiderivative was successfully verified.

[In] Int[Sin[x]/(a + b\*Cos[x]^2),x]

[Out] -(ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]]/(Sqrt[a]\*Sqrt[b]))

#### Rule 3190

Int[cos[(e\_.) + (f\_.)\*(x\_.)]^(m\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^(p\_.), x\_Symbol] :> With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b\*ff^2\*x^2)^p, x], x, Sin[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 205

Int[((a\_.) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

#### Rubi steps

$$\begin{aligned} \int \frac{\sin(x)}{a+b \cos^2(x)} dx &= -\text{Subst}\left(\int \frac{1}{a+bx^2} dx, x, \cos(x)\right) \\ &= -\frac{\tan^{-1}\left(\frac{\sqrt{b}\cos(x)}{\sqrt{a}}\right)}{\sqrt{a}\sqrt{b}} \end{aligned}$$

**Mathematica [A]** time = 0.0192716, size = 26, normalized size = 1.

$$-\frac{\tan^{-1}\left(\frac{\sqrt{b}\cos(x)}{\sqrt{a}}\right)}{\sqrt{a}\sqrt{b}}$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]/(a + b\*Cos[x]^2),x]

[Out]  $-(\text{ArcTan}[(\text{Sqrt}[b] * \text{Cos}[x]) / \text{Sqrt}[a]] / (\text{Sqrt}[a] * \text{Sqrt}[b]))$

**Maple [A]** time = 0.012, size = 18, normalized size = 0.7

$$-\arctan\left(b \cos(x) \frac{1}{\sqrt{ab}}\right) \frac{1}{\sqrt{ab}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In]  $\text{int}(\sin(x)/(a+b*\cos(x)^2), x)$

[Out]  $-1/(a*b)^{(1/2)}*\arctan(b*\cos(x)/(a*b)^{(1/2)})$

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In]  $\text{integrate}(\sin(x)/(a+b*\cos(x)^2), x, \text{algorithm}="maxima")$

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.67127, size = 181, normalized size = 6.96

$$\left[ \frac{\sqrt{-ab} \log\left(\frac{-b \cos(x)^2 + 2\sqrt{-ab} \cos(x) - a}{b \cos(x)^2 + a}\right)}{2ab}, \frac{\sqrt{ab} \arctan\left(\frac{\sqrt{ab} \cos(x)}{a}\right)}{ab} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In]  $\text{integrate}(\sin(x)/(a+b*\cos(x)^2), x, \text{algorithm}="fricas")$

[Out]  $[-1/2*\sqrt{-a*b}*\log(-(b*\cos(x)^2 + 2*\sqrt{-a*b})*\cos(x) - a)/(b*\cos(x)^2 + a))/(a*b), -\sqrt{a*b}*\arctan(\sqrt{a*b}*\cos(x)/a)/(a*b)]$

**Sympy [A]** time = 1.94691, size = 87, normalized size = 3.35

$$\begin{cases} \frac{\infty}{\cos(x)} & \text{for } a = 0 \wedge b = 0 \\ \frac{1}{\cos(x)} & \text{for } a = 0 \\ \frac{b \cos(x)}{\cos(x)} & \text{for } b = 0 \\ \frac{i \log\left(-i\sqrt{a}\sqrt{\frac{1}{b}} + \cos(x)\right)}{2\sqrt{ab}\sqrt{\frac{1}{b}}} - \frac{i \log\left(i\sqrt{a}\sqrt{\frac{1}{b}} + \cos(x)\right)}{2\sqrt{ab}\sqrt{\frac{1}{b}}} & \text{otherwise} \end{cases}$$

Verification of antiderivative is not currently implemented for this CAS.

[In]  $\text{integrate}(\sin(x)/(a+b*\cos(x)**2), x)$

```
[Out] Piecewise((zoo/cos(x), Eq(a, 0) & Eq(b, 0)), (1/(b*cos(x)), Eq(a, 0)), (-cos(x)/a, Eq(b, 0)), (I*log(-I*sqrt(a)*sqrt(1/b) + cos(x))/(2*sqrt(a)*b*sqrt(1/b)) - I*log(I*sqrt(a)*sqrt(1/b) + cos(x))/(2*sqrt(a)*b*sqrt(1/b)), True))
```

**Giac [A]** time = 1.12251, size = 23, normalized size = 0.88

$$-\frac{\arctan\left(\frac{b\cos(x)}{\sqrt{ab}}\right)}{\sqrt{ab}}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(sin(x)/(a+b*cos(x)^2),x, algorithm="giac")
```

```
[Out] -arctan(b*cos(x)/sqrt(a*b))/sqrt(a*b)
```

### 3.14 $\int \frac{\csc(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=42

$$-\frac{\sqrt{b} \tan^{-1}\left(\frac{\sqrt{b} \cos(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)} - \frac{\tanh^{-1}(\cos(x))}{a+b}$$

[Out] -((Sqrt[b]\*ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]]/(Sqrt[a]\*(a+b))) - ArcTanh[Cos[x]]/(a+b))

**Rubi [A]** time = 0.0491304, antiderivative size = 42, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 13,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.308$ , Rules used = {3190, 391, 206, 205}

$$-\frac{\sqrt{b} \tan^{-1}\left(\frac{\sqrt{b} \cos(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)} - \frac{\tanh^{-1}(\cos(x))}{a+b}$$

Antiderivative was successfully verified.

[In] Int[Csc[x]/(a + b\*cos[x]^2), x]

[Out] -((Sqrt[b]\*ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]]/(Sqrt[a]\*(a+b))) - ArcTanh[Cos[x]]/(a+b))

#### Rule 3190

Int[cos[(e\_.) + (f\_.)\*(x\_.)]^(m\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^(p\_.), x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b\*ff^2\*x^2)^p, x], x, Sin[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 391

Int[1/(((a\_.) + (b\_.)\*(x\_)^(n\_))\*((c\_.) + (d\_.)\*(x\_)^(n\_))), x\_Symbol] := Dist[b/(b\*c - a\*d), Int[1/(a + b\*x^n), x], x] - Dist[d/(b\*c - a\*d), Int[1/(c + d\*x^n), x], x] /; FreeQ[{a, b, c, d, n}, x] && NeQ[b\*c - a\*d, 0]

#### Rule 206

Int[((a\_.) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(1\*ArcTanh[(Rt[-b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (GtQ[a, 0] || LtQ[b, 0])

#### Rule 205

Int[((a\_.) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

#### Rubi steps

$$\begin{aligned} \int \frac{\csc(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{1}{(1-x^2)(a+bx^2)} dx, x, \cos(x) \right) \\ &= -\frac{\text{Subst} \left( \int \frac{1}{1-x^2} dx, x, \cos(x) \right)}{a+b} - \frac{b \text{Subst} \left( \int \frac{1}{a+bx^2} dx, x, \cos(x) \right)}{a+b} \\ &= -\frac{\sqrt{b} \tan^{-1} \left( \frac{\sqrt{b} \cos(x)}{\sqrt{a}} \right)}{\sqrt{a}(a+b)} - \frac{\tanh^{-1}(\cos(x))}{a+b} \end{aligned}$$

**Mathematica [A]** time = 0.0469493, size = 50, normalized size = 1.19

$$\frac{-\frac{2\sqrt{b} \tan^{-1} \left( \frac{\sqrt{b} \cos(x)}{\sqrt{a}} \right)}{\sqrt{a}} + \log(1 - \cos(x)) - \log(\cos(x) + 1)}{2(a+b)}$$

Antiderivative was successfully verified.

[In] Integrate[Csc[x]/(a + b\*Cos[x]^2), x]

[Out] ((-2\*Sqrt[b]\*ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]])/Sqrt[a] + Log[1 - Cos[x]] - Log[1 + Cos[x]])/(2\*(a + b))

**Maple [A]** time = 0.036, size = 56, normalized size = 1.3

$$-\frac{\ln(1 + \cos(x))}{2a + 2b} + \frac{\ln(\cos(x) - 1)}{2a + 2b} - \frac{b}{a+b} \arctan\left(b \cos(x) \frac{1}{\sqrt{ab}}\right) \frac{1}{\sqrt{ab}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(csc(x)/(a+b\*cos(x)^2), x)

[Out] -1/(2\*a+2\*b)\*ln(1+cos(x))+1/(2\*a+2\*b)\*ln(cos(x)-1)-b/(a+b)/(a\*b)^(1/2)\*arctan(b\*cos(x)/(a\*b)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.78181, size = 329, normalized size = 7.83

$$\left[ \frac{\sqrt{\frac{b}{a}} \log\left(\frac{b \cos(x)^2 - 2a\sqrt{\frac{b}{a}} \cos(x) - a}{b \cos(x)^2 + a}\right) - \log\left(\frac{1}{2} \cos(x) + \frac{1}{2}\right) + \log\left(-\frac{1}{2} \cos(x) + \frac{1}{2}\right)}{2(a+b)}, -\frac{2\sqrt{\frac{b}{a}} \arctan\left(\sqrt{\frac{b}{a}} \cos(x)\right) + \log\left(\frac{1}{2} \cos(x) + \frac{1}{2}\right)}{2(a+b)} \right]$$



Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/2\*(sqrt(-b/a)\*log((b\*cos(x)^2 - 2\*a\*sqrt(-b/a)\*cos(x) - a)/(b\*cos(x)^2 + a)) - log(1/2\*cos(x) + 1/2) + log(-1/2\*cos(x) + 1/2))/(a + b), -1/2\*(2\*sqrt(b/a)\*arctan(sqrt(b/a)\*cos(x)) + log(1/2\*cos(x) + 1/2) - log(-1/2\*cos(x) + 1/2))/(a + b)]

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\csc(x)}{a + b \cos^2(x)} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)/(a+b\*cos(x)\*\*2),x)

[Out] Integral(csc(x)/(a + b\*cos(x)\*\*2), x)

**Giac [A]** time = 1.20055, size = 68, normalized size = 1.62

$$-\frac{b \arctan\left(\frac{b \cos(x)}{\sqrt{ab}}\right)}{\sqrt{ab}(a+b)} - \frac{\log(\cos(x)+1)}{2(a+b)} + \frac{\log(-\cos(x)+1)}{2(a+b)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] -b\*arctan(b\*cos(x)/sqrt(a\*b))/(sqrt(a\*b)\*(a + b)) - 1/2\*log(cos(x) + 1)/(a + b) + 1/2\*log(-cos(x) + 1)/(a + b)

$$3.15 \quad \int \frac{\csc^3(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=62

$$-\frac{b^{3/2} \tan^{-1}\left(\frac{\sqrt{b} \cos(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)^2} - \frac{(a+3b) \tanh^{-1}(\cos(x))}{2(a+b)^2} - \frac{\cot(x) \csc(x)}{2(a+b)}$$

[Out]  $-\left(\frac{b^{3/2} \operatorname{ArcTan}\left[\frac{\sqrt{b} \cos[x]}{\sqrt{a}}\right]}{\sqrt{a}(a+b)^2}\right) - \left(\frac{(a+3b) \operatorname{ArcTanh}[\cos[x]]}{2(a+b)^2}\right) - \left(\frac{\cot[x] \csc[x]}{2(a+b)}\right)$

**Rubi [A]** time = 0.085531, antiderivative size = 62, normalized size of antiderivative = 1., number of steps used = 5, number of rules used = 5, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3190, 414, 522, 206, 205}

$$-\frac{b^{3/2} \tan^{-1}\left(\frac{\sqrt{b} \cos(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)^2} - \frac{(a+3b) \tanh^{-1}(\cos(x))}{2(a+b)^2} - \frac{\cot(x) \csc(x)}{2(a+b)}$$

Antiderivative was successfully verified.

[In] Int[Csc[x]^3/(a + b\*Cos[x]^2), x]

[Out]  $-\left(\frac{b^{3/2} \operatorname{ArcTan}\left[\frac{\sqrt{b} \cos[x]}{\sqrt{a}}\right]}{\sqrt{a}(a+b)^2}\right) - \left(\frac{(a+3b) \operatorname{ArcTanh}[\cos[x]]}{2(a+b)^2}\right) - \left(\frac{\cot[x] \csc[x]}{2(a+b)}\right)$

#### Rule 3190

Int[cos[(e\_.) + (f\_.)\*(x\_.)]^(m\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^(p\_.), x\_Symbol] :> With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b\*ff^2\*x^2)^p, x], x, Sin[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 414

Int[((a\_.) + (b\_.)\*(x\_)^(n\_))^(p\_)\*((c\_.) + (d\_.)\*(x\_)^(n\_))^(q\_), x\_Symbol] :> -Simp[(b\*x\*(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^(q + 1))/(a\*n\*(p + 1)\*(b\*c - a\*d)), x] + Dist[1/(a\*n\*(p + 1)\*(b\*c - a\*d)), Int[(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^q\*Simp[b\*c + n\*(p + 1)\*(b\*c - a\*d) + d\*b\*(n\*(p + q + 2) + 1)\*x^n, x], x] /; FreeQ[{a, b, c, d, n, q}, x] && NeQ[b\*c - a\*d, 0] && LtQ[p, -1] && !(IntegerQ[p] && IntegerQ[q] && LtQ[q, -1]) && IntBinomialQ[a, b, c, d, n, p, q, x]

#### Rule 522

Int[((e\_.) + (f\_.)\*(x\_)^(n\_))/((a\_.) + (b\_.)\*(x\_)^(n\_))\*((c\_.) + (d\_.)\*(x\_)^(n\_)), x\_Symbol] :> Dist[(b\*e - a\*f)/(b\*c - a\*d), Int[1/(a + b\*x^n), x], x] - Dist[(d\*e - c\*f)/(b\*c - a\*d), Int[1/(c + d\*x^n), x], x] /; FreeQ[{a, b, c, d, e, f, n}, x]

#### Rule 206

Int[((a\_.) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(1\*ArcTanh[(Rt[-b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (GtQ[a, 0] || LtQ[b, 0])

**Rule 205**

$\text{Int}[(a + b \cdot x^2)^{-1}, x\_Symbol] \rightarrow \text{Simp}[(\text{Rt}[a/b, 2] \cdot \text{ArcTan}[x/\text{Rt}[a/b, 2]])/a, x] /; \text{FreeQ}\{a, b, x\} \ \&\& \ \text{PosQ}[a/b]$

**Rubi steps**

$$\begin{aligned} \int \frac{\csc^3(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{1}{(1-x^2)^2 (a+bx^2)} dx, x, \cos(x) \right) \\ &= -\frac{\cot(x) \csc(x)}{2(a+b)} - \frac{\text{Subst} \left( \int \frac{a+2b+bx^2}{(1-x^2)(a+bx^2)} dx, x, \cos(x) \right)}{2(a+b)} \\ &= -\frac{\cot(x) \csc(x)}{2(a+b)} - \frac{b^2 \text{Subst} \left( \int \frac{1}{a+bx^2} dx, x, \cos(x) \right)}{(a+b)^2} - \frac{(a+3b) \text{Subst} \left( \int \frac{1}{1-x^2} dx, x, \cos(x) \right)}{2(a+b)^2} \\ &= -\frac{b^{3/2} \tan^{-1} \left( \frac{\sqrt{b} \cos(x)}{\sqrt{a}} \right)}{\sqrt{a}(a+b)^2} - \frac{(a+3b) \tanh^{-1}(\cos(x))}{2(a+b)^2} - \frac{\cot(x) \csc(x)}{2(a+b)} \end{aligned}$$

**Mathematica [B]** time = 0.507946, size = 140, normalized size = 2.26

$$\frac{-8b^{3/2} \tan^{-1} \left( \frac{\sqrt{b}-\sqrt{a+b} \tan(\frac{x}{2})}{\sqrt{a}} \right) - 8b^{3/2} \tan^{-1} \left( \frac{\sqrt{a+b} \tan(\frac{x}{2})+\sqrt{b}}{\sqrt{a}} \right) + \sqrt{a} \left( -(a+b) \csc^2 \left( \frac{x}{2} \right) + (a+b) \sec^2 \left( \frac{x}{2} \right) - 4(a+3b) \right)}{8\sqrt{a}(a+b)^2}$$

Antiderivative was successfully verified.

[In] Integrate[Csc[x]^3/(a + b\*Cos[x]^2), x]

[Out]  $(-8*b^{(3/2)}*ArcTan[(Sqrt[b] - Sqrt[a + b]*Tan[x/2])/Sqrt[a]] - 8*b^{(3/2)}*ArcTan[(Sqrt[b] + Sqrt[a + b]*Tan[x/2])/Sqrt[a]] + Sqrt[a]*(-(a + b)*Csc[x/2]^2) - 4*(a + 3*b)*(Log[Cos[x/2]] - Log[Sin[x/2]]) + (a + b)*Sec[x/2]^2)/(8*Sqrt[a]*(a + b)^2)$

**Maple [B]** time = 0.041, size = 111, normalized size = 1.8

$$\frac{1}{(4a+4b)(1+\cos(x))} - \frac{\ln(1+\cos(x))a}{4(a+b)^2} - \frac{3\ln(1+\cos(x))b}{4(a+b)^2} + \frac{1}{(4a+4b)(\cos(x)-1)} + \frac{\ln(\cos(x)-1)a}{4(a+b)^2} + \frac{3\ln(\cos(x)-1)b}{4(a+b)^2}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(csc(x)^3/(a+b\*cos(x)^2), x)

[Out]  $1/(4*a+4*b)/(1+\cos(x))-1/4/(a+b)^2*\ln(1+\cos(x))*a-3/4/(a+b)^2*\ln(1+\cos(x))*b+1/(4*a+4*b)/(\cos(x)-1)+1/4/(a+b)^2*\ln(\cos(x)-1)*a+3/4/(a+b)^2*\ln(\cos(x)-1)*b-b^2/(a+b)^2/(a*b)^{(1/2)}*arctan(b*\cos(x)/(a*b)^{(1/2)})$

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^3/(a+b\*cos(x)^2),x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 2.12142, size = 713, normalized size = 11.5

$$\frac{2(b \cos(x)^2 - b) \sqrt{-\frac{b}{a}} \log\left(\frac{b \cos(x)^2 - 2a \sqrt{-\frac{b}{a}} \cos(x) - a}{b \cos(x)^2 + a}\right) + 2(a + b) \cos(x) - ((a + 3b) \cos(x)^2 - a - 3b) \log\left(\frac{1}{2} \cos(x) + \frac{1}{2}\right)}{4((a^2 + 2ab + b^2) \cos(x)^2 - a^2 - 2ab - b^2)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^3/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/4\*(2\*(b\*cos(x)^2 - b)\*sqrt(-b/a)\*log((b\*cos(x)^2 - 2\*a\*sqrt(-b/a)\*cos(x) - a)/(b\*cos(x)^2 + a)) + 2\*(a + b)\*cos(x) - ((a + 3\*b)\*cos(x)^2 - a - 3\*b)\*log(1/2\*cos(x) + 1/2) + ((a + 3\*b)\*cos(x)^2 - a - 3\*b)\*log(-1/2\*cos(x) + 1/2))/((a^2 + 2\*a\*b + b^2)\*cos(x)^2 - a^2 - 2\*a\*b - b^2), -1/4\*(4\*(b\*cos(x)^2 - b)\*sqrt(b/a)\*arctan(sqrt(b/a)\*cos(x)) - 2\*(a + b)\*cos(x) + ((a + 3\*b)\*cos(x)^2 - a - 3\*b)\*log(1/2\*cos(x) + 1/2) - ((a + 3\*b)\*cos(x)^2 - a - 3\*b)\*log(-1/2\*cos(x) + 1/2))/((a^2 + 2\*a\*b + b^2)\*cos(x)^2 - a^2 - 2\*a\*b - b^2)]

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\csc^3(x)}{a + b \cos^2(x)} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)\*\*3/(a+b\*cos(x)\*\*2),x)

[Out] Integral(csc(x)\*\*3/(a + b\*cos(x)\*\*2), x)

**Giac [B]** time = 1.1568, size = 139, normalized size = 2.24

$$-\frac{b^2 \arctan\left(\frac{b \cos(x)}{\sqrt{ab}}\right)}{(a^2 + 2ab + b^2) \sqrt{ab}} - \frac{(a + 3b) \log(\cos(x) + 1)}{4(a^2 + 2ab + b^2)} + \frac{(a + 3b) \log(-\cos(x) + 1)}{4(a^2 + 2ab + b^2)} + \frac{\cos(x)}{2(\cos(x)^2 - 1)(a + b)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^3/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] -b^2\*arctan(b\*cos(x)/sqrt(a\*b))/((a^2 + 2\*a\*b + b^2)\*sqrt(a\*b)) - 1/4\*(a + 3\*b)\*log(cos(x) + 1)/(a^2 + 2\*a\*b + b^2) + 1/4\*(a + 3\*b)\*log(-cos(x) + 1)/(a^2 + 2\*a\*b + b^2) + 1/2\*cos(x)/((cos(x)^2 - 1)\*(a + b))

### 3.16 $\int \frac{\csc^5(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=94

$$\frac{(3a^2 + 10ab + 15b^2) \tanh^{-1}(\cos(x))}{8(a+b)^3} - \frac{b^{5/2} \tan^{-1}\left(\frac{\sqrt{b} \cos(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)^3} - \frac{\cot(x) \csc^3(x)}{4(a+b)} - \frac{(3a+7b) \cot(x) \csc(x)}{8(a+b)^2}$$

[Out] -((b^(5/2)\*ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]])/(Sqrt[a]\*(a+b)^3)) - ((3\*a^2 + 10\*a\*b + 15\*b^2)\*ArcTanh[Cos[x]])/(8\*(a+b)^3) - ((3\*a + 7\*b)\*Cot[x]\*Cs c[x])/(8\*(a+b)^2) - (Cot[x]\*Csc[x]^3)/(4\*(a+b))

**Rubi [A]** time = 0.137888, antiderivative size = 94, normalized size of antiderivative = 1., number of steps used = 6, number of rules used = 6, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.4$ , Rules used = {3190, 414, 527, 522, 206, 205}

$$\frac{(3a^2 + 10ab + 15b^2) \tanh^{-1}(\cos(x))}{8(a+b)^3} - \frac{b^{5/2} \tan^{-1}\left(\frac{\sqrt{b} \cos(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)^3} - \frac{\cot(x) \csc^3(x)}{4(a+b)} - \frac{(3a+7b) \cot(x) \csc(x)}{8(a+b)^2}$$

Antiderivative was successfully verified.

[In] Int[Csc[x]^5/(a + b\*cos[x]^2), x]

[Out] -((b^(5/2)\*ArcTan[(Sqrt[b]\*Cos[x])/Sqrt[a]])/(Sqrt[a]\*(a+b)^3)) - ((3\*a^2 + 10\*a\*b + 15\*b^2)\*ArcTanh[Cos[x]])/(8\*(a+b)^3) - ((3\*a + 7\*b)\*Cot[x]\*Cs c[x])/(8\*(a+b)^2) - (Cot[x]\*Csc[x]^3)/(4\*(a+b))

#### Rule 3190

Int[cos[(e\_.) + (f\_.)\*(x\_)]^(m\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_.), x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b\*ff^2\*x^2)^p, x], x, Sin[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 414

Int[((a\_.) + (b\_.)\*(x\_)^(n\_))^(p\_)\*((c\_.) + (d\_.)\*(x\_)^(n\_))^(q\_), x\_Symbol] := -Simp[(b\*x\*(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^(q + 1))/(a\*n\*(p + 1)\*(b\*c - a\*d)), x] + Dist[1/(a\*n\*(p + 1)\*(b\*c - a\*d)), Int[(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^q\*Simp[b\*c + n\*(p + 1)\*(b\*c - a\*d) + d\*b\*(n\*(p + q + 2) + 1)\*x^n, x], x] /; FreeQ[{a, b, c, d, n, q}, x] && NeQ[b\*c - a\*d, 0] && LtQ[p, -1] && !(IntegerQ[p] && IntegerQ[q] && LtQ[q, -1]) && IntBinomialQ[a, b, c, d, n, p, q, x]

#### Rule 527

Int[((a\_.) + (b\_.)\*(x\_)^(n\_))^(p\_)\*((c\_.) + (d\_.)\*(x\_)^(n\_))^(q\_.)\*((e\_.) + (f\_.)\*(x\_)^(n\_)), x\_Symbol] := -Simp[((b\*e - a\*f)\*x\*(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^(q + 1))/(a\*n\*(b\*c - a\*d)\*(p + 1)), x] + Dist[1/(a\*n\*(b\*c - a\*d)\*(p + 1)), Int[(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^q\*Simp[c\*(b\*e - a\*f) + e\*n\*(b\*c - a\*d)\*(p + 1) + d\*(b\*e - a\*f)\*(n\*(p + q + 2) + 1)\*x^n, x], x] /; FreeQ[{a, b, c, d, e, f, n, q}, x] && LtQ[p, -1]

#### Rule 522

```
Int[((e_) + (f_)*(x_)^(n_))/((a_) + (b_)*(x_)^(n_))*((c_) + (d_)*(x_)^(n_)), x_Symbol] := Dist[(b*e - a*f)/(b*c - a*d), Int[1/(a + b*x^n), x], x] - Dist[(d*e - c*f)/(b*c - a*d), Int[1/(c + d*x^n), x], x] /; FreeQ[{a, b, c, d, e, f, n}, x]
```

### Rule 206

```
Int[((a_) + (b_)*(x_)^2)^(-1), x_Symbol] := Simp[(1*ArcTanh[(Rt[-b, 2]*x)/Rt[a, 2]])/(Rt[a, 2]*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (GtQ[a, 0] || LtQ[b, 0])
```

### Rule 205

```
Int[((a_) + (b_)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[a/b, 2]*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]
```

### Rubi steps

$$\begin{aligned} \int \frac{\csc^5(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{1}{(1-x^2)^3 (a+bx^2)} dx, x, \cos(x) \right) \\ &= -\frac{\cot(x) \csc^3(x)}{4(a+b)} - \frac{\text{Subst} \left( \int \frac{3a+4b+3bx^2}{(1-x^2)^2 (a+bx^2)} dx, x, \cos(x) \right)}{4(a+b)} \\ &= -\frac{(3a+7b) \cot(x) \csc(x)}{8(a+b)^2} - \frac{\cot(x) \csc^3(x)}{4(a+b)} - \frac{\text{Subst} \left( \int \frac{3a^2+7ab+8b^2+b(3a+7b)x^2}{(1-x^2)(a+bx^2)} dx, x, \cos(x) \right)}{8(a+b)^2} \\ &= -\frac{(3a+7b) \cot(x) \csc(x)}{8(a+b)^2} - \frac{\cot(x) \csc^3(x)}{4(a+b)} - \frac{b^3 \text{Subst} \left( \int \frac{1}{a+bx^2} dx, x, \cos(x) \right)}{(a+b)^3} - \frac{(3a^2+10ab+15b^2) \tanh^{-1}(\cos(x))}{8(a+b)^2} \\ &= -\frac{b^{5/2} \tan^{-1} \left( \frac{\sqrt{b} \cos(x)}{\sqrt{a}} \right)}{\sqrt{a}(a+b)^3} - \frac{(3a^2+10ab+15b^2) \tanh^{-1}(\cos(x))}{8(a+b)^3} - \frac{(3a+7b) \cot(x) \csc(x)}{8(a+b)^2} - \frac{\cot(x) \csc^3(x)}{4(a+b)} \end{aligned}$$

**Mathematica [B]** time = 1.23215, size = 204, normalized size = 2.17

$$\frac{\sqrt{a} \left( -2(3a^2 + 10ab + 7b^2) \csc^2\left(\frac{x}{2}\right) + 2(3a^2 + 10ab + 7b^2) \sec^2\left(\frac{x}{2}\right) - 8(3a^2 + 10ab + 15b^2) \left( \log\left(\cos\left(\frac{x}{2}\right)\right) - \log\left(\sin\left(\frac{x}{2}\right)\right) \right) \right)}{64\sqrt{a}(a+b)^3}$$

Antiderivative was successfully verified.

```
[In] Integrate[Csc[x]^5/(a + b*Cos[x]^2), x]
```

```
[Out] (-64*b^(5/2)*ArcTan[(Sqrt[b] - Sqrt[a + b]*Tan[x/2])/Sqrt[a]] - 64*b^(5/2)*ArcTan[(Sqrt[b] + Sqrt[a + b]*Tan[x/2])/Sqrt[a]] + Sqrt[a]*(-2*(3*a^2 + 10*a*b + 7*b^2)*Csc[x/2]^2 - (a + b)^2*Csc[x/2]^4 - 8*(3*a^2 + 10*a*b + 15*b^2)*(Log[Cos[x/2]] - Log[Sin[x/2]]) + 2*(3*a^2 + 10*a*b + 7*b^2)*Sec[x/2]^2 + (a + b)^2*Sec[x/2]^4)/(64*Sqrt[a]*(a + b)^3)
```

**Maple [B]** time = 0.049, size = 205, normalized size = 2.2

$$\frac{1}{(16a + 16b)(1 + \cos(x))^2} + \frac{3a}{16(a+b)^2(1 + \cos(x))} + \frac{7b}{16(a+b)^2(1 + \cos(x))} - \frac{3 \ln(1 + \cos(x)) a^2}{16(a+b)^3} - \frac{5 \ln(1 + \cos(x))}{8(a+b)^3}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] int(csc(x)^5/(a+b*cos(x)^2),x)
```

```
[Out] 1/2/(8*a+8*b)/(1+cos(x))^2+3/16/(a+b)^2/(1+cos(x))
)*b-3/16/(a+b)^3*ln(1+cos(x))*a^2-5/8/(a+b)^3*ln(1+cos(x))*a*b-15/16/(a+b)^
3*ln(1+cos(x))*b^2-1/2/(8*a+8*b)/(cos(x)-1)^2+3/16/(a+b)^2/(cos(x)-1)*a+7/1
6/(a+b)^2/(cos(x)-1)*b+3/16/(a+b)^3*ln(cos(x)-1)*a^2+5/8/(a+b)^3*ln(cos(x)-
1)*a*b+15/16/(a+b)^3*ln(cos(x)-1)*b^2-b^3/(a+b)^3/(a*b)^(1/2)*arctan(b*cos(
x)/(a*b)^(1/2))
```

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(csc(x)^5/(a+b*cos(x)^2),x, algorithm="maxima")
```

```
[Out] Exception raised: ValueError
```

**Fricas [B]** time = 2.49897, size = 1490, normalized size = 15.85

result too large to display

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(csc(x)^5/(a+b*cos(x)^2),x, algorithm="fricas")
```

```
[Out] [1/16*(2*(3*a^2 + 10*a*b + 7*b^2)*cos(x)^3 + 8*(b^2*cos(x)^4 - 2*b^2*cos(x)
^2 + b^2)*sqrt(-b/a)*log((b*cos(x)^2 - 2*a*sqrt(-b/a)*cos(x) - a)/(b*cos(x)
^2 + a)) - 2*(5*a^2 + 14*a*b + 9*b^2)*cos(x) - ((3*a^2 + 10*a*b + 15*b^2)*c
os(x)^4 - 2*(3*a^2 + 10*a*b + 15*b^2)*cos(x)^2 + 3*a^2 + 10*a*b + 15*b^2)*l
og(1/2*cos(x) + 1/2) + ((3*a^2 + 10*a*b + 15*b^2)*cos(x)^4 - 2*(3*a^2 + 10*
a*b + 15*b^2)*cos(x)^2 + 3*a^2 + 10*a*b + 15*b^2)*log(-1/2*cos(x) + 1/2))/
(a^3 + 3*a^2*b + 3*a*b^2 + b^3)*cos(x)^4 + a^3 + 3*a^2*b + 3*a*b^2 + b^3 -
2*(a^3 + 3*a^2*b + 3*a*b^2 + b^3)*cos(x)^2), 1/16*(2*(3*a^2 + 10*a*b + 7*b^
2)*cos(x)^3 - 16*(b^2*cos(x)^4 - 2*b^2*cos(x)^2 + b^2)*sqrt(b/a)*arctan(sqr
t(b/a)*cos(x)) - 2*(5*a^2 + 14*a*b + 9*b^2)*cos(x) - ((3*a^2 + 10*a*b + 15*
b^2)*cos(x)^4 - 2*(3*a^2 + 10*a*b + 15*b^2)*cos(x)^2 + 3*a^2 + 10*a*b + 15*
b^2)*log(1/2*cos(x) + 1/2) + ((3*a^2 + 10*a*b + 15*b^2)*cos(x)^4 - 2*(3*a^2
+ 10*a*b + 15*b^2)*cos(x)^2 + 3*a^2 + 10*a*b + 15*b^2)*log(-1/2*cos(x) + 1
/2))/((a^3 + 3*a^2*b + 3*a*b^2 + b^3)*cos(x)^4 + a^3 + 3*a^2*b + 3*a*b^2 +
b^3 - 2*(a^3 + 3*a^2*b + 3*a*b^2 + b^3)*cos(x)^2)]
```

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(csc(x)**5/(a+b*cos(x)**2),x)
```

[Out] Timed out

**Giac [B]** time = 1.15854, size = 240, normalized size = 2.55

$$\frac{b^3 \arctan\left(\frac{b \cos(x)}{\sqrt{ab}}\right)}{(a^3 + 3a^2b + 3ab^2 + b^3)\sqrt{ab}} - \frac{(3a^2 + 10ab + 15b^2) \log(\cos(x) + 1)}{16(a^3 + 3a^2b + 3ab^2 + b^3)} + \frac{(3a^2 + 10ab + 15b^2) \log(-\cos(x) + 1)}{16(a^3 + 3a^2b + 3ab^2 + b^3)} + \frac{3a^2}{16(a^3 + 3a^2b + 3ab^2 + b^3)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^5/(a+b\*cos(x)^2),x, algorithm="giac")

[Out]  $-b^3 \arctan(b \cos(x) / \sqrt{a \cdot b}) / ((a^3 + 3a^2b + 3ab^2 + b^3) \sqrt{a \cdot b})$   
 $- 1/16 \cdot (3a^2 + 10ab + 15b^2) \cdot \log(\cos(x) + 1) / (a^3 + 3a^2b + 3ab^2 + b^3)$   
 $+ 1/16 \cdot (3a^2 + 10ab + 15b^2) \cdot \log(-\cos(x) + 1) / (a^3 + 3a^2b + 3ab^2 + b^3)$   
 $+ 1/8 \cdot (3a \cos(x)^3 + 7b \cos(x)^3 - 5a \cos(x) - 9b \cos(x)) / ((a^2 + 2ab + b^2) \cdot (\cos(x)^2 - 1)^2)$



### 3.17 $\int \frac{\sin^6(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=88

$$-\frac{x(8a^2 + 20ab + 15b^2)}{8b^3} + \frac{(4a + 7b)\sin(x)\cos(x)}{8b^2} - \frac{(a+b)^{5/2} \tan^{-1}\left(\frac{\sqrt{a+b}\cot(x)}{\sqrt{a}}\right)}{\sqrt{ab^3}} + \frac{\sin^3(x)\cos(x)}{4b}$$

[Out]  $-\frac{x(8a^2 + 20ab + 15b^2)}{8b^3} - \frac{(a+b)^{5/2} \text{ArcTan}[\frac{\sqrt{a+b}\cot(x)}{\sqrt{a}}]}{\sqrt{ab^3}} + \frac{\sin^3(x)\cos(x)}{4b} + \frac{(4a+7b)\cos(x)\sin(x)}{8b^2}$

**Rubi [A]** time = 0.181215, antiderivative size = 88, normalized size of antiderivative = 1., number of steps used = 6, number of rules used = 6, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.4$ , Rules used = {3191, 414, 527, 522, 203, 205}

$$-\frac{x(8a^2 + 20ab + 15b^2)}{8b^3} + \frac{(4a + 7b)\sin(x)\cos(x)}{8b^2} - \frac{(a+b)^{5/2} \tan^{-1}\left(\frac{\sqrt{a+b}\cot(x)}{\sqrt{a}}\right)}{\sqrt{ab^3}} + \frac{\sin^3(x)\cos(x)}{4b}$$

Antiderivative was successfully verified.

[In]  $\text{Int}[\sin(x)^6/(a + b\cos(x)^2), x]$

[Out]  $-\frac{x(8a^2 + 20ab + 15b^2)}{8b^3} - \frac{(a+b)^{5/2} \text{ArcTan}[\frac{\sqrt{a+b}\cot(x)}{\sqrt{a}}]}{\sqrt{ab^3}} + \frac{\sin^3(x)\cos(x)}{4b} + \frac{(4a+7b)\cos(x)\sin(x)}{8b^2}$

#### Rule 3191

$\text{Int}[\cos[(e_.) + (f_.)(x_.)]^{(m_.)}((a_.) + (b_.)\sin[(e_.) + (f_.)(x_.)]^2)^{(p_.)}, x\_Symbol] \rightarrow \text{With}[\{ff = \text{FreeFactors}[\text{Tan}[e + f*x], x]\}, \text{Dist}[ff/f, \text{Subst}[\text{Int}[(a + (a + b)*ff^2*x^2)^p/(1 + ff^2*x^2)^{(m/2 + p + 1)}], x], x, \text{Tan}[e + f*x]/ff], x] /; \text{FreeQ}[\{a, b, e, f\}, x] \&\& \text{IntegerQ}[m/2] \&\& \text{IntegerQ}[p]$

#### Rule 414

$\text{Int}[(a_. + (b_.)(x_.)^{(n_.)})^{(p_.)}((c_.) + (d_.)(x_.)^{(n_.)})^{(q_.)}, x\_Symbol] \rightarrow -\text{Simp}[(b*x*(a + b*x^n)^{(p+1)}*(c + d*x^n)^{(q+1)})/(a*n*(p+1)*(b*c - a*d)), x] + \text{Dist}[1/(a*n*(p+1)*(b*c - a*d)), \text{Int}[(a + b*x^n)^{(p+1)}*(c + d*x^n)^q * \text{Simp}[b*c + n*(p+1)*(b*c - a*d) + d*b*(n*(p+q+2) + 1)*x^n, x], x] /; \text{FreeQ}[\{a, b, c, d, n, q\}, x] \&\& \text{NeQ}[b*c - a*d, 0] \&\& \text{LtQ}[p, -1] \&\& !( !\text{IntegerQ}[p] \&\& \text{IntegerQ}[q] \&\& \text{LtQ}[q, -1]) \&\& \text{IntBinomialQ}[a, b, c, d, n, p, q, x]$

#### Rule 527

$\text{Int}[(a_. + (b_.)(x_.)^{(n_.)})^{(p_.)}((c_.) + (d_.)(x_.)^{(n_.)})^{(q_.)}((e_.) + (f_.)(x_.)^{(n_.)}), x\_Symbol] \rightarrow -\text{Simp}[(b*e - a*f)*x*(a + b*x^n)^{(p+1)}*(c + d*x^n)^{(q+1)})/(a*n*(b*c - a*d)*(p+1)), x] + \text{Dist}[1/(a*n*(b*c - a*d)*(p+1)), \text{Int}[(a + b*x^n)^{(p+1)}*(c + d*x^n)^q * \text{Simp}[c*(b*e - a*f) + e*n*(b*c - a*d)*(p+1) + d*(b*e - a*f)*(n*(p+q+2) + 1)*x^n, x], x], x] /; \text{FreeQ}[\{a, b, c, d, e, f, n, q\}, x] \&\& \text{LtQ}[p, -1]$

#### Rule 522

```
Int[((e_) + (f_)*(x_)^(n_))/((a_) + (b_)*(x_)^(n_))*((c_) + (d_)*(x_)^(n_)), x_Symbol] := Dist[(b*e - a*f)/(b*c - a*d), Int[1/(a + b*x^n), x], x] - Dist[(d*e - c*f)/(b*c - a*d), Int[1/(c + d*x^n), x], x] /; FreeQ[{a, b, c, d, e, f, n}, x]
```

### Rule 203

```
Int[((a_) + (b_)*(x_)^2)^(-1), x_Symbol] := Simp[(1*ArcTan[(Rt[b, 2]*x)/Rt[a, 2]])/(Rt[a, 2]*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])
```

### Rule 205

```
Int[((a_) + (b_)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[a/b, 2]*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]
```

### Rubi steps

$$\begin{aligned} \int \frac{\sin^6(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{1}{(1+x^2)^3 (a+(a+b)x^2)} dx, x, \cot(x) \right) \\ &= \frac{\cos(x) \sin^3(x)}{4b} - \frac{\text{Subst} \left( \int \frac{a+4b-3(a+b)x^2}{(1+x^2)^2 (a+(a+b)x^2)} dx, x, \cot(x) \right)}{4b} \\ &= \frac{(4a+7b) \cos(x) \sin(x)}{8b^2} + \frac{\cos(x) \sin^3(x)}{4b} - \frac{\text{Subst} \left( \int \frac{4a^2+9ab+8b^2-(a+b)(4a+7b)x^2}{(1+x^2)(a+(a+b)x^2)} dx, x, \cot(x) \right)}{8b^2} \\ &= \frac{(4a+7b) \cos(x) \sin(x)}{8b^2} + \frac{\cos(x) \sin^3(x)}{4b} - \frac{(a+b)^3 \text{Subst} \left( \int \frac{1}{a+(a+b)x^2} dx, x, \cot(x) \right)}{b^3} + \frac{(8a^2+20ab+15b^2)x}{8b^3} \\ &= -\frac{(8a^2+20ab+15b^2)x}{8b^3} - \frac{(a+b)^{5/2} \tan^{-1} \left( \frac{\sqrt{a+b} \cot(x)}{\sqrt{a}} \right)}{\sqrt{ab^3}} + \frac{(4a+7b) \cos(x) \sin(x)}{8b^2} + \frac{\cos(x) \sin^3(x)}{4b} \end{aligned}$$

**Mathematica [A]** time = 0.187739, size = 77, normalized size = 0.88

$$\frac{-4x(8a^2 + 20ab + 15b^2) + 8b(a + 2b) \sin(2x) + \frac{32(a+b)^{5/2} \tan^{-1} \left( \frac{\sqrt{a} \tan(x)}{\sqrt{a+b}} \right)}{\sqrt{a}} - b^2 \sin(4x)}{32b^3}$$

Antiderivative was successfully verified.

```
[In] Integrate[Sin[x]^6/(a + b*Cos[x]^2), x]
```

```
[Out] (-4*(8*a^2 + 20*a*b + 15*b^2)*x + (32*(a + b)^(5/2)*ArcTan[(Sqrt[a]*Tan[x])/Sqrt[a + b]])/Sqrt[a] + 8*b*(a + 2*b)*Sin[2*x] - b^2*Sin[4*x])/(32*b^3)
```

**Maple [B]** time = 0.033, size = 194, normalized size = 2.2

$$\frac{a^3}{b^3} \arctan \left( a \tan(x) \frac{1}{\sqrt{(a+b)a}} \right) \frac{1}{\sqrt{(a+b)a}} + 3 \frac{a^2}{b^2 \sqrt{(a+b)a}} \arctan \left( \frac{a \tan(x)}{\sqrt{(a+b)a}} \right) + 3 \frac{a}{b \sqrt{(a+b)a}} \arctan \left( \frac{a \tan(x)}{\sqrt{(a+b)a}} \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(sin(x)^6/(a+b*cos(x)^2),x)`

[Out]  $\frac{1}{b^3} \left( \frac{a^3 + 3a^2 b}{(a+b)a^{3/2}} \arctan\left(\frac{a \tan(x)}{(a+b)a^{1/2}}\right) + \frac{3a^2 b + 3b^2}{(a+b)a^{5/2}} \arctan\left(\frac{a \tan(x)}{(a+b)a^{1/2}}\right) + \frac{a^2 + 3ab + 3b^2}{(a+b)a^{7/2}} \arctan\left(\frac{a \tan(x)}{(a+b)a^{1/2}}\right) + \frac{a^2 + 3ab + 3b^2}{(a+b)a^{9/2}} \arctan\left(\frac{a \tan(x)}{(a+b)a^{1/2}}\right) + \frac{1}{2b^2} \frac{1}{(\tan(x)^2 + 1)^2} \tan(x)^3 + \frac{9}{8b} \frac{1}{(\tan(x)^2 + 1)^2} \tan(x)^3 + \frac{1}{2b^2} \frac{1}{(\tan(x)^2 + 1)^2} \tan(x)^3 + \frac{7}{8b} \frac{1}{(\tan(x)^2 + 1)^2} \tan(x) - \frac{1}{b^3} \arctan(\tan(x)) \right) a^2 - \frac{5}{2b^2} \arctan(\tan(x)) a - \frac{15}{8b} \arctan(\tan(x))$

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)^6/(a+b*cos(x)^2),x, algorithm="maxima")`

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.93262, size = 702, normalized size = 7.98

$$\frac{2(a^2 + 2ab + b^2) \sqrt{-\frac{a+b}{a}} \log\left(\frac{(8a^2 + 8ab + b^2) \cos(x)^4 - 2(4a^2 + 3ab) \cos(x)^2 - 4((2a^2 + ab) \cos(x)^3 - a^2 \cos(x)) \sqrt{-\frac{a+b}{a}} \sin(x) + a^2}{b^2 \cos(x)^4 + 2ab \cos(x)^2 + a^2}\right) - (8a^2 + 20ab + 15b^2)x - (2b^2 \cos(x)^3 - (4ab + 9b^2) \cos(x)) \sin(x)}{8b^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)^6/(a+b*cos(x)^2),x, algorithm="fricas")`

[Out]  $\frac{1}{8} (2(a^2 + 2ab + b^2) \sqrt{-(a+b)/a} \log((8a^2 + 8ab + b^2) \cos(x)^4 - 2(4a^2 + 3ab) \cos(x)^2 - 4((2a^2 + ab) \cos(x)^3 - a^2 \cos(x)) \sqrt{-(a+b)/a} \sin(x) + a^2) - (8a^2 + 20ab + 15b^2)x - (2b^2 \cos(x)^3 - (4ab + 9b^2) \cos(x)) \sin(x)) / (b^2 \cos(x)^4 + 2ab \cos(x)^2 + a^2) - (8a^2 + 20ab + 15b^2)x - (2b^2 \cos(x)^3 - (4ab + 9b^2) \cos(x)) \sin(x) / b^3, -1/8 (4(a^2 + 2ab + b^2) \sqrt{(a+b)/a} \arctan(1/2((2a+b) \cos(x)^2 - a) \sqrt{(a+b)/a} / ((a+b) \cos(x) \sin(x))) + (8a^2 + 20ab + 15b^2)x + (2b^2 \cos(x)^3 - (4ab + 9b^2) \cos(x)) \sin(x)) / b^3]$

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sin(x)**6/(a+b*cos(x)**2),x)`

[Out] Timed out

**Giac [A]** time = 1.19013, size = 161, normalized size = 1.83

$$-\frac{(8a^2 + 20ab + 15b^2)x}{8b^3} + \frac{(a^3 + 3a^2b + 3ab^2 + b^3)\left(\pi\left\lfloor\frac{x}{\pi} + \frac{1}{2}\right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)\right)}{\sqrt{a^2 + ab}b^3} + \frac{4a \tan(x)^3 + 9b \tan(x)^3}{8(\tan(x)^2 + 1)^2}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^6/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] -1/8\*(8\*a^2 + 20\*a\*b + 15\*b^2)\*x/b^3 + (a^3 + 3\*a^2\*b + 3\*a\*b^2 + b^3)\*(pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))/(sqrt(a^2 + a\*b)\*b^3) + 1/8\*(4\*a\*tan(x)^3 + 9\*b\*tan(x)^3 + 4\*a\*tan(x) + 7\*b\*tan(x))/((tan(x)^2 + 1)^2\*b^2)

### 3.18 $\int \frac{\sin^4(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=60

$$-\frac{x(2a+3b)}{2b^2} - \frac{(a+b)^{3/2} \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{ab^2}} + \frac{\sin(x) \cos(x)}{2b}$$

[Out]  $-\frac{x(2a+3b)}{2b^2} - \frac{(a+b)^{3/2} \text{ArcTan}[\text{Sqrt}[a+b] \text{Cot}[x]]/\text{Sqrt}[a]}{\text{Sqrt}[a] b^2} + \frac{\text{Cos}[x] \text{Sin}[x]}{2b}$

**Rubi [A]** time = 0.105133, antiderivative size = 60, normalized size of antiderivative = 1., number of steps used = 5, number of rules used = 5, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3191, 414, 522, 203, 205}

$$-\frac{x(2a+3b)}{2b^2} - \frac{(a+b)^{3/2} \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{ab^2}} + \frac{\sin(x) \cos(x)}{2b}$$

Antiderivative was successfully verified.

[In]  $\text{Int}[\text{Sin}[x]^4/(a+b \text{Cos}[x]^2), x]$

[Out]  $-\frac{x(2a+3b)}{2b^2} - \frac{(a+b)^{3/2} \text{ArcTan}[\text{Sqrt}[a+b] \text{Cot}[x]]/\text{Sqrt}[a]}{\text{Sqrt}[a] b^2} + \frac{\text{Cos}[x] \text{Sin}[x]}{2b}$

#### Rule 3191

$\text{Int}[\cos[(e_.) + (f_.)(x_.)]^{(m_.)} * ((a_.) + (b_.) \sin[(e_.) + (f_.)(x_.)]^2)^{(p_.)}, x\_Symbol] \rightarrow \text{With}[\{ff = \text{FreeFactors}[\text{Tan}[e + f*x], x]\}, \text{Dist}[ff/f, \text{Subst}[\text{Int}[(a + (a + b)*ff^2*x^2)^p / (1 + ff^2*x^2)^{(m/2 + p + 1)}, x], x, \text{Tan}[e + f*x]/ff], x] /; \text{FreeQ}[\{a, b, e, f\}, x] \ \&\& \ \text{IntegerQ}[m/2] \ \&\& \ \text{IntegerQ}[p]$

#### Rule 414

$\text{Int}[(a_.) + (b_.)(x_.)^{(n_.)}]^{(p_.)} * ((c_.) + (d_.)(x_.)^{(n_.)})^{(q_.)}, x\_Symbol] \rightarrow -\text{Simp}[(b*x*(a + b*x^n)^{(p+1)} * (c + d*x^n)^{(q+1)}) / (a*n*(p+1)*(b*c - a*d)), x] + \text{Dist}[1/(a*n*(p+1)*(b*c - a*d)), \text{Int}[(a + b*x^n)^{(p+1)} * (c + d*x^n)^q * \text{Simp}[b*c + n*(p+1)*(b*c - a*d) + d*b*(n*(p+q+2) + 1)*x^n, x], x] /; \text{FreeQ}[\{a, b, c, d, n, q\}, x] \ \&\& \ \text{NeQ}[b*c - a*d, 0] \ \&\& \ \text{LtQ}[p, -1] \ \&\& \ !( \ \&\& \ \text{IntegerQ}[p] \ \&\& \ \text{IntegerQ}[q] \ \&\& \ \text{LtQ}[q, -1]) \ \&\& \ \text{IntBinomialQ}[a, b, c, d, n, p, q, x]$

#### Rule 522

$\text{Int}[(e_.) + (f_.)(x_.)^{(n_.)}] / (((a_.) + (b_.)(x_.)^{(n_.)}) * ((c_.) + (d_.)(x_.)^{(n_.)})), x\_Symbol] \rightarrow \text{Dist}[(b*e - a*f) / (b*c - a*d), \text{Int}[1/(a + b*x^n), x], x] - \text{Dist}[(d*e - c*f) / (b*c - a*d), \text{Int}[1/(c + d*x^n), x], x] /; \text{FreeQ}[\{a, b, c, d, e, f, n\}, x]$

#### Rule 203

$\text{Int}[(a_.) + (b_.)(x_.)^2]^{(-1)}, x\_Symbol] \rightarrow \text{Simp}[(1 * \text{ArcTan}[\text{Rt}[b, 2]*x] / \text{Rt}[a, 2]) / (\text{Rt}[a, 2] * \text{Rt}[b, 2]), x] /; \text{FreeQ}[\{a, b\}, x] \ \&\& \ \text{PosQ}[a/b] \ \&\& \ (\text{GtQ}[a, 0] \ || \ \text{GtQ}[b, 0])$

Rule 205

Int[((a\_) + (b\_)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

Rubi steps

$$\begin{aligned} \int \frac{\sin^4(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{1}{(1+x^2)^2 (a+(a+b)x^2)} dx, x, \cot(x) \right) \\ &= \frac{\cos(x) \sin(x)}{2b} - \frac{\text{Subst} \left( \int \frac{a+2b+(-a-b)x^2}{(1+x^2)(a+(a+b)x^2)} dx, x, \cot(x) \right)}{2b} \\ &= \frac{\cos(x) \sin(x)}{2b} - \frac{(a+b)^2 \text{Subst} \left( \int \frac{1}{a+(a+b)x^2} dx, x, \cot(x) \right)}{b^2} + \frac{(2a+3b) \text{Subst} \left( \int \frac{1}{1+x^2} dx, x, \cot(x) \right)}{2b^2} \\ &= -\frac{(2a+3b)x}{2b^2} - \frac{(a+b)^{3/2} \tan^{-1} \left( \frac{\sqrt{a+b} \cot(x)}{\sqrt{a}} \right)}{\sqrt{ab^2}} + \frac{\cos(x) \sin(x)}{2b} \end{aligned}$$

**Mathematica [A]** time = 0.0981396, size = 52, normalized size = 0.87

$$\frac{4(a+b)^{3/2} \tan^{-1} \left( \frac{\sqrt{a} \tan(x)}{\sqrt{a+b}} \right) - 4ax - 6bx + b \sin(2x)}{4b^2}$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]^4/(a + b\*Cos[x]^2), x]

[Out] (-4\*a\*x - 6\*b\*x + (4\*(a + b)^(3/2)\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]])/Sqrt[a + b]\*Sin[2\*x])/(4\*b^2)

**Maple [B]** time = 0.025, size = 105, normalized size = 1.8

$$\frac{a^2}{b^2} \arctan \left( a \tan(x) \frac{1}{\sqrt{(a+b)a}} \right) \frac{1}{\sqrt{(a+b)a}} + 2 \frac{a}{b\sqrt{(a+b)a}} \arctan \left( \frac{a \tan(x)}{\sqrt{(a+b)a}} \right) + \arctan \left( a \tan(x) \frac{1}{\sqrt{(a+b)a}} \right) \frac{1}{\sqrt{(a+b)a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sin(x)^4/(a+b\*cos(x)^2), x)

[Out] 1/b^2/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))\*a^2+2/b/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))\*a+1/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))+1/2/b\*tan(x)/(tan(x)^2+1)-3/2/b\*arctan(tan(x))-1/b^2\*arctan(tan(x))\*a

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^4/(a+b\*cos(x)^2),x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.90039, size = 541, normalized size = 9.02

$$\frac{2 b \cos (x) \sin (x) + (a + b) \sqrt{-\frac{a+b}{a}} \log \left( \frac{(8 a^2+8 a b+b^2) \cos (x)^4-2(4 a^2+3 a b) \cos (x)^2-4\left(2 a^2+a b\right) \cos (x)^3-a^2 \cos (x)}{b^2 \cos (x)^4+2 a b \cos (x)^2+a^2} \sqrt{-\frac{a+b}{a}} \sin (x)+a^2 \right)}{4 b^2} - 2$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^4/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/4\*(2\*b\*cos(x)\*sin(x) + (a + b)\*sqrt(-(a + b)/a)\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 - 4\*((2\*a^2 + a\*b)\*cos(x)^3 - a^2\*cos(x))\*sqrt(-(a + b)/a)\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2)) - 2\*(2\*a + 3\*b)\*x)/b^2, 1/2\*(b\*cos(x)\*sin(x) - (a + b)\*sqrt((a + b)/a)\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)\*sqrt((a + b)/a)/((a + b)\*cos(x)\*sin(x))) - (2\*a + 3\*b)\*x)/b^2]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)\*\*4/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

**Giac [A]** time = 1.15312, size = 108, normalized size = 1.8

$$-\frac{(2 a+3 b) x}{2 b^2} + \frac{\left(\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan (x)}{\sqrt{a^2+a b}}\right)\right)\left(a^2+2 a b+b^2\right)}{\sqrt{a^2+a b} b^2} + \frac{\tan (x)}{2\left(\tan (x)^2+1\right) b}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^4/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] -1/2\*(2\*a + 3\*b)\*x/b^2 + (pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))\*(a^2 + 2\*a\*b + b^2)/(sqrt(a^2 + a\*b)\*b^2) + 1/2\*tan(x)/((tan(x)^2 + 1)\*b)

$$3.19 \quad \int \frac{\sin^2(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=40

$$-\frac{\sqrt{a+b} \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{ab}} - \frac{x}{b}$$

[Out]  $-(x/b) - (\text{Sqrt}[a + b] * \text{ArcTan}[(\text{Sqrt}[a + b] * \text{Cot}[x]) / \text{Sqrt}[a]]) / (\text{Sqrt}[a] * b)$

**Rubi [A]** time = 0.0589508, antiderivative size = 40, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.267$ , Rules used = {3191, 391, 203, 205}

$$-\frac{\sqrt{a+b} \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{ab}} - \frac{x}{b}$$

Antiderivative was successfully verified.

[In]  $\text{Int}[\text{Sin}[x]^2 / (a + b * \text{Cos}[x]^2), x]$

[Out]  $-(x/b) - (\text{Sqrt}[a + b] * \text{ArcTan}[(\text{Sqrt}[a + b] * \text{Cot}[x]) / \text{Sqrt}[a]]) / (\text{Sqrt}[a] * b)$

#### Rule 3191

$\text{Int}[\cos[(e_.) + (f_.)(x_.)]^{(m_)} * ((a_.) + (b_.) * \sin[(e_.) + (f_.)(x_.)]^{(p_.)}), x\_Symbol] \rightarrow \text{With}\{\text{ff} = \text{FreeFactors}[\text{Tan}[e + f*x], x]\}, \text{Dist}[\text{ff}/f, \text{Subst}[\text{Int}[(a + (a + b) * \text{ff}^2 * x^2)^p / (1 + \text{ff}^2 * x^2)^{(m/2 + p + 1)}], x], x, \text{Tan}[e + f*x] / \text{ff}], x] /;$   $\text{FreeQ}\{a, b, e, f\}, x\} \ \&\& \ \text{IntegerQ}[m/2] \ \&\& \ \text{IntegerQ}[p]$

#### Rule 391

$\text{Int}[1 / (((a_.) + (b_.)(x_.)^{(n_.)}) * ((c_.) + (d_.)(x_.)^{(n_.)})), x\_Symbol] \rightarrow \text{Dist}[b / (b*c - a*d), \text{Int}[1 / (a + b*x^n), x], x] - \text{Dist}[d / (b*c - a*d), \text{Int}[1 / (c + d*x^n), x], x] /;$   $\text{FreeQ}\{a, b, c, d, n\}, x\} \ \&\& \ \text{NeQ}[b*c - a*d, 0]$

#### Rule 203

$\text{Int}[(a_.) + (b_.)(x_.)^2)^{-1}, x\_Symbol] \rightarrow \text{Simp}[(1 * \text{ArcTan}[(\text{Rt}[b, 2] * x) / \text{Rt}[a, 2]]) / (\text{Rt}[a, 2] * \text{Rt}[b, 2]), x] /;$   $\text{FreeQ}\{a, b\}, x\} \ \&\& \ \text{PosQ}[a/b] \ \&\& \ (\text{GtQ}[a, 0] \ || \ \text{GtQ}[b, 0])$

#### Rule 205

$\text{Int}[(a_.) + (b_.)(x_.)^2)^{-1}, x\_Symbol] \rightarrow \text{Simp}[(\text{Rt}[a/b, 2] * \text{ArcTan}[x / \text{Rt}[a/b, 2]]) / a, x] /;$   $\text{FreeQ}\{a, b\}, x\} \ \&\& \ \text{PosQ}[a/b]$

#### Rubi steps



$$\begin{aligned} \int \frac{\sin^2(x)}{a+b\cos^2(x)} dx &= -\text{Subst}\left(\int \frac{1}{(1+x^2)(a+(a+b)x^2)} dx, x, \cot(x)\right) \\ &= \frac{\text{Subst}\left(\int \frac{1}{1+x^2} dx, x, \cot(x)\right)}{b} - \frac{(a+b)\text{Subst}\left(\int \frac{1}{a+(a+b)x^2} dx, x, \cot(x)\right)}{b} \\ &= -\frac{x}{b} - \frac{\sqrt{a+b}\tan^{-1}\left(\frac{\sqrt{a+b}\cot(x)}{\sqrt{a}}\right)}{\sqrt{ab}} \end{aligned}$$

**Mathematica [A]** time = 0.0653565, size = 37, normalized size = 0.92

$$\frac{\sqrt{a+b}\tan^{-1}\left(\frac{\sqrt{a}\tan(x)}{\sqrt{a+b}}\right)}{\sqrt{a}} - x$$

Antiderivative was successfully verified.

[In] Integrate[Sin[x]^2/(a + b\*Cos[x]^2), x]

[Out] (-x + (Sqrt[a + b]\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]])/Sqrt[a])/b

**Maple [A]** time = 0.023, size = 54, normalized size = 1.4

$$\frac{a}{b} \arctan\left(a \tan(x) \frac{1}{\sqrt{(a+b)a}}\right) \frac{1}{\sqrt{(a+b)a}} + \arctan\left(a \tan(x) \frac{1}{\sqrt{(a+b)a}}\right) \frac{1}{\sqrt{(a+b)a}} - \frac{\arctan(\tan(x))}{b}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sin(x)^2/(a+b\*cos(x)^2), x)

[Out] 1/b/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))\*a+1/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))-1/b\*arctan(tan(x))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^2/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.97643, size = 435, normalized size = 10.88

$$\left[ \frac{\sqrt{-\frac{a+b}{a}} \log\left(\frac{(8a^2+8ab+b^2)\cos(x)^4 - 2(4a^2+3ab)\cos(x)^2 - 4((2a^2+ab)\cos(x)^3 - a^2\cos(x))\sqrt{-\frac{a+b}{a}}\sin(x) + a^2}{b^2\cos(x)^4 + 2ab\cos(x)^2 + a^2}\right) - 4x}{4b}, -\frac{\sqrt{\frac{a+b}{a}} \arctan\left(\frac{(2a+b)}{2(a+b)}\right)}{2b} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^2/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/4\*(sqrt(-(a + b)/a)\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 - 4\*((2\*a^2 + a\*b)\*cos(x)^3 - a^2\*cos(x))\*sqrt(-(a + b)/a)\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2)) - 4\*x)/b, -1/2\*(sqrt((a + b)/a)\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)\*sqrt((a + b)/a)/((a + b)\*cos(x)\*sin(x))) + 2\*x)/b]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)\*\*2/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

**Giac [A]** time = 1.20393, size = 68, normalized size = 1.7

$$\frac{\left(\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)\right)(a + b)}{\sqrt{a^2 + ab}} - \frac{x}{b}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)^2/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] (pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))\*(a + b)/(sqrt(a^2 + a\*b)\*b) - x/b

$$3.20 \quad \int \frac{1}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=30

$$-\frac{\tan^{-1}\left(\frac{\sqrt{a+b}\cot(x)}{\sqrt{a}}\right)}{\sqrt{a}\sqrt{a+b}}$$

[Out] -(ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]]/(Sqrt[a]\*Sqrt[a + b]))

**Rubi [A]** time = 0.0185856, antiderivative size = 30, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3181, 205}

$$-\frac{\tan^{-1}\left(\frac{\sqrt{a+b}\cot(x)}{\sqrt{a}}\right)}{\sqrt{a}\sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] Int[(a + b\*Cos[x]^2)^(-1), x]

[Out] -(ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]]/(Sqrt[a]\*Sqrt[a + b]))

#### Rule 3181

Int[((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(-1), x\_Symbol] :> With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x]

#### Rule 205

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

#### Rubi steps

$$\begin{aligned} \int \frac{1}{a+b \cos^2(x)} dx &= -\text{Subst}\left(\int \frac{1}{a+(a+b)x^2} dx, x, \cot(x)\right) \\ &= -\frac{\tan^{-1}\left(\frac{\sqrt{a+b}\cot(x)}{\sqrt{a}}\right)}{\sqrt{a}\sqrt{a+b}} \end{aligned}$$

**Mathematica [A]** time = 0.0567149, size = 29, normalized size = 0.97

$$\frac{\tan^{-1}\left(\frac{\sqrt{a}\tan(x)}{\sqrt{a+b}}\right)}{\sqrt{a}\sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] Integrate[(a + b\*Cos[x]^2)^(-1), x]

[Out] ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]]/(Sqrt[a]\*Sqrt[a + b])

**Maple [A]** time = 0.014, size = 21, normalized size = 0.7

$$\arctan\left(a \tan(x) \frac{1}{\sqrt{(a+b)a}}\right) \frac{1}{\sqrt{(a+b)a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(a+b\*cos(x)^2),x)

[Out] 1/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2),x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 1.80338, size = 406, normalized size = 13.53

$$\left[ \frac{\sqrt{-a^2 - ab} \log\left(\frac{(8a^2 + 8ab + b^2)\cos(x)^4 - 2(4a^2 + 3ab)\cos(x)^2 + 4((2a+b)\cos(x)^3 - a\cos(x))\sqrt{-a^2 - ab}\sin(x) + a^2}{b^2\cos(x)^4 + 2ab\cos(x)^2 + a^2}\right)}{4(a^2 + ab)}, -\frac{\arctan\left(\frac{(2a+b)\cos(x)^2 - a}{2\sqrt{a^2 + ab}\cos(x)\sin(x)}\right)}{2\sqrt{a^2 + ab}} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [-1/4\*sqrt(-a^2 - a\*b)\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 + 4\*((2\*a + b)\*cos(x)^3 - a\*cos(x))\*sqrt(-a^2 - a\*b)\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2))/(a^2 + a\*b), -1/2\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)/(sqrt(a^2 + a\*b)\*cos(x)\*sin(x)))/sqrt(a^2 + a\*b)]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

---

**Giac [A]** time = 1.13554, size = 50, normalized size = 1.67

$$\frac{\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)}{\sqrt{a^2 + ab}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] (pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))/sqrt(a^2 + a\*b)

$$3.21 \quad \int \frac{\csc^2(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=41

$$-\frac{\cot(x)}{a+b} - \frac{b \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)^{3/2}}$$

[Out]  $-\left(\frac{b \operatorname{ArcTan}\left[\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right]}{\sqrt{a}(a+b)^{3/2}}\right) - \frac{\cot(x)}{a+b}$

**Rubi [A]** time = 0.0560492, antiderivative size = 41, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3191, 388, 205}

$$-\frac{\cot(x)}{a+b} - \frac{b \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)^{3/2}}$$

Antiderivative was successfully verified.

[In] Int[Csc[x]^2/(a + b\*Cos[x]^2), x]

[Out]  $-\left(\frac{b \operatorname{ArcTan}\left[\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right]}{\sqrt{a}(a+b)^{3/2}}\right) - \frac{\cot(x)}{a+b}$

#### Rule 3191

Int[cos[(e\_.) + (f\_.)\*(x\_)]^(m\_)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_.), x\_Symbol] :> With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[(a + (a + b)\*ff^2\*x^2)^p/(1 + ff^2\*x^2)^(m/2 + p + 1), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[m/2] && IntegerQ[p]

#### Rule 388

Int[((a\_) + (b\_.)\*(x\_)^(n\_))^(p\_)\*((c\_) + (d\_.)\*(x\_)^(n\_)), x\_Symbol] :> Simp[(d\*x\*(a + b\*x^n)^(p + 1))/(b\*(n\*(p + 1) + 1)), x] - Dist[(a\*d - b\*c\*(n\*(p + 1) + 1))/(b\*(n\*(p + 1) + 1)), Int[(a + b\*x^n)^p, x], x] /; FreeQ[{a, b, c, d, n}, x] && NeQ[b\*c - a\*d, 0] && NeQ[n\*(p + 1) + 1, 0]

#### Rule 205

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

#### Rubi steps

$$\begin{aligned} \int \frac{\csc^2(x)}{a+b \cos^2(x)} dx &= -\operatorname{Subst}\left(\int \frac{1+x^2}{a+(a+b)x^2} dx, x, \cot(x)\right) \\ &= -\frac{\cot(x)}{a+b} - \frac{b \operatorname{Subst}\left(\int \frac{1}{a+(a+b)x^2} dx, x, \cot(x)\right)}{a+b} \\ &= -\frac{b \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)^{3/2}} - \frac{\cot(x)}{a+b} \end{aligned}$$

**Mathematica [A]** time = 0.0894784, size = 40, normalized size = 0.98

$$\frac{b \tan^{-1}\left(\frac{\sqrt{a} \tan(x)}{\sqrt{a+b}}\right)}{\sqrt{a}(a+b)^{3/2}} - \frac{\cot(x)}{a+b}$$

Antiderivative was successfully verified.

[In] Integrate[Csc[x]^2/(a + b\*Cos[x]^2), x]

[Out] (b\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]]/(Sqrt[a]\*(a + b)^(3/2)) - Cot[x]/(a + b))

**Maple [A]** time = 0.03, size = 39, normalized size = 1.

$$\frac{b}{a+b} \arctan\left(a \tan(x) \frac{1}{\sqrt{(a+b)a}}\right) \frac{1}{\sqrt{(a+b)a}} - \frac{1}{(a+b) \tan(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(csc(x)^2/(a+b\*cos(x)^2), x)

[Out] b/(a+b)/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))-1/(a+b)/tan(x)

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^2/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 1.91062, size = 571, normalized size = 13.93

$$\left[ \frac{\sqrt{-a^2 - abb} \log\left(\frac{(8a^2 + 8ab + b^2) \cos(x)^4 - 2(4a^2 + 3ab) \cos(x)^2 + 4((2a+b) \cos(x)^3 - a \cos(x)) \sqrt{-a^2 - ab} \sin(x) + a^2}{b^2 \cos(x)^4 + 2ab \cos(x)^2 + a^2}\right) \sin(x) + 4(a^2 + ab) \cos(x)}{4(a^3 + 2a^2b + ab^2) \sin(x)} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^2/(a+b\*cos(x)^2), x, algorithm="fricas")

[Out] [-1/4\*(sqrt(-a^2 - a\*b)\*b\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 + 4\*((2\*a + b)\*cos(x)^3 - a\*cos(x))\*sqrt(-a^2 - a\*b)\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2))\*sin(x) + 4\*(a^2 + a\*b)\*cos(x))/((a^3 + 2\*a^2\*b + a\*b^2)\*sin(x)), -1/2\*(sqrt(a^2 + a\*b)\*b\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)/(sqrt(a^2 + a\*b)\*cos(x)\*sin(x)))\*sin(x) + 2\*(a^2 + a\*b)\*cos(x))/((a^3 + 2\*a^2\*b + a\*b^2)\*sin(x))]

---

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\csc^2(x)}{a + b \cos^2(x)} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)\*\*2/(a+b\*cos(x)\*\*2),x)

[Out] Integral(csc(x)\*\*2/(a + b\*cos(x)\*\*2), x)

---

**Giac [A]** time = 1.17665, size = 74, normalized size = 1.8

$$\frac{\left(\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)\right) b}{\sqrt{a^2 + ab}(a + b)} - \frac{1}{(a + b) \tan(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^2/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] (pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))\*b/(sqrt(a^2 + a\*b)\*(a + b)) - 1/((a + b)\*tan(x))



$$3.22 \quad \int \frac{\csc^4(x)}{a+b \cos^2(x)} dx$$

Optimal. Leaf size=61

$$-\frac{b^2 \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)^{5/2}} - \frac{\cot^3(x)}{3(a+b)} - \frac{(a+2b) \cot(x)}{(a+b)^2}$$

[Out]  $-\left(\frac{b^2 \operatorname{ArcTan}\left[\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right]}{\sqrt{a}(a+b)^{5/2}}\right) - \left(\frac{(a+2b) \cot(x)}{(a+b)^2} - \frac{\cot^3(x)}{3(a+b)}\right)$

**Rubi [A]** time = 0.0802187, antiderivative size = 61, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3191, 390, 205}

$$-\frac{b^2 \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)^{5/2}} - \frac{\cot^3(x)}{3(a+b)} - \frac{(a+2b) \cot(x)}{(a+b)^2}$$

Antiderivative was successfully verified.

[In] Int[Csc[x]^4/(a + b\*Cos[x]^2), x]

[Out]  $-\left(\frac{b^2 \operatorname{ArcTan}\left[\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right]}{\sqrt{a}(a+b)^{5/2}}\right) - \left(\frac{(a+2b) \cot(x)}{(a+b)^2} - \frac{\cot^3(x)}{3(a+b)}\right)$

#### Rule 3191

Int[cos[(e\_.) + (f\_.)\*(x\_)]^(m\_)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_.), x\_Symbol] :> With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[(a + (a + b)\*ff^2\*x^2)^p/(1 + ff^2\*x^2)^(m/2 + p + 1), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[m/2] && IntegerQ[p]

#### Rule 390

Int[((a\_) + (b\_.)\*(x\_)^(n\_))^(p\_)\*((c\_) + (d\_.)\*(x\_)^(n\_))^(q\_), x\_Symbol] :> Int[PolynomialDivide[(a + b\*x^n)^p, (c + d\*x^n)^(-q), x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0] && IGtQ[n, 0] && IGtQ[p, 0] && ILtQ[q, 0] && GeQ[p, -q]

#### Rule 205

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

#### Rubi steps

$$\begin{aligned}
\int \frac{\csc^4(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{(1+x^2)^2}{a + (a+b)x^2} dx, x, \cot(x) \right) \\
&= -\text{Subst} \left( \int \left( \frac{a+2b}{(a+b)^2} + \frac{x^2}{a+b} + \frac{b^2}{(a+b)^2(a+(a+b)x^2)} \right) dx, x, \cot(x) \right) \\
&= -\frac{(a+2b)\cot(x)}{(a+b)^2} - \frac{\cot^3(x)}{3(a+b)} - \frac{b^2 \text{Subst} \left( \int \frac{1}{a+(a+b)x^2} dx, x, \cot(x) \right)}{(a+b)^2} \\
&= -\frac{b^2 \tan^{-1} \left( \frac{\sqrt{a+b} \cot(x)}{\sqrt{a}} \right)}{\sqrt{a}(a+b)^{5/2}} - \frac{(a+2b)\cot(x)}{(a+b)^2} - \frac{\cot^3(x)}{3(a+b)}
\end{aligned}$$

**Mathematica [A]** time = 0.200132, size = 59, normalized size = 0.97

$$\frac{b^2 \tan^{-1} \left( \frac{\sqrt{a} \tan(x)}{\sqrt{a+b}} \right)}{\sqrt{a}(a+b)^{5/2}} - \frac{\cot(x) \left( (a+b) \csc^2(x) + 2a + 5b \right)}{3(a+b)^2}$$

Antiderivative was successfully verified.

[In] Integrate[Csc[x]^4/(a + b\*Cos[x]^2),x]

[Out] (b^2\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]]/(Sqrt[a]\*(a + b)^(5/2)) - (Cot[x]\*(2\*a + 5\*b + (a + b)\*Csc[x]^2))/(3\*(a + b)^2))

**Maple [A]** time = 0.038, size = 65, normalized size = 1.1

$$\frac{b^2}{(a+b)^2} \arctan \left( a \tan(x) \frac{1}{\sqrt{(a+b)a}} \right) \frac{1}{\sqrt{(a+b)a}} - \frac{1}{(3a+3b)(\tan(x))^3} - \frac{a}{(a+b)^2 \tan(x)} - 2 \frac{b}{(a+b)^2 \tan(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(csc(x)^4/(a+b\*cos(x)^2),x)

[Out] b^2/(a+b)^2/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))-1/3/(a+b)/tan(x)^3-1/(a+b)^2/tan(x)\*a-2/(a+b)^2/tan(x)\*b

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^4/(a+b\*cos(x)^2),x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 1.97951, size = 936, normalized size = 15.34

$$\frac{4(2a^3 + 7a^2b + 5ab^2)\cos(x)^3 + 3(b^2\cos(x)^2 - b^2)\sqrt{-a^2 - ab}\log\left(\frac{(8a^2 + 8ab + b^2)\cos(x)^4 - 2(4a^2 + 3ab)\cos(x)^2 + 4(2a+b)\cos(x)}{b^2\cos(x)^4 + 2ab\cos(x)^2 + a^2}\right)}{12(a^4 + 3a^3b + 3a^2b^2 + ab^3 - (a^4 + 3a^3b + 3a^2b^2 + ab^3)\cos(x))}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^4/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/12\*(4\*(2\*a^3 + 7\*a^2\*b + 5\*a\*b^2)\*cos(x)^3 + 3\*(b^2\*cos(x)^2 - b^2)\*sqrt(-a^2 - a\*b)\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 + 4\*((2\*a + b)\*cos(x)^3 - a\*cos(x))\*sqrt(-a^2 - a\*b)\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2))\*sin(x) - 12\*(a^3 + 3\*a^2\*b + 2\*a\*b^2)\*cos(x))/((a^4 + 3\*a^3\*b + 3\*a^2\*b^2 + a\*b^3 - (a^4 + 3\*a^3\*b + 3\*a^2\*b^2 + a\*b^3)\*cos(x)^2)\*sin(x)), 1/6\*(2\*(2\*a^3 + 7\*a^2\*b + 5\*a\*b^2)\*cos(x)^3 + 3\*(b^2\*cos(x)^2 - b^2)\*sqrt(a^2 + a\*b)\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)/(sqrt(a^2 + a\*b)\*cos(x)\*sin(x)))\*sin(x) - 6\*(a^3 + 3\*a^2\*b + 2\*a\*b^2)\*cos(x))/((a^4 + 3\*a^3\*b + 3\*a^2\*b^2 + a\*b^3 - (a^4 + 3\*a^3\*b + 3\*a^2\*b^2 + a\*b^3)\*cos(x)^2)\*sin(x))]

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\csc^4(x)}{a + b \cos^2(x)} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)\*\*4/(a+b\*cos(x)\*\*2),x)

[Out] Integral(csc(x)\*\*4/(a + b\*cos(x)\*\*2), x)

**Giac [A]** time = 1.21711, size = 122, normalized size = 2.

$$\frac{\left(\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)\right) b^2}{(a^2 + 2ab + b^2)\sqrt{a^2 + ab}} - \frac{3a \tan(x)^2 + 6b \tan(x)^2 + a + b}{3(a^2 + 2ab + b^2) \tan(x)^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^4/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] (pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))\*b^2/((a^2 + 2\*a\*b + b^2)\*sqrt(a^2 + a\*b)) - 1/3\*(3\*a\*tan(x)^2 + 6\*b\*tan(x)^2 + a + b)/((a^2 + 2\*a\*b + b^2)\*tan(x)^3)

### 3.23 $\int \frac{\csc^6(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=89

$$-\frac{(a^2 + 3ab + 3b^2) \cot(x)}{(a+b)^3} - \frac{b^3 \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)^{7/2}} - \frac{\cot^5(x)}{5(a+b)} - \frac{(2a+3b) \cot^3(x)}{3(a+b)^2}$$

[Out]  $-\left(\frac{b^3 \operatorname{ArcTan}\left[\frac{\sqrt{a+b} \operatorname{Cot}[x]}{\sqrt{a}}\right]}{\sqrt{a}(a+b)^{7/2}}\right) - \left(\frac{(a^2 + 3ab + 3b^2) \operatorname{Cot}[x]}{(a+b)^3} - \frac{(2a+3b) \operatorname{Cot}[x]^3}{3(a+b)^2} - \frac{\operatorname{Cot}[x]^5}{5(a+b)}\right)$

**Rubi [A]** time = 0.101601, antiderivative size = 89, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3191, 390, 205}

$$-\frac{(a^2 + 3ab + 3b^2) \cot(x)}{(a+b)^3} - \frac{b^3 \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{a}(a+b)^{7/2}} - \frac{\cot^5(x)}{5(a+b)} - \frac{(2a+3b) \cot^3(x)}{3(a+b)^2}$$

Antiderivative was successfully verified.

[In]  $\operatorname{Int}[\operatorname{Csc}[x]^6/(a + b \operatorname{Cos}[x]^2), x]$

[Out]  $-\left(\frac{b^3 \operatorname{ArcTan}\left[\frac{\sqrt{a+b} \operatorname{Cot}[x]}{\sqrt{a}}\right]}{\sqrt{a}(a+b)^{7/2}}\right) - \left(\frac{(a^2 + 3ab + 3b^2) \operatorname{Cot}[x]}{(a+b)^3} - \frac{(2a+3b) \operatorname{Cot}[x]^3}{3(a+b)^2} - \frac{\operatorname{Cot}[x]^5}{5(a+b)}\right)$

#### Rule 3191

$\operatorname{Int}[\cos[(e_.) + (f_.)(x_.)]^{(m_.)}((a_.) + (b_.)\sin[(e_.) + (f_.)(x_.)]^2)^{(p_.)}, x\_Symbol] \rightarrow \operatorname{With}[\{ff = \operatorname{FreeFactors}[\operatorname{Tan}[e + f*x], x]\}, \operatorname{Dist}[ff/f, \operatorname{Subst}[\operatorname{Int}[(a + (a + b)ff^2*x^2)^p/(1 + ff^2*x^2)^{(m/2 + p + 1)}], x], x, \operatorname{Tan}[e + f*x]/ff], x] /; \operatorname{FreeQ}\{a, b, e, f, x\} \ \&\& \operatorname{IntegerQ}[m/2] \ \&\& \operatorname{IntegerQ}[p]$

#### Rule 390

$\operatorname{Int}[(a_.) + (b_.)(x_.)^{(n_.)}]^{(p_.)}((c_.) + (d_.)(x_.)^{(n_.)})^{(q_.)}, x\_Symbol] \rightarrow \operatorname{Int}[\operatorname{PolynomialDivide}[(a + b*x^n)^p, (c + d*x^n)^{-q}], x] /; \operatorname{FreeQ}\{a, b, c, d, x\} \ \&\& \operatorname{NeQ}[b*c - a*d, 0] \ \&\& \operatorname{IGtQ}[n, 0] \ \&\& \operatorname{IGtQ}[p, 0] \ \&\& \operatorname{ILtQ}[q, 0] \ \&\& \operatorname{GeQ}[p, -q]$

#### Rule 205

$\operatorname{Int}[(a_.) + (b_.)(x_.)^2]^{(-1)}, x\_Symbol] \rightarrow \operatorname{Simp}[(\operatorname{Rt}[a/b, 2] * \operatorname{ArcTan}[x/\operatorname{Rt}[a/b, 2]])/a, x] /; \operatorname{FreeQ}\{a, b, x\} \ \&\& \operatorname{PosQ}[a/b]$

#### Rubi steps

$$\begin{aligned}
\int \frac{\csc^6(x)}{a+b\cos^2(x)} dx &= -\text{Subst} \left( \int \frac{(1+x^2)^3}{a+(a+b)x^2} dx, x, \cot(x) \right) \\
&= -\text{Subst} \left( \int \left( \frac{a^2+3ab+3b^2}{(a+b)^3} + \frac{(2a+3b)x^2}{(a+b)^2} + \frac{x^4}{a+b} + \frac{b^3}{(a+b)^3(a+(a+b)x^2)} \right) dx, x, \cot(x) \right) \\
&= -\frac{(a^2+3ab+3b^2)\cot(x)}{(a+b)^3} - \frac{(2a+3b)\cot^3(x)}{3(a+b)^2} - \frac{\cot^5(x)}{5(a+b)} - \frac{b^3 \text{Subst} \left( \int \frac{1}{a+(a+b)x^2} dx, x, \cot(x) \right)}{(a+b)^3} \\
&= -\frac{b^3 \tan^{-1} \left( \frac{\sqrt{a+b}\cot(x)}{\sqrt{a}} \right)}{\sqrt{a}(a+b)^{7/2}} - \frac{(a^2+3ab+3b^2)\cot(x)}{(a+b)^3} - \frac{(2a+3b)\cot^3(x)}{3(a+b)^2} - \frac{\cot^5(x)}{5(a+b)}
\end{aligned}$$

**Mathematica [A]** time = 0.38139, size = 90, normalized size = 1.01

$$\frac{b^3 \tan^{-1} \left( \frac{\sqrt{a} \tan(x)}{\sqrt{a+b}} \right)}{\sqrt{a}(a+b)^{7/2}} - \frac{\cot(x) \left( (4a^2 + 13ab + 9b^2) \csc^2(x) + 8a^2 + 3(a+b)^2 \csc^4(x) + 26ab + 33b^2 \right)}{15(a+b)^3}$$

Antiderivative was successfully verified.

[In] Integrate[Csc[x]^6/(a + b\*Cos[x]^2), x]

[Out] (b^3\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]])/(Sqrt[a]\*(a + b)^(7/2)) - (Cot[x]\*(8\*a^2 + 26\*a\*b + 33\*b^2 + (4\*a^2 + 13\*a\*b + 9\*b^2)\*Csc[x]^2 + 3\*(a + b)^2\*Csc[x]^4))/(15\*(a + b)^3)

**Maple [A]** time = 0.042, size = 106, normalized size = 1.2

$$\frac{b^3}{(a+b)^3} \arctan \left( a \tan(x) \frac{1}{\sqrt{(a+b)a}} \right) \frac{1}{\sqrt{(a+b)a}} - \frac{1}{(5a+5b)(\tan(x))^5} - \frac{2a}{3(a+b)^2(\tan(x))^3} - \frac{b}{(a+b)^2(\tan(x))^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(csc(x)^6/(a+b\*cos(x)^2), x)

[Out] b^3/(a+b)^3/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))-1/5/(a+b)/tan(x)^5-2/3/(a+b)^2/tan(x)^3\*a-1/(a+b)^2/tan(x)^3\*b-1/(a+b)^3/tan(x)\*a^2-3/(a+b)^3/tan(x)\*a\*b-3/(a+b)^3/tan(x)\*b^2

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^6/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 2.04315, size = 1446, normalized size = 16.25

result too large to display

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^6/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] 
$$\begin{aligned} & [-1/60*(4*(8*a^4 + 34*a^3*b + 59*a^2*b^2 + 33*a*b^3)*\cos(x)^5 - 20*(4*a^4 + \\ & 17*a^3*b + 28*a^2*b^2 + 15*a*b^3)*\cos(x)^3 + 15*(b^3*\cos(x)^4 - 2*b^3*\cos(x)^2 + b^3)*\sqrt{-a^2 - a*b}*\log(((8*a^2 + 8*a*b + b^2)*\cos(x)^4 - 2*(4*a^2 \\ & + 3*a*b)*\cos(x)^2 + 4*((2*a + b)*\cos(x)^3 - a*\cos(x))*\sqrt{-a^2 - a*b}*\sin(x) + a^2)/(b^2*\cos(x)^4 + 2*a*b*\cos(x)^2 + a^2))*\sin(x) + 60*(a^4 + 4*a^3*b \\ & + 6*a^2*b^2 + 3*a*b^3)*\cos(x))/((a^5 + 4*a^4*b + 6*a^3*b^2 + 4*a^2*b^3 + a*b^4 + (a^5 + 4*a^4*b + 6*a^3*b^2 + 4*a^2*b^3 + a*b^4)*\cos(x)^4 - 2*(a^5 + \\ & 4*a^4*b + 6*a^3*b^2 + 4*a^2*b^3 + a*b^4)*\cos(x)^2)*\sin(x)), -1/30*(2*(8*a^4 + 34*a^3*b + 59*a^2*b^2 + 33*a*b^3)*\cos(x)^5 - 10*(4*a^4 + 17*a^3*b + 28*a^2*b^2 + 15*a*b^3)*\cos(x)^3 + 15*(b^3*\cos(x)^4 - 2*b^3*\cos(x)^2 + b^3)*\sqrt{a^2 + a*b}*\arctan(1/2*((2*a + b)*\cos(x)^2 - a)/(\sqrt{a^2 + a*b}*\cos(x)*\sin(x)))*\sin(x) + 30*(a^4 + 4*a^3*b + 6*a^2*b^2 + 3*a*b^3)*\cos(x))/((a^5 + 4*a^4*b + 6*a^3*b^2 + 4*a^2*b^3 + a*b^4 + (a^5 + 4*a^4*b + 6*a^3*b^2 + 4*a^2*b^3 + a*b^4)*\cos(x)^4 - 2*(a^5 + 4*a^4*b + 6*a^3*b^2 + 4*a^2*b^3 + a*b^4)*\cos(x)^2)*\sin(x))] \end{aligned}$$

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)\*\*6/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

**Giac [B]** time = 1.21034, size = 211, normalized size = 2.37

$$\frac{\left(\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)\right) b^3}{(a^3 + 3a^2b + 3ab^2 + b^3)\sqrt{a^2 + ab}} - \frac{15a^2 \tan(x)^4 + 45ab \tan(x)^4 + 45b^2 \tan(x)^4 + 10a^2 \tan(x)^2 + 25ab \tan(x)^2}{15(a^3 + 3a^2b + 3ab^2 + b^3) \tan(x)^5}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(csc(x)^6/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] 
$$\begin{aligned} & (\pi*\text{floor}(x/\pi + 1/2)*\text{sgn}(a) + \arctan(a*\tan(x)/\sqrt{a^2 + a*b}))*b^3/((a^3 + 3*a^2*b + 3*a*b^2 + b^3)*\sqrt{a^2 + a*b}) - 1/15*(15*a^2*\tan(x)^4 + 45*a*b*\tan(x)^4 + 45*b^2*\tan(x)^4 + 10*a^2*\tan(x)^2 + 25*a*b*\tan(x)^2 + 15*b^2*\tan(x)^2 + 3*a^2 + 6*a*b + 3*b^2)/((a^3 + 3*a^2*b + 3*a*b^2 + b^3)*\tan(x)^5) \end{aligned}$$

### 3.24 $\int \frac{\sin(x)}{4-3\cos^3(x)} dx$

**Optimal.** Leaf size=98

$$-\frac{\log\left(3^{2/3}\cos^2(x)+2^{2/3}\sqrt[3]{3}\cos(x)+2\sqrt[3]{2}\right)}{12\sqrt[3]{6}}+\frac{\log\left(2^{2/3}-\sqrt[3]{3}\cos(x)\right)}{6\sqrt[3]{6}}-\frac{\tan^{-1}\left(\frac{\sqrt[3]{6}\cos(x)+1}{\sqrt{3}}\right)}{2\sqrt[3]{23^{5/6}}}$$

[Out] -ArcTan[(1 + 6^(1/3)\*Cos[x])/Sqrt[3]]/(2\*2^(1/3)\*3^(5/6)) + Log[2^(2/3) - 3^(1/3)\*Cos[x]]/(6\*6^(1/3)) - Log[2\*2^(1/3) + 2^(2/3)\*3^(1/3)\*Cos[x] + 3^(2/3)\*Cos[x]^2]/(12\*6^(1/3))

**Rubi [A]** time = 0.0903281, antiderivative size = 98, normalized size of antiderivative = 1., number of steps used = 7, number of rules used = 7, integrand size = 13,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.538$ , Rules used = {3223, 200, 31, 634, 617, 204, 628}

$$-\frac{\log\left(3^{2/3}\cos^2(x)+2^{2/3}\sqrt[3]{3}\cos(x)+2\sqrt[3]{2}\right)}{12\sqrt[3]{6}}+\frac{\log\left(2^{2/3}-\sqrt[3]{3}\cos(x)\right)}{6\sqrt[3]{6}}-\frac{\tan^{-1}\left(\frac{\sqrt[3]{6}\cos(x)+1}{\sqrt{3}}\right)}{2\sqrt[3]{23^{5/6}}}$$

Antiderivative was successfully verified.

[In] Int[Sin[x]/(4 - 3\*Cos[x]^3), x]

[Out] -ArcTan[(1 + 6^(1/3)\*Cos[x])/Sqrt[3]]/(2\*2^(1/3)\*3^(5/6)) + Log[2^(2/3) - 3^(1/3)\*Cos[x]]/(6\*6^(1/3)) - Log[2\*2^(1/3) + 2^(2/3)\*3^(1/3)\*Cos[x] + 3^(2/3)\*Cos[x]^2]/(12\*6^(1/3))

#### Rule 3223

Int[cos[(e\_.) + (f\_.)\*(x\_)]^(m\_.)\*((a\_) + (b\_.)\*((c\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^(n\_))^(p\_.), x\_Symbol] :> With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b\*(c\*ff\*x)^n)^p, x], x, Sin[e + f\*x]/ff], x] /; FreeQ[{a, b, c, e, f, n, p}, x] && IntegerQ[(m - 1)/2] && (EqQ[n, 4] || GtQ[m, 0] || IGtQ[p, 0] || IntegersQ[m, p])

#### Rule 200

Int[((a\_) + (b\_.)\*(x\_)^3)^(-1), x\_Symbol] :> Dist[1/(3\*Rt[a, 3]^2), Int[1/(Rt[a, 3] + Rt[b, 3]\*x), x], x] + Dist[1/(3\*Rt[a, 3]^2), Int[(2\*Rt[a, 3] - Rt[b, 3]\*x)/(Rt[a, 3]^2 - Rt[a, 3]\*Rt[b, 3]\*x + Rt[b, 3]^2\*x^2), x], x] /; FreeQ[{a, b}, x]

#### Rule 31

Int[((a\_) + (b\_.)\*(x\_))^(n\_), x\_Symbol] :> Simp[Log[RemoveContent[a + b\*x, x]]/b, x] /; FreeQ[{a, b}, x]

#### Rule 634

Int[((d\_.) + (e\_.)\*(x\_))/((a\_) + (b\_.)\*(x\_) + (c\_.)\*(x\_)^2), x\_Symbol] :> Dist[(2\*c\*d - b\*e)/(2\*c), Int[1/(a + b\*x + c\*x^2), x], x] + Dist[e/(2\*c), Int[(b + 2\*c\*x)/(a + b\*x + c\*x^2), x], x] /; FreeQ[{a, b, c, d, e}, x] && NeQ[2\*c\*d - b\*e, 0] && NeQ[b^2 - 4\*a\*c, 0] && !NiceSqrtQ[b^2 - 4\*a\*c]

#### Rule 617

```
Int[((a_) + (b_.)*(x_) + (c_.)*(x_)^2)^(-1), x_Symbol] := With[{q = 1 - 4*S
implify[(a*c)/b^2]}, Dist[-2/b, Subst[Int[1/(q - x^2), x], x, 1 + (2*c*x)/b
], x] /; RationalQ[q] && (EqQ[q^2, 1] || !RationalQ[b^2 - 4*a*c])] /; Free
Q[{a, b, c}, x] && NeQ[b^2 - 4*a*c, 0]
```

### Rule 204

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] := -Simp[ArcTan[(Rt[-b, 2]*x)/Rt[
-a, 2]]/(Rt[-a, 2]*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (LtQ[
a, 0] || LtQ[b, 0])
```

### Rule 628

```
Int[((d_) + (e_.)*(x_))/((a_.) + (b_.)*(x_) + (c_.)*(x_)^2), x_Symbol] := S
imp[(d*Log[RemoveContent[a + b*x + c*x^2, x]])/b, x] /; FreeQ[{a, b, c, d,
e}, x] && EqQ[2*c*d - b*e, 0]
```

### Rubi steps

$$\begin{aligned}
\int \frac{\sin(x)}{4 - 3 \cos^3(x)} dx &= -\text{Subst} \left( \int \frac{1}{4 - 3x^3} dx, x, \cos(x) \right) \\
&= -\frac{\text{Subst} \left( \int \frac{1}{2^{2/3} - \sqrt[3]{3}x} dx, x, \cos(x) \right)}{6\sqrt[3]{2}} - \frac{\text{Subst} \left( \int \frac{2 \cdot 2^{2/3} + \sqrt[3]{3}x}{2\sqrt[3]{2} + 2^{2/3}\sqrt[3]{3}x + 3^{2/3}x^2} dx, x, \cos(x) \right)}{6\sqrt[3]{2}} \\
&= \frac{\log(2^{2/3} - \sqrt[3]{3} \cos(x))}{6\sqrt[3]{6}} - \frac{\text{Subst} \left( \int \frac{1}{2\sqrt[3]{2} + 2^{2/3}\sqrt[3]{3}x + 3^{2/3}x^2} dx, x, \cos(x) \right)}{2 \cdot 2^{2/3}} - \frac{\text{Subst} \left( \int \frac{2^{2/3}\sqrt[3]{3} + 2 \cdot 3^{2/3}x}{2\sqrt[3]{2} + 2^{2/3}\sqrt[3]{3}x + 3^{2/3}x^2} dx, x, \cos(x) \right)}{12\sqrt[3]{6}} \\
&= \frac{\log(2^{2/3} - \sqrt[3]{3} \cos(x))}{6\sqrt[3]{6}} - \frac{\log(2\sqrt[3]{2} + 2^{2/3}\sqrt[3]{3} \cos(x) + 3^{2/3} \cos^2(x))}{12\sqrt[3]{6}} + \frac{\text{Subst} \left( \int \frac{1}{-3-x^2} dx, x, 1 + \sqrt[3]{6} \cos(x) \right)}{2\sqrt[3]{6}} \\
&= -\frac{\tan^{-1} \left( \frac{1 + \sqrt[3]{6} \cos(x)}{\sqrt{3}} \right)}{2\sqrt[3]{23^{5/6}}} + \frac{\log(2^{2/3} - \sqrt[3]{3} \cos(x))}{6\sqrt[3]{6}} - \frac{\log(2\sqrt[3]{2} + 2^{2/3}\sqrt[3]{3} \cos(x) + 3^{2/3} \cos^2(x))}{12\sqrt[3]{6}}
\end{aligned}$$

**Mathematica [A]** time = 0.0983305, size = 79, normalized size = 0.81

$$\frac{1}{72} \left( 6^{2/3} \left( 2 \log(2 - \sqrt[3]{6} \cos(x)) - \log(6^{2/3} \cos^2(x) + 2\sqrt[3]{6} \cos(x) + 4) \right) - 6 \cdot 2^{2/3} \sqrt[3]{3} \tan^{-1} \left( \frac{\sqrt[3]{6} \cos(x) + 1}{\sqrt{3}} \right) \right)$$

Antiderivative was successfully verified.

```
[In] Integrate[Sin[x]/(4 - 3*Cos[x]^3), x]
```

```
[Out] (-6*2^(2/3)*3^(1/6)*ArcTan[(1 + 6^(1/3)*Cos[x])/Sqrt[3]] + 6^(2/3)*(2*Log[2
- 6^(1/3)*Cos[x]] - Log[4 + 2*6^(1/3)*Cos[x] + 6^(2/3)*Cos[x]^2])/72
```

**Maple [A]** time = 0.017, size = 80, normalized size = 0.8

$$\frac{\sqrt[3]{43}^{\frac{2}{3}}}{36} \ln \left( \cos(x) - \frac{\sqrt[3]{43}^{\frac{2}{3}}}{3} \right) - \frac{\sqrt[3]{43}^{\frac{2}{3}}}{72} \ln \left( (\cos(x))^2 + \frac{\sqrt[3]{43}^{\frac{2}{3}} \cos(x)}{3} + \frac{4^{\frac{2}{3}} \sqrt[3]{3}}{3} \right) - \frac{\sqrt[3]{4} \sqrt[3]{3}}{12} \arctan \left( \frac{\sqrt{3}}{3} \left( \frac{4^{\frac{2}{3}} \sqrt[3]{3} \cos(x)}{2} + 1 \right) \right)$$

Verification of antiderivative is not currently implemented for this CAS.



[In] int(sin(x)/(4-3\*cos(x)^3),x)

[Out]  $\frac{1}{36}4^{1/3}3^{2/3}\ln(\cos(x)-1/34^{1/3}3^{2/3})-1/724^{1/3}3^{2/3}\ln(\cos(x)^2+1/34^{1/3}3^{2/3}\cos(x)+1/34^{2/3}3^{1/3})-1/124^{1/3}3^{1/6}\arctan(1/33^{1/2}*(1/24^{2/3}3^{1/3}\cos(x)+1))$

**Maxima [A]** time = 1.43933, size = 120, normalized size = 1.22

$$-\frac{1}{72} \cdot 4^{1/3}3^{2/3} \log\left(3^{2/3} \cos(x)^2 + 4^{1/3}3^{1/3} \cos(x) + 4^{2/3}\right) + \frac{1}{36} \cdot 4^{1/3}3^{2/3} \log\left(\frac{1}{3} \cdot 3^{2/3}\left(3^{1/3} \cos(x) - 4^{1/3}\right)\right) - \frac{1}{12} \cdot 4^{1/3}3^{1/6} \arctan\left(\frac{1}{12} \cdot 4^{2/3}3^{1/3} \cos(x) + 4^{1/3}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)/(4-3\*cos(x)^3),x, algorithm="maxima")

[Out]  $-1/724^{1/3}3^{2/3}\log(3^{2/3}\cos(x)^2 + 4^{1/3}3^{1/3}\cos(x) + 4^{2/3}) + 1/364^{1/3}3^{2/3}\log(1/33^{2/3}(3^{1/3}\cos(x) - 4^{1/3})) - 1/124^{1/3}3^{1/6}\arctan(1/124^{2/3}3^{1/3}\cos(x) + 4^{1/3}3^{1/3})$

**Fricas [A]** time = 1.75272, size = 251, normalized size = 2.56

$$-\frac{1}{12} \cdot 6^{1/6} \sqrt{2} \arctan\left(\frac{1}{6} \cdot 6^{1/6} \left(6^{2/3} \sqrt{2} \cos(x) + 6^{1/3} \sqrt{2}\right)\right) - \frac{1}{72} \cdot 6^{2/3} \log\left(-3 \cos(x)^2 - 6^{2/3} \cos(x) - 2 \cdot 6^{1/3}\right) + \frac{1}{36} \cdot 6^{2/3} \log\left(6^{2/3} \cos(x) - 6^{1/3}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)/(4-3\*cos(x)^3),x, algorithm="fricas")

[Out]  $-1/12*6^{1/6}*sqrt(2)*arctan(1/6*6^{1/6}*(6^{2/3}*sqrt(2)*cos(x) + 6^{1/3}*sqrt(2))) - 1/72*6^{2/3}*log(-3*cos(x)^2 - 6^{2/3}*cos(x) - 2*6^{1/3}) + 1/36*6^{2/3}*log(6^{2/3} - 3*cos(x))$

**Sympy [A]** time = 3.14148, size = 85, normalized size = 0.87

$$\frac{6^{2/3} \log\left(\cos(x) - \frac{6^{2/3}}{3}\right)}{36} - \frac{6^{2/3} \log\left(36 \cos^2(x) + 12 \cdot 6^{2/3} \cos(x) + 24\sqrt[3]{6}\right)}{72} - \frac{2^{2/3} \sqrt[6]{3} \operatorname{atan}\left(\frac{\sqrt[3]{2} \cdot 3^{5/6} \cos(x)}{3} + \frac{\sqrt{3}}{3}\right)}{12}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sin(x)/(4-3\*cos(x)\*\*3),x)

[Out]  $6^{2/3}\log(\cos(x) - 6^{2/3}/3)/36 - 6^{2/3}\log(36*\cos(x)**2 + 12*6^{2/3}\cos(x) + 24*6^{1/3})/72 - 2^{2/3}*3^{1/6}*atan(2^{1/3}*3^{5/6}\cos(x)/3 + sqrt(3)/3)/12$

**Giac [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: NotImplementedError

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(sin(x)/(4-3*cos(x)^3),x, algorithm="giac")
```

```
[Out] Exception raised: NotImplementedError
```

$$3.25 \quad \int \frac{1}{1-\cos^2(x)} dx$$

**Optimal.** Leaf size=4

$$-\cot(x)$$

[Out] -Cot[x]

**Rubi [A]** time = 0.0135559, antiderivative size = 4, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.3$ , Rules used = {3175, 3767, 8}

$$-\cot(x)$$

Antiderivative was successfully verified.

[In] Int[(1 - Cos[x]^2)^(-1),x]

[Out] -Cot[x]

#### Rule 3175

Int[(u\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_), x\_Symbol] :> Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

#### Rule 3767

Int[csc[(c\_.) + (d\_.)\*(x\_)]^(n\_), x\_Symbol] :> -Dist[d^(-1), Subst[Int[ExpandIntegrand[(1 + x^2)^(n/2 - 1), x], x], x, Cot[c + d\*x]], x] /; FreeQ[{c, d}, x] && IGtQ[n/2, 0]

#### Rule 8

Int[a\_, x\_Symbol] :> Simp[a\*x, x] /; FreeQ[a, x]

#### Rubi steps

$$\begin{aligned} \int \frac{1}{1-\cos^2(x)} dx &= \int \csc^2(x) dx \\ &= -\text{Subst}\left(\int 1 dx, x, \cot(x)\right) \\ &= -\cot(x) \end{aligned}$$

**Mathematica [A]** time = 0.0022625, size = 4, normalized size = 1.

$$-\cot(x)$$

Antiderivative was successfully verified.

[In] Integrate[(1 - Cos[x]^2)^(-1),x]

[Out]  $-\text{Cot}[x]$

---

**Maple [A]** time = 0.014, size = 7, normalized size = 1.8

$$-(\tan(x))^{-1}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(1/(1-cos(x)^2),x)`

[Out]  $-1/\tan(x)$

---

**Maxima [A]** time = 0.956744, size = 8, normalized size = 2.

$$-\frac{1}{\tan(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(1-cos(x)^2),x, algorithm="maxima")`

[Out]  $-1/\tan(x)$

---

**Fricas [B]** time = 1.59319, size = 22, normalized size = 5.5

$$-\frac{\cos(x)}{\sin(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(1-cos(x)^2),x, algorithm="fricas")`

[Out]  $-\cos(x)/\sin(x)$

---

**Sympy [B]** time = 0.596599, size = 14, normalized size = 3.5

$$\frac{\tan\left(\frac{x}{2}\right)}{2} - \frac{1}{2\tan\left(\frac{x}{2}\right)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(1-cos(x)**2),x)`

[Out]  $\tan(x/2)/2 - 1/(2*\tan(x/2))$

---

**Giac [A]** time = 1.17903, size = 8, normalized size = 2.

$$-\frac{1}{\tan(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(1-cos(x)^2),x, algorithm="giac")
```

```
[Out] -1/tan(x)
```

$$3.26 \quad \int \frac{1}{(1-\cos^2(x))^2} dx$$

**Optimal.** Leaf size=13

$$-\frac{1}{3} \cot^3(x) - \cot(x)$$

[Out] -Cot[x] - Cot[x]^3/3

**Rubi [A]** time = 0.0148672, antiderivative size = 13, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 2, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3175, 3767}

$$-\frac{1}{3} \cot^3(x) - \cot(x)$$

Antiderivative was successfully verified.

[In] Int[(1 - Cos[x]^2)^(-2), x]

[Out] -Cot[x] - Cot[x]^3/3

#### Rule 3175

Int[(u\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^p, x\_Symbol] :> Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

#### Rule 3767

Int[csc[(c\_.) + (d\_.)\*(x\_)]^n, x\_Symbol] :> -Dist[d^(-1), Subst[Int[ExpandIntegrand[(1 + x^2)^(n/2 - 1), x], x], x, Cot[c + d\*x]], x] /; FreeQ[{c, d}, x] && IGtQ[n/2, 0]

#### Rubi steps

$$\begin{aligned} \int \frac{1}{(1-\cos^2(x))^2} dx &= \int \csc^4(x) dx \\ &= -\text{Subst} \left( \int (1+x^2) dx, x, \cot(x) \right) \\ &= -\cot(x) - \frac{\cot^3(x)}{3} \end{aligned}$$

**Mathematica [A]** time = 0.0031777, size = 17, normalized size = 1.31

$$-\frac{2 \cot(x)}{3} - \frac{1}{3} \cot(x) \csc^2(x)$$

Antiderivative was successfully verified.

[In] Integrate[(1 - Cos[x]^2)^(-2), x]

[Out]  $(-2*\text{Cot}[x])/3 - (\text{Cot}[x]*\text{Csc}[x]^2)/3$

**Maple [A]** time = 0.017, size = 14, normalized size = 1.1

$$-\frac{1}{3(\tan(x))^3} - (\tan(x))^{-1}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(1/(1-cos(x)^2)^2,x)`

[Out]  $-1/3/\tan(x)^3-1/\tan(x)$

**Maxima [A]** time = 0.96259, size = 19, normalized size = 1.46

$$-\frac{3 \tan(x)^2 + 1}{3 \tan(x)^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(1-cos(x)^2)^2,x, algorithm="maxima")`

[Out]  $-1/3*(3*\tan(x)^2 + 1)/\tan(x)^3$

**Fricas [B]** time = 1.5386, size = 73, normalized size = 5.62

$$\frac{2 \cos(x)^3 - 3 \cos(x)}{3(\cos(x)^2 - 1)\sin(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(1-cos(x)^2)^2,x, algorithm="fricas")`

[Out]  $-1/3*(2*\cos(x)^3 - 3*\cos(x))/((\cos(x)^2 - 1)*\sin(x))$

**Sympy [B]** time = 2.42905, size = 34, normalized size = 2.62

$$\frac{\tan^3\left(\frac{x}{2}\right)}{24} + \frac{3 \tan\left(\frac{x}{2}\right)}{8} - \frac{3}{8 \tan\left(\frac{x}{2}\right)} - \frac{1}{24 \tan^3\left(\frac{x}{2}\right)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(1-cos(x)**2)**2,x)`

[Out]  $\tan(x/2)**3/24 + 3*\tan(x/2)/8 - 3/(8*\tan(x/2)) - 1/(24*\tan(x/2)**3)$

**Giac [A]** time = 1.21659, size = 19, normalized size = 1.46

$$-\frac{3 \tan(x)^2 + 1}{3 \tan(x)^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^2)^2,x, algorithm="giac")

[Out] -1/3\*(3\*tan(x)^2 + 1)/tan(x)^3



$$3.27 \quad \int \frac{1}{(1-\cos^2(x))^3} dx$$

**Optimal.** Leaf size=21

$$-\frac{1}{5} \cot^5(x) - \frac{2 \cot^3(x)}{3} - \cot(x)$$

[Out] -Cot[x] - (2\*Cot[x]^3)/3 - Cot[x]^5/5

**Rubi [A]** time = 0.0171482, antiderivative size = 21, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 2, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3175, 3767}

$$-\frac{1}{5} \cot^5(x) - \frac{2 \cot^3(x)}{3} - \cot(x)$$

Antiderivative was successfully verified.

[In] Int[(1 - Cos[x]^2)^(-3), x]

[Out] -Cot[x] - (2\*Cot[x]^3)/3 - Cot[x]^5/5

#### Rule 3175

Int[(u\_)\*((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^(p\_), x\_Symbol] := Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

#### Rule 3767

Int[csc[(c\_) + (d\_)\*(x\_)]^(n\_), x\_Symbol] := -Dist[d^(-1), Subst[Int[ExpandIntegrand[(1 + x^2)^(n/2 - 1), x], x], x, Cot[c + d\*x]], x] /; FreeQ[{c, d}, x] && IGtQ[n/2, 0]

#### Rubi steps

$$\begin{aligned} \int \frac{1}{(1-\cos^2(x))^3} dx &= \int \csc^6(x) dx \\ &= -\text{Subst} \left( \int (1 + 2x^2 + x^4) dx, x, \cot(x) \right) \\ &= -\cot(x) - \frac{2 \cot^3(x)}{3} - \frac{\cot^5(x)}{5} \end{aligned}$$

**Mathematica [A]** time = 0.003592, size = 27, normalized size = 1.29

$$-\frac{8 \cot(x)}{15} - \frac{1}{5} \cot(x) \csc^4(x) - \frac{4}{15} \cot(x) \csc^2(x)$$

Antiderivative was successfully verified.

[In] Integrate[(1 - Cos[x]^2)^(-3), x]

[Out]  $(-8*\text{Cot}[x])/15 - (4*\text{Cot}[x]*\text{Csc}[x]^2)/15 - (\text{Cot}[x]*\text{Csc}[x]^4)/5$

**Maple [A]** time = 0.017, size = 20, normalized size = 1.

$$-(\tan(x))^{-1} - \frac{2}{3(\tan(x))^3} - \frac{1}{5(\tan(x))^5}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(1/(1-cos(x)^2)^3,x)`

[Out]  $-1/\tan(x) - 2/3/\tan(x)^3 - 1/5/\tan(x)^5$

**Maxima [A]** time = 0.951776, size = 27, normalized size = 1.29

$$-\frac{15 \tan(x)^4 + 10 \tan(x)^2 + 3}{15 \tan(x)^5}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(1-cos(x)^2)^3,x, algorithm="maxima")`

[Out]  $-1/15*(15*\tan(x)^4 + 10*\tan(x)^2 + 3)/\tan(x)^5$

**Fricas [B]** time = 1.58894, size = 112, normalized size = 5.33

$$-\frac{8 \cos(x)^5 - 20 \cos(x)^3 + 15 \cos(x)}{15(\cos(x)^4 - 2 \cos(x)^2 + 1) \sin(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(1-cos(x)^2)^3,x, algorithm="fricas")`

[Out]  $-1/15*(8*\cos(x)^5 - 20*\cos(x)^3 + 15*\cos(x))/((\cos(x)^4 - 2*\cos(x)^2 + 1)*\sin(x))$

**Sympy [B]** time = 9.11888, size = 54, normalized size = 2.57

$$\frac{\tan^5\left(\frac{x}{2}\right)}{160} + \frac{5 \tan^3\left(\frac{x}{2}\right)}{96} + \frac{5 \tan\left(\frac{x}{2}\right)}{16} - \frac{5}{16 \tan\left(\frac{x}{2}\right)} - \frac{5}{96 \tan^3\left(\frac{x}{2}\right)} - \frac{1}{160 \tan^5\left(\frac{x}{2}\right)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(1-cos(x)**2)**3,x)`

[Out]  $\tan(x/2)**5/160 + 5*\tan(x/2)**3/96 + 5*\tan(x/2)/16 - 5/(16*\tan(x/2)) - 5/(96*\tan(x/2)**3) - 1/(160*\tan(x/2)**5)$

---

**Giac [A]** time = 1.16443, size = 27, normalized size = 1.29

$$-\frac{15 \tan(x)^4 + 10 \tan(x)^2 + 3}{15 \tan(x)^5}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^2)^3,x, algorithm="giac")

[Out] -1/15\*(15\*tan(x)^4 + 10\*tan(x)^2 + 3)/tan(x)^5

$$3.28 \quad \int \frac{\cos^7(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=78

$$\frac{(a^2 - ab + b^2) \sin(x)}{b^3} - \frac{a^3 \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{b^{7/2} \sqrt{a+b}} + \frac{(a-2b) \sin^3(x)}{3b^2} + \frac{\sin^5(x)}{5b}$$

[Out] -((a^3\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a+b]]/(b^(7/2)\*Sqrt[a+b])) + ((a^2 - a\*b + b^2)\*Sin[x])/b^3 + ((a - 2\*b)\*Sin[x]^3)/(3\*b^2) + Sin[x]^5/(5\*b))

**Rubi [A]** time = 0.0840385, antiderivative size = 78, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3186, 390, 208}

$$\frac{(a^2 - ab + b^2) \sin(x)}{b^3} - \frac{a^3 \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{b^{7/2} \sqrt{a+b}} + \frac{(a-2b) \sin^3(x)}{3b^2} + \frac{\sin^5(x)}{5b}$$

Antiderivative was successfully verified.

[In] Int[Cos[x]^7/(a + b\*Cos[x]^2), x]

[Out] -((a^3\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a+b]]/(b^(7/2)\*Sqrt[a+b])) + ((a^2 - a\*b + b^2)\*Sin[x])/b^3 + ((a - 2\*b)\*Sin[x]^3)/(3\*b^2) + Sin[x]^5/(5\*b))

#### Rule 3186

```
Int[sin[(e_.) + (f_.)*(x_.)]^(m_.)*((a_.) + (b_.)*sin[(e_.) + (f_.)*(x_.)]^2)^(p_.), x_Symbol]
:> With[{ff = FreeFactors[Cos[e + f*x], x]}, -Dist[ff/f, Subst[Int[(1 - ff^2*x^2)^((m - 1)/2)*(a + b - b*ff^2*x^2)^p, x], x, Cos[e + f*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]
```

#### Rule 390

```
Int[((a_.) + (b_.)*(x_.)^(n_.))^(p_.)*((c_.) + (d_.)*(x_.)^(n_.))^(q_.), x_Symbol]
:> Int[PolynomialDivide[(a + b*x^n)^p, (c + d*x^n)^(-q), x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b*c - a*d, 0] && IGtQ[n, 0] && IGtQ[p, 0] && ILtQ[q, 0] && GeQ[p, -q]
```

#### Rule 208

```
Int[((a_.) + (b_.)*(x_.)^2)^(-1), x_Symbol]
:> Simp[(Rt[-(a/b), 2]*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]
```

#### Rubi steps

$$\begin{aligned}
\int \frac{\cos^7(x)}{a+b\cos^2(x)} dx &= \text{Subst} \left( \int \frac{(1-x^2)^3}{a+b-bx^2} dx, x, \sin(x) \right) \\
&= \text{Subst} \left( \int \left( \frac{a^2-ab+b^2}{b^3} + \frac{(a-2b)x^2}{b^2} + \frac{x^4}{b} - \frac{a^3}{b^3(a+b-bx^2)} \right) dx, x, \sin(x) \right) \\
&= \frac{(a^2-ab+b^2)\sin(x)}{b^3} + \frac{(a-2b)\sin^3(x)}{3b^2} + \frac{\sin^5(x)}{5b} - \frac{a^3 \text{Subst} \left( \int \frac{1}{a+b-bx^2} dx, x, \sin(x) \right)}{b^3} \\
&= -\frac{a^3 \tanh^{-1} \left( \frac{\sqrt{b}\sin(x)}{\sqrt{a+b}} \right)}{b^{7/2}\sqrt{a+b}} + \frac{(a^2-ab+b^2)\sin(x)}{b^3} + \frac{(a-2b)\sin^3(x)}{3b^2} + \frac{\sin^5(x)}{5b}
\end{aligned}$$

**Mathematica [A]** time = 0.385071, size = 111, normalized size = 1.42

$$\frac{(8a^2 - 6ab + 5b^2)\sin(x)}{8b^3} + \frac{a^3 (\log(\sqrt{a+b} - \sqrt{b}\sin(x)) - \log(\sqrt{a+b} + \sqrt{b}\sin(x)))}{2b^{7/2}\sqrt{a+b}} + \frac{(5b-4a)\sin(3x)}{48b^2} + \frac{\sin(5x)}{80b}$$

Antiderivative was successfully verified.

[In] Integrate[Cos[x]^7/(a + b\*Cos[x]^2), x]

[Out] (a^3\*(Log[Sqrt[a + b] - Sqrt[b]\*Sin[x]] - Log[Sqrt[a + b] + Sqrt[b]\*Sin[x]]))/(2\*b^(7/2)\*Sqrt[a + b]) + ((8\*a^2 - 6\*a\*b + 5\*b^2)\*Sin[x])/(8\*b^3) + ((-4\*a + 5\*b)\*Sin[3\*x])/(48\*b^2) + Sin[5\*x]/(80\*b)

**Maple [A]** time = 0.02, size = 78, normalized size = 1.

$$\frac{1}{b^3} \left( \frac{(\sin(x))^5 b^2}{5} + \frac{(\sin(x))^3 ba}{3} - \frac{2(\sin(x))^3 b^2}{3} + a^2 \sin(x) - ab \sin(x) + b^2 \sin(x) \right) - \frac{a^3}{b^3} \text{Artanh} \left( b \sin(x) \frac{1}{\sqrt{a+b}} \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(cos(x)^7/(a+b\*cos(x)^2), x)

[Out] 1/b^3\*(1/5\*sin(x)^5\*b^2+1/3\*sin(x)^3\*b\*a-2/3\*sin(x)^3\*b^2+a^2\*sin(x)-a\*b\*sin(x)+b^2\*sin(x))-a^3/b^3/((a+b)\*b)^(1/2)\*arctanh(b\*sin(x)/((a+b)\*b)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^7/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.91061, size = 597, normalized size = 7.65

$$\frac{15 \sqrt{ab + b^2} a^3 \log\left(-\frac{b \cos(x)^2 + 2 \sqrt{ab + b^2} \sin(x) - a - 2b}{b \cos(x)^2 + a}\right) + 2 \left(3 (ab^3 + b^4) \cos(x)^4 + 15 a^3 b + 5 a^2 b^2 - 2 ab^3 + 8 b^4 - (5 a^2 b^2 + ab^3)\right)}{30 (ab^4 + b^5)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^7/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/30\*(15\*sqrt(a\*b + b^2)\*a^3\*log(-(b\*cos(x)^2 + 2\*sqrt(a\*b + b^2)\*sin(x) - a - 2\*b)/(b\*cos(x)^2 + a)) + 2\*(3\*(a\*b^3 + b^4)\*cos(x)^4 + 15\*a^3\*b + 5\*a^2\*b^2 - 2\*a\*b^3 + 8\*b^4 - (5\*a^2\*b^2 + a\*b^3 - 4\*b^4)\*cos(x)^2)\*sin(x))/(a\*b^4 + b^5), 1/15\*(15\*sqrt(-a\*b - b^2)\*a^3\*arctan(sqrt(-a\*b - b^2)\*sin(x)/(a + b)) + (3\*(a\*b^3 + b^4)\*cos(x)^4 + 15\*a^3\*b + 5\*a^2\*b^2 - 2\*a\*b^3 + 8\*b^4 - (5\*a^2\*b^2 + a\*b^3 - 4\*b^4)\*cos(x)^2)\*sin(x))/(a\*b^4 + b^5)]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)\*\*7/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

**Giac [A]** time = 1.16356, size = 130, normalized size = 1.67

$$\frac{a^3 \arctan\left(\frac{b \sin(x)}{\sqrt{-ab - b^2}}\right)}{\sqrt{-ab - b^2} b^3} + \frac{3 b^4 \sin(x)^5 + 5 ab^3 \sin(x)^3 - 10 b^4 \sin(x)^3 + 15 a^2 b^2 \sin(x) - 15 ab^3 \sin(x) + 15 b^4 \sin(x)}{15 b^5}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^7/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] a^3\*arctan(b\*sin(x)/sqrt(-a\*b - b^2))/(sqrt(-a\*b - b^2)\*b^3) + 1/15\*(3\*b^4\*sin(x)^5 + 5\*a\*b^3\*sin(x)^3 - 10\*b^4\*sin(x)^3 + 15\*a^2\*b^2\*sin(x) - 15\*a\*b^3\*sin(x) + 15\*b^4\*sin(x))/b^5

$$3.29 \quad \int \frac{\cos^5(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=56

$$\frac{a^2 \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{b^{5/2} \sqrt{a+b}} - \frac{(a-b) \sin(x)}{b^2} - \frac{\sin^3(x)}{3b}$$

[Out] (a^2\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]])/(b^(5/2)\*Sqrt[a + b]) - ((a - b)\*Sin[x])/b^2 - Sin[x]^3/(3\*b)

**Rubi [A]** time = 0.071169, antiderivative size = 56, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3186, 390, 208}

$$\frac{a^2 \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{b^{5/2} \sqrt{a+b}} - \frac{(a-b) \sin(x)}{b^2} - \frac{\sin^3(x)}{3b}$$

Antiderivative was successfully verified.

[In] Int[Cos[x]^5/(a + b\*Cos[x]^2), x]

[Out] (a^2\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]])/(b^(5/2)\*Sqrt[a + b]) - ((a - b)\*Sin[x])/b^2 - Sin[x]^3/(3\*b)

#### Rule 3186

Int[sin[(e\_.) + (f\_.)\*(x\_)^(m\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)^2])^(p\_.), x\_Symbol] := With[{ff = FreeFactors[Cos[e + f\*x], x]}, -Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b - b\*ff^2\*x^2)^p, x], x, Cos[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 390

Int[((a\_) + (b\_.)\*(x\_)^(n\_))^(p\_)\*((c\_) + (d\_.)\*(x\_)^(n\_))^(q\_), x\_Symbol] := Int[PolynomialDivide[(a + b\*x^n)^p, (c + d\*x^n)^(-q), x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0] && IGtQ[n, 0] && IGtQ[p, 0] && ILtQ[q, 0] && GeQ[p, -q]

#### Rule 208

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(Rt[-(a/b), 2]\*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]

#### Rubi steps

$$\begin{aligned}
\int \frac{\cos^5(x)}{a + b \cos^2(x)} dx &= \text{Subst} \left( \int \frac{(1-x^2)^2}{a+b-bx^2} dx, x, \sin(x) \right) \\
&= \text{Subst} \left( \int \left( -\frac{a-b}{b^2} - \frac{x^2}{b} + \frac{a^2}{b^2(a+b-bx^2)} \right) dx, x, \sin(x) \right) \\
&= -\frac{(a-b)\sin(x)}{b^2} - \frac{\sin^3(x)}{3b} + \frac{a^2 \text{Subst} \left( \int \frac{1}{a+b-bx^2} dx, x, \sin(x) \right)}{b^2} \\
&= \frac{a^2 \tanh^{-1} \left( \frac{\sqrt{b}\sin(x)}{\sqrt{a+b}} \right)}{b^{5/2}\sqrt{a+b}} - \frac{(a-b)\sin(x)}{b^2} - \frac{\sin^3(x)}{3b}
\end{aligned}$$

**Mathematica [A]** time = 0.184982, size = 86, normalized size = 1.54

$$\frac{6a^2(\log(\sqrt{a+b}+\sqrt{b}\sin(x))-\log(\sqrt{a+b}-\sqrt{b}\sin(x)))}{\sqrt{a+b}} + 3\sqrt{b}(3b-4a)\sin(x) + b^{3/2}\sin(3x)$$


---


$$12b^{5/2}$$

Antiderivative was successfully verified.

[In] Integrate[Cos[x]^5/(a + b\*Cos[x]^2), x]

[Out] ((6\*a^2\*(-Log[Sqrt[a + b] - Sqrt[b]\*Sin[x]] + Log[Sqrt[a + b] + Sqrt[b]\*Sin[x]]))/Sqrt[a + b] + 3\*Sqrt[b]\*(-4\*a + 3\*b)\*Sin[x] + b^(3/2)\*Sin[3\*x])/(12\*b^(5/2))

**Maple [A]** time = 0.015, size = 50, normalized size = 0.9

$$-\frac{1}{b^2} \left( \frac{(\sin(x))^3 b}{3} + \sin(x) a - \sin(x) b \right) + \frac{a^2}{b^2} \text{Artanh} \left( \sin(x) b \frac{1}{\sqrt{(a+b)b}} \right) \frac{1}{\sqrt{(a+b)b}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(cos(x)^5/(a+b\*cos(x)^2), x)

[Out] -1/b^2\*(1/3\*sin(x)^3\*b+sin(x)\*a-sin(x)\*b)+a^2/b^2/((a+b)\*b)^(1/2)\*arctanh(b\*sin(x)/((a+b)\*b)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^5/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError



**Fricas [A]** time = 1.87134, size = 441, normalized size = 7.88

$$\left[ \frac{3\sqrt{ab+b^2}a^2 \log\left(-\frac{b\cos(x)^2-2\sqrt{ab+b^2}\sin(x)-a-2b}{b\cos(x)^2+a}\right) - 2(3a^2b+ab^2-2b^3-(ab^2+b^3)\cos(x)^2)\sin(x) - 3\sqrt{-ab-b^2}a^2}{6(ab^3+b^4)}, \dots \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^5/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/6\*(3\*sqrt(a\*b + b^2)\*a^2\*log(-(b\*cos(x)^2 - 2\*sqrt(a\*b + b^2)\*sin(x) - a - 2\*b)/(b\*cos(x)^2 + a)) - 2\*(3\*a^2\*b + a\*b^2 - 2\*b^3 - (a\*b^2 + b^3)\*cos(x)^2)\*sin(x))/(a\*b^3 + b^4), -1/3\*(3\*sqrt(-a\*b - b^2)\*a^2\*arctan(sqrt(-a\*b - b^2)\*sin(x)/(a + b)) + (3\*a^2\*b + a\*b^2 - 2\*b^3 - (a\*b^2 + b^3)\*cos(x)^2)\*sin(x))/(a\*b^3 + b^4)]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)\*\*5/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

**Giac [A]** time = 1.16901, size = 88, normalized size = 1.57

$$-\frac{a^2 \arctan\left(\frac{b\sin(x)}{\sqrt{-ab-b^2}}\right)}{\sqrt{-ab-b^2}b^2} - \frac{b^2 \sin(x)^3 + 3ab \sin(x) - 3b^2 \sin(x)}{3b^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^5/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] -a^2\*arctan(b\*sin(x)/sqrt(-a\*b - b^2))/(sqrt(-a\*b - b^2)\*b^2) - 1/3\*(b^2\*sin(x)^3 + 3\*a\*b\*sin(x) - 3\*b^2\*sin(x))/b^3

$$3.30 \quad \int \frac{\cos^3(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=38

$$\frac{\sin(x)}{b} - \frac{a \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{b^{3/2} \sqrt{a+b}}$$

[Out]  $-\left(\frac{a \operatorname{ArcTanh}\left[\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right]}{b^{3/2} \sqrt{a+b}}\right) + \frac{\sin(x)}{b}$

**Rubi [A]** time = 0.0550803, antiderivative size = 38, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3186, 388, 208}

$$\frac{\sin(x)}{b} - \frac{a \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{b^{3/2} \sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] `Int[Cos[x]^3/(a + b*Cos[x]^2), x]`

[Out]  $-\left(\frac{a \operatorname{ArcTanh}\left[\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right]}{b^{3/2} \sqrt{a+b}}\right) + \frac{\sin(x)}{b}$

#### Rule 3186

`Int[sin[(e_.) + (f_.)*(x_)]^(m_.)*((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^2)^(p_.), x_Symbol] :> With[{ff = FreeFactors[Cos[e + f*x], x]}, -Dist[ff/f, Subst[Int[(1 - ff^2*x^2)^((m - 1)/2)*(a + b - b*ff^2*x^2)^p, x], x, Cos[e + f*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]`

#### Rule 388

`Int[((a_) + (b_.)*(x_)^(n_))^(p_)*((c_) + (d_.)*(x_)^(n_)), x_Symbol] :> Simp[(d*x*(a + b*x^n)^(p + 1))/(b*(n*(p + 1) + 1)), x] - Dist[(a*d - b*c*(n*(p + 1) + 1))/(b*(n*(p + 1) + 1)), Int[(a + b*x^n)^p, x], x] /; FreeQ[{a, b, c, d, n}, x] && NeQ[b*c - a*d, 0] && NeQ[n*(p + 1) + 1, 0]`

#### Rule 208

`Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(Rt[-(a/b), 2]*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]`

#### Rubi steps

$$\begin{aligned} \int \frac{\cos^3(x)}{a+b \cos^2(x)} dx &= \text{Subst} \left( \int \frac{1-x^2}{a+b-bx^2} dx, x, \sin(x) \right) \\ &= \frac{\sin(x)}{b} - \frac{a \text{Subst} \left( \int \frac{1}{a+b-bx^2} dx, x, \sin(x) \right)}{b} \\ &= -\frac{a \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{b^{3/2} \sqrt{a+b}} + \frac{\sin(x)}{b} \end{aligned}$$

**Mathematica [A]** time = 0.0294949, size = 38, normalized size = 1.

$$\frac{\sin(x)}{b} - \frac{a \tanh^{-1}\left(\frac{\sqrt{b}\sin(x)}{\sqrt{a+b}}\right)}{b^{3/2}\sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] Integrate[Cos[x]^3/(a + b\*Cos[x]^2), x]

[Out] -((a\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]])/(b^(3/2)\*Sqrt[a + b])) + Sin[x]/b

**Maple [A]** time = 0.013, size = 33, normalized size = 0.9

$$\frac{\sin(x)}{b} - \frac{a}{b} \operatorname{Arctanh}\left(\sin(x) b \frac{1}{\sqrt{(a+b)b}}\right) \frac{1}{\sqrt{(a+b)b}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(cos(x)^3/(a+b\*cos(x)^2), x)

[Out] sin(x)/b-1/b\*a/((a+b)\*b)^(1/2)\*arctanh(b\*sin(x)/((a+b)\*b)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^3/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.87761, size = 319, normalized size = 8.39

$$\left[ \frac{\sqrt{ab + b^2} a \log\left(-\frac{b \cos(x)^2 + 2\sqrt{ab+b^2}\sin(x) - a - 2b}{b \cos(x)^2 + a}\right) + 2(ab + b^2) \sin(x) \sqrt{-ab - b^2} a \arctan\left(\frac{\sqrt{-ab - b^2}\sin(x)}{a+b}\right) + (ab + b^2) \sin(x)}{2(ab^2 + b^3)}, \frac{\sqrt{-ab - b^2} a \arctan\left(\frac{\sqrt{-ab - b^2}\sin(x)}{a+b}\right) + (ab + b^2) \sin(x)}{ab^2 + b^3} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^3/(a+b\*cos(x)^2), x, algorithm="fricas")

[Out] [1/2\*(sqrt(a\*b + b^2)\*a\*log(-(b\*cos(x)^2 + 2\*sqrt(a\*b + b^2)\*sin(x) - a - 2\*b)/(b\*cos(x)^2 + a)) + 2\*(a\*b + b^2)\*sin(x))/(a\*b^2 + b^3), (sqrt(-a\*b - b^2)\*a\*arctan(sqrt(-a\*b - b^2)\*sin(x)/(a + b)) + (a\*b + b^2)\*sin(x))/(a\*b^2 + b^3)]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)\*\*3/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

**Giac [A]** time = 1.15699, size = 55, normalized size = 1.45

$$\frac{a \arctan\left(\frac{b \sin(x)}{\sqrt{-ab-b^2}}\right)}{\sqrt{-ab-b^2}b} + \frac{\sin(x)}{b}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^3/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] a\*arctan(b\*sin(x)/sqrt(-a\*b - b^2))/(sqrt(-a\*b - b^2)\*b) + sin(x)/b

$$3.31 \quad \int \frac{\cos(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=29

$$\frac{\tanh^{-1}\left(\frac{\sqrt{b}\sin(x)}{\sqrt{a+b}}\right)}{\sqrt{b}\sqrt{a+b}}$$

[Out] ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]]/(Sqrt[b]\*Sqrt[a + b])

**Rubi [A]** time = 0.030828, antiderivative size = 29, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 13,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.154$ , Rules used = {3186, 208}

$$\frac{\tanh^{-1}\left(\frac{\sqrt{b}\sin(x)}{\sqrt{a+b}}\right)}{\sqrt{b}\sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] Int[Cos[x]/(a + b\*Cos[x]^2), x]

[Out] ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]]/(Sqrt[b]\*Sqrt[a + b])

#### Rule 3186

Int[sin[(e\_.) + (f\_.)\*(x\_.)]^(m\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^(p\_.), x\_Symbol] :> With[{ff = FreeFactors[Cos[e + f\*x], x]}, -Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b - b\*ff^2\*x^2)^p, x], x, Cos[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 208

Int[((a\_.) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[-(a/b), 2]\*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]

#### Rubi steps

$$\begin{aligned} \int \frac{\cos(x)}{a+b \cos^2(x)} dx &= \text{Subst}\left(\int \frac{1}{a+b-bx^2} dx, x, \sin(x)\right) \\ &= \frac{\tanh^{-1}\left(\frac{\sqrt{b}\sin(x)}{\sqrt{a+b}}\right)}{\sqrt{b}\sqrt{a+b}} \end{aligned}$$

**Mathematica [A]** time = 0.0112525, size = 29, normalized size = 1.

$$\frac{\tanh^{-1}\left(\frac{\sqrt{b}\sin(x)}{\sqrt{a+b}}\right)}{\sqrt{b}\sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] Integrate[Cos[x]/(a + b\*Cos[x]^2), x]

[Out] ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]]/(Sqrt[b]\*Sqrt[a + b])

**Maple [A]** time = 0.011, size = 21, normalized size = 0.7

$$\operatorname{Artanh}\left(\sin(x)b\frac{1}{\sqrt{(a+b)b}}\right)\frac{1}{\sqrt{(a+b)b}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(cos(x)/(a+b\*cos(x)^2),x)

[Out] 1/((a+b)\*b)^(1/2)\*arctanh(b\*sin(x)/((a+b)\*b)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)/(a+b\*cos(x)^2),x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 1.78319, size = 228, normalized size = 7.86

$$\left[ \frac{\log\left(\frac{b\cos(x)^2 - 2\sqrt{ab+b^2}\sin(x) - a - 2b}{b\cos(x)^2 + a}\right)}{2\sqrt{ab+b^2}}, -\frac{\sqrt{-ab-b^2}\arctan\left(\frac{\sqrt{-ab-b^2}\sin(x)}{a+b}\right)}{ab+b^2} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/2\*log(-(b\*cos(x)^2 - 2\*sqrt(a\*b + b^2)\*sin(x) - a - 2\*b)/(b\*cos(x)^2 + a))/sqrt(a\*b + b^2), -sqrt(-a\*b - b^2)\*arctan(sqrt(-a\*b - b^2)\*sin(x)/(a + b))/((a\*b + b^2))]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

**Giac [A]** time = 1.12551, size = 42, normalized size = 1.45

$$-\frac{\arctan\left(\frac{b\sin(x)}{\sqrt{-ab-b^2}}\right)}{\sqrt{-ab-b^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(cos(x)/(a+b*cos(x)^2),x, algorithm="giac")
```

```
[Out] -arctan(b*sin(x)/sqrt(-a*b - b^2))/sqrt(-a*b - b^2)
```

### 3.32 $\int \frac{\sec(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=41

$$\frac{\tanh^{-1}(\sin(x))}{a} - \frac{\sqrt{b} \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{a\sqrt{a+b}}$$

[Out] ArcTanh[Sin[x]]/a - (Sqrt[b]\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]])/(a\*Sqrt[a + b])

**Rubi [A]** time = 0.0524032, antiderivative size = 41, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 13,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.308$ , Rules used = {3186, 391, 206, 208}

$$\frac{\tanh^{-1}(\sin(x))}{a} - \frac{\sqrt{b} \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{a\sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] Int[Sec[x]/(a + b\*Cos[x]^2), x]

[Out] ArcTanh[Sin[x]]/a - (Sqrt[b]\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]])/(a\*Sqrt[a + b])

#### Rule 3186

```
Int[sin[(e_.) + (f_.)*(x_)]^(m_.)*((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^2)^(p_.), x_Symbol] :> With[{ff = FreeFactors[Cos[e + f*x], x]}, -Dist[ff/f, Subst[Int[(1 - ff^2*x^2)^((m - 1)/2)*(a + b - b*ff^2*x^2)^p, x], x, Cos[e + f*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]
```

#### Rule 391

```
Int[1/(((a_) + (b_.)*(x_)^(n_))*((c_) + (d_.)*(x_)^(n_))), x_Symbol] :> Dist[b/(b*c - a*d), Int[1/(a + b*x^n), x], x] - Dist[d/(b*c - a*d), Int[1/(c + d*x^n), x], x] /; FreeQ[{a, b, c, d, n}, x] && NeQ[b*c - a*d, 0]
```

#### Rule 206

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(1*ArcTanh[(Rt[-b, 2]*x)/Rt[a, 2]])/(Rt[a, 2]*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (GtQ[a, 0] || LtQ[b, 0])
```

#### Rule 208

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(Rt[-(a/b), 2]*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]
```

#### Rubi steps



$$\begin{aligned} \int \frac{\sec(x)}{a + b \cos^2(x)} dx &= \text{Subst} \left( \int \frac{1}{(1-x^2)(a+b-bx^2)} dx, x, \sin(x) \right) \\ &= \frac{\text{Subst} \left( \int \frac{1}{1-x^2} dx, x, \sin(x) \right)}{a} - \frac{b \text{Subst} \left( \int \frac{1}{a+b-bx^2} dx, x, \sin(x) \right)}{a} \\ &= \frac{\tanh^{-1}(\sin(x))}{a} - \frac{\sqrt{b} \tanh^{-1} \left( \frac{\sqrt{b} \sin(x)}{\sqrt{a+b}} \right)}{a\sqrt{a+b}} \end{aligned}$$

**Mathematica [A]** time = 0.0556557, size = 38, normalized size = 0.93

$$\frac{\tanh^{-1}(\sin(x)) - \frac{\sqrt{b} \tanh^{-1} \left( \frac{\sqrt{b} \sin(x)}{\sqrt{a+b}} \right)}{\sqrt{a+b}}}{a}$$

Antiderivative was successfully verified.

[In] Integrate[Sec[x]/(a + b\*Cos[x]^2), x]

[Out] (ArcTanh[Sin[x]] - (Sqrt[b]\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]])/Sqrt[a + b])/a

**Maple [A]** time = 0.028, size = 47, normalized size = 1.2

$$\frac{\ln(\sin(x) + 1)}{2a} - \frac{b}{a} \text{Arctanh} \left( \sin(x) b \frac{1}{\sqrt{(a+b)b}} \right) \frac{1}{\sqrt{(a+b)b}} - \frac{\ln(\sin(x) - 1)}{2a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sec(x)/(a+b\*cos(x)^2), x)

[Out] 1/2/a\*ln(sin(x)+1)-b/a/((a+b)\*b)^(1/2)\*arctanh(b\*sin(x)/((a+b)\*b)^(1/2))-1/2/a\*ln(sin(x)-1)

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.87842, size = 329, normalized size = 8.02

$$\left[ \frac{\sqrt{\frac{b}{a+b}} \log \left( -\frac{b \cos(x)^2 + 2(a+b)\sqrt{\frac{b}{a+b}} \sin(x) - a - 2b}{b \cos(x)^2 + a} \right) + \log(\sin(x) + 1) - \log(-\sin(x) + 1)}{2a}, \frac{2\sqrt{-\frac{b}{a+b}} \arctan \left( \sqrt{-\frac{b}{a+b}} \sin(x) \right)}{2a} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/2\*(sqrt(b/(a + b))\*log(-(b\*cos(x)^2 + 2\*(a + b)\*sqrt(b/(a + b))\*sin(x) - a - 2\*b)/(b\*cos(x)^2 + a)) + log(sin(x) + 1) - log(-sin(x) + 1))/a, 1/2\*(2\*sqrt(-b/(a + b))\*arctan(sqrt(-b/(a + b))\*sin(x)) + log(sin(x) + 1) - log(-sin(x) + 1))/a]

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\sec(x)}{a + b \cos^2(x)} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)/(a+b\*cos(x)\*\*2),x)

[Out] Integral(sec(x)/(a + b\*cos(x)\*\*2), x)

**Giac [A]** time = 1.18786, size = 77, normalized size = 1.88

$$\frac{b \arctan\left(\frac{b \sin(x)}{\sqrt{-ab-b^2}}\right)}{\sqrt{-ab-b^2}a} + \frac{\log(\sin(x) + 1)}{2a} - \frac{\log(-\sin(x) + 1)}{2a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] b\*arctan(b\*sin(x)/sqrt(-a\*b - b^2))/(sqrt(-a\*b - b^2)\*a) + 1/2\*log(sin(x) + 1)/a - 1/2\*log(-sin(x) + 1)/a

$$3.33 \quad \int \frac{\sec^3(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=59

$$\frac{b^{3/2} \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{a^2 \sqrt{a+b}} + \frac{(a-2b) \tanh^{-1}(\sin(x))}{2a^2} + \frac{\tan(x) \sec(x)}{2a}$$

[Out] ((a - 2\*b)\*ArcTanh[Sin[x]])/(2\*a^2) + (b^(3/2)\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]])/(a^2\*Sqrt[a + b]) + (Sec[x]\*Tan[x])/(2\*a)

**Rubi [A]** time = 0.0981543, antiderivative size = 59, normalized size of antiderivative = 1., number of steps used = 5, number of rules used = 5, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3186, 414, 522, 206, 208}

$$\frac{b^{3/2} \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{a^2 \sqrt{a+b}} + \frac{(a-2b) \tanh^{-1}(\sin(x))}{2a^2} + \frac{\tan(x) \sec(x)}{2a}$$

Antiderivative was successfully verified.

[In] Int[Sec[x]^3/(a + b\*Cos[x]^2), x]

[Out] ((a - 2\*b)\*ArcTanh[Sin[x]])/(2\*a^2) + (b^(3/2)\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]])/(a^2\*Sqrt[a + b]) + (Sec[x]\*Tan[x])/(2\*a)

#### Rule 3186

Int[sin[(e\_.) + (f\_.)\*(x\_.)]^(m\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^(p\_.), x\_Symbol] := With[{ff = FreeFactors[Cos[e + f\*x], x]}, -Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b - b\*ff^2\*x^2)^p, x], x, Cos[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 414

Int[((a\_.) + (b\_.)\*(x\_)^(n\_))^(p\_)\*((c\_.) + (d\_.)\*(x\_)^(n\_))^(q\_), x\_Symbol] := -Simp[(b\*x\*(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^(q + 1))/(a\*n\*(p + 1)\*(b\*c - a\*d)), x] + Dist[1/(a\*n\*(p + 1)\*(b\*c - a\*d)), Int[(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^q\*Simp[b\*c + n\*(p + 1)\*(b\*c - a\*d) + d\*b\*(n\*(p + q + 2) + 1)\*x^n, x], x] /; FreeQ[{a, b, c, d, n, q}, x] && NeQ[b\*c - a\*d, 0] && LtQ[p, -1] && !(IntegerQ[p] && IntegerQ[q] && LtQ[q, -1]) && IntBinomialQ[a, b, c, d, n, p, q, x]

#### Rule 522

Int[((e\_.) + (f\_.)\*(x\_)^(n\_))/((a\_.) + (b\_.)\*(x\_)^(n\_))\*((c\_.) + (d\_.)\*(x\_)^(n\_)), x\_Symbol] := Dist[(b\*e - a\*f)/(b\*c - a\*d), Int[1/(a + b\*x^n), x], x] - Dist[(d\*e - c\*f)/(b\*c - a\*d), Int[1/(c + d\*x^n), x], x] /; FreeQ[{a, b, c, d, e, f, n}, x]

#### Rule 206

Int[((a\_.) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(1\*ArcTanh[(Rt[-b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (GtQ[a, 0] || LtQ[b, 0])

**Rule 208**

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[-(a/b), 2]*ArcTanh[x/
Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]
```

**Rubi steps**

$$\begin{aligned} \int \frac{\sec^3(x)}{a + b \cos^2(x)} dx &= \text{Subst} \left( \int \frac{1}{(1-x^2)^2 (a+b-bx^2)} dx, x, \sin(x) \right) \\ &= \frac{\sec(x) \tan(x)}{2a} + \frac{\text{Subst} \left( \int \frac{a-b-bx^2}{(1-x^2)(a+b-bx^2)} dx, x, \sin(x) \right)}{2a} \\ &= \frac{\sec(x) \tan(x)}{2a} + \frac{(a-2b) \text{Subst} \left( \int \frac{1}{1-x^2} dx, x, \sin(x) \right)}{2a^2} + \frac{b^2 \text{Subst} \left( \int \frac{1}{a+b-bx^2} dx, x, \sin(x) \right)}{a^2} \\ &= \frac{(a-2b) \tanh^{-1}(\sin(x))}{2a^2} + \frac{b^{3/2} \tanh^{-1} \left( \frac{\sqrt{b} \sin(x)}{\sqrt{a+b}} \right)}{a^2 \sqrt{a+b}} + \frac{\sec(x) \tan(x)}{2a} \end{aligned}$$

**Mathematica [B]** time = 0.36146, size = 152, normalized size = 2.58

$$\frac{-\frac{2b^{3/2} \log(\sqrt{a+b}-\sqrt{b} \sin(x))}{\sqrt{a+b}} + \frac{2b^{3/2} \log(\sqrt{a+b}+\sqrt{b} \sin(x))}{\sqrt{a+b}}}{4a^2} - 2(a-2b) \log\left(\cos\left(\frac{x}{2}\right) - \sin\left(\frac{x}{2}\right)\right) + 2(a-2b) \log\left(\sin\left(\frac{x}{2}\right) + \cos\left(\frac{x}{2}\right)\right) + \dots$$

Antiderivative was successfully verified.

```
[In] Integrate[Sec[x]^3/(a + b*cos[x]^2), x]
```

```
[Out] (-2*(a - 2*b)*Log[Cos[x/2] - Sin[x/2]] + 2*(a - 2*b)*Log[Cos[x/2] + Sin[x/2]] - (2*b^(3/2)*Log[Sqrt[a + b] - Sqrt[b]*Sin[x]])/Sqrt[a + b] + (2*b^(3/2)*Log[Sqrt[a + b] + Sqrt[b]*Sin[x]])/Sqrt[a + b] + a/(Cos[x/2] - Sin[x/2])^2 - a/(Cos[x/2] + Sin[x/2])^2)/(4*a^2)
```

**Maple [A]** time = 0.039, size = 92, normalized size = 1.6

$$-\frac{1}{4a(\sin(x)+1)} + \frac{\ln(\sin(x)+1)}{4a} - \frac{\ln(\sin(x)+1)b}{2a^2} + \frac{b^2}{a^2} \text{Artanh}\left(\sin(x)b \frac{1}{\sqrt{(a+b)b}}\right) \frac{1}{\sqrt{(a+b)b}} - \frac{1}{4a(\sin(x)-1)}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] int(sec(x)^3/(a+b*cos(x)^2), x)
```

```
[Out] -1/4/a/(sin(x)+1)+1/4/a*ln(sin(x)+1)-1/2/a^2*ln(sin(x)+1)*b+b^2/a^2/((a+b)*b)^(1/2)*arctanh(b*sin(x)/((a+b)*b)^(1/2))-1/4/a/(sin(x)-1)-1/4/a*ln(sin(x)-1)+1/2/a^2*ln(sin(x)-1)*b
```

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(sec(x)^3/(a+b*cos(x)^2),x, algorithm="maxima")
```

```
[Out] Exception raised: ValueError
```

**Fricas [A]** time = 1.99673, size = 536, normalized size = 9.08

$$\frac{2b\sqrt{\frac{b}{a+b}}\cos(x)^2\log\left(-\frac{b\cos(x)^2-2(a+b)\sqrt{\frac{b}{a+b}}\sin(x)-a-2b}{b\cos(x)^2+a}\right)+(a-2b)\cos(x)^2\log(\sin(x)+1)-(a-2b)\cos(x)^2\log(-\sin(x)+1)}{4a^2\cos(x)^2}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(sec(x)^3/(a+b*cos(x)^2),x, algorithm="fricas")
```

```
[Out] [1/4*(2*b*sqrt(b/(a + b))*cos(x)^2*log(-(b*cos(x)^2 - 2*(a + b)*sqrt(b/(a + b))*sin(x) - a - 2*b)/(b*cos(x)^2 + a)) + (a - 2*b)*cos(x)^2*log(sin(x) + 1) - (a - 2*b)*cos(x)^2*log(-sin(x) + 1) + 2*a*sin(x))/(a^2*cos(x)^2), -1/4*(4*b*sqrt(-b/(a + b))*arctan(sqrt(-b/(a + b))*sin(x))*cos(x)^2 - (a - 2*b)*cos(x)^2*log(sin(x) + 1) + (a - 2*b)*cos(x)^2*log(-sin(x) + 1) - 2*a*sin(x))/(a^2*cos(x)^2)]
```

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\sec^3(x)}{a + b \cos^2(x)} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(sec(x)**3/(a+b*cos(x)**2),x)
```

```
[Out] Integral(sec(x)**3/(a + b*cos(x)**2), x)
```

**Giac [A]** time = 1.22048, size = 115, normalized size = 1.95

$$-\frac{b^2 \arctan\left(\frac{b \sin(x)}{\sqrt{-ab-b^2}}\right)}{\sqrt{-ab-b^2}a^2} + \frac{(a-2b)\log(\sin(x)+1)}{4a^2} - \frac{(a-2b)\log(-\sin(x)+1)}{4a^2} - \frac{\sin(x)}{2(\sin(x)^2-1)a}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(sec(x)^3/(a+b*cos(x)^2),x, algorithm="giac")
```

```
[Out] -b^2*arctan(b*sin(x)/sqrt(-a*b - b^2))/(sqrt(-a*b - b^2)*a^2) + 1/4*(a - 2*b)*log(sin(x) + 1)/a^2 - 1/4*(a - 2*b)*log(-sin(x) + 1)/a^2 - 1/2*sin(x)/((sin(x)^2 - 1)*a)
```

### 3.34 $\int \frac{\sec^5(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=90

$$\frac{(3a^2 - 4ab + 8b^2) \tanh^{-1}(\sin(x))}{8a^3} - \frac{b^{5/2} \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{a^3 \sqrt{a+b}} + \frac{(3a - 4b) \tan(x) \sec(x)}{8a^2} + \frac{\tan(x) \sec^3(x)}{4a}$$

[Out] ((3\*a^2 - 4\*a\*b + 8\*b^2)\*ArcTanh[Sin[x]])/(8\*a^3) - (b^(5/2)\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]])/(a^3\*Sqrt[a + b]) + ((3\*a - 4\*b)\*Sec[x]\*Tan[x])/(8\*a^2) + (Sec[x]^3\*Tan[x])/(4\*a)

**Rubi [A]** time = 0.165703, antiderivative size = 90, normalized size of antiderivative = 1., number of steps used = 6, number of rules used = 6, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.4$ , Rules used = {3186, 414, 527, 522, 206, 208}

$$\frac{(3a^2 - 4ab + 8b^2) \tanh^{-1}(\sin(x))}{8a^3} - \frac{b^{5/2} \tanh^{-1}\left(\frac{\sqrt{b} \sin(x)}{\sqrt{a+b}}\right)}{a^3 \sqrt{a+b}} + \frac{(3a - 4b) \tan(x) \sec(x)}{8a^2} + \frac{\tan(x) \sec^3(x)}{4a}$$

Antiderivative was successfully verified.

[In] Int[Sec[x]^5/(a + b\*Cos[x]^2), x]

[Out] ((3\*a^2 - 4\*a\*b + 8\*b^2)\*ArcTanh[Sin[x]])/(8\*a^3) - (b^(5/2)\*ArcTanh[(Sqrt[b]\*Sin[x])/Sqrt[a + b]])/(a^3\*Sqrt[a + b]) + ((3\*a - 4\*b)\*Sec[x]\*Tan[x])/(8\*a^2) + (Sec[x]^3\*Tan[x])/(4\*a)

#### Rule 3186

Int[sin[(e\_.) + (f\_.)\*(x\_.)]^(m\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^(p\_.), x\_Symbol] :> With[{ff = FreeFactors[Cos[e + f\*x], x]}, -Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b - b\*ff^2\*x^2)^p, x], x, Cos[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 414

Int[((a\_.) + (b\_.)\*(x\_.)^(n\_.))^(p\_.)\*((c\_.) + (d\_.)\*(x\_.)^(n\_.))^(q\_.), x\_Symbol] :> -Simp[(b\*x\*(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^(q + 1))/(a\*n\*(p + 1)\*(b\*c - a\*d)), x] + Dist[1/(a\*n\*(p + 1)\*(b\*c - a\*d)), Int[(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^q\*Simp[b\*c + n\*(p + 1)\*(b\*c - a\*d) + d\*b\*(n\*(p + q + 2) + 1)\*x^n, x], x] /; FreeQ[{a, b, c, d, n, q}, x] && NeQ[b\*c - a\*d, 0] && LtQ[p, -1] && !(IntegerQ[p] && IntegerQ[q] && LtQ[q, -1]) && IntBinomialQ[a, b, c, d, n, p, q, x]

#### Rule 527

Int[((a\_.) + (b\_.)\*(x\_.)^(n\_.))^(p\_.)\*((c\_.) + (d\_.)\*(x\_.)^(n\_.))^(q\_.)\*((e\_.) + (f\_.)\*(x\_.)^(n\_.)), x\_Symbol] :> -Simp[((b\*e - a\*f)\*x\*(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^(q + 1))/(a\*n\*(b\*c - a\*d)\*(p + 1)), x] + Dist[1/(a\*n\*(b\*c - a\*d)\*(p + 1)), Int[(a + b\*x^n)^(p + 1)\*(c + d\*x^n)^q\*Simp[c\*(b\*e - a\*f) + e\*n\*(b\*c - a\*d)\*(p + 1) + d\*(b\*e - a\*f)\*(n\*(p + q + 2) + 1)\*x^n, x], x] /; FreeQ[{a, b, c, d, e, f, n, q}, x] && LtQ[p, -1]

#### Rule 522

```
Int[((e_) + (f_)*(x_)^(n_))/(((a_) + (b_)*(x_)^(n_))*((c_) + (d_)*(x_)^(n_))), x_Symbol] := Dist[(b*e - a*f)/(b*c - a*d), Int[1/(a + b*x^n), x], x] - Dist[(d*e - c*f)/(b*c - a*d), Int[1/(c + d*x^n), x], x] /; FreeQ[{a, b, c, d, e, f, n}, x]
```

**Rule 206**

```
Int[((a_) + (b_)*(x_)^2)^(-1), x_Symbol] := Simp[(1*ArcTanh[(Rt[-b, 2]*x)/Rt[a, 2]])/(Rt[a, 2]*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (GtQ[a, 0] || LtQ[b, 0])
```

**Rule 208**

```
Int[((a_) + (b_)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[-(a/b), 2]*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]
```

**Rubi steps**

$$\begin{aligned} \int \frac{\sec^5(x)}{a + b \cos^2(x)} dx &= \text{Subst} \left( \int \frac{1}{(1-x^2)^3 (a+b-bx^2)} dx, x, \sin(x) \right) \\ &= \frac{\sec^3(x) \tan(x)}{4a} + \frac{\text{Subst} \left( \int \frac{3a-b-3bx^2}{(1-x^2)^2 (a+b-bx^2)} dx, x, \sin(x) \right)}{4a} \\ &= \frac{(3a-4b) \sec(x) \tan(x)}{8a^2} + \frac{\sec^3(x) \tan(x)}{4a} + \frac{\text{Subst} \left( \int \frac{3a^2-ab+4b^2-(3a-4b)bx^2}{(1-x^2)(a+b-bx^2)} dx, x, \sin(x) \right)}{8a^2} \\ &= \frac{(3a-4b) \sec(x) \tan(x)}{8a^2} + \frac{\sec^3(x) \tan(x)}{4a} - \frac{b^3 \text{Subst} \left( \int \frac{1}{a+b-bx^2} dx, x, \sin(x) \right)}{a^3} + \frac{(3a^2-4ab+8b^2) \tanh^{-1}(\sin(x))}{8a^3} \\ &= \frac{(3a^2-4ab+8b^2) \tanh^{-1}(\sin(x))}{8a^3} - \frac{b^{5/2} \tanh^{-1} \left( \frac{\sqrt{b} \sin(x)}{\sqrt{a+b}} \right)}{a^3 \sqrt{a+b}} + \frac{(3a-4b) \sec(x) \tan(x)}{8a^2} + \frac{\sec^3(x)}{4a} \end{aligned}$$

**Mathematica [B]** time = 1.09786, size = 215, normalized size = 2.39

$$\frac{-2(3a^2 - 4ab + 8b^2) \log\left(\cos\left(\frac{x}{2}\right) - \sin\left(\frac{x}{2}\right)\right) + 2(3a^2 - 4ab + 8b^2) \log\left(\sin\left(\frac{x}{2}\right) + \cos\left(\frac{x}{2}\right)\right) + \frac{a^2}{\left(\cos\left(\frac{x}{2}\right) - \sin\left(\frac{x}{2}\right)\right)^4} - \frac{a^2}{\left(\sin\left(\frac{x}{2}\right) + \cos\left(\frac{x}{2}\right)\right)^4}}{16a^3}$$

Antiderivative was successfully verified.

```
[In] Integrate[Sec[x]^5/(a + b*Cos[x]^2), x]
```

```
[Out] (-2*(3*a^2 - 4*a*b + 8*b^2)*Log[Cos[x/2] - Sin[x/2]] + 2*(3*a^2 - 4*a*b + 8*b^2)*Log[Cos[x/2] + Sin[x/2]] + (8*b^(5/2)*Log[Sqrt[a + b] - Sqrt[b]*Sin[x]])/Sqrt[a + b] - (8*b^(5/2)*Log[Sqrt[a + b] + Sqrt[b]*Sin[x]])/Sqrt[a + b] + a^2/(Cos[x/2] - Sin[x/2])^4 - a^2/(Cos[x/2] + Sin[x/2])^4 + (a*(-3*a + 4*b))/(Cos[x/2] + Sin[x/2])^2 + (a*(-3*a + 4*b))/(-1 + Sin[x])/(16*a^3)
```

**Maple [B]** time = 0.042, size = 165, normalized size = 1.8

$$-\frac{1}{16a(\sin(x)+1)^2} - \frac{3}{16a(\sin(x)+1)} + \frac{b}{4a^2(\sin(x)+1)} + \frac{3 \ln(\sin(x)+1)}{16a} - \frac{\ln(\sin(x)+1)b}{4a^2} + \frac{\ln(\sin(x)+1)b}{2a^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(sec(x)^5/(a+b*cos(x)^2),x)`

[Out] 
$$-1/16/a/(\sin(x)+1)^2-3/16/a/(\sin(x)+1)+1/4/a^2/(\sin(x)+1)*b+3/16/a*\ln(\sin(x)+1)-1/4/a^2*\ln(\sin(x)+1)*b+1/2/a^3*\ln(\sin(x)+1)*b^2-b^3/a^3/((a+b)*b)^{(1/2)}*\operatorname{arctanh}(b*\sin(x)/((a+b)*b)^{(1/2)})+1/16/a/(\sin(x)-1)^2-3/16/a/(\sin(x)-1)+1/4/a^2/(\sin(x)-1)*b-3/16/a*\ln(\sin(x)-1)+1/4/a^2*\ln(\sin(x)-1)*b-1/2/a^3*\ln(\sin(x)-1)*b^2$$

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sec(x)^5/(a+b*cos(x)^2),x, algorithm="maxima")`

[Out] Exception raised: ValueError

**Fricas [A]** time = 2.1347, size = 709, normalized size = 7.88

$$\frac{8b^2\sqrt{\frac{b}{a+b}}\cos(x)^4\log\left(-\frac{b\cos(x)^2+2(a+b)\sqrt{\frac{b}{a+b}}\sin(x)-a-2b}{b\cos(x)^2+a}\right)+(3a^2-4ab+8b^2)\cos(x)^4\log(\sin(x)+1)-(3a^2-4ab+8b^2)\cos(x)^4\log(-\sin(x)+1)+2*((3a^2-4ab)\cos(x)^2+2a^2)\sin(x)/(a^3\cos(x)^4)}{16a^3\cos(x)^4}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sec(x)^5/(a+b*cos(x)^2),x, algorithm="fricas")`

[Out] 
$$\left[ \frac{1}{16}*(8*b^2*\sqrt{b/(a+b)}*\cos(x)^4*\log(-(b*\cos(x)^2+2*(a+b)*\sqrt{b/(a+b)}*\sin(x)-a-2*b)/(b*\cos(x)^2+a))+(3*a^2-4*a*b+8*b^2)*\cos(x)^4*\log(\sin(x)+1)-(3*a^2-4*a*b+8*b^2)*\cos(x)^4*\log(-\sin(x)+1)+2*((3*a^2-4*a*b)*\cos(x)^2+2*a^2)*\sin(x)/(a^3*\cos(x)^4), \frac{1}{16}*(16*b^2*\sqrt{-b/(a+b)}*\arctan(\sqrt{-b/(a+b)}*\sin(x))*\cos(x)^4+(3*a^2-4*a*b+8*b^2)*\cos(x)^4*\log(\sin(x)+1)-(3*a^2-4*a*b+8*b^2)*\cos(x)^4*\log(-\sin(x)+1)+2*((3*a^2-4*a*b)*\cos(x)^2+2*a^2)*\sin(x)/(a^3*\cos(x)^4) \right]$$

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(sec(x)**5/(a+b*cos(x)**2),x)`

[Out] Timed out



**Giac [A]** time = 1.1724, size = 171, normalized size = 1.9

$$\frac{b^3 \arctan\left(\frac{b \sin(x)}{\sqrt{-ab-b^2}}\right)}{\sqrt{-ab-b^2}a^3} + \frac{(3a^2 - 4ab + 8b^2) \log(\sin(x) + 1)}{16a^3} - \frac{(3a^2 - 4ab + 8b^2) \log(-\sin(x) + 1)}{16a^3} - \frac{3a \sin(x)^3 - 4b \sin(x)^2}{((\sin(x)^2 - 1)^2 a^2)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)^5/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] b^3\*arctan(b\*sin(x)/sqrt(-a\*b - b^2))/(sqrt(-a\*b - b^2)\*a^3) + 1/16\*(3\*a^2 - 4\*a\*b + 8\*b^2)\*log(sin(x) + 1)/a^3 - 1/16\*(3\*a^2 - 4\*a\*b + 8\*b^2)\*log(-sin(x) + 1)/a^3 - 1/8\*(3\*a\*sin(x)^3 - 4\*b\*sin(x)^3 - 5\*a\*sin(x) + 4\*b\*sin(x))/((sin(x)^2 - 1)^2\*a^2)

### 3.35 $\int \frac{\cos^6(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=87

$$\frac{x(8a^2 - 4ab + 3b^2)}{8b^3} + \frac{a^{5/2} \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{b^3 \sqrt{a+b}} - \frac{(4a - 3b) \sin(x) \cos(x)}{8b^2} + \frac{\sin(x) \cos^3(x)}{4b}$$

[Out]  $((8*a^2 - 4*a*b + 3*b^2)*x)/(8*b^3) + (a^{(5/2)}*ArcTan[(Sqrt[a + b]*Cot[x])/Sqrt[a]])/(b^3*Sqrt[a + b]) - ((4*a - 3*b)*Cos[x]*Sin[x])/(8*b^2) + (Cos[x]^3*Sin[x])/(4*b)$

**Rubi [A]** time = 0.196291, antiderivative size = 87, normalized size of antiderivative = 1., number of steps used = 6, number of rules used = 6, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.4$ , Rules used = {3187, 470, 578, 522, 203, 205}

$$\frac{x(8a^2 - 4ab + 3b^2)}{8b^3} + \frac{a^{5/2} \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{b^3 \sqrt{a+b}} - \frac{(4a - 3b) \sin(x) \cos(x)}{8b^2} + \frac{\sin(x) \cos^3(x)}{4b}$$

Antiderivative was successfully verified.

[In]  $\text{Int}[\text{Cos}[x]^6/(a + b*\text{Cos}[x]^2), x]$

[Out]  $((8*a^2 - 4*a*b + 3*b^2)*x)/(8*b^3) + (a^{(5/2)}*ArcTan[(Sqrt[a + b]*Cot[x])/Sqrt[a]])/(b^3*Sqrt[a + b]) - ((4*a - 3*b)*Cos[x]*Sin[x])/(8*b^2) + (Cos[x]^3*Sin[x])/(4*b)$

#### Rule 3187

$\text{Int}[\sin[(e_.) + (f_.)*(x_.)]^{(m_.)}*((a_.) + (b_.)*\sin[(e_.) + (f_.)*(x_.)]^{(n_.)})^{(p_.)}, x\_Symbol] \rightarrow \text{With}[\{ff = \text{FreeFactors}[\text{Tan}[e + f*x], x]\}, \text{Dist}[ff^{(m+1)}/f, \text{Subst}[\text{Int}[(x^m*(a + (a+b)*ff^2*x^2)^p]/(1 + ff^2*x^2)^{(m/2+p+1)}], x], x, \text{Tan}[e + f*x]/ff], x] /; \text{FreeQ}\{a, b, e, f\}, x \&\& \text{IntegerQ}[m/2] \&\& \text{IntegerQ}[p]$

#### Rule 470

$\text{Int}[(e_.)*(x_.)^{(m_.)}*((a_.) + (b_.)*(x_.)^{(n_.)})^{(p_.)}*((c_.) + (d_.)*(x_.)^{(n_.)})^{(q_.)}, x\_Symbol] \rightarrow -\text{Simp}[(a*e^{(2*n-1)}*(e*x)^{(m-2*n+1)}*(a+b*x^n)^{(p+1)}*(c+d*x^n)^{(q+1)})/(b*n*(b*c-a*d)*(p+1)], x] + \text{Dist}[e^{(2*n)}/(b*n*(b*c-a*d)*(p+1)), \text{Int}[(e*x)^{(m-2*n)}*(a+b*x^n)^{(p+1)}*(c+d*x^n)^q*\text{Simp}[a*c*(m-2*n+1) + (a*d*(m-n+n*q+1) + b*c*n*(p+1))*x^n, x], x] /; \text{FreeQ}\{a, b, c, d, e, q\}, x \&\& \text{NeQ}[b*c-a*d, 0] \&\& \text{IGtQ}[n, 0] \&\& \text{LtQ}[p, -1] \&\& \text{GtQ}[m-n+1, n] \&\& \text{IntBinomialQ}[a, b, c, d, e, m, n, p, q, x]$

#### Rule 578

$\text{Int}[(g_.)*(x_.)^{(m_.)}*((a_.) + (b_.)*(x_.)^{(n_.)})^{(p_.)}*((c_.) + (d_.)*(x_.)^{(n_.)})^{(q_.)}*((e_.) + (f_.)*(x_.)^{(n_.)}), x\_Symbol] \rightarrow \text{Simp}[(g^{(n-1)}*(b*e-a*f)*(g*x)^{(m-n+1)}*(a+b*x^n)^{(p+1)}*(c+d*x^n)^{(q+1)})/(b*n*(b*c-a*d)*(p+1)], x] - \text{Dist}[g^n/(b*n*(b*c-a*d)*(p+1)), \text{Int}[(g*x)^{(m-n)}*(a+b*x^n)^{(p+1)}*(c+d*x^n)^q*\text{Simp}[c*(b*e-a*f)*(m-n+1) + (d*(b*e-a*f))*(m+n*q+1) - b*n*(c*f-d*e)*(p+1))*x^n, x], x] /; \text{FreeQ}\{a, b, c, d, e, f, g, q\}, x \&\& \text{IGtQ}[n, 0] \&\& \text{LtQ}[p, -1] \&\& \text{GtQ}[m-n+1, 0]$

Rule 522

Int[((e\_) + (f\_)\*(x\_)^(n\_))/(((a\_) + (b\_)\*(x\_)^(n\_))\*((c\_) + (d\_)\*(x\_)^(n\_))), x\_Symbol] := Dist[(b\*e - a\*f)/(b\*c - a\*d), Int[1/(a + b\*x^n), x], x] - Dist[(d\*e - c\*f)/(b\*c - a\*d), Int[1/(c + d\*x^n), x], x] /; FreeQ[{a, b, c, d, e, f, n}, x]

Rule 203

Int[((a\_) + (b\_)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(1\*ArcTan[(Rt[b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])

Rule 205

Int[((a\_) + (b\_)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

Rubi steps

$$\begin{aligned} \int \frac{\cos^6(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{x^6}{(1+x^2)^3 (a + (a+b)x^2)} dx, x, \cot(x) \right) \\ &= \frac{\cos^3(x) \sin(x)}{4b} - \frac{\text{Subst} \left( \int \frac{x^2(3a+(-a+3b)x^2)}{(1+x^2)^2 (a+(a+b)x^2)} dx, x, \cot(x) \right)}{4b} \\ &= -\frac{(4a-3b) \cos(x) \sin(x)}{8b^2} + \frac{\cos^3(x) \sin(x)}{4b} + \frac{\text{Subst} \left( \int \frac{a(4a-3b)+(-4a^2+ab-3b^2)x^2}{(1+x^2)(a+(a+b)x^2)} dx, x, \cot(x) \right)}{8b^2} \\ &= -\frac{(4a-3b) \cos(x) \sin(x)}{8b^2} + \frac{\cos^3(x) \sin(x)}{4b} + \frac{a^3 \text{Subst} \left( \int \frac{1}{a+(a+b)x^2} dx, x, \cot(x) \right)}{b^3} - \frac{(8a^2-4ab+3b^2)x}{8b^3} \\ &= \frac{(8a^2-4ab+3b^2)x}{8b^3} + \frac{a^{5/2} \tan^{-1} \left( \frac{\sqrt{a+b} \cot(x)}{\sqrt{a}} \right)}{b^3 \sqrt{a+b}} - \frac{(4a-3b) \cos(x) \sin(x)}{8b^2} + \frac{\cos^3(x) \sin(x)}{4b} \end{aligned}$$

**Mathematica [A]** time = 0.212795, size = 76, normalized size = 0.87

$$\frac{4x(8a^2 - 4ab + 3b^2) - \frac{32a^{5/2} \tan^{-1} \left( \frac{\sqrt{a} \tan(x)}{\sqrt{a+b}} \right)}{\sqrt{a+b}} - 8b(a-b) \sin(2x) + b^2 \sin(4x)}{32b^3}$$

Antiderivative was successfully verified.

[In] Integrate[Cos[x]^6/(a + b\*Cos[x]^2), x]

[Out] (4\*(8\*a^2 - 4\*a\*b + 3\*b^2)\*x - (32\*a^(5/2)\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]])/Sqrt[a + b] - 8\*(a - b)\*b\*Sin[2\*x] + b^2\*Sin[4\*x])/(32\*b^3)

**Maple [A]** time = 0.022, size = 122, normalized size = 1.4

$$-\frac{a^3}{b^3} \arctan \left( a \tan(x) \frac{1}{\sqrt{(a+b)a}} \right) \frac{1}{\sqrt{(a+b)a}} - \frac{(\tan(x))^3 a}{2b^2 ((\tan(x))^2 + 1)^2} + \frac{3(\tan(x))^3}{8b ((\tan(x))^2 + 1)^2} - \frac{a \tan(x)}{2b^2 ((\tan(x))^2 + 1)^2}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(cos(x)^6/(a+b*cos(x)^2),x)`

[Out]  $-1/b^3/((a+b)*a)^{(1/2)}*\arctan(a*\tan(x)/((a+b)*a)^{(1/2)})*a^3-1/2/b^2/(\tan(x)^2+1)^2*\tan(x)^3+a+3/8/b/(\tan(x)^2+1)^2*\tan(x)^3-1/2/b^2/(\tan(x)^2+1)^2*\tan(x)*a+5/8/b/(\tan(x)^2+1)^2*\tan(x)+1/b^3*\arctan(\tan(x))*a^2-1/2/b^2*\arctan(\tan(x))*a+3/8/b*\arctan(\tan(x))$

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(cos(x)^6/(a+b*cos(x)^2),x, algorithm="maxima")`

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.94392, size = 666, normalized size = 7.66

$$\left[ \frac{2a^2 \sqrt{-\frac{a}{a+b}} \log\left(\frac{(8a^2+8ab+b^2)\cos(x)^4 - 2(4a^2+3ab)\cos(x)^2 + 4((2a^2+3ab+b^2)\cos(x)^3 - (a^2+ab)\cos(x))\sqrt{-\frac{a}{a+b}}\sin(x) + a^2}{b^2\cos(x)^4 + 2ab\cos(x)^2 + a^2}\right) + (8a^2 - 4ab + 3b^2)}{8b^3} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(cos(x)^6/(a+b*cos(x)^2),x, algorithm="fricas")`

[Out]  $[1/8*(2*a^2*\sqrt{-a/(a+b)})*\log(((8*a^2+8*a*b+b^2)*\cos(x)^4-2*(4*a^2+3*a*b)*\cos(x)^2+4*((2*a^2+3*ab+b^2)*\cos(x)^3-(a^2+ab)*\cos(x))*\sqrt{-a/(a+b)}*\sin(x)+a^2)/(b^2*\cos(x)^4+2*a*b*\cos(x)^2+a^2))+((8*a^2-4*a*b+3*b^2)*x+(2*b^2*\cos(x)^3-(4*a*b-3*b^2)*\cos(x))*\sin(x))/b^3, 1/8*(4*a^2*\sqrt{a/(a+b)})*\arctan(1/2*((2*a+b)*\cos(x)^2-a)*\sqrt{a/(a+b)})/(a*\cos(x)*\sin(x))+(8*a^2-4*a*b+3*b^2)*x+(2*b^2*\cos(x)^3-(4*a*b-3*b^2)*\cos(x))*\sin(x))/b^3]$

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(cos(x)**6/(a+b*cos(x)**2),x)`

[Out] Timed out

**Giac [A]** time = 1.16225, size = 140, normalized size = 1.61

$$\frac{\left(\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)\right) a^3}{\sqrt{a^2 + ab} b^3} + \frac{(8a^2 - 4ab + 3b^2)x}{8b^3} - \frac{4a \tan(x)^3 - 3b \tan(x)^3 + 4a \tan(x) - 5b \tan(x)}{8(\tan(x)^2 + 1)^2 b^2}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^6/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] -(pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))\*a^3/(sqrt(a^2 + a\*b)\*b^3) + 1/8\*(8\*a^2 - 4\*a\*b + 3\*b^2)\*x/b^3 - 1/8\*(4\*a\*tan(x)^3 - 3\*b\*tan(x)^3 + 4\*a\*tan(x) - 5\*b\*tan(x))/((tan(x)^2 + 1)^2\*b^2)

### 3.36 $\int \frac{\cos^4(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=60

$$-\frac{a^{3/2} \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{b^2 \sqrt{a+b}} - \frac{x(2a-b)}{2b^2} + \frac{\sin(x) \cos(x)}{2b}$$

[Out]  $-\frac{(2a-b)x}{2b^2} - \frac{a^{3/2} \text{ArcTan}[\frac{\sqrt{a+b} \text{Cot}[x]}{\sqrt{a}}]}{b^2 \sqrt{a+b}} + \frac{\text{Cos}[x] \text{Sin}[x]}{2b}$

**Rubi [A]** time = 0.0980954, antiderivative size = 60, normalized size of antiderivative = 1., number of steps used = 5, number of rules used = 5, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3187, 470, 522, 203, 205}

$$-\frac{a^{3/2} \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{b^2 \sqrt{a+b}} - \frac{x(2a-b)}{2b^2} + \frac{\sin(x) \cos(x)}{2b}$$

Antiderivative was successfully verified.

[In] `Int[Cos[x]^4/(a + b*Cos[x]^2), x]`

[Out]  $-\frac{(2a-b)x}{2b^2} - \frac{a^{3/2} \text{ArcTan}[\frac{\sqrt{a+b} \text{Cot}[x]}{\sqrt{a}}]}{b^2 \sqrt{a+b}} + \frac{\text{Cos}[x] \text{Sin}[x]}{2b}$

#### Rule 3187

```
Int[sin[(e_.) + (f_.)*(x_)]^(m_)*((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^2)^(p_.), x_Symbol]
:> With[{ff = FreeFactors[Tan[e + f*x], x]}, Dist[ff^(m + 1)/f, Subst[Int[(x^m*(a + (a + b)*ff^2*x^2)^p]/(1 + ff^2*x^2)^(m/2 + p + 1), x], x, Tan[e + f*x]/ff], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[m/2] && IntegerQ[p]
```

#### Rule 470

```
Int[((e_.)*(x_))^(m_.)*((a_) + (b_.)*(x_)^(n_))^(p_)*((c_) + (d_.)*(x_)^(n_))^(q_), x_Symbol]
:> -Simp[(a*e^(2*n - 1)*(e*x)^(m - 2*n + 1)*(a + b*x^n)^(p + 1)*(c + d*x^n)^(q + 1))/(b*n*(b*c - a*d)*(p + 1)), x] + Dist[e^(2*n)/(b*n*(b*c - a*d)*(p + 1)), Int[(e*x)^(m - 2*n)*(a + b*x^n)^(p + 1)*(c + d*x^n)^q*Simp[a*c*(m - 2*n + 1) + (a*d*(m - n + n*q + 1) + b*c*n*(p + 1))*x^n, x], x] /; FreeQ[{a, b, c, d, e, q}, x] && NeQ[b*c - a*d, 0] && IGtQ[n, 0] && LtQ[p, -1] && GtQ[m - n + 1, n] && IntBinomialQ[a, b, c, d, e, m, n, p, q, x]
```

#### Rule 522

```
Int[((e_) + (f_.)*(x_)^(n_))/(((a_) + (b_.)*(x_)^(n_))*((c_) + (d_.)*(x_)^(n_))), x_Symbol]
:> Dist[(b*e - a*f)/(b*c - a*d), Int[1/(a + b*x^n), x], x] - Dist[(d*e - c*f)/(b*c - a*d), Int[1/(c + d*x^n), x], x] /; FreeQ[{a, b, c, d, e, f, n}, x]
```

#### Rule 203

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol]
:> Simp[(1*ArcTan[Rt[b, 2]*x]/Rt[a, 2])]/(Rt[a, 2]*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a
```

, 0] || GtQ[b, 0])

### Rule 205

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

### Rubi steps

$$\begin{aligned} \int \frac{\cos^4(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{x^4}{(1+x^2)^2 (a + (a+b)x^2)} dx, x, \cot(x) \right) \\ &= \frac{\cos(x) \sin(x)}{2b} - \frac{\text{Subst} \left( \int \frac{a+(-a+b)x^2}{(1+x^2)(a+(a+b)x^2)} dx, x, \cot(x) \right)}{2b} \\ &= \frac{\cos(x) \sin(x)}{2b} - \frac{a^2 \text{Subst} \left( \int \frac{1}{a+(a+b)x^2} dx, x, \cot(x) \right)}{b^2} + \frac{(2a-b) \text{Subst} \left( \int \frac{1}{1+x^2} dx, x, \cot(x) \right)}{2b^2} \\ &= -\frac{(2a-b)x}{2b^2} - \frac{a^{3/2} \tan^{-1} \left( \frac{\sqrt{a+b} \cot(x)}{\sqrt{a}} \right)}{b^2 \sqrt{a+b}} + \frac{\cos(x) \sin(x)}{2b} \end{aligned}$$

**Mathematica [A]** time = 0.120827, size = 52, normalized size = 0.87

$$\frac{4a^{3/2} \tan^{-1} \left( \frac{\sqrt{a} \tan(x)}{\sqrt{a+b}} \right)}{\sqrt{a+b}} + \frac{2x(b-2a) + b \sin(2x)}{4b^2}$$

Antiderivative was successfully verified.

[In] Integrate[Cos[x]^4/(a + b\*Cos[x]^2), x]

[Out] (2\*(-2\*a + b)\*x + (4\*a^(3/2)\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]])/Sqrt[a + b] + b\*Sin[2\*x])/(4\*b^2)

**Maple [A]** time = 0.02, size = 60, normalized size = 1.

$$\frac{a^2}{b^2} \arctan \left( a \tan(x) \frac{1}{\sqrt{(a+b)a}} \right) \frac{1}{\sqrt{(a+b)a}} + \frac{\tan(x)}{2b((\tan(x))^2 + 1)} + \frac{\arctan(\tan(x))}{2b} - \frac{\arctan(\tan(x))a}{b^2}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(cos(x)^4/(a+b\*cos(x)^2), x)

[Out] 1/b^2/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))\*a^2+1/2/b\*tan(x)/(tan(x)^2+1)+1/2/b\*arctan(tan(x))-1/b^2\*arctan(tan(x))\*a

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^4/(a+b\*cos(x)^2),x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.89124, size = 533, normalized size = 8.88

$$\left[ \frac{2 b \cos(x) \sin(x) + a \sqrt{-\frac{a}{a+b}} \log\left(\frac{(8 a^2+8 a b+b^2) \cos(x)^4-2(4 a^2+3 a b) \cos(x)^2-4((2 a^2+3 a b+b^2) \cos(x)^3-(a^2+a b) \cos(x)) \sqrt{-\frac{a}{a+b}} \sin(x)+a^2}}{b^2 \cos(x)^4+2 a b \cos(x)^2+a^2}\right)}{4 b^2} \right] - 2$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^4/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [1/4\*(2\*b\*cos(x)\*sin(x) + a\*sqrt(-a/(a + b))\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 - 4\*((2\*a^2 + 3\*a\*b + b^2)\*cos(x)^3 - (a^2 + a\*b)\*cos(x))\*sqrt(-a/(a + b))\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2)) - 2\*(2\*a - b)\*x)/b^2, 1/2\*(b\*cos(x)\*sin(x) - a\*sqrt(a/(a + b))\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)\*sqrt(a/(a + b))/(a\*cos(x)\*sin(x))) - (2\*a - b)\*x)/b^2]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)\*\*4/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

**Giac [A]** time = 1.17355, size = 97, normalized size = 1.62

$$\frac{\left(\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2+ab}}\right)\right) a^2}{\sqrt{a^2+abb^2}} - \frac{(2a-b)x}{2b^2} + \frac{\tan(x)}{2(\tan(x)^2+1)b}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^4/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] (pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))\*a^2/(sqrt(a^2 + a\*b)\*b^2) - 1/2\*(2\*a - b)\*x/b^2 + 1/2\*tan(x)/((tan(x)^2 + 1)\*b)



$$3.37 \quad \int \frac{\cos^2(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=38

$$\frac{\sqrt{a} \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{b\sqrt{a+b}} + \frac{x}{b}$$

[Out] x/b + (Sqrt[a]\*ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]])/(b\*Sqrt[a + b])

**Rubi [A]** time = 0.0596243, antiderivative size = 38, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3171, 3181, 205}

$$\frac{\sqrt{a} \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{b\sqrt{a+b}} + \frac{x}{b}$$

Antiderivative was successfully verified.

[In] Int[Cos[x]^2/(a + b\*Cos[x]^2), x]

[Out] x/b + (Sqrt[a]\*ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]])/(b\*Sqrt[a + b])

#### Rule 3171

Int[((A\_) + (B\_)\*sin[(e\_) + (f\_)\*(x\_)^2])/((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)^2]), x\_Symbol] := Simp[(B\*x)/b, x] + Dist[(A\*b - a\*B)/b, Int[1/(a + b\*Sin[e + f\*x]^2), x], x] /; FreeQ[{a, b, e, f, A, B}, x]

#### Rule 3181

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)^2])^(-1), x\_Symbol] := With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x]

#### Rule 205

Int[((a\_) + (b\_)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

#### Rubi steps

$$\begin{aligned} \int \frac{\cos^2(x)}{a+b \cos^2(x)} dx &= \frac{x}{b} - \frac{a \int \frac{1}{a+b \cos^2(x)} dx}{b} \\ &= \frac{x}{b} + \frac{a \operatorname{Subst}\left(\int \frac{1}{a+(a+b)x^2} dx, x, \cot(x)\right)}{b} \\ &= \frac{x}{b} + \frac{\sqrt{a} \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{b\sqrt{a+b}} \end{aligned}$$

**Mathematica [A]** time = 0.0786466, size = 36, normalized size = 0.95

$$x - \frac{\sqrt{a} \tan^{-1}\left(\frac{\sqrt{a} \tan(x)}{\sqrt{a+b}}\right)}{\sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] Integrate[Cos[x]^2/(a + b\*Cos[x]^2), x]

[Out] (x - (Sqrt[a]\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]])/Sqrt[a + b])/b

**Maple [A]** time = 0.017, size = 32, normalized size = 0.8

$$-\frac{a}{b} \arctan\left(a \tan(x) \frac{1}{\sqrt{(a+b)a}}\right) \frac{1}{\sqrt{(a+b)a}} + \frac{x}{b}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(cos(x)^2/(a+b\*cos(x)^2), x)

[Out] -1/b/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))\*a+x/b

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^2/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.83715, size = 447, normalized size = 11.76

$$\left[ \frac{\sqrt{-\frac{a}{a+b}} \log\left(\frac{(8a^2+8ab+b^2)\cos(x)^4 - 2(4a^2+3ab)\cos(x)^2 + 4((2a^2+3ab+b^2)\cos(x)^3 - (a^2+ab)\cos(x))\sqrt{-\frac{a}{a+b}}\sin(x) + a^2}}{b^2\cos(x)^4 + 2ab\cos(x)^2 + a^2}\right) + 4x \sqrt{\frac{a}{a+b}} \arctan\left(\frac{(2a+b)\cos(x)}{\sqrt{a(a+b)}}\right)}{4b}, \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^2/(a+b\*cos(x)^2), x, algorithm="fricas")

[Out] [1/4\*(sqrt(-a/(a + b))\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 + 4\*((2\*a^2 + 3\*a\*b + b^2)\*cos(x)^3 - (a^2 + a\*b)\*cos(x))\*sqrt(-a/(a + b))\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2)) + 4\*x)/b, 1/2\*(sqrt(a/(a + b))\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)\*sqrt(a/(a + b)))/(a\*cos(x)\*sin(x)) + 2\*x)/b]

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)\*\*2/(a+b\*cos(x)\*\*2), x)

[Out] Timed out

---

**Giac [A]** time = 1.18379, size = 65, normalized size = 1.71

$$-\frac{\left(\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)\right) a}{\sqrt{a^2 + ab}} + \frac{x}{b}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)^2/(a+b\*cos(x)^2), x, algorithm="giac")

[Out] -(pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))\*a/(sqrt(a^2 + a\*b)\*b) + x/b

$$3.38 \quad \int \frac{1}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=30

$$\frac{\tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{a}\sqrt{a+b}}$$

[Out] -(ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]]/(Sqrt[a]\*Sqrt[a + b]))

**Rubi [A]** time = 0.0187539, antiderivative size = 30, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3181, 205}

$$\frac{\tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{a}\sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] Int[(a + b\*Cos[x]^2)^(-1), x]

[Out] -(ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]]/(Sqrt[a]\*Sqrt[a + b]))

#### Rule 3181

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)^2]^(-1), x\_Symbol] := With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x]

#### Rule 205

Int[((a\_) + (b\_)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

#### Rubi steps

$$\begin{aligned} \int \frac{1}{a+b \cos^2(x)} dx &= -\text{Subst}\left(\int \frac{1}{a+(a+b)x^2} dx, x, \cot(x)\right) \\ &= -\frac{\tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{\sqrt{a}\sqrt{a+b}} \end{aligned}$$

**Mathematica [A]** time = 0.048437, size = 29, normalized size = 0.97

$$\frac{\tan^{-1}\left(\frac{\sqrt{a} \tan(x)}{\sqrt{a+b}}\right)}{\sqrt{a}\sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] Integrate[(a + b\*Cos[x]^2)^(-1), x]

[Out] ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]]/(Sqrt[a]\*Sqrt[a + b])

**Maple [A]** time = 0.001, size = 21, normalized size = 0.7

$$\arctan\left(a \tan(x) \frac{1}{\sqrt{(a+b)a}}\right) \frac{1}{\sqrt{(a+b)a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(a+b\*cos(x)^2),x)

[Out] 1/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2),x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 2.1992, size = 406, normalized size = 13.53

$$\left[ \frac{\sqrt{-a^2 - ab} \log\left(\frac{(8a^2 + 8ab + b^2)\cos(x)^4 - 2(4a^2 + 3ab)\cos(x)^2 + 4(2a + b)\cos(x)^3 - a\cos(x)\sqrt{-a^2 - ab}\sin(x) + a^2}{b^2\cos(x)^4 + 2ab\cos(x)^2 + a^2}\right)}{4(a^2 + ab)}, -\frac{\arctan\left(\frac{(2a + b)\cos(x)^2 - 2\sqrt{a^2 + ab}\cos(x)\sin(x)}{2\sqrt{a^2 + ab}}\right)}{2\sqrt{a^2 + ab}} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [-1/4\*sqrt(-a^2 - a\*b)\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 + 4\*((2\*a + b)\*cos(x)^3 - a\*cos(x))\*sqrt(-a^2 - a\*b)\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2))/(a^2 + a\*b), -1/2\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)/(sqrt(a^2 + a\*b)\*cos(x)\*sin(x)))/sqrt(a^2 + a\*b)]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

---

**Giac [A]** time = 1.177, size = 50, normalized size = 1.67

$$\frac{\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)}{\sqrt{a^2 + ab}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] (pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))/sqrt(a^2 + a\*b)

$$3.39 \quad \int \frac{\sec^2(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=37

$$\frac{b \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{a^{3/2} \sqrt{a+b}} + \frac{\tan(x)}{a}$$

[Out] (b\*ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]])/(a^(3/2)\*Sqrt[a + b]) + Tan[x]/a

**Rubi [A]** time = 0.0605322, antiderivative size = 37, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3187, 453, 205}

$$\frac{b \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{a^{3/2} \sqrt{a+b}} + \frac{\tan(x)}{a}$$

Antiderivative was successfully verified.

[In] Int[Sec[x]^2/(a + b\*Cos[x]^2), x]

[Out] (b\*ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]])/(a^(3/2)\*Sqrt[a + b]) + Tan[x]/a

#### Rule 3187

Int[sin[(e\_.) + (f\_.)\*(x\_)]^(m\_)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_.), x\_Symbol] :> With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff^(m + 1)/f, Subst[Int[(x^m\*(a + (a + b)\*ff^2\*x^2)^p]/(1 + ff^2\*x^2)^(m/2 + p + 1), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[m/2] && IntegerQ[p]

#### Rule 453

Int[((e\_.)\*(x\_))^(m\_.)\*((a\_) + (b\_.)\*(x\_)^(n\_))^(p\_.)\*((c\_) + (d\_.)\*(x\_)^(n\_)), x\_Symbol] :> Simp[(c\*(e\*x)^(m + 1)\*(a + b\*x^n)^(p + 1))/(a\*e\*(m + 1)), x] + Dist[(a\*d\*(m + 1) - b\*c\*(m + n\*(p + 1) + 1))/(a\*e^n\*(m + 1)), Int[(e\*x)^(m + n)\*(a + b\*x^n)^p, x], x] /; FreeQ[{a, b, c, d, e, p}, x] && NeQ[b\*c - a\*d, 0] && (IntegerQ[n] || GtQ[e, 0]) && ((GtQ[n, 0] && LtQ[m, -1]) || (LtQ[n, 0] && GtQ[m + n, -1])) && !ILtQ[p, -1]

#### Rule 205

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

#### Rubi steps

$$\begin{aligned} \int \frac{\sec^2(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{1 + x^2}{x^2 (a + (a + b)x^2)} dx, x, \cot(x) \right) \\ &= \frac{\tan(x)}{a} + \frac{b \text{Subst} \left( \int \frac{1}{a + (a+b)x^2} dx, x, \cot(x) \right)}{a} \\ &= \frac{b \tan^{-1} \left( \frac{\sqrt{a+b} \cot(x)}{\sqrt{a}} \right)}{a^{3/2} \sqrt{a+b}} + \frac{\tan(x)}{a} \end{aligned}$$

**Mathematica [A]** time = 0.0743614, size = 38, normalized size = 1.03

$$\frac{\tan(x)}{a} - \frac{b \tan^{-1} \left( \frac{\sqrt{a} \tan(x)}{\sqrt{a+b}} \right)}{a^{3/2} \sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] Integrate[Sec[x]^2/(a + b\*Cos[x]^2),x]

[Out] -((b\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]])/(a^(3/2)\*Sqrt[a + b])) + Tan[x]/a

**Maple [A]** time = 0.028, size = 33, normalized size = 0.9

$$\frac{\tan(x)}{a} - \frac{b}{a} \arctan \left( \tan(x) a \frac{1}{\sqrt{(a+b)a}} \right) \frac{1}{\sqrt{(a+b)a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sec(x)^2/(a+b\*cos(x)^2),x)

[Out] tan(x)/a-b/a/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)^2/(a+b\*cos(x)^2),x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 1.92837, size = 543, normalized size = 14.68

$$\left[ \frac{\sqrt{-a^2 - abb} \cos(x) \log \left( \frac{(8a^2 + 8ab + b^2) \cos(x)^4 - 2(4a^2 + 3ab) \cos(x)^2 - 4((2a+b) \cos(x)^3 - a \cos(x)) \sqrt{-a^2 - ab} \sin(x) + a^2}{b^2 \cos(x)^4 + 2ab \cos(x)^2 + a^2} \right) - 4(a^2 + ab) \sin(x)}{4(a^3 + a^2b) \cos(x)} \right]$$



Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)^2/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [-1/4\*(sqrt(-a^2 - a\*b)\*b\*cos(x)\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 - 4\*((2\*a + b)\*cos(x)^3 - a\*cos(x))\*sqrt(-a^2 - a\*b)\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2)) - 4\*(a^2 + a\*b)\*sin(x))/((a^3 + a^2\*b)\*cos(x)), 1/2\*(sqrt(a^2 + a\*b)\*b\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)/(sqrt(a^2 + a\*b)\*cos(x)\*sin(x)))\*cos(x) + 2\*(a^2 + a\*b)\*sin(x))/((a^3 + a^2\*b)\*cos(x))]

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\sec^2(x)}{a + b \cos^2(x)} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)\*\*2/(a+b\*cos(x)\*\*2),x)

[Out] Integral(sec(x)\*\*2/(a + b\*cos(x)\*\*2), x)

**Giac [A]** time = 1.12358, size = 49, normalized size = 1.32

$$-\frac{b \arctan\left(\frac{a \tan(x)}{\sqrt{a^2+ab}}\right)}{\sqrt{a^2+aba}} + \frac{\tan(x)}{a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)^2/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] -b\*arctan(a\*tan(x)/sqrt(a^2 + a\*b))/(sqrt(a^2 + a\*b)\*a) + tan(x)/a

$$3.40 \quad \int \frac{\sec^4(x)}{a+b \cos^2(x)} dx$$

**Optimal.** Leaf size=56

$$-\frac{b^2 \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{a^{5/2} \sqrt{a+b}} + \frac{(a-b) \tan(x)}{a^2} + \frac{\tan^3(x)}{3a}$$

[Out]  $-\left(\frac{b^2 \operatorname{ArcTan}\left[\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right]}{a^{5/2} \sqrt{a+b}}\right) + \left(\frac{(a-b) \tan(x)}{a^2} + \frac{\tan^3(x)}{3a}\right)$

**Rubi [A]** time = 0.0860343, antiderivative size = 56, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3187, 461, 205}

$$-\frac{b^2 \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{a^{5/2} \sqrt{a+b}} + \frac{(a-b) \tan(x)}{a^2} + \frac{\tan^3(x)}{3a}$$

Antiderivative was successfully verified.

[In] `Int[Sec[x]^4/(a + b*Cos[x]^2), x]`

[Out]  $-\left(\frac{b^2 \operatorname{ArcTan}\left[\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right]}{a^{5/2} \sqrt{a+b}}\right) + \left(\frac{(a-b) \tan(x)}{a^2} + \frac{\tan^3(x)}{3a}\right)$

#### Rule 3187

```
Int[sin[(e_.) + (f_.)*(x_)]^(m_)*((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^2)^(p_.), x_Symbol] :> With[{ff = FreeFactors[Tan[e + f*x], x]}, Dist[ff^(m + 1)/f, Subst[Int[(x^m*(a + (a + b)*ff^2*x^2)^p]/(1 + ff^2*x^2)^(m/2 + p + 1), x], x, Tan[e + f*x]/ff], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[m/2] && IntegerQ[p]
```

#### Rule 461

```
Int[(((e_.)*(x_))^(m_.)*((a_) + (b_.)*(x_)^(n_))^(p_))/((c_) + (d_.)*(x_)^(n_)), x_Symbol] :> Int[ExpandIntegrand[((e*x)^m*(a + b*x^n)^p]/(c + d*x^n), x], x] /; FreeQ[{a, b, c, d, e, m}, x] && NeQ[b*c - a*d, 0] && IGtQ[n, 0] && IGtQ[p, 0] && (IntegerQ[m] || IGtQ[2*(m + 1), 0] || !RationalQ[m])
```

#### Rule 205

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(Rt[a/b, 2]*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]
```

#### Rubi steps

$$\begin{aligned}
\int \frac{\sec^4(x)}{a + b \cos^2(x)} dx &= -\text{Subst} \left( \int \frac{(1+x^2)^2}{x^4(a+(a+b)x^2)} dx, x, \cot(x) \right) \\
&= -\text{Subst} \left( \int \left( \frac{1}{ax^4} + \frac{a-b}{a^2x^2} + \frac{b^2}{a^2(a+(a+b)x^2)} \right) dx, x, \cot(x) \right) \\
&= \frac{(a-b)\tan(x)}{a^2} + \frac{\tan^3(x)}{3a} - \frac{b^2 \text{Subst} \left( \int \frac{1}{a+(a+b)x^2} dx, x, \cot(x) \right)}{a^2} \\
&= -\frac{b^2 \tan^{-1} \left( \frac{\sqrt{a+b} \cot(x)}{\sqrt{a}} \right)}{a^{5/2} \sqrt{a+b}} + \frac{(a-b)\tan(x)}{a^2} + \frac{\tan^3(x)}{3a}
\end{aligned}$$

**Mathematica [A]** time = 0.135363, size = 55, normalized size = 0.98

$$\frac{b^2 \tan^{-1} \left( \frac{\sqrt{a} \tan(x)}{\sqrt{a+b}} \right)}{a^{5/2} \sqrt{a+b}} + \frac{\tan(x)(a \sec^2(x) + 2a - 3b)}{3a^2}$$

Antiderivative was successfully verified.

[In] Integrate[Sec[x]^4/(a + b\*Cos[x]^2),x]

[Out] (b^2\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]]/(a^(5/2)\*Sqrt[a + b]) + ((2\*a - 3\*b + a\*Sec[x]^2)\*Tan[x])/(3\*a^2))

**Maple [A]** time = 0.03, size = 51, normalized size = 0.9

$$\frac{(\tan(x))^3}{3a} + \frac{\tan(x)}{a} - \frac{\tan(x)b}{a^2} + \frac{b^2}{a^2} \arctan \left( \tan(x) a \frac{1}{\sqrt{(a+b)a}} \right) \frac{1}{\sqrt{(a+b)a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sec(x)^4/(a+b\*cos(x)^2),x)

[Out] 1/3\*tan(x)^3/a+tan(x)/a-1/a^2\*tan(x)\*b+b^2/a^2/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)^4/(a+b\*cos(x)^2),x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 1.89319, size = 672, normalized size = 12.

$$\left[ \frac{3 \sqrt{-a^2 - ab} b^2 \cos(x)^3 \log\left(\frac{(8a^2 + 8ab + b^2) \cos(x)^4 - 2(4a^2 + 3ab) \cos(x)^2 + 4((2a+b) \cos(x)^3 - a \cos(x)) \sqrt{-a^2 - ab} \sin(x) + a^2}}{b^2 \cos(x)^4 + 2ab \cos(x)^2 + a^2}\right) - 4(a^3 + a^2b + (2a^3 - a^2b - 3ab^2) \cos(x)^2) \sin(x)}{12(a^4 + a^3b) \cos(x)^3} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)^4/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [-1/12\*(3\*sqrt(-a^2 - a\*b)\*b^2\*cos(x)^3\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 + 4\*((2\*a + b)\*cos(x)^3 - a\*cos(x))\*sqrt(-a^2 - a\*b)\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2)) - 4\*(a^3 + a^2\*b + (2\*a^3 - a^2\*b - 3\*a\*b^2)\*cos(x)^2)\*sin(x)/((a^4 + a^3\*b)\*cos(x)^3), -1/6\*(3\*sqrt(a^2 + a\*b)\*b^2\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)/(sqrt(a^2 + a\*b)\*cos(x)\*sin(x)))\*cos(x)^3 - 2\*(a^3 + a^2\*b + (2\*a^3 - a^2\*b - 3\*a\*b^2)\*cos(x)^2)\*sin(x))/((a^4 + a^3\*b)\*cos(x)^3)]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)\*\*4/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

**Giac [A]** time = 1.19087, size = 96, normalized size = 1.71

$$\frac{\left(\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)\right) b^2}{\sqrt{a^2 + ab} a^2} + \frac{a^2 \tan(x)^3 + 3a^2 \tan(x) - 3ab \tan(x)}{3a^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)^4/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] (pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))\*b^2/(sqrt(a^2 + a\*b)\*a^2) + 1/3\*(a^2\*tan(x)^3 + 3\*a^2\*tan(x) - 3\*a\*b\*tan(x))/a^3

### 3.41 $\int \frac{\sec^6(x)}{a+b \cos^2(x)} dx$

**Optimal.** Leaf size=79

$$\frac{(a^2 - ab + b^2) \tan(x)}{a^3} + \frac{b^3 \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{a^{7/2} \sqrt{a+b}} + \frac{(2a-b) \tan^3(x)}{3a^2} + \frac{\tan^5(x)}{5a}$$

[Out] (b^3\*ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]])/(a^(7/2)\*Sqrt[a + b]) + ((a^2 - a\*b + b^2)\*Tan[x])/a^3 + ((2\*a - b)\*Tan[x]^3)/(3\*a^2) + Tan[x]^5/(5\*a)

**Rubi [A]** time = 0.101229, antiderivative size = 79, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3187, 461, 205}

$$\frac{(a^2 - ab + b^2) \tan(x)}{a^3} + \frac{b^3 \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{a^{7/2} \sqrt{a+b}} + \frac{(2a-b) \tan^3(x)}{3a^2} + \frac{\tan^5(x)}{5a}$$

Antiderivative was successfully verified.

[In] Int[Sec[x]^6/(a + b\*Cos[x]^2), x]

[Out] (b^3\*ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]])/(a^(7/2)\*Sqrt[a + b]) + ((a^2 - a\*b + b^2)\*Tan[x])/a^3 + ((2\*a - b)\*Tan[x]^3)/(3\*a^2) + Tan[x]^5/(5\*a)

#### Rule 3187

```
Int[sin[(e_.) + (f_.)*(x_)]^(m_.)*((a_.) + (b_.)*sin[(e_.) + (f_.)*(x_)]^2)^(p_.), x_Symbol] :> With[{ff = FreeFactors[Tan[e + f*x], x]}, Dist[ff^(m + 1)/f, Subst[Int[(x^m*(a + (a + b)*ff^2*x^2)^p]/(1 + ff^2*x^2)^(m/2 + p + 1), x], x, Tan[e + f*x]/ff], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[m/2] && IntegerQ[p]
```

#### Rule 461

```
Int[(((e_.)*(x_))^(m_.)*((a_.) + (b_.)*(x_)^(n_))^(p_))/((c_.) + (d_.)*(x_)^(n_)), x_Symbol] :> Int[ExpandIntegrand[((e*x)^m*(a + b*x^n)^p)/(c + d*x^n), x], x] /; FreeQ[{a, b, c, d, e, m}, x] && NeQ[b*c - a*d, 0] && IGtQ[n, 0] && IGtQ[p, 0] && (IntegerQ[m] || IGtQ[2*(m + 1), 0] || !RationalQ[m])
```

#### Rule 205

```
Int[((a_.) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(Rt[a/b, 2]*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]
```

#### Rubi steps

$$\begin{aligned}
\int \frac{\sec^6(x)}{a+b\cos^2(x)} dx &= -\text{Subst}\left(\int \frac{(1+x^2)^3}{x^6(a+(a+b)x^2)} dx, x, \cot(x)\right) \\
&= -\text{Subst}\left(\int \left(\frac{1}{ax^6} + \frac{2a-b}{a^2x^4} + \frac{a^2-ab+b^2}{a^3x^2} + \frac{b^3}{a^3(-a-(a+b)x^2)}\right) dx, x, \cot(x)\right) \\
&= \frac{(a^2-ab+b^2)\tan(x)}{a^3} + \frac{(2a-b)\tan^3(x)}{3a^2} + \frac{\tan^5(x)}{5a} - \frac{b^3\text{Subst}\left(\int \frac{1}{-a-(a+b)x^2} dx, x, \cot(x)\right)}{a^3} \\
&= \frac{b^3\tan^{-1}\left(\frac{\sqrt{a+b}\cot(x)}{\sqrt{a}}\right)}{a^{7/2}\sqrt{a+b}} + \frac{(a^2-ab+b^2)\tan(x)}{a^3} + \frac{(2a-b)\tan^3(x)}{3a^2} + \frac{\tan^5(x)}{5a}
\end{aligned}$$

**Mathematica [A]** time = 0.319061, size = 80, normalized size = 1.01

$$\frac{\tan(x)(3a^2\sec^4(x) + 8a^2 + a(4a - 5b)\sec^2(x) - 10ab + 15b^2)}{15a^3} - \frac{b^3\tan^{-1}\left(\frac{\sqrt{a}\tan(x)}{\sqrt{a+b}}\right)}{a^{7/2}\sqrt{a+b}}$$

Antiderivative was successfully verified.

[In] Integrate[Sec[x]^6/(a + b\*Cos[x]^2), x]

[Out] -((b^3\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]])/(a^(7/2)\*Sqrt[a + b])) + ((8\*a^2 - 10\*a\*b + 15\*b^2 + a\*(4\*a - 5\*b)\*Sec[x]^2 + 3\*a^2\*Sec[x]^4)\*Tan[x])/(15\*a^3)

**Maple [A]** time = 0.034, size = 80, normalized size = 1.

$$\frac{(\tan(x))^5}{5a} + \frac{2(\tan(x))^3}{3a} - \frac{(\tan(x))^3 b}{3a^2} + \frac{\tan(x)}{a} - \frac{\tan(x)b}{a^2} + \frac{b^2\tan(x)}{a^3} - \frac{b^3}{a^3} \arctan\left(\tan(x)a\frac{1}{\sqrt{(a+b)a}}\right) \frac{1}{\sqrt{(a+b)a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(sec(x)^6/(a+b\*cos(x)^2), x)

[Out] 1/5\*tan(x)^5/a+2/3\*tan(x)^3/a-1/3/a^2\*tan(x)^3\*b+tan(x)/a-1/a^2\*tan(x)\*b+1/a^3\*b^2\*tan(x)-b^3/a^3/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)^6/(a+b\*cos(x)^2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 1.8482, size = 832, normalized size = 10.53

$$\left[ \frac{15 \sqrt{-a^2 - ab} b^3 \cos(x)^5 \log\left(\frac{(8a^2 + 8ab + b^2) \cos(x)^4 - 2(4a^2 + 3ab) \cos(x)^2 - 4((2a+b) \cos(x)^3 - a \cos(x)) \sqrt{-a^2 - ab} \sin(x) + a^2}{b^2 \cos(x)^4 + 2ab \cos(x)^2 + a^2}\right) - 4((8a^4 - 2a^3b + 5a^2b^2 + 15ab^3) \cos(x)^4 + 3a^4 + 3a^3b + (4a^4 - a^3b - 5a^2b^2) \cos(x)^2) \sin(x)}{60(a^5 + a^4b) \cos(x)^5} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)^6/(a+b\*cos(x)^2),x, algorithm="fricas")

[Out] [-1/60\*(15\*sqrt(-a^2 - a\*b)\*b^3\*cos(x)^5\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 - 4\*((2\*a + b)\*cos(x)^3 - a\*cos(x))\*sqrt(-a^2 - a\*b)\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2)) - 4\*((8\*a^4 - 2\*a^3\*b + 5\*a^2\*b^2 + 15\*a\*b^3)\*cos(x)^4 + 3\*a^4 + 3\*a^3\*b + (4\*a^4 - a^3\*b - 5\*a^2\*b^2)\*cos(x)^2)\*sin(x))/((a^5 + a^4\*b)\*cos(x)^5), 1/30\*(15\*sqrt(a^2 + a\*b)\*b^3\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)/(sqrt(a^2 + a\*b)\*cos(x)\*sin(x)))\*cos(x)^5 + 2\*((8\*a^4 - 2\*a^3\*b + 5\*a^2\*b^2 + 15\*a\*b^3)\*cos(x)^4 + 3\*a^4 + 3\*a^3\*b + (4\*a^4 - a^3\*b - 5\*a^2\*b^2)\*cos(x)^2)\*sin(x))/((a^5 + a^4\*b)\*cos(x)^5)]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)\*\*6/(a+b\*cos(x)\*\*2),x)

[Out] Timed out

**Giac [A]** time = 1.18315, size = 140, normalized size = 1.77

$$\frac{\left(\pi \left[\frac{x}{\pi} + \frac{1}{2}\right] \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)\right) b^3}{\sqrt{a^2 + ab} a^3} + \frac{3a^4 \tan(x)^5 + 10a^4 \tan(x)^3 - 5a^3b \tan(x)^3 + 15a^4 \tan(x) - 15a^3b \tan(x)}{15a^5}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(sec(x)^6/(a+b\*cos(x)^2),x, algorithm="giac")

[Out] -(pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))\*b^3/(sqrt(a^2 + a\*b)\*a^3) + 1/15\*(3\*a^4\*tan(x)^5 + 10\*a^4\*tan(x)^3 - 5\*a^3\*b\*tan(x)^3 + 15\*a^4\*tan(x) - 15\*a^3\*b\*tan(x) + 15\*a^2\*b^2\*tan(x))/a^5

$$3.42 \quad \int \frac{1}{(a+b \cos^2(x))^2} dx$$

**Optimal.** Leaf size=65

$$-\frac{(2a+b) \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{2a^{3/2}(a+b)^{3/2}} - \frac{b \sin(x) \cos(x)}{2a(a+b)(a+b \cos^2(x))}$$

[Out] -((2\*a + b)\*ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]])/(2\*a^(3/2)\*(a + b)^(3/2)) - (b\*Cos[x]\*Sin[x])/(2\*a\*(a + b)\*(a + b\*Cos[x]^2))

**Rubi [A]** time = 0.0493253, antiderivative size = 65, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.4$ , Rules used = {3184, 12, 3181, 205}

$$-\frac{(2a+b) \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{2a^{3/2}(a+b)^{3/2}} - \frac{b \sin(x) \cos(x)}{2a(a+b)(a+b \cos^2(x))}$$

Antiderivative was successfully verified.

[In] Int[(a + b\*Cos[x]^2)^(-2), x]

[Out] -((2\*a + b)\*ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]])/(2\*a^(3/2)\*(a + b)^(3/2)) - (b\*Cos[x]\*Sin[x])/(2\*a\*(a + b)\*(a + b\*Cos[x]^2))

#### Rule 3184

```
Int[((a_) + (b_)*sin[(e_) + (f_)*(x_)]^2)^(p_), x_Symbol] := -Simp[(b*Cos[e + f*x]*Sin[e + f*x]*(a + b*Ssin[e + f*x]^2)^(p + 1))/(2*a*f*(p + 1)*(a + b)), x] + Dist[1/(2*a*(p + 1)*(a + b)), Int[(a + b*Ssin[e + f*x]^2)^(p + 1)*Simp[2*a*(p + 1) + b*(2*p + 3) - 2*b*(p + 2)*Ssin[e + f*x]^2, x], x], x] /; FreeQ[{a, b, e, f}, x] && NeQ[a + b, 0] && LtQ[p, -1]
```

#### Rule 12

```
Int[(a_)*(u_), x_Symbol] := Dist[a, Int[u, x], x] /; FreeQ[a, x] && !MatchQ[u, (b_)*(v_) /; FreeQ[b, x]]
```

#### Rule 3181

```
Int[((a_) + (b_)*sin[(e_) + (f_)*(x_)]^2)^(-1), x_Symbol] := With[{ff = FreeFactors[Tan[e + f*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)*ff^2*x^2), x], x, Tan[e + f*x]/ff], x] /; FreeQ[{a, b, e, f}, x]
```

#### Rule 205

```
Int[((a_) + (b_)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[a/b, 2]*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]
```

#### Rubi steps



$$\begin{aligned}
\int \frac{1}{(a+b\cos^2(x))^2} dx &= -\frac{b\cos(x)\sin(x)}{2a(a+b)(a+b\cos^2(x))} - \frac{\int \frac{-2a-b}{a+b\cos^2(x)} dx}{2a(a+b)} \\
&= -\frac{b\cos(x)\sin(x)}{2a(a+b)(a+b\cos^2(x))} + \frac{(2a+b)\int \frac{1}{a+b\cos^2(x)} dx}{2a(a+b)} \\
&= -\frac{b\cos(x)\sin(x)}{2a(a+b)(a+b\cos^2(x))} - \frac{(2a+b)\text{Subst}\left(\int \frac{1}{a+(a+b)x^2} dx, x, \cot(x)\right)}{2a(a+b)} \\
&= -\frac{(2a+b)\tan^{-1}\left(\frac{\sqrt{a+b}\cot(x)}{\sqrt{a}}\right)}{2a^{3/2}(a+b)^{3/2}} - \frac{b\cos(x)\sin(x)}{2a(a+b)(a+b\cos^2(x))}
\end{aligned}$$

**Mathematica [A]** time = 0.221658, size = 70, normalized size = 1.08

$$-\frac{(-2a-b)\tan^{-1}\left(\frac{\sqrt{a}\tan(x)}{\sqrt{a+b}}\right)}{2a^{3/2}(a+b)^{3/2}} - \frac{b\sin(2x)}{2a(a+b)(2a+b\cos(2x)+b)}$$

Antiderivative was successfully verified.

[In] Integrate[(a + b\*Cos[x]^2)^(-2), x]

[Out] -((-2\*a - b)\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]])/(2\*a^(3/2)\*(a + b)^(3/2)) - (b\*Sin[2\*x])/(2\*a\*(a + b)\*(2\*a + b + b\*Cos[2\*x]))

**Maple [A]** time = 0.02, size = 81, normalized size = 1.3

$$-\frac{b\tan(x)}{(2a+2b)a((\tan(x))^2a+a+b)} + \frac{1}{a+b}\arctan\left(a\tan(x)\frac{1}{\sqrt{(a+b)a}}\right)\frac{1}{\sqrt{(a+b)a}} + \frac{b}{(2a+2b)a}\arctan\left(a\tan(x)\frac{1}{\sqrt{(a+b)a}}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(a+b\*cos(x)^2)^2, x)

[Out] -1/2\*b/(a+b)/a\*tan(x)/(tan(x)^2\*a+a+b)+1/(a+b)/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))+1/2/(a+b)/a/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))\*b

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2)^2, x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 1.91031, size = 774, normalized size = 11.91

$$\left[ \frac{4(a^2b + ab^2)\cos(x)\sin(x) + ((2ab + b^2)\cos(x)^2 + 2a^2 + ab)\sqrt{-a^2 - ab}\log\left(\frac{(8a^2 + 8ab + b^2)\cos(x)^4 - 2(4a^2 + 3ab)\cos(x)^2 + 4(2a^2 + ab)\cos(x) + 4a^2}{b^2\cos(x)^4 + 2ab\cos(x)^2 + a^2}\right)}{8(a^5 + 2a^4b + a^3b^2 + (a^4b + 2a^3b^2 + a^2b^3)\cos(x)^2)} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2)^2,x, algorithm="fricas")

[Out] [-1/8\*(4\*(a^2\*b + a\*b^2)\*cos(x)\*sin(x) + ((2\*a\*b + b^2)\*cos(x)^2 + 2\*a^2 + a\*b)\*sqrt(-a^2 - a\*b)\*log(((8\*a^2 + 8\*a\*b + b^2)\*cos(x)^4 - 2\*(4\*a^2 + 3\*a\*b)\*cos(x)^2 + 4\*((2\*a + b)\*cos(x)^3 - a\*cos(x))\*sqrt(-a^2 - a\*b)\*sin(x) + a^2)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2)))/(a^5 + 2\*a^4\*b + a^3\*b^2 + (a^4\*b + 2\*a^3\*b^2 + a^2\*b^3)\*cos(x)^2), -1/4\*(2\*(a^2\*b + a\*b^2)\*cos(x)\*sin(x) + ((2\*a\*b + b^2)\*cos(x)^2 + 2\*a^2 + a\*b)\*sqrt(a^2 + a\*b)\*arctan(1/2\*((2\*a + b)\*cos(x)^2 - a)/(sqrt(a^2 + a\*b)\*cos(x)\*sin(x)))/(a^5 + 2\*a^4\*b + a^3\*b^2 + (a^4\*b + 2\*a^3\*b^2 + a^2\*b^3)\*cos(x)^2)]

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)\*\*2)\*\*2,x)

[Out] Timed out

**Giac [A]** time = 1.16169, size = 93, normalized size = 1.43

$$\frac{\left(\pi \left\lfloor \frac{x}{\pi} + \frac{1}{2} \right\rfloor \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)\right)(2a + b)}{2(a^2 + ab)^{\frac{3}{2}}} - \frac{b \tan(x)}{2(a \tan(x)^2 + a + b)(a^2 + ab)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2)^2,x, algorithm="giac")

[Out] 1/2\*(pi\*floor(x/pi + 1/2)\*sgn(a) + arctan(a\*tan(x)/sqrt(a^2 + a\*b)))\*(2\*a + b)/(a^2 + a\*b)^(3/2) - 1/2\*b\*tan(x)/((a\*tan(x)^2 + a + b)\*(a^2 + a\*b))

$$3.43 \quad \int \frac{1}{(a+b \cos^2(x))^3} dx$$

**Optimal.** Leaf size=107

$$-\frac{(8a^2 + 8ab + 3b^2) \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{8a^{5/2}(a+b)^{5/2}} - \frac{3b(2a+b) \sin(x) \cos(x)}{8a^2(a+b)^2 (a+b \cos^2(x))} - \frac{b \sin(x) \cos(x)}{4a(a+b) (a+b \cos^2(x))^2}$$

[Out] -((8\*a^2 + 8\*a\*b + 3\*b^2)\*ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]])/(8\*a^(5/2)\*(a + b)^(5/2)) - (b\*Cos[x]\*Sin[x])/(4\*a\*(a + b)\*(a + b\*Cos[x]^2)^2) - (3\*b\*(2\*a + b)\*Cos[x]\*Sin[x])/(8\*a^2\*(a + b)^2\*(a + b\*Cos[x]^2))

**Rubi [A]** time = 0.117157, antiderivative size = 107, normalized size of antiderivative = 1., number of steps used = 5, number of rules used = 5, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.5$ , Rules used = {3184, 3173, 12, 3181, 205}

$$-\frac{(8a^2 + 8ab + 3b^2) \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{8a^{5/2}(a+b)^{5/2}} - \frac{3b(2a+b) \sin(x) \cos(x)}{8a^2(a+b)^2 (a+b \cos^2(x))} - \frac{b \sin(x) \cos(x)}{4a(a+b) (a+b \cos^2(x))^2}$$

Antiderivative was successfully verified.

[In] Int[(a + b\*Cos[x]^2)^(-3), x]

[Out] -((8\*a^2 + 8\*a\*b + 3\*b^2)\*ArcTan[(Sqrt[a + b]\*Cot[x])/Sqrt[a]])/(8\*a^(5/2)\*(a + b)^(5/2)) - (b\*Cos[x]\*Sin[x])/(4\*a\*(a + b)\*(a + b\*Cos[x]^2)^2) - (3\*b\*(2\*a + b)\*Cos[x]\*Sin[x])/(8\*a^2\*(a + b)^2\*(a + b\*Cos[x]^2))

#### Rule 3184

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^(p\_), x\_Symbol] :> -Simp[(b\*Cos[e + f\*x]\*Sin[e + f\*x]\*(a + b\*Sin[e + f\*x]^2)^(p + 1))/(2\*a\*f\*(p + 1)\*(a + b)), x] + Dist[1/(2\*a\*(p + 1)\*(a + b)), Int[(a + b\*Sin[e + f\*x]^2)^(p + 1)\*Simp[2\*a\*(p + 1) + b\*(2\*p + 3) - 2\*b\*(p + 2)\*Sin[e + f\*x]^2, x], x], x] /; FreeQ[{a, b, e, f}, x] && NeQ[a + b, 0] && LtQ[p, -1]

#### Rule 3173

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^(p\_)\*((A\_) + (B\_)\*sin[(e\_) + (f\_)\*(x\_)]^2), x\_Symbol] :> -Simp[((A\*b - a\*B)\*Cos[e + f\*x]\*Sin[e + f\*x]\*(a + b\*Sin[e + f\*x]^2)^(p + 1))/(2\*a\*f\*(a + b)\*(p + 1)), x] - Dist[1/(2\*a\*(a + b)\*(p + 1)), Int[(a + b\*Sin[e + f\*x]^2)^(p + 1)\*Simp[a\*B - A\*(2\*a\*(p + 1) + b\*(2\*p + 3)) + 2\*(A\*b - a\*B)\*(p + 2)\*Sin[e + f\*x]^2, x], x], x] /; FreeQ[{a, b, e, f, A, B}, x] && LtQ[p, -1] && NeQ[a + b, 0]

#### Rule 12

Int[(a\_)\*(u\_), x\_Symbol] :> Dist[a, Int[u, x], x] /; FreeQ[a, x] && !MatchQ[u, (b\_)\*(v\_)] /; FreeQ[b, x]

#### Rule 3181

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^(-1), x\_Symbol] :> With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2

), x], x, Tan[e + f\*x]/ff], x]] /; FreeQ[{a, b, e, f}, x]

**Rule 205**

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

Rubi steps

$$\int \frac{1}{(a + b \cos^2(x))^3} dx = -\frac{b \cos(x) \sin(x)}{4a(a + b)(a + b \cos^2(x))^2} - \frac{\int \frac{-4a - 3b + 2b \cos^2(x)}{(a + b \cos^2(x))^2} dx}{4a(a + b)}$$

$$= -\frac{b \cos(x) \sin(x)}{4a(a + b)(a + b \cos^2(x))^2} - \frac{3b(2a + b) \cos(x) \sin(x)}{8a^2(a + b)^2(a + b \cos^2(x))} - \frac{\int \frac{-8a^2 - 8ab - 3b^2}{a + b \cos^2(x)} dx}{8a^2(a + b)^2}$$

$$= -\frac{b \cos(x) \sin(x)}{4a(a + b)(a + b \cos^2(x))^2} - \frac{3b(2a + b) \cos(x) \sin(x)}{8a^2(a + b)^2(a + b \cos^2(x))} + \frac{(8a^2 + 8ab + 3b^2) \int \frac{1}{a + b \cos^2(x)} dx}{8a^2(a + b)^2}$$

$$= -\frac{b \cos(x) \sin(x)}{4a(a + b)(a + b \cos^2(x))^2} - \frac{3b(2a + b) \cos(x) \sin(x)}{8a^2(a + b)^2(a + b \cos^2(x))} - \frac{(8a^2 + 8ab + 3b^2) \text{Subst}\left(\int \frac{1}{a + (a+b)u^2} du\right)}{8a^2(a + b)^2}$$

$$= -\frac{(8a^2 + 8ab + 3b^2) \tan^{-1}\left(\frac{\sqrt{a+b} \cot(x)}{\sqrt{a}}\right)}{8a^{5/2}(a + b)^{5/2}} - \frac{b \cos(x) \sin(x)}{4a(a + b)(a + b \cos^2(x))^2} - \frac{3b(2a + b) \cos(x) \sin(x)}{8a^2(a + b)^2(a + b \cos^2(x))}$$

**Mathematica [A]** time = 0.615142, size = 106, normalized size = 0.99

$$\frac{(8a^2 + 8ab + 3b^2) \tan^{-1}\left(\frac{\sqrt{a} \tan(x)}{\sqrt{a+b}}\right)}{(a+b)^{5/2}} - \frac{\sqrt{ab} \sin(2x)(16a^2 + 3b(2a+b) \cos(2x) + 16ab + 3b^2)}{(a+b)^2(2a + b \cos(2x) + b)^2}$$

$8a^{5/2}$

Antiderivative was successfully verified.

[In] Integrate[(a + b\*cos[x]^2)^(-3), x]

[Out] (((8\*a^2 + 8\*a\*b + 3\*b^2)\*ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + b]])/(a + b)^(5/2) - (Sqrt[a]\*b\*(16\*a^2 + 16\*a\*b + 3\*b^2 + 3\*b\*(2\*a + b)\*Cos[2\*x])\*Sin[2\*x])/((a + b)^2\*(2\*a + b + b\*Cos[2\*x])^2))/(8\*a^(5/2))

**Maple [A]** time = 0.022, size = 175, normalized size = 1.6

$$\frac{1}{((\tan(x))^2 a + a + b)^2} \left( -\frac{b(8a + 5b)(\tan(x))^3}{8a(a^2 + 2ab + b^2)} - \frac{(8a + 3b)b \tan(x)}{8a^2(a + b)} \right) + \frac{1}{a^2 + 2ab + b^2} \arctan\left(a \tan(x) \frac{1}{\sqrt{(a + b)a}}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(a+b\*cos(x)^2)^3, x)

[Out] (-1/8\*b\*(8\*a+5\*b)/a/(a^2+2\*a\*b+b^2)\*tan(x)^3-1/8\*(8\*a+3\*b)/a^2\*b/(a+b)\*tan(x))/(tan(x)^2\*a+a+b)^2+1/(a^2+2\*a\*b+b^2)/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a)^(1/2))+1/(a^2+2\*a\*b+b^2)/a/((a+b)\*a)^(1/2)\*arctan(a\*tan(x)/((a+b)\*a

$)^{(1/2)} * b + 3/8 / (a^2 + 2 * a * b + b^2) / a^2 / ((a+b) * a)^{(1/2)} * \arctan(a * \tan(x) / ((a+b) * a)^{(1/2)}) * b^2$

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2)^3,x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [B]** time = 2.18925, size = 1381, normalized size = 12.91

result too large to display

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2)^3,x, algorithm="fricas")

[Out] 
$$\begin{aligned} & [-1/32 * (((8 * a^2 * b^2 + 8 * a * b^3 + 3 * b^4) * \cos(x)^4 + 8 * a^4 + 8 * a^3 * b + 3 * a^2 * b^2 + 2 * (8 * a^3 * b + 8 * a^2 * b^2 + 3 * a * b^3) * \cos(x)^2) * \sqrt{-a^2 - a * b} * \log(((8 * a^2 + 8 * a * b + b^2) * \cos(x)^4 - 2 * (4 * a^2 + 3 * a * b) * \cos(x)^2 + 4 * ((2 * a + b) * \cos(x)^3 - a * \cos(x)) * \sqrt{-a^2 - a * b} * \sin(x) + a^2) / (b^2 * \cos(x)^4 + 2 * a * b * \cos(x)^2 + a^2)) + 4 * (3 * (2 * a^3 * b^2 + 3 * a^2 * b^3 + a * b^4) * \cos(x)^3 + (8 * a^4 * b + 13 * a^3 * b^2 + 5 * a^2 * b^3) * \cos(x)) * \sin(x)) / (a^8 + 3 * a^7 * b + 3 * a^6 * b^2 + a^5 * b^3 + (a^6 * b^2 + 3 * a^5 * b^3 + 3 * a^4 * b^4 + a^3 * b^5) * \cos(x)^4 + 2 * (a^7 * b + 3 * a^6 * b^2 + 3 * a^5 * b^3 + a^4 * b^4) * \cos(x)^2), -1/16 * (((8 * a^2 * b^2 + 8 * a * b^3 + 3 * b^4) * \cos(x)^4 + 8 * a^4 + 8 * a^3 * b + 3 * a^2 * b^2 + 2 * (8 * a^3 * b + 8 * a^2 * b^2 + 3 * a * b^3) * \cos(x)^2) * \sqrt{a^2 + a * b} * \arctan(1/2 * ((2 * a + b) * \cos(x)^2 - a) / (\sqrt{a^2 + a * b} * \cos(x) * \sin(x))) + 2 * (3 * (2 * a^3 * b^2 + 3 * a^2 * b^3 + a * b^4) * \cos(x)^3 + (8 * a^4 * b + 13 * a^3 * b^2 + 5 * a^2 * b^3) * \cos(x)) * \sin(x)) / (a^8 + 3 * a^7 * b + 3 * a^6 * b^2 + a^5 * b^3 + (a^6 * b^2 + 3 * a^5 * b^3 + 3 * a^4 * b^4 + a^3 * b^5) * \cos(x)^4 + 2 * (a^7 * b + 3 * a^6 * b^2 + 3 * a^5 * b^3 + a^4 * b^4) * \cos(x)^2)] \end{aligned}$$

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)\*\*2)\*\*3,x)

[Out] Timed out

**Giac [A]** time = 1.15086, size = 201, normalized size = 1.88

$$\frac{\left(\pi \left[\frac{x}{\pi} + \frac{1}{2}\right] \operatorname{sgn}(a) + \arctan\left(\frac{a \tan(x)}{\sqrt{a^2 + ab}}\right)\right) (8a^2 + 8ab + 3b^2)}{8(a^4 + 2a^3b + a^2b^2)\sqrt{a^2 + ab}} - \frac{8a^2b \tan(x)^3 + 5ab^2 \tan(x)^3 + 8a^2b \tan(x) + 11ab^2 \tan(x)}{8(a^4 + 2a^3b + a^2b^2)(a \tan(x)^2 + a + b)}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(a+b*cos(x)^2)^3,x, algorithm="giac")
```

```
[Out] 1/8*(pi*floor(x/pi + 1/2)*sgn(a) + arctan(a*tan(x)/sqrt(a^2 + a*b)))*(8*a^2
+ 8*a*b + 3*b^2)/((a^4 + 2*a^3*b + a^2*b^2)*sqrt(a^2 + a*b)) - 1/8*(8*a^2*
b*tan(x)^3 + 5*a*b^2*tan(x)^3 + 8*a^2*b*tan(x) + 11*a*b^2*tan(x) + 3*b^3*ta
n(x))/((a^4 + 2*a^3*b + a^2*b^2)*(a*tan(x)^2 + a + b)^2)
```

$$3.44 \quad \int \frac{1}{1+\cos^2(x)} dx$$

**Optimal.** Leaf size=34

$$\frac{x}{\sqrt{2}} - \frac{\tan^{-1}\left(\frac{\sin(x)\cos(x)}{\cos^2(x)+\sqrt{2}+1}\right)}{\sqrt{2}}$$

[Out] x/Sqrt[2] - ArcTan[(Cos[x]\*Sin[x])/(1 + Sqrt[2] + Cos[x]^2)]/Sqrt[2]

**Rubi [A]** time = 0.0129128, antiderivative size = 34, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 8,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.25$ , Rules used = {3181, 203}

$$\frac{x}{\sqrt{2}} - \frac{\tan^{-1}\left(\frac{\sin(x)\cos(x)}{\cos^2(x)+\sqrt{2}+1}\right)}{\sqrt{2}}$$

Antiderivative was successfully verified.

[In] Int[(1 + Cos[x]^2)^(-1), x]

[Out] x/Sqrt[2] - ArcTan[(Cos[x]\*Sin[x])/(1 + Sqrt[2] + Cos[x]^2)]/Sqrt[2]

#### Rule 3181

Int[((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(-1), x\_Symbol] :> With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x]

#### Rule 203

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(1\*ArcTan[(Rt[b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])

#### Rubi steps

$$\begin{aligned} \int \frac{1}{1+\cos^2(x)} dx &= -\text{Subst}\left(\int \frac{1}{1+2x^2} dx, x, \cot(x)\right) \\ &= \frac{x}{\sqrt{2}} - \frac{\tan^{-1}\left(\frac{\cos(x)\sin(x)}{1+\sqrt{2}+\cos^2(x)}\right)}{\sqrt{2}} \end{aligned}$$

**Mathematica [A]** time = 0.0239075, size = 15, normalized size = 0.44

$$\frac{\tan^{-1}\left(\frac{\tan(x)}{\sqrt{2}}\right)}{\sqrt{2}}$$

Antiderivative was successfully verified.

[In] Integrate[(1 + Cos[x]^2)^(-1), x]

[Out] ArcTan[Tan[x]/Sqrt[2]]/Sqrt[2]

**Maple [A]** time = 0.011, size = 14, normalized size = 0.4

$$\frac{\sqrt{2}}{2} \arctan\left(\frac{\tan(x) \sqrt{2}}{2}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1+cos(x)^2),x)

[Out] 1/2\*arctan(1/2\*tan(x)\*2^(1/2))\*2^(1/2)

**Maxima [A]** time = 1.48428, size = 18, normalized size = 0.53

$$\frac{1}{2} \sqrt{2} \arctan\left(\frac{1}{2} \sqrt{2} \tan(x)\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2),x, algorithm="maxima")

[Out] 1/2\*sqrt(2)\*arctan(1/2\*sqrt(2)\*tan(x))

**Fricas [A]** time = 1.61721, size = 99, normalized size = 2.91

$$-\frac{1}{4} \sqrt{2} \arctan\left(\frac{3 \sqrt{2} \cos(x)^2 - \sqrt{2}}{4 \cos(x) \sin(x)}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2),x, algorithm="fricas")

[Out] -1/4\*sqrt(2)\*arctan(1/4\*(3\*sqrt(2)\*cos(x)^2 - sqrt(2))/(cos(x)\*sin(x)))

**Sympy [A]** time = 1.0749, size = 63, normalized size = 1.85

$$\frac{\sqrt{2} \left( \operatorname{atan}\left(\sqrt{2} \tan\left(\frac{x}{2}\right) - 1\right) + \pi \left\lfloor \frac{\frac{x}{2} - \frac{\pi}{2}}{\pi} \right\rfloor \right)}{2} + \frac{\sqrt{2} \left( \operatorname{atan}\left(\sqrt{2} \tan\left(\frac{x}{2}\right) + 1\right) + \pi \left\lfloor \frac{\frac{x}{2} - \frac{\pi}{2}}{\pi} \right\rfloor \right)}{2}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)\*\*2),x)

[Out] sqrt(2)\*(atan(sqrt(2)\*tan(x/2) - 1) + pi\*floor((x/2 - pi/2)/pi))/2 + sqrt(2)\*(atan(sqrt(2)\*tan(x/2) + 1) + pi\*floor((x/2 - pi/2)/pi))/2



---

**Giac [A]** time = 1.186, size = 62, normalized size = 1.82

$$\frac{1}{2} \sqrt{2} \left( x + \arctan \left( -\frac{\sqrt{2} \sin(2x) - \sin(2x)}{\sqrt{2} \cos(2x) + \sqrt{2} - \cos(2x) + 1} \right) \right)$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(1+cos(x)^2),x, algorithm="giac")
```

```
[Out] 1/2*sqrt(2)*(x + arctan(-(sqrt(2)*sin(2*x) - sin(2*x))/(sqrt(2)*cos(2*x) + sqrt(2) - cos(2*x) + 1)))
```

$$3.45 \quad \int \frac{1}{(1+\cos^2(x))^2} dx$$

**Optimal.** Leaf size=55

$$\frac{3x}{4\sqrt{2}} - \frac{\sin(x)\cos(x)}{4(\cos^2(x)+1)} - \frac{3 \tan^{-1}\left(\frac{\sin(x)\cos(x)}{\cos^2(x)+\sqrt{2}+1}\right)}{4\sqrt{2}}$$

[Out] (3\*x)/(4\*Sqrt[2]) - (3\*ArcTan[(Cos[x]\*Sin[x])/(1 + Sqrt[2] + Cos[x]^2)])/(4\*Sqrt[2]) - (Cos[x]\*Sin[x])/(4\*(1 + Cos[x]^2))

**Rubi [A]** time = 0.0257585, antiderivative size = 55, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 8,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.5$ , Rules used = {3184, 12, 3181, 203}

$$\frac{3x}{4\sqrt{2}} - \frac{\sin(x)\cos(x)}{4(\cos^2(x)+1)} - \frac{3 \tan^{-1}\left(\frac{\sin(x)\cos(x)}{\cos^2(x)+\sqrt{2}+1}\right)}{4\sqrt{2}}$$

Antiderivative was successfully verified.

[In] Int[(1 + Cos[x]^2)^(-2), x]

[Out] (3\*x)/(4\*Sqrt[2]) - (3\*ArcTan[(Cos[x]\*Sin[x])/(1 + Sqrt[2] + Cos[x]^2)])/(4\*Sqrt[2]) - (Cos[x]\*Sin[x])/(4\*(1 + Cos[x]^2))

#### Rule 3184

```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^2)^(p_), x_Symbol] := -Simp[(b*Cos[e + f*x]*Sin[e + f*x]*(a + b*Sin[e + f*x]^2)^(p + 1))/(2*a*f*(p + 1)*(a + b)), x] + Dist[1/(2*a*(p + 1)*(a + b)), Int[(a + b*Sin[e + f*x]^2)^(p + 1)*Simp[2*a*(p + 1) + b*(2*p + 3) - 2*b*(p + 2)*Sin[e + f*x]^2, x], x], x] /; FreeQ[{a, b, e, f}, x] && NeQ[a + b, 0] && LtQ[p, -1]
```

#### Rule 12

```
Int[(a_)*(u_), x_Symbol] := Dist[a, Int[u, x], x] /; FreeQ[a, x] && !MatchQ[u, (b_)*(v_) /; FreeQ[b, x]]
```

#### Rule 3181

```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^2)^(-1), x_Symbol] := With[{ff = FreeFactors[Tan[e + f*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)*ff^2*x^2), x], x, Tan[e + f*x]/ff], x] /; FreeQ[{a, b, e, f}, x]
```

#### Rule 203

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] := Simp[(1*ArcTan[(Rt[b, 2]*x)/Rt[a, 2]])/(Rt[a, 2]*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])
```

#### Rubi steps

$$\begin{aligned}
\int \frac{1}{(1 + \cos^2(x))^2} dx &= -\frac{\cos(x) \sin(x)}{4(1 + \cos^2(x))} - \frac{1}{4} \int -\frac{3}{1 + \cos^2(x)} dx \\
&= -\frac{\cos(x) \sin(x)}{4(1 + \cos^2(x))} + \frac{3}{4} \int \frac{1}{1 + \cos^2(x)} dx \\
&= -\frac{\cos(x) \sin(x)}{4(1 + \cos^2(x))} - \frac{3}{4} \text{Subst} \left( \int \frac{1}{1 + 2x^2} dx, x, \cot(x) \right) \\
&= \frac{3x}{4\sqrt{2}} - \frac{3 \tan^{-1} \left( \frac{\cos(x) \sin(x)}{1 + \sqrt{2} + \cos^2(x)} \right)}{4\sqrt{2}} - \frac{\cos(x) \sin(x)}{4(1 + \cos^2(x))}
\end{aligned}$$

**Mathematica [A]** time = 0.0757308, size = 35, normalized size = 0.64

$$\frac{3 \tan^{-1} \left( \frac{\tan(x)}{\sqrt{2}} \right)}{4\sqrt{2}} - \frac{\sin(2x)}{4(\cos(2x) + 3)}$$

Antiderivative was successfully verified.

[In] Integrate[(1 + Cos[x]^2)^(-2), x]

[Out] (3\*ArcTan[Tan[x]/Sqrt[2]])/(4\*Sqrt[2]) - Sin[2\*x]/(4\*(3 + Cos[2\*x]))

**Maple [A]** time = 0.017, size = 27, normalized size = 0.5

$$-\frac{\tan(x)}{4(\tan(x))^2 + 8} + \frac{3\sqrt{2}}{8} \arctan\left(\frac{\tan(x)\sqrt{2}}{2}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1+cos(x)^2)^2,x)

[Out] -1/4\*tan(x)/(tan(x)^2+2)+3/8\*arctan(1/2\*tan(x)\*2^(1/2))\*2^(1/2)

**Maxima [A]** time = 1.49173, size = 35, normalized size = 0.64

$$\frac{3}{8} \sqrt{2} \arctan\left(\frac{1}{2} \sqrt{2} \tan(x)\right) - \frac{\tan(x)}{4(\tan(x)^2 + 2)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^2,x, algorithm="maxima")

[Out] 3/8\*sqrt(2)\*arctan(1/2\*sqrt(2)\*tan(x)) - 1/4\*tan(x)/(tan(x)^2 + 2)

**Fricas [A]** time = 1.66115, size = 178, normalized size = 3.24

$$\frac{3(\sqrt{2} \cos(x)^2 + \sqrt{2}) \arctan\left(\frac{3\sqrt{2} \cos(x)^2 - \sqrt{2}}{4 \cos(x) \sin(x)}\right) + 4 \cos(x) \sin(x)}{16(\cos(x)^2 + 1)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^2,x, algorithm="fricas")

[Out]  $-1/16*(3*(\sqrt{2}*\cos(x)^2 + \sqrt{2})*\arctan(1/4*(3*\sqrt{2}*\cos(x)^2 - \sqrt{2}*(2))/(\cos(x)*\sin(x))) + 4*\cos(x)*\sin(x))/(\cos(x)^2 + 1)$

**Sympy [B]** time = 7.45973, size = 218, normalized size = 3.96

$$\frac{3\sqrt{2}\left(\operatorname{atan}\left(\sqrt{2}\tan\left(\frac{x}{2}\right)-1\right)+\pi\left\lfloor\frac{\frac{x}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)\tan^4\left(\frac{x}{2}\right)}{8\tan^4\left(\frac{x}{2}\right)+8} + \frac{3\sqrt{2}\left(\operatorname{atan}\left(\sqrt{2}\tan\left(\frac{x}{2}\right)-1\right)+\pi\left\lfloor\frac{\frac{x}{2}-\frac{\pi}{2}}{\pi}\right\rfloor\right)}{8\tan^4\left(\frac{x}{2}\right)+8} + \frac{3\sqrt{2}\left(\operatorname{atan}\left(\sqrt{2}\tan\left(\frac{x}{2}\right)\right)\right)}{8\tan^4\left(\frac{x}{2}\right)+8}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)\*\*2)\*\*2,x)

[Out]  $3*\sqrt{2}*(\operatorname{atan}(\sqrt{2}*\tan(x/2) - 1) + \pi*\operatorname{floor}((x/2 - \pi/2)/\pi))*\tan(x/2)^4/(8*\tan(x/2)^4 + 8) + 3*\sqrt{2}*(\operatorname{atan}(\sqrt{2}*\tan(x/2) - 1) + \pi*\operatorname{floor}((x/2 - \pi/2)/\pi))/(8*\tan(x/2)^4 + 8) + 3*\sqrt{2}*(\operatorname{atan}(\sqrt{2}*\tan(x/2) + 1) + \pi*\operatorname{floor}((x/2 - \pi/2)/\pi))*\tan(x/2)^4/(8*\tan(x/2)^4 + 8) + 3*\sqrt{2}*(\operatorname{atan}(\sqrt{2}*\tan(x/2) + 1) + \pi*\operatorname{floor}((x/2 - \pi/2)/\pi))/(8*\tan(x/2)^4 + 8) + 2*\tan(x/2)^3/(8*\tan(x/2)^4 + 8) - 2*\tan(x/2)/(8*\tan(x/2)^4 + 8)$

**Giac [A]** time = 1.19517, size = 80, normalized size = 1.45

$$\frac{3}{8}\sqrt{2}\left(x + \arctan\left(-\frac{\sqrt{2}\sin(2x) - \sin(2x)}{\sqrt{2}\cos(2x) + \sqrt{2} - \cos(2x) + 1}\right)\right) - \frac{\tan(x)}{4(\tan(x)^2 + 2)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^2,x, algorithm="giac")

[Out]  $3/8*\sqrt{2}*(x + \arctan(-(\sqrt{2}*\sin(2*x) - \sin(2*x))/(\sqrt{2}*\cos(2*x) + \sqrt{2} - \cos(2*x) + 1))) - 1/4*\tan(x)/(\tan(x)^2 + 2)$

$$3.46 \quad \int \frac{1}{(1+\cos^2(x))^3} dx$$

**Optimal.** Leaf size=71

$$\frac{19x}{32\sqrt{2}} - \frac{9 \sin(x) \cos(x)}{32(\cos^2(x) + 1)} - \frac{\sin(x) \cos(x)}{8(\cos^2(x) + 1)^2} - \frac{19 \tan^{-1}\left(\frac{\sin(x) \cos(x)}{\cos^2(x) + \sqrt{2} + 1}\right)}{32\sqrt{2}}$$

[Out] (19\*x)/(32\*Sqrt[2]) - (19\*ArcTan[(Cos[x]\*Sin[x])/(1 + Sqrt[2] + Cos[x]^2)])/(32\*Sqrt[2]) - (Cos[x]\*Sin[x])/(8\*(1 + Cos[x]^2)^2) - (9\*Cos[x]\*Sin[x])/(32\*(1 + Cos[x]^2))

**Rubi [A]** time = 0.0523739, antiderivative size = 71, normalized size of antiderivative = 1., number of steps used = 5, number of rules used = 5, integrand size = 8,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.625$ , Rules used = {3184, 3173, 12, 3181, 203}

$$\frac{19x}{32\sqrt{2}} - \frac{9 \sin(x) \cos(x)}{32(\cos^2(x) + 1)} - \frac{\sin(x) \cos(x)}{8(\cos^2(x) + 1)^2} - \frac{19 \tan^{-1}\left(\frac{\sin(x) \cos(x)}{\cos^2(x) + \sqrt{2} + 1}\right)}{32\sqrt{2}}$$

Antiderivative was successfully verified.

[In] Int[(1 + Cos[x]^2)^(-3), x]

[Out] (19\*x)/(32\*Sqrt[2]) - (19\*ArcTan[(Cos[x]\*Sin[x])/(1 + Sqrt[2] + Cos[x]^2)])/(32\*Sqrt[2]) - (Cos[x]\*Sin[x])/(8\*(1 + Cos[x]^2)^2) - (9\*Cos[x]\*Sin[x])/(32\*(1 + Cos[x]^2))

#### Rule 3184

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)])^2^(p\_), x\_Symbol] :> -Simp[(b\*Cos[e + f\*x]\*Sin[e + f\*x]\*(a + b\*Sin[e + f\*x]^2)^(p + 1))/(2\*a\*f\*(p + 1)\*(a + b)), x] + Dist[1/(2\*a\*(p + 1)\*(a + b)), Int[(a + b\*Sin[e + f\*x]^2)^(p + 1)\*Simp[2\*a\*(p + 1) + b\*(2\*p + 3) - 2\*b\*(p + 2)\*Sin[e + f\*x]^2, x], x], x] /; FreeQ[{a, b, e, f}, x] && NeQ[a + b, 0] && LtQ[p, -1]

#### Rule 3173

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)])^2^(p\_)\*((A\_) + (B\_)\*sin[(e\_) + (f\_)\*(x\_)])^2, x\_Symbol] :> -Simp[((A\*b - a\*B)\*Cos[e + f\*x]\*Sin[e + f\*x]\*(a + b\*Sin[e + f\*x]^2)^(p + 1))/(2\*a\*f\*(a + b)\*(p + 1)), x] - Dist[1/(2\*a\*(a + b)\*(p + 1)), Int[(a + b\*Sin[e + f\*x]^2)^(p + 1)\*Simp[a\*B - A\*(2\*a\*(p + 1) + b\*(2\*p + 3)) + 2\*(A\*b - a\*B)\*(p + 2)\*Sin[e + f\*x]^2, x], x], x] /; FreeQ[{a, b, e, f, A, B}, x] && LtQ[p, -1] && NeQ[a + b, 0]

#### Rule 12

Int[(a\_)\*(u\_), x\_Symbol] :> Dist[a, Int[u, x], x] /; FreeQ[a, x] && !MatchQ[u, (b\_)\*(v\_) /; FreeQ[b, x]]

#### Rule 3181

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)])^2^(-1), x\_Symbol] :> With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x]

**Rule 203**

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] := Simp[(1*ArcTan[(Rt[b, 2]*x)/Rt[a, 2]])/(Rt[a, 2]*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])
```

**Rubi steps**

$$\begin{aligned} \int \frac{1}{(1 + \cos^2(x))^3} dx &= -\frac{\cos(x) \sin(x)}{8(1 + \cos^2(x))^2} - \frac{1}{8} \int \frac{-7 + 2 \cos^2(x)}{(1 + \cos^2(x))^2} dx \\ &= -\frac{\cos(x) \sin(x)}{8(1 + \cos^2(x))^2} - \frac{9 \cos(x) \sin(x)}{32(1 + \cos^2(x))} - \frac{1}{32} \int -\frac{19}{1 + \cos^2(x)} dx \\ &= -\frac{\cos(x) \sin(x)}{8(1 + \cos^2(x))^2} - \frac{9 \cos(x) \sin(x)}{32(1 + \cos^2(x))} + \frac{19}{32} \int \frac{1}{1 + \cos^2(x)} dx \\ &= -\frac{\cos(x) \sin(x)}{8(1 + \cos^2(x))^2} - \frac{9 \cos(x) \sin(x)}{32(1 + \cos^2(x))} - \frac{19}{32} \text{Subst} \left( \int \frac{1}{1 + 2x^2} dx, x, \cot(x) \right) \\ &= \frac{19x}{32\sqrt{2}} - \frac{19 \tan^{-1} \left( \frac{\cos(x) \sin(x)}{1 + \sqrt{2} + \cos^2(x)} \right)}{32\sqrt{2}} - \frac{\cos(x) \sin(x)}{8(1 + \cos^2(x))^2} - \frac{9 \cos(x) \sin(x)}{32(1 + \cos^2(x))} \end{aligned}$$

**Mathematica [A]** time = 0.123027, size = 51, normalized size = 0.72

$$\frac{19 \tan^{-1} \left( \frac{\tan(x)}{\sqrt{2}} \right)}{32\sqrt{2}} - \frac{9 \sin(2x)}{32(\cos(2x) + 3)} - \frac{\sin(2x)}{4(\cos(2x) + 3)^2}$$

Antiderivative was successfully verified.

```
[In] Integrate[(1 + Cos[x]^2)^(-3), x]
```

```
[Out] (19*ArcTan[Tan[x]/Sqrt[2]])/(32*Sqrt[2]) - Sin[2*x]/(4*(3 + Cos[2*x])^2) - (9*Sin[2*x])/(32*(3 + Cos[2*x]))
```

**Maple [A]** time = 0.016, size = 35, normalized size = 0.5

$$\frac{1}{((\tan(x))^2 + 2)^2} \left( -\frac{13 (\tan(x))^3}{32} - \frac{11 \tan(x)}{16} \right) + \frac{19 \sqrt{2}}{64} \arctan \left( \frac{\tan(x) \sqrt{2}}{2} \right)$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] int(1/(1+cos(x)^2)^3, x)
```

```
[Out] (-13/32*tan(x)^3-11/16*tan(x))/(tan(x)^2+2)^2+19/64*arctan(1/2*tan(x)*2^(1/2))*2^(1/2)
```

**Maxima [A]** time = 1.45831, size = 55, normalized size = 0.77

$$\frac{19}{64} \sqrt{2} \arctan \left( \frac{1}{2} \sqrt{2} \tan(x) \right) - \frac{13 \tan(x)^3 + 22 \tan(x)}{32 (\tan(x)^4 + 4 \tan(x)^2 + 4)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^3,x, algorithm="maxima")

[Out]  $\frac{19\sqrt{2}\arctan\left(\frac{1}{2}\sqrt{2}\tan(x)\right) - \frac{1}{32}(13\tan(x)^3 + 22\tan(x))}{\tan(x)^4 + 4\tan(x)^2 + 4}$

**Fricas [A]** time = 1.6348, size = 251, normalized size = 3.54

$$\frac{19\left(\sqrt{2}\cos(x)^4 + 2\sqrt{2}\cos(x)^2 + \sqrt{2}\right)\arctan\left(\frac{3\sqrt{2}\cos(x)^2 - \sqrt{2}}{4\cos(x)\sin(x)}\right) + 4\left(9\cos(x)^3 + 13\cos(x)\right)\sin(x)}{128\left(\cos(x)^4 + 2\cos(x)^2 + 1\right)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^3,x, algorithm="fricas")

[Out]  $-\frac{1}{128}(19(\sqrt{2}\cos(x)^4 + 2\sqrt{2}\cos(x)^2 + \sqrt{2})\arctan\left(\frac{3\sqrt{2}\cos(x)^2 - \sqrt{2}}{4\cos(x)\sin(x)}\right) + 4(9\cos(x)^3 + 13\cos(x))\sin(x))/(\cos(x)^4 + 2\cos(x)^2 + 1)$

**Sympy [B]** time = 34.9375, size = 439, normalized size = 6.18

result too large to display

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)\*\*2)\*\*3,x)

[Out]  $19\sqrt{2}\left(\operatorname{atan}\left(\sqrt{2}\tan\left(\frac{x}{2}\right) - 1\right) + \pi\left\lfloor\frac{x/2 - \pi/2}{\pi}\right\rfloor\right)\tan\left(\frac{x}{2}\right)^8 / (64\tan\left(\frac{x}{2}\right)^8 + 128\tan\left(\frac{x}{2}\right)^4 + 64) + 38\sqrt{2}\left(\operatorname{atan}\left(\sqrt{2}\tan\left(\frac{x}{2}\right) - 1\right) + \pi\left\lfloor\frac{x/2 - \pi/2}{\pi}\right\rfloor\right)\tan\left(\frac{x}{2}\right)^4 / (64\tan\left(\frac{x}{2}\right)^8 + 128\tan\left(\frac{x}{2}\right)^4 + 64) + 19\sqrt{2}\left(\operatorname{atan}\left(\sqrt{2}\tan\left(\frac{x}{2}\right) - 1\right) + \pi\left\lfloor\frac{x/2 - \pi/2}{\pi}\right\rfloor\right) / (64\tan\left(\frac{x}{2}\right)^8 + 128\tan\left(\frac{x}{2}\right)^4 + 64) + 19\sqrt{2}\left(\operatorname{atan}\left(\sqrt{2}\tan\left(\frac{x}{2}\right) + 1\right) + \pi\left\lfloor\frac{x/2 - \pi/2}{\pi}\right\rfloor\right)\tan\left(\frac{x}{2}\right)^8 / (64\tan\left(\frac{x}{2}\right)^8 + 128\tan\left(\frac{x}{2}\right)^4 + 64) + 38\sqrt{2}\left(\operatorname{atan}\left(\sqrt{2}\tan\left(\frac{x}{2}\right) + 1\right) + \pi\left\lfloor\frac{x/2 - \pi/2}{\pi}\right\rfloor\right)\tan\left(\frac{x}{2}\right)^4 / (64\tan\left(\frac{x}{2}\right)^8 + 128\tan\left(\frac{x}{2}\right)^4 + 64) + 19\sqrt{2}\left(\operatorname{atan}\left(\sqrt{2}\tan\left(\frac{x}{2}\right) + 1\right) + \pi\left\lfloor\frac{x/2 - \pi/2}{\pi}\right\rfloor\right) / (64\tan\left(\frac{x}{2}\right)^8 + 128\tan\left(\frac{x}{2}\right)^4 + 64) + 22\tan\left(\frac{x}{2}\right)^7 / (64\tan\left(\frac{x}{2}\right)^8 + 128\tan\left(\frac{x}{2}\right)^4 + 64) - 14\tan\left(\frac{x}{2}\right)^5 / (64\tan\left(\frac{x}{2}\right)^8 + 128\tan\left(\frac{x}{2}\right)^4 + 64) + 14\tan\left(\frac{x}{2}\right)^3 / (64\tan\left(\frac{x}{2}\right)^8 + 128\tan\left(\frac{x}{2}\right)^4 + 64) - 22\tan\left(\frac{x}{2}\right) / (64\tan\left(\frac{x}{2}\right)^8 + 128\tan\left(\frac{x}{2}\right)^4 + 64)$

**Giac [A]** time = 1.22654, size = 92, normalized size = 1.3

$$\frac{19}{64}\sqrt{2}\left(x + \arctan\left(-\frac{\sqrt{2}\sin(2x) - \sin(2x)}{\sqrt{2}\cos(2x) + \sqrt{2} - \cos(2x) + 1}\right)\right) - \frac{13\tan(x)^3 + 22\tan(x)}{32(\tan(x)^2 + 2)^2}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^3,x, algorithm="giac")

```
[Out] 19/64*sqrt(2)*(x + arctan(-(sqrt(2)*sin(2*x) - sin(2*x))/(sqrt(2)*cos(2*x)
+ sqrt(2) - cos(2*x) + 1))) - 1/32*(13*tan(x)^3 + 22*tan(x))/(tan(x)^2 + 2)
^2
```



### 3.47 $\int \sqrt{1 - \cos^2(x)} dx$

**Optimal.** Leaf size=12

$$\sqrt{\sin^2(x)(-\cot(x))}$$

[Out] -(Cot[x]\*Sqrt[Sin[x]^2])

**Rubi [A]** time = 0.0158364, antiderivative size = 12, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.25$ , Rules used = {3176, 3207, 2638}

$$\sqrt{\sin^2(x)(-\cot(x))}$$

Antiderivative was successfully verified.

[In] Int[Sqrt[1 - Cos[x]^2],x]

[Out] -(Cot[x]\*Sqrt[Sin[x]^2])

#### Rule 3176

Int[(u\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^p], x\_Symbol] := Int[ActivateTrig[u\*(a\*cos[e + f\*x]^2)^p], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0]

#### Rule 3207

Int[(u\_.)\*((b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^n)^p], x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[((b\*ff^n)^IntPart[p]\*(b\*Ssin[e + f\*x]^n)^FracPart[p])/(Sin[e + f\*x]/ff)^(n\*FracPart[p]), Int[ActivateTrig[u]\*(Sin[e + f\*x]/ff)^(n\*p), x], x]] /; FreeQ[{b, e, f, n, p}, x] && !IntegerQ[p] && IntegerQ[n] && (EqQ[u, 1] || MatchQ[u, ((d\_.)\*(trig\_)[e + f\*x])^(m\_.) /; FreeQ[{d, m}, x] && MemberQ[{sin, cos, tan, cot, sec, csc}, trig])]

#### Rule 2638

Int[sin[(c\_.) + (d\_.)\*(x\_)], x\_Symbol] := -Simp[Cos[c + d\*x]/d, x] /; FreeQ[{c, d}, x]

#### Rubi steps

$$\begin{aligned} \int \sqrt{1 - \cos^2(x)} dx &= \int \sqrt{\sin^2(x)} dx \\ &= \left( \csc(x) \sqrt{\sin^2(x)} \right) \int \sin(x) dx \\ &= -\cot(x) \sqrt{\sin^2(x)} \end{aligned}$$

**Mathematica [A]** time = 0.0061805, size = 12, normalized size = 1.

$$\sqrt{\sin^2(x)(-\cot(x))}$$

Antiderivative was successfully verified.

[In] Integrate[Sqrt[1 - Cos[x]^2], x]

[Out] -(Cot[x]\*Sqrt[Sin[x]^2])

**Maple [A]** time = 0.463, size = 13, normalized size = 1.1

$$-\cos(x) \sin(x) \frac{1}{\sqrt{(\sin(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((1-cos(x)^2)^(1/2), x)

[Out] -sin(x)\*cos(x)/(sin(x)^2)^(1/2)

**Maxima [A]** time = 1.44539, size = 14, normalized size = 1.17

$$-\frac{1}{\sqrt{\tan(x)^2 + 1}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((1-cos(x)^2)^(1/2), x, algorithm="maxima")

[Out] -1/sqrt(tan(x)^2 + 1)

**Fricas [A]** time = 1.89958, size = 12, normalized size = 1.

$$-\cos(x)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((1-cos(x)^2)^(1/2), x, algorithm="fricas")

[Out] -cos(x)

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{1 - \cos^2(x)} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((1-cos(x)\*\*2)\*\*(1/2), x)

[Out] Integral(sqrt(1 - cos(x)\*\*2), x)

---

**Giac [B]** time = 1.271, size = 32, normalized size = 2.67

$$-\frac{2 \operatorname{sgn}\left(\tan\left(\frac{1}{2}x\right)^3 + \tan\left(\frac{1}{2}x\right)\right)}{\tan\left(\frac{1}{2}x\right)^2 + 1}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate((1-cos(x)^2)^(1/2),x, algorithm="giac")
```

```
[Out] -2*sgn(tan(1/2*x)^3 + tan(1/2*x))/(tan(1/2*x)^2 + 1)
```

### 3.48 $\int \sqrt{-1 + \cos^2(x)} dx$

**Optimal.** Leaf size=14

$$\sqrt{-\sin^2(x)(-\cot(x))}$$

[Out] -(Cot[x]\*Sqrt[-Sin[x]^2])

**Rubi [A]** time = 0.0158867, antiderivative size = 14, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.3$ , Rules used = {3176, 3207, 2638}

$$\sqrt{-\sin^2(x)(-\cot(x))}$$

Antiderivative was successfully verified.

[In] Int[Sqrt[-1 + Cos[x]^2], x]

[Out] -(Cot[x]\*Sqrt[-Sin[x]^2])

#### Rule 3176

```
Int[(u_.)*((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^2)^p, x_Symbol] := Int[ActivateTrig[u*(a*cos[e + f*x]^2)^p], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0]
```

#### Rule 3207

```
Int[(u_.)*((b_.)*sin[(e_.) + (f_.)*(x_)]^n)^p, x_Symbol] := With[{ff = FreeFactors[Sin[e + f*x], x]}, Dist[((b*ff^n)^IntPart[p]*(b*Ssin[e + f*x]^n)^FracPart[p])/(Sin[e + f*x]/ff)^(n*FracPart[p]), Int[ActivateTrig[u*(Sin[e + f*x]/ff)^(n*p), x], x]] /; FreeQ[{b, e, f, n, p}, x] && !IntegerQ[p] && IntegerQ[n] && (EqQ[u, 1] || MatchQ[u, ((d_.)*(trig_)[e + f*x])^(m_.)] /; FreeQ[{d, m}, x] && MemberQ[{sin, cos, tan, cot, sec, csc}, trig])
```

#### Rule 2638

```
Int[sin[(c_.) + (d_.)*(x_)], x_Symbol] := -Simp[Cos[c + d*x]/d, x] /; FreeQ[{c, d}, x]
```

#### Rubi steps

$$\begin{aligned} \int \sqrt{-1 + \cos^2(x)} dx &= \int \sqrt{-\sin^2(x)} dx \\ &= \left( \csc(x) \sqrt{-\sin^2(x)} \right) \int \sin(x) dx \\ &= -\cot(x) \sqrt{-\sin^2(x)} \end{aligned}$$

**Mathematica [A]** time = 0.0046514, size = 14, normalized size = 1.

$$\sqrt{-\sin^2(x)(-\cot(x))}$$

Antiderivative was successfully verified.

[In] Integrate[Sqrt[-1 + Cos[x]^2],x]

[Out] -(Cot[x]\*Sqrt[-Sin[x]^2])

**Maple [A]** time = 0.231, size = 14, normalized size = 1.

$$\cos(x) \sin(x) \frac{1}{\sqrt{-(\sin(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((-1+cos(x)^2)^(1/2),x)

[Out] sin(x)\*cos(x)/(-sin(x)^2)^(1/2)

**Maxima [A]** time = 1.45688, size = 16, normalized size = 1.14

$$-\frac{1}{\sqrt{-\tan(x)^2 - 1}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1+cos(x)^2)^(1/2),x, algorithm="maxima")

[Out] -1/sqrt(-tan(x)^2 - 1)

**Fricas [A]** time = 1.77924, size = 4, normalized size = 0.29

0

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1+cos(x)^2)^(1/2),x, algorithm="fricas")

[Out] 0

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{\cos^2(x) - 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1+cos(x)\*\*2)\*\*(1/2),x)

[Out] Integral(sqrt(cos(x)\*\*2 - 1), x)

---

**Giac [C]** time = 1.1781, size = 38, normalized size = 2.71

$$\frac{2i \operatorname{sgn}\left(-\tan\left(\frac{1}{2}x\right)^3 - \tan\left(\frac{1}{2}x\right)\right)}{\tan\left(\frac{1}{2}x\right)^2 + 1}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1+cos(x)^2)^(1/2),x, algorithm="giac")

[Out] 2\*I\*sgn(-tan(1/2\*x)^3 - tan(1/2\*x))/(tan(1/2\*x)^2 + 1)

$$3.49 \quad \int (1 - \cos^2(x))^{3/2} dx$$

**Optimal.** Leaf size=29

$$-\frac{1}{3} \sin^2(x)^{3/2} \cot(x) - \frac{2}{3} \sqrt{\sin^2(x)} \cot(x)$$

[Out]  $(-2*\text{Cot}[x]*\text{Sqrt}[\text{Sin}[x]^2])/3 - (\text{Cot}[x]*(\text{Sin}[x]^2)^{(3/2)})/3$

**Rubi [A]** time = 0.022335, antiderivative size = 29, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3176, 3203, 3207, 2638}

$$-\frac{1}{3} \sin^2(x)^{3/2} \cot(x) - \frac{2}{3} \sqrt{\sin^2(x)} \cot(x)$$

Antiderivative was successfully verified.

[In]  $\text{Int}[(1 - \text{Cos}[x]^2)^{(3/2)}, x]$

[Out]  $(-2*\text{Cot}[x]*\text{Sqrt}[\text{Sin}[x]^2])/3 - (\text{Cot}[x]*(\text{Sin}[x]^2)^{(3/2)})/3$

#### Rule 3176

$\text{Int}[(u_.)*((a_.) + (b_.)*\sin[(e_.) + (f_.)*(x_)]^2)^{(p_)}, x\_Symbol] \rightarrow \text{Int}[\text{ActivateTrig}[u*(a*\cos[e + f*x]^2)^p], x] /; \text{FreeQ}\{a, b, e, f, p\}, x] \&\& \text{EqQ}[a + b, 0]$

#### Rule 3203

$\text{Int}[(b_.)*\sin[(e_.) + (f_.)*(x_)]^2)^{(p_)}, x\_Symbol] \rightarrow -\text{Simp}[(\text{Cot}[e + f*x] * (b*\sin[e + f*x]^2)^p)/(2*f*p), x] + \text{Dist}[(b*(2*p - 1))/(2*p), \text{Int}[(b*\sin[e + f*x]^2)^{(p - 1)}, x], x] /; \text{FreeQ}\{b, e, f\}, x] \&\& !\text{IntegerQ}[p] \&\& \text{GtQ}[p, 1]$

#### Rule 3207

$\text{Int}[(u_.)*((b_.)*\sin[(e_.) + (f_.)*(x_)]^n)^{(p_)}, x\_Symbol] \rightarrow \text{With}\{\{ff = \text{FreeFactors}[\sin[e + f*x], x]\}, \text{Dist}[(b*ff^n)^{\text{IntPart}[p]} * (b*\sin[e + f*x]^n)^{\text{FracPart}[p]}] / (\sin[e + f*x]/ff)^{(n*\text{FracPart}[p])}, \text{Int}[\text{ActivateTrig}[u*(\sin[e + f*x]/ff)^{(n*p)}, x], x] /; \text{FreeQ}\{b, e, f, n, p\}, x] \&\& !\text{IntegerQ}[p] \&\& \text{IntegerQ}[n] \&\& (\text{EqQ}[u, 1] \|\ \text{MatchQ}[u, ((d_.)*(\text{trig}_)[e + f*x])^m]) /; \text{FreeQ}\{d, m\}, x] \&\& \text{MemberQ}\{\{\sin, \cos, \tan, \cot, \sec, \csc\}, \text{trig}\}$

#### Rule 2638

$\text{Int}[\sin[(c_.) + (d_.)*(x_)], x\_Symbol] \rightarrow -\text{Simp}[\text{Cos}[c + d*x]/d, x] /; \text{FreeQ}\{c, d\}, x]$

#### Rubi steps

$$\begin{aligned}
\int (1 - \cos^2(x))^{3/2} dx &= \int \sin^2(x)^{3/2} dx \\
&= -\frac{1}{3} \cot(x) \sin^2(x)^{3/2} + \frac{2}{3} \int \sqrt{\sin^2(x)} dx \\
&= -\frac{1}{3} \cot(x) \sin^2(x)^{3/2} + \frac{1}{3} \left( 2 \csc(x) \sqrt{\sin^2(x)} \right) \int \sin(x) dx \\
&= -\frac{2}{3} \cot(x) \sqrt{\sin^2(x)} - \frac{1}{3} \cot(x) \sin^2(x)^{3/2}
\end{aligned}$$

**Mathematica [A]** time = 0.0263914, size = 23, normalized size = 0.79

$$\frac{1}{12} \sqrt{\sin^2(x)} (\cos(3x) - 9 \cos(x)) \csc(x)$$

Antiderivative was successfully verified.

[In] Integrate[(1 - Cos[x]^2)^(3/2), x]

[Out] ((-9\*Cos[x] + Cos[3\*x])\*Csc[x]\*Sqrt[Sin[x]^2])/12

**Maple [A]** time = 0.756, size = 19, normalized size = 0.7

$$\frac{\cos(x) \sin(x) ((\cos(x))^2 - 3)}{3} \frac{1}{\sqrt{(\sin(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((1-cos(x)^2)^(3/2), x)

[Out] 1/3\*sin(x)\*cos(x)\*(cos(x)^2-3)/(sin(x)^2)^(1/2)

**Maxima [A]** time = 1.63589, size = 15, normalized size = 0.52

$$-\frac{1}{12} \cos(3x) + \frac{3}{4} \cos(x)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((1-cos(x)^2)^(3/2), x, algorithm="maxima")

[Out] -1/12\*cos(3\*x) + 3/4\*cos(x)

**Fricas [A]** time = 1.72423, size = 31, normalized size = 1.07

$$\frac{1}{3} \cos(x)^3 - \cos(x)$$

Verification of antiderivative is not currently implemented for this CAS.



[In] integrate((1-cos(x)^2)^(3/2),x, algorithm="fricas")

[Out] 1/3\*cos(x)^3 - cos(x)

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((1-cos(x)\*\*2)\*\*(3/2),x)

[Out] Timed out

**Giac [B]** time = 1.21325, size = 61, normalized size = 2.1

$$\frac{4 \left( 3 \operatorname{sgn} \left( \tan \left( \frac{1}{2} x \right)^3 + \tan \left( \frac{1}{2} x \right) \right) \tan \left( \frac{1}{2} x \right)^2 + \operatorname{sgn} \left( \tan \left( \frac{1}{2} x \right)^3 + \tan \left( \frac{1}{2} x \right) \right) \right)}{3 \left( \tan \left( \frac{1}{2} x \right)^2 + 1 \right)^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((1-cos(x)^2)^(3/2),x, algorithm="giac")

[Out] -4/3\*(3\*sgn(tan(1/2\*x)^3 + tan(1/2\*x))\*tan(1/2\*x)^2 + sgn(tan(1/2\*x)^3 + tan(1/2\*x)))/(tan(1/2\*x)^2 + 1)^3

### 3.50 $\int (-1 + \cos^2(x))^{3/2} dx$

**Optimal.** Leaf size=33

$$\frac{2}{3}\sqrt{-\sin^2(x)}\cot(x) - \frac{1}{3}(-\sin^2(x))^{3/2}\cot(x)$$

[Out] (2\*Cot[x]\*Sqrt[-Sin[x]^2])/3 - (Cot[x]\*(-Sin[x]^2)^(3/2))/3

**Rubi [A]** time = 0.0246809, antiderivative size = 33, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.4$ , Rules used = {3176, 3203, 3207, 2638}

$$\frac{2}{3}\sqrt{-\sin^2(x)}\cot(x) - \frac{1}{3}(-\sin^2(x))^{3/2}\cot(x)$$

Antiderivative was successfully verified.

[In] Int[(-1 + Cos[x]^2)^(3/2), x]

[Out] (2\*Cot[x]\*Sqrt[-Sin[x]^2])/3 - (Cot[x]\*(-Sin[x]^2)^(3/2))/3

#### Rule 3176

Int[(u\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_), x\_Symbol] := Int[ActivateTrig[u\*(a\*cos[e + f\*x]^2)^p], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0]

#### Rule 3203

Int[((b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_), x\_Symbol] := -Simp[(Cot[e + f\*x]\*(b\*Sint[e + f\*x]^2)^p)/(2\*f\*p), x] + Dist[(b\*(2\*p - 1))/(2\*p), Int[(b\*Sint[e + f\*x]^2)^(p - 1), x], x] /; FreeQ[{b, e, f}, x] && !IntegerQ[p] && GtQ[p, 1]

#### Rule 3207

Int[(u\_.)\*((b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^(n\_))^(p\_), x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[((b\*ff^n)^IntPart[p]\*(b\*Sint[e + f\*x]^n)^FracPart[p])/(Sin[e + f\*x]/ff)^(n\*FracPart[p]), Int[ActivateTrig[u\*(Sin[e + f\*x]/ff)^(n\*p), x], x]] /; FreeQ[{b, e, f, n, p}, x] && !IntegerQ[p] && IntegerQ[n] && (EqQ[u, 1] || MatchQ[u, ((d\_.)\*(trig\_)[e + f\*x])^(m\_.)] /; FreeQ[{d, m}, x] && MemberQ[{sin, cos, tan, cot, sec, csc}, trig])

#### Rule 2638

Int[sin[(c\_.) + (d\_.)\*(x\_)], x\_Symbol] := -Simp[Cos[c + d\*x]/d, x] /; FreeQ[{c, d}, x]

#### Rubi steps

$$\begin{aligned}
\int (-1 + \cos^2(x))^{3/2} dx &= \int (-\sin^2(x))^{3/2} dx \\
&= -\frac{1}{3} \cot(x) (-\sin^2(x))^{3/2} - \frac{2}{3} \int \sqrt{-\sin^2(x)} dx \\
&= -\frac{1}{3} \cot(x) (-\sin^2(x))^{3/2} - \frac{1}{3} \left( 2 \csc(x) \sqrt{-\sin^2(x)} \right) \int \sin(x) dx \\
&= \frac{2}{3} \cot(x) \sqrt{-\sin^2(x)} - \frac{1}{3} \cot(x) (-\sin^2(x))^{3/2}
\end{aligned}$$

**Mathematica [A]** time = 0.0255911, size = 25, normalized size = 0.76

$$-\frac{1}{12} \sqrt{-\sin^2(x)} (\cos(3x) - 9 \cos(x)) \csc(x)$$

Antiderivative was successfully verified.

[In] Integrate[(-1 + Cos[x]^2)^(3/2), x]

[Out] -((-9\*Cos[x] + Cos[3\*x])\*Csc[x]\*Sqrt[-Sin[x]^2])/12

**Maple [A]** time = 0.464, size = 21, normalized size = 0.6

$$-\frac{\cos(x) \sin(x) ((\sin(x))^2 + 2)}{3} \frac{1}{\sqrt{-(\sin(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((-1+cos(x)^2)^(3/2), x)

[Out] -1/3\*sin(x)\*cos(x)\*(sin(x)^2+2)/(-sin(x)^2)^(1/2)

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int (\cos(x)^2 - 1)^{3/2} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1+cos(x)^2)^(3/2), x, algorithm="maxima")

[Out] integrate((cos(x)^2 - 1)^(3/2), x)

**Fricas [A]** time = 1.54771, size = 4, normalized size = 0.12

0

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1+cos(x)^2)^(3/2),x, algorithm="fricas")

[Out] 0

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1+cos(x)\*\*2)\*\*(3/2),x)

[Out] Timed out

**Giac [C]** time = 1.24418, size = 74, normalized size = 2.24

$$\frac{12i \operatorname{sgn}\left(-\tan\left(\frac{1}{2}x\right)^3 - \tan\left(\frac{1}{2}x\right)\right) \tan\left(\frac{1}{2}x\right)^2 + 4i \operatorname{sgn}\left(-\tan\left(\frac{1}{2}x\right)^3 - \tan\left(\frac{1}{2}x\right)\right)}{3\left(\tan\left(\frac{1}{2}x\right)^2 + 1\right)^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1+cos(x)^2)^(3/2),x, algorithm="giac")

[Out] -1/3\*(12\*I\*sgn(-tan(1/2\*x)^3 - tan(1/2\*x))\*tan(1/2\*x)^2 + 4\*I\*sgn(-tan(1/2\*x)^3 - tan(1/2\*x)))/(tan(1/2\*x)^2 + 1)^3

$$3.51 \quad \int \frac{1}{\sqrt{1-\cos^2(x)}} dx$$

**Optimal.** Leaf size=15

$$\frac{\sin(x) \tanh^{-1}(\cos(x))}{\sqrt{\sin^2(x)}}$$

[Out] -((ArcTanh[Cos[x]]\*Sin[x])/Sqrt[Sin[x]^2])

**Rubi [A]** time = 0.0198256, antiderivative size = 15, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.25$ , Rules used = {3176, 3207, 3770}

$$\frac{\sin(x) \tanh^{-1}(\cos(x))}{\sqrt{\sin^2(x)}}$$

Antiderivative was successfully verified.

[In] Int[1/Sqrt[1 - Cos[x]^2], x]

[Out] -((ArcTanh[Cos[x]]\*Sin[x])/Sqrt[Sin[x]^2])

#### Rule 3176

Int[(u\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_), x\_Symbol] :> Int[ActivateTrig[u\*(a\*cos[e + f\*x]^2)^p], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0]

#### Rule 3207

Int[(u\_.)\*((b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^(n\_))^(p\_), x\_Symbol] :> With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[((b\*ff^n)^IntPart[p]\*(b\*Ssin[e + f\*x]^n)^FracPart[p])/(Sin[e + f\*x]/ff)^(n\*FracPart[p]), Int[ActivateTrig[u]\*(Sin[e + f\*x]/ff)^(n\*p), x], x] /; FreeQ[{b, e, f, n, p}, x] && !IntegerQ[p] && IntegerQ[n] && (EqQ[u, 1] || MatchQ[u, ((d\_.)\*(trig\_)[e + f\*x])^(m\_.) /; FreeQ[{d, m}, x] && MemberQ[{sin, cos, tan, cot, sec, csc}, trig])]

#### Rule 3770

Int[csc[(c\_.) + (d\_.)\*(x\_)], x\_Symbol] :> -Simp[ArcTanh[Cos[c + d\*x]]/d, x] /; FreeQ[{c, d}, x]

#### Rubi steps

$$\begin{aligned} \int \frac{1}{\sqrt{1-\cos^2(x)}} dx &= \int \frac{1}{\sqrt{\sin^2(x)}} dx \\ &= \frac{\sin(x) \int \csc(x) dx}{\sqrt{\sin^2(x)}} \\ &= -\frac{\tanh^{-1}(\cos(x)) \sin(x)}{\sqrt{\sin^2(x)}} \end{aligned}$$

**Mathematica [A]** time = 0.0153835, size = 28, normalized size = 1.87

$$\frac{\sin(x) \left( \log \left( \sin \left( \frac{x}{2} \right) \right) - \log \left( \cos \left( \frac{x}{2} \right) \right) \right)}{\sqrt{\sin^2(x)}}$$

Antiderivative was successfully verified.

[In] Integrate[1/Sqrt[1 - Cos[x]^2],x]

[Out] ((-Log[Cos[x/2]] + Log[Sin[x/2]])\*Sin[x])/Sqrt[Sin[x]^2]

**Maple [A]** time = 0.336, size = 14, normalized size = 0.9

$$-\operatorname{Arctanh}(\cos(x)) \sin(x) \frac{1}{\sqrt{(\sin(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1-cos(x)^2)^(1/2),x)

[Out] -arctanh(cos(x))\*sin(x)/(sin(x)^2)^(1/2)

**Maxima [B]** time = 1.63955, size = 47, normalized size = 3.13

$$\frac{1}{2} \log(\cos(x)^2 + \sin(x)^2 + 2 \cos(x) + 1) - \frac{1}{2} \log(\cos(x)^2 + \sin(x)^2 - 2 \cos(x) + 1)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^2)^(1/2),x, algorithm="maxima")

[Out] 1/2\*log(cos(x)^2 + sin(x)^2 + 2\*cos(x) + 1) - 1/2\*log(cos(x)^2 + sin(x)^2 - 2\*cos(x) + 1)

**Fricas [A]** time = 1.61243, size = 77, normalized size = 5.13

$$-\frac{1}{2} \log\left(\frac{1}{2} \cos(x) + \frac{1}{2}\right) + \frac{1}{2} \log\left(-\frac{1}{2} \cos(x) + \frac{1}{2}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^2)^(1/2),x, algorithm="fricas")

[Out] -1/2\*log(1/2\*cos(x) + 1/2) + 1/2\*log(-1/2\*cos(x) + 1/2)

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{1 - \cos^2(x)}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)\*\*2)\*\*(1/2), x)

[Out] Integral(1/sqrt(1 - cos(x)\*\*2), x)

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{-\cos(x)^2 + 1}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^2)^(1/2), x, algorithm="giac")

[Out] integrate(1/sqrt(-cos(x)^2 + 1), x)

$$3.52 \quad \int \frac{1}{\sqrt{-1+\cos^2(x)}} dx$$

**Optimal.** Leaf size=17

$$-\frac{\sin(x) \tanh^{-1}(\cos(x))}{\sqrt{-\sin^2(x)}}$$

[Out] -((ArcTanh[Cos[x]]\*Sin[x])/Sqrt[-Sin[x]^2])

**Rubi [A]** time = 0.0184225, antiderivative size = 17, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.3$ , Rules used = {3176, 3207, 3770}

$$-\frac{\sin(x) \tanh^{-1}(\cos(x))}{\sqrt{-\sin^2(x)}}$$

Antiderivative was successfully verified.

[In] Int[1/Sqrt[-1 + Cos[x]^2], x]

[Out] -((ArcTanh[Cos[x]]\*Sin[x])/Sqrt[-Sin[x]^2])

#### Rule 3176

Int[(u\_)\*((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^p], x\_Symbol] :> Int[ActivateTrig[u\*(a\*cos[e + f\*x]^2)^p], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0]

#### Rule 3207

Int[(u\_)\*((b\_)\*sin[(e\_) + (f\_)\*(x\_)]^n)^p], x\_Symbol] :> With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[((b\*ff^n)^IntPart[p]\*(b\*Ssin[e + f\*x]^n)^FracPart[p])/(Sin[e + f\*x]/ff)^(n\*FracPart[p]), Int[ActivateTrig[u\*(Sin[e + f\*x]/ff)^(n\*p), x], x] /; FreeQ[{b, e, f, n, p}, x] && !IntegerQ[p] && IntegerQ[n] && (EqQ[u, 1] || MatchQ[u, ((d\_)\*(trig\_)[e + f\*x])^(m\_) /; FreeQ[{d, m}, x] && MemberQ[{sin, cos, tan, cot, sec, csc}, trig])]

#### Rule 3770

Int[csc[(c\_) + (d\_)\*(x\_)], x\_Symbol] :> -Simp[ArcTanh[Cos[c + d\*x]]/d, x] /; FreeQ[{c, d}, x]

#### Rubi steps

$$\begin{aligned} \int \frac{1}{\sqrt{-1+\cos^2(x)}} dx &= \int \frac{1}{\sqrt{-\sin^2(x)}} dx \\ &= \frac{\sin(x) \int \csc(x) dx}{\sqrt{-\sin^2(x)}} \\ &= -\frac{\tanh^{-1}(\cos(x)) \sin(x)}{\sqrt{-\sin^2(x)}} \end{aligned}$$



**Mathematica [A]** time = 0.0102452, size = 30, normalized size = 1.76

$$\frac{\sin(x) \left( \log \left( \sin \left( \frac{x}{2} \right) \right) - \log \left( \cos \left( \frac{x}{2} \right) \right) \right)}{\sqrt{-\sin^2(x)}}$$

Antiderivative was successfully verified.

[In] Integrate[1/Sqrt[-1 + Cos[x]^2], x]

[Out] ((-Log[Cos[x/2]] + Log[Sin[x/2]])\*Sin[x])/Sqrt[-Sin[x]^2]

**Maple [B]** time = 0.233, size = 34, normalized size = 2.

$$-\frac{\sin(x)}{\cos(x)} \sqrt{-(\cos(x))^2} \arctan \left( \frac{1}{\sqrt{-(\cos(x))^2}} \right) \frac{1}{\sqrt{-(\sin(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(-1+cos(x)^2)^(1/2), x)

[Out] -sin(x)\*(-cos(x)^2)^(1/2)\*arctan(1/(-cos(x)^2)^(1/2))/cos(x)/(-sin(x)^2)^(1/2)

**Maxima [A]** time = 1.58404, size = 23, normalized size = 1.35

$$-\arctan(\sin(x), \cos(x) + 1) + \arctan(\sin(x), \cos(x) - 1)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1+cos(x)^2)^(1/2), x, algorithm="maxima")

[Out] -arctan2(sin(x), cos(x) + 1) + arctan2(sin(x), cos(x) - 1)

**Fricas [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: UnboundLocalError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1+cos(x)^2)^(1/2), x, algorithm="fricas")

[Out] Exception raised: UnboundLocalError

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{\cos^2(x) - 1}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(-1+cos(x)**2)**(1/2),x)
```

```
[Out] Integral(1/sqrt(cos(x)**2 - 1), x)
```

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{\cos(x)^2 - 1}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(-1+cos(x)^2)^(1/2),x, algorithm="giac")
```

```
[Out] integrate(1/sqrt(cos(x)^2 - 1), x)
```

$$3.53 \quad \int \frac{1}{(1-\cos^2(x))^{3/2}} dx$$

**Optimal.** Leaf size=32

$$-\frac{\cot(x)}{2\sqrt{\sin^2(x)}} - \frac{\sin(x) \tanh^{-1}(\cos(x))}{2\sqrt{\sin^2(x)}}$$

[Out] -Cot[x]/(2\*Sqrt[Sin[x]^2]) - (ArcTanh[Cos[x]]\*Sin[x])/(2\*Sqrt[Sin[x]^2])

**Rubi [A]** time = 0.0269628, antiderivative size = 32, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3176, 3204, 3207, 3770}

$$-\frac{\cot(x)}{2\sqrt{\sin^2(x)}} - \frac{\sin(x) \tanh^{-1}(\cos(x))}{2\sqrt{\sin^2(x)}}$$

Antiderivative was successfully verified.

[In] Int[(1 - Cos[x]^2)^(-3/2), x]

[Out] -Cot[x]/(2\*Sqrt[Sin[x]^2]) - (ArcTanh[Cos[x]]\*Sin[x])/(2\*Sqrt[Sin[x]^2])

#### Rule 3176

Int[(u\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^p], x\_Symbol] := Int[ActivateTrig[u\*(a\*cos[e + f\*x]^2)^p], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0]

#### Rule 3204

Int[((b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^p], x\_Symbol] := Simp[(Cot[e + f\*x]\*(b\*Sin[e + f\*x]^2)^(p + 1))/(b\*f\*(2\*p + 1)), x] + Dist[(2\*(p + 1))/(b\*(2\*p + 1)), Int[(b\*Sin[e + f\*x]^2)^(p + 1), x], x] /; FreeQ[{b, e, f}, x] && ! IntegerQ[p] && LtQ[p, -1]

#### Rule 3207

Int[(u\_.)\*((b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^n)^p], x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[((b\*ff^n)^IntPart[p]\*(b\*Sin[e + f\*x]^n)^FracPart[p])/(Sin[e + f\*x]/ff)^(n\*FracPart[p]), Int[ActivateTrig[u\*(Sin[e + f\*x]/ff)^(n\*p), x], x]] /; FreeQ[{b, e, f, n, p}, x] && ! IntegerQ[p] && IntegerQ[n] && (EqQ[u, 1] || MatchQ[u, ((d\_.)\*(trig\_)[e + f\*x])^(m\_.)] /; FreeQ[{d, m}, x] && MemberQ[{sin, cos, tan, cot, sec, csc}, trig])

#### Rule 3770

Int[csc[(c\_.) + (d\_.)\*(x\_.)], x\_Symbol] := -Simp[ArcTanh[Cos[c + d\*x]]/d, x] /; FreeQ[{c, d}, x]

#### Rubi steps

$$\begin{aligned}
\int \frac{1}{(1 - \cos^2(x))^{3/2}} dx &= \int \frac{1}{\sin^2(x)^{3/2}} dx \\
&= -\frac{\cot(x)}{2\sqrt{\sin^2(x)}} + \frac{1}{2} \int \frac{1}{\sqrt{\sin^2(x)}} dx \\
&= -\frac{\cot(x)}{2\sqrt{\sin^2(x)}} + \frac{\sin(x) \int \csc(x) dx}{2\sqrt{\sin^2(x)}} \\
&= -\frac{\cot(x)}{2\sqrt{\sin^2(x)}} - \frac{\tanh^{-1}(\cos(x)) \sin(x)}{2\sqrt{\sin^2(x)}}
\end{aligned}$$

**Mathematica [A]** time = 0.0441808, size = 51, normalized size = 1.59

$$-\frac{\sin(x) \left( \csc^2\left(\frac{x}{2}\right) - \sec^2\left(\frac{x}{2}\right) - 4 \log\left(\sin\left(\frac{x}{2}\right)\right) + 4 \log\left(\cos\left(\frac{x}{2}\right)\right) \right)}{8\sqrt{\sin^2(x)}}$$

Antiderivative was successfully verified.

[In] Integrate[(1 - Cos[x]^2)^(-3/2), x]

[Out] -((Csc[x/2]^2 + 4\*Log[Cos[x/2]] - 4\*Log[Sin[x/2]] - Sec[x/2]^2)\*Sin[x])/(8\*Sqrt[Sin[x]^2])

**Maple [A]** time = 0.812, size = 37, normalized size = 1.2

$$-\frac{1}{\sin(x)} \left( \frac{\cos(x)}{2} + \frac{(\ln(1 + \cos(x)) - \ln(\cos(x) - 1)) (\sin(x))^2}{4} \right) \frac{1}{\sqrt{(\sin(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1-cos(x)^2)^(3/2), x)

[Out] -(1/2\*cos(x)+1/4\*(ln(1+cos(x))-ln(cos(x)-1))\*sin(x)^2)/sin(x)/(sin(x)^2)^(1/2)

**Maxima [B]** time = 1.63815, size = 405, normalized size = 12.66

$$\frac{4(\cos(3x) + \cos(x))\cos(4x) - 4(2\cos(2x) - 1)\cos(3x) - 8\cos(2x)\cos(x) + (2(2\cos(2x) - 1)\cos(4x) - \cos(4x))}{\sin^2(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^2)^(3/2), x, algorithm="maxima")

[Out] 1/4\*(4\*(cos(3\*x) + cos(x))\*cos(4\*x) - 4\*(2\*cos(2\*x) - 1)\*cos(3\*x) - 8\*cos(2\*x)\*cos(x) + (2\*(2\*cos(2\*x) - 1)\*cos(4\*x) - cos(4\*x)^2 - 4\*cos(2\*x)^2 - sin(4\*x)^2 + 4\*sin(4\*x)\*sin(2\*x) - 4\*sin(2\*x)^2 + 4\*cos(2\*x) - 1)\*log(cos(x)^2)

$$+ \sin(x)^2 + 2*\cos(x) + 1) - (2*(2*\cos(2*x) - 1)*\cos(4*x) - \cos(4*x)^2 - 4*\cos(2*x)^2 - \sin(4*x)^2 + 4*\sin(4*x)*\sin(2*x) - 4*\sin(2*x)^2 + 4*\cos(2*x) - 1)*\log(\cos(x)^2 + \sin(x)^2 - 2*\cos(x) + 1) + 4*(\sin(3*x) + \sin(x))*\sin(4*x) - 8*\sin(3*x)*\sin(2*x) - 8*\sin(2*x)*\sin(x) + 4*\cos(x))/(2*(2*\cos(2*x) - 1)*\cos(4*x) - \cos(4*x)^2 - 4*\cos(2*x)^2 - \sin(4*x)^2 + 4*\sin(4*x)*\sin(2*x) - 4*\sin(2*x)^2 + 4*\cos(2*x) - 1)$$

**Fricas [A]** time = 1.60996, size = 150, normalized size = 4.69

$$\frac{(\cos(x)^2 - 1)\log\left(\frac{1}{2}\cos(x) + \frac{1}{2}\right) - (\cos(x)^2 - 1)\log\left(-\frac{1}{2}\cos(x) + \frac{1}{2}\right) - 2\cos(x)}{4(\cos(x)^2 - 1)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^2)^(3/2),x, algorithm="fricas")

[Out] -1/4\*((cos(x)^2 - 1)\*log(1/2\*cos(x) + 1/2) - (cos(x)^2 - 1)\*log(-1/2\*cos(x) + 1/2) - 2\*cos(x))/(cos(x)^2 - 1)

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)\*\*2)\*\*(3/2),x)

[Out] Timed out

**Giac [B]** time = 1.27541, size = 105, normalized size = 3.28

$$\frac{\tan\left(\frac{1}{2}x\right)^2}{8\operatorname{sgn}\left(\tan\left(\frac{1}{2}x\right)^3 + \tan\left(\frac{1}{2}x\right)\right)} + \frac{\log\left(\tan\left(\frac{1}{2}x\right)^2\right)}{4\operatorname{sgn}\left(\tan\left(\frac{1}{2}x\right)^3 + \tan\left(\frac{1}{2}x\right)\right)} - \frac{2\tan\left(\frac{1}{2}x\right)^2 + 1}{8\operatorname{sgn}\left(\tan\left(\frac{1}{2}x\right)^3 + \tan\left(\frac{1}{2}x\right)\right)\tan\left(\frac{1}{2}x\right)^2}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^2)^(3/2),x, algorithm="giac")

[Out] 1/8\*tan(1/2\*x)^2/sgn(tan(1/2\*x)^3 + tan(1/2\*x)) + 1/4\*log(tan(1/2\*x)^2)/sgn(tan(1/2\*x)^3 + tan(1/2\*x)) - 1/8\*(2\*tan(1/2\*x)^2 + 1)/(sgn(tan(1/2\*x)^3 + tan(1/2\*x))\*tan(1/2\*x)^2)

$$3.54 \quad \int \frac{1}{(-1+\cos^2(x))^{3/2}} dx$$

**Optimal.** Leaf size=36

$$\frac{\cot(x)}{2\sqrt{-\sin^2(x)}} + \frac{\sin(x) \tanh^{-1}(\cos(x))}{2\sqrt{-\sin^2(x)}}$$

[Out] Cot[x]/(2\*Sqrt[-Sin[x]^2]) + (ArcTanh[Cos[x]]\*Sin[x])/(2\*Sqrt[-Sin[x]^2])

**Rubi [A]** time = 0.025746, antiderivative size = 36, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.4$ , Rules used = {3176, 3204, 3207, 3770}

$$\frac{\cot(x)}{2\sqrt{-\sin^2(x)}} + \frac{\sin(x) \tanh^{-1}(\cos(x))}{2\sqrt{-\sin^2(x)}}$$

Antiderivative was successfully verified.

[In] Int[(-1 + Cos[x]^2)^(-3/2), x]

[Out] Cot[x]/(2\*Sqrt[-Sin[x]^2]) + (ArcTanh[Cos[x]]\*Sin[x])/(2\*Sqrt[-Sin[x]^2])

#### Rule 3176

Int[(u\_)\*((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^p, x\_Symbol] :> Int[ActivateTrig[u\*(a\*cos[e + f\*x]^2)^p], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0]

#### Rule 3204

Int[((b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^p, x\_Symbol] :> Simp[(Cot[e + f\*x]\*(b\*Ssin[e + f\*x]^2)^(p + 1))/(b\*f\*(2\*p + 1)), x] + Dist[(2\*(p + 1))/(b\*(2\*p + 1)), Int[(b\*Ssin[e + f\*x]^2)^(p + 1), x], x] /; FreeQ[{b, e, f}, x] && !IntegerQ[p] && LtQ[p, -1]

#### Rule 3207

Int[(u\_)\*((b\_)\*sin[(e\_) + (f\_)\*(x\_)]^n)^p, x\_Symbol] :> With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[((b\*ff^n)^IntPart[p]\*(b\*Ssin[e + f\*x]^n)^FracPart[p])/(Sin[e + f\*x]/ff)^(n\*FracPart[p]), Int[ActivateTrig[u\*(Sin[e + f\*x]/ff)^(n\*p), x], x] /; FreeQ[{b, e, f, n, p}, x] && !IntegerQ[p] && IntegerQ[n] && (EqQ[u, 1] || MatchQ[u, ((d\_)\*(trig\_)[e + f\*x])^m\_]) /; FreeQ[{d, m}, x] && MemberQ[{sin, cos, tan, cot, sec, csc}, trig]]

#### Rule 3770

Int[csc[(c\_) + (d\_)\*(x\_)], x\_Symbol] :> -Simp[ArcTanh[Cos[c + d\*x]]/d, x] /; FreeQ[{c, d}, x]

#### Rubi steps

$$\begin{aligned}
\int \frac{1}{(-1 + \cos^2(x))^{3/2}} dx &= \int \frac{1}{(-\sin^2(x))^{3/2}} dx \\
&= \frac{\cot(x)}{2\sqrt{-\sin^2(x)}} - \frac{1}{2} \int \frac{1}{\sqrt{-\sin^2(x)}} dx \\
&= \frac{\cot(x)}{2\sqrt{-\sin^2(x)}} - \frac{\sin(x) \int \csc(x) dx}{2\sqrt{-\sin^2(x)}} \\
&= \frac{\cot(x)}{2\sqrt{-\sin^2(x)}} + \frac{\tanh^{-1}(\cos(x)) \sin(x)}{2\sqrt{-\sin^2(x)}}
\end{aligned}$$

**Mathematica [A]** time = 0.0300801, size = 53, normalized size = 1.47

$$\frac{\sin(x) \left( \csc^2\left(\frac{x}{2}\right) - \sec^2\left(\frac{x}{2}\right) - 4 \log\left(\sin\left(\frac{x}{2}\right)\right) + 4 \log\left(\cos\left(\frac{x}{2}\right)\right) \right)}{8\sqrt{-\sin^2(x)}}$$

Antiderivative was successfully verified.

[In] Integrate[(-1 + Cos[x]^2)^(-3/2), x]

[Out] ((Csc[x/2]^2 + 4\*Log[Cos[x/2]] - 4\*Log[Sin[x/2]] - Sec[x/2]^2)\*Sin[x])/(8\*Sqrt[-Sin[x]^2])

**Maple [A]** time = 0.499, size = 51, normalized size = 1.4

$$-\frac{1}{2 \cos(x) \sin(x)} \sqrt{-(\cos(x))^2} \left( -\arctan\left(\frac{1}{\sqrt{-(\cos(x))^2}}\right) (\sin(x))^2 + \sqrt{-(\cos(x))^2} \right) \frac{1}{\sqrt{-(\sin(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(-1+cos(x)^2)^(3/2), x)

[Out] -1/2\*(-cos(x)^2)^(1/2)\*(-arctan(1/(-cos(x)^2)^(1/2))\*sin(x)^2+(-cos(x)^2)^(1/2))/sin(x)/cos(x)/(-sin(x)^2)^(1/2)

**Maxima [B]** time = 1.67064, size = 383, normalized size = 10.64

$$\frac{(2(2 \cos(2x) - 1) \cos(4x) - \cos(4x)^2 - 4 \cos(2x)^2 - \sin(4x)^2 + 4 \sin(4x) \sin(2x) - 4 \sin(2x)^2 + 4 \cos(2x) - 1)}{8\sqrt{-\sin^2(x)}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1+cos(x)^2)^(3/2), x, algorithm="maxima")

[Out] 1/2\*((2\*(2\*cos(2\*x) - 1)\*cos(4\*x) - cos(4\*x)^2 - 4\*cos(2\*x)^2 - sin(4\*x)^2 + 4\*sin(4\*x)\*sin(2\*x) - 4\*sin(2\*x)^2 + 4\*cos(2\*x) - 1)\*arctan2(sin(x), cos(x) + 1) - (2\*(2\*cos(2\*x) - 1)\*cos(4\*x) - cos(4\*x)^2 - 4\*cos(2\*x)^2 - sin(4\*x)^2 + 4\*sin(4\*x)\*sin(2\*x) - 4\*sin(2\*x)^2 + 4\*cos(2\*x) - 1)/8\*sqrt(-sin(x)^2))

$$x)^2 + 4*\sin(4*x)*\sin(2*x) - 4*\sin(2*x)^2 + 4*\cos(2*x) - 1)*\arctan2(\sin(x), \cos(x) - 1) + 2*(\sin(3*x) + \sin(x))*\cos(4*x) - 2*(\cos(3*x) + \cos(x))*\sin(4*x) - 2*(2*\cos(2*x) - 1)*\sin(3*x) + 4*\cos(3*x)*\sin(2*x) + 4*\cos(x)*\sin(2*x) - 4*\cos(2*x)*\sin(x) + 2*\sin(x))/(2*(2*\cos(2*x) - 1)*\cos(4*x) - \cos(4*x)^2 - 4*\cos(2*x)^2 - \sin(4*x)^2 + 4*\sin(4*x)*\sin(2*x) - 4*\sin(2*x)^2 + 4*\cos(2*x) - 1)$$

**Fricas [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: UnboundLocalError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1+cos(x)^2)^(3/2),x, algorithm="fricas")

[Out] Exception raised: UnboundLocalError

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1+cos(x)\*\*2)\*\*(3/2),x)

[Out] Timed out

**Giac [C]** time = 1.29558, size = 122, normalized size = 3.39

$$\frac{i \tan\left(\frac{1}{2}x\right)^2}{8 \operatorname{sgn}\left(-\tan\left(\frac{1}{2}x\right)^3 - \tan\left(\frac{1}{2}x\right)\right)} - \frac{i \log\left(\tan\left(\frac{1}{2}x\right)^2\right)}{4 \operatorname{sgn}\left(-\tan\left(\frac{1}{2}x\right)^3 - \tan\left(\frac{1}{2}x\right)\right)} + \frac{2i \tan\left(\frac{1}{2}x\right)^2 + i}{8 \operatorname{sgn}\left(-\tan\left(\frac{1}{2}x\right)^3 - \tan\left(\frac{1}{2}x\right)\right) \tan\left(\frac{1}{2}x\right)^2}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1+cos(x)^2)^(3/2),x, algorithm="giac")

[Out] -1/8\*I\*tan(1/2\*x)^2/sgn(-tan(1/2\*x)^3 - tan(1/2\*x)) - 1/4\*I\*log(tan(1/2\*x)^2)/sgn(-tan(1/2\*x)^3 - tan(1/2\*x)) + 1/8\*(2\*I\*tan(1/2\*x)^2 + I)/(sgn(-tan(1/2\*x)^3 - tan(1/2\*x))\*tan(1/2\*x)^2)



### 3.55 $\int \sqrt{1 + \cos^2(x)} dx$

**Optimal.** Leaf size=9

$$E\left(x + \frac{\pi}{2} \middle| -1\right)$$

[Out] EllipticE[Pi/2 + x, -1]

**Rubi [A]** time = 0.0080177, antiderivative size = 9, normalized size of antiderivative = 1., number of steps used = 1, number of rules used = 1, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.1$ , Rules used = {3177}

$$E\left(x + \frac{\pi}{2} \middle| -1\right)$$

Antiderivative was successfully verified.

[In] Int[Sqrt[1 + Cos[x]^2], x]

[Out] EllipticE[Pi/2 + x, -1]

**Rule 3177**

Int[Sqrt[(a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2], x\_Symbol] :> Simp[(Sqrt[a] \* EllipticE[e + f\*x, -(b/a)])]/f, x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]

**Rubi steps**

$$\int \sqrt{1 + \cos^2(x)} dx = E\left(\frac{\pi}{2} + x \middle| -1\right)$$

**Mathematica [A]** time = 0.0211922, size = 11, normalized size = 1.22

$$\sqrt{2} E\left(x \middle| \frac{1}{2}\right)$$

Antiderivative was successfully verified.

[In] Integrate[Sqrt[1 + Cos[x]^2], x]

[Out] Sqrt[2]\*EllipticE[x, 1/2]

**Maple [B]** time = 0.747, size = 41, normalized size = 4.6

$$-\frac{\text{EllipticE}(\cos(x), i)}{\sin(x)} \sqrt{(1 + (\cos(x))^2) (\sin(x))^2} \sqrt{(\sin(x))^2} \frac{1}{\sqrt{1 - (\cos(x))^4}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((1+cos(x)^2)^(1/2), x)

[Out]  $-\left(\left(1+\cos(x)^2\right)\sin(x)^2\right)^{1/2}\left(\sin(x)^2\right)^{1/2}\text{EllipticE}\left(\cos(x),1\right)/\left(1-\cos(x)^4\right)^{1/2}/\sin(x)$

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{\cos(x)^2 + 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate((1+cos(x)^2)^(1/2),x, algorithm="maxima")`

[Out] `integrate(sqrt(cos(x)^2 + 1), x)`

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$\text{integral}\left(\sqrt{\cos(x)^2 + 1}, x\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate((1+cos(x)^2)^(1/2),x, algorithm="fricas")`

[Out] `integral(sqrt(cos(x)^2 + 1), x)`

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{\cos^2(x) + 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate((1+cos(x)**2)**(1/2),x)`

[Out] `Integral(sqrt(cos(x)**2 + 1), x)`

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{\cos(x)^2 + 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate((1+cos(x)^2)^(1/2),x, algorithm="giac")`

[Out] `integrate(sqrt(cos(x)^2 + 1), x)`

### 3.56 $\int \sqrt{-1 - \cos^2(x)} dx$

**Optimal.** Leaf size=32

$$\frac{\sqrt{-\cos^2(x)-1}E\left(x+\frac{\pi}{2}\middle|-1\right)}{\sqrt{\cos^2(x)+1}}$$

[Out] (Sqrt[-1 - Cos[x]^2]\*EllipticE[Pi/2 + x, -1])/Sqrt[1 + Cos[x]^2]

**Rubi [A]** time = 0.0222627, antiderivative size = 32, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.167$ , Rules used = {3178, 3177}

$$\frac{\sqrt{-\cos^2(x)-1}E\left(x+\frac{\pi}{2}\middle|-1\right)}{\sqrt{\cos^2(x)+1}}$$

Antiderivative was successfully verified.

[In] Int[Sqrt[-1 - Cos[x]^2],x]

[Out] (Sqrt[-1 - Cos[x]^2]\*EllipticE[Pi/2 + x, -1])/Sqrt[1 + Cos[x]^2]

#### Rule 3178

Int[Sqrt[(a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2], x\_Symbol] := Dist[Sqrt[a + b\*Sin[e + f\*x]^2]/Sqrt[1 + (b\*Sin[e + f\*x]^2)/a], Int[Sqrt[1 + (b\*Sin[e + f\*x]^2)/a], x], x] /; FreeQ[{a, b, e, f}, x] && !GtQ[a, 0]

#### Rule 3177

Int[Sqrt[(a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2], x\_Symbol] := Simp[(Sqrt[a]\*EllipticE[e + f\*x, -(b/a)])/f, x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]

#### Rubi steps

$$\begin{aligned} \int \sqrt{-1 - \cos^2(x)} dx &= \frac{\sqrt{-1 - \cos^2(x)} \int \sqrt{1 + \cos^2(x)} dx}{\sqrt{1 + \cos^2(x)}} \\ &= \frac{\sqrt{-1 - \cos^2(x)}E\left(\frac{\pi}{2} + x\middle|-1\right)}{\sqrt{1 + \cos^2(x)}} \end{aligned}$$

**Mathematica [A]** time = 0.0375725, size = 34, normalized size = 1.06

$$\frac{\sqrt{2}\sqrt{\cos(2x)+3}E\left(x\middle|\frac{1}{2}\right)}{\sqrt{-\cos(2x)-3}}$$

Antiderivative was successfully verified.

[In] Integrate[Sqrt[-1 - Cos[x]^2],x]

[Out] -((Sqrt[2]\*Sqrt[3 + Cos[2\*x]]\*EllipticE[x, 1/2])/Sqrt[-3 - Cos[2\*x]])

---

**Maple [B]** time = 1.302, size = 75, normalized size = 2.3

$$\frac{-i(2 \operatorname{EllipticF}(i \cos(x), i) - \operatorname{EllipticE}(i \cos(x), i))}{\sin(x)} \sqrt{-\left(1 + (\cos(x))^2\right) (\sin(x))^2} \sqrt{1 + (\cos(x))^2} \sqrt{(\sin(x))^2} \frac{1}{\sqrt{(\cos(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((-1-cos(x)^2)^(1/2), x)

[Out] -I\*(-(1+cos(x)^2)\*sin(x)^2)^(1/2)\*(1+cos(x)^2)^(1/2)\*(sin(x)^2)^(1/2)\*(2\*EllipticF(I\*cos(x), I)-EllipticE(I\*cos(x), I))/(cos(x)^4-1)^(1/2)/sin(x)/(-1-cos(x)^2)^(1/2)

---

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{-\cos(x)^2 - 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1-cos(x)^2)^(1/2), x, algorithm="maxima")

[Out] integrate(sqrt(-cos(x)^2 - 1), x)

---

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$\frac{2(e^{2ix} - e^{ix}) \operatorname{integral}\left(\frac{4\sqrt{e^{4ix}+6e^{2ix}+1}(e^{2ix}+1)}{e^{6ix}-2e^{5ix}+7e^{4ix}-12e^{3ix}+7e^{2ix}-2e^{ix}+1}, x\right) + \sqrt{e^{4ix}+6e^{2ix}+1}(e^{ix}+1)}{2(e^{2ix} - e^{ix})}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1-cos(x)^2)^(1/2), x, algorithm="fricas")

[Out] 1/2\*(2\*(e^(2\*I\*x) - e^(I\*x))\*integral(4\*sqrt(e^(4\*I\*x) + 6\*e^(2\*I\*x) + 1)\*(e^(2\*I\*x) + 1)/(e^(6\*I\*x) - 2\*e^(5\*I\*x) + 7\*e^(4\*I\*x) - 12\*e^(3\*I\*x) + 7\*e^(2\*I\*x) - 2\*e^(I\*x) + 1), x) + sqrt(e^(4\*I\*x) + 6\*e^(2\*I\*x) + 1)\*(e^(I\*x) + 1))/(e^(2\*I\*x) - e^(I\*x))

---

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{-\cos^2(x) - 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1-cos(x)\*\*2)\*\*(1/2), x)

[Out] Integral(sqrt(-cos(x)\*\*2 - 1), x)

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{-\cos(x)^2 - 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1-cos(x)^2)^(1/2),x, algorithm="giac")

[Out] integrate(sqrt(-cos(x)^2 - 1), x)

### 3.57 $\int \sqrt{a + b \cos^2(x)} dx$

**Optimal.** Leaf size=42

$$\frac{\sqrt{a + b \cos^2(x)} E\left(x + \frac{\pi}{2} \middle| -\frac{b}{a}\right)}{\sqrt{\frac{b \cos^2(x)}{a} + 1}}$$

[Out] (Sqrt[a + b\*Cos[x]^2]\*EllipticE[Pi/2 + x, -(b/a)])/Sqrt[1 + (b\*Cos[x]^2)/a]

**Rubi [A]** time = 0.0350783, antiderivative size = 42, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.167$ , Rules used = {3178, 3177}

$$\frac{\sqrt{a + b \cos^2(x)} E\left(x + \frac{\pi}{2} \middle| -\frac{b}{a}\right)}{\sqrt{\frac{b \cos^2(x)}{a} + 1}}$$

Antiderivative was successfully verified.

[In] Int[Sqrt[a + b\*Cos[x]^2], x]

[Out] (Sqrt[a + b\*Cos[x]^2]\*EllipticE[Pi/2 + x, -(b/a)])/Sqrt[1 + (b\*Cos[x]^2)/a]

#### Rule 3178

Int[Sqrt[(a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2], x\_Symbol] :> Dist[Sqrt[a + b\*Sin[e + f\*x]^2]/Sqrt[1 + (b\*Sin[e + f\*x]^2)/a], Int[Sqrt[1 + (b\*Sin[e + f\*x]^2)/a], x], x] /; FreeQ[{a, b, e, f}, x] && !GtQ[a, 0]

#### Rule 3177

Int[Sqrt[(a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2], x\_Symbol] :> Simp[(Sqrt[a]\*EllipticE[e + f\*x, -(b/a)])/f, x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]

#### Rubi steps

$$\begin{aligned} \int \sqrt{a + b \cos^2(x)} dx &= \frac{\sqrt{a + b \cos^2(x)} \int \sqrt{1 + \frac{b \cos^2(x)}{a}} dx}{\sqrt{1 + \frac{b \cos^2(x)}{a}}} \\ &= \frac{\sqrt{a + b \cos^2(x)} E\left(\frac{\pi}{2} + x \middle| -\frac{b}{a}\right)}{\sqrt{1 + \frac{b \cos^2(x)}{a}}} \end{aligned}$$

**Mathematica [A]** time = 0.0722043, size = 46, normalized size = 1.1

$$\frac{\sqrt{2a + b \cos(2x) + b} E\left(x \middle| \frac{b}{a+b}\right)}{\sqrt{\frac{2a + b \cos(2x) + b}{a+b}}}$$

Antiderivative was successfully verified.

[In] Integrate[Sqrt[a + b\*Cos[x]^2], x]

[Out] (Sqrt[2\*a + b + b\*Cos[2\*x]]\*EllipticE[x, b/(a + b)]/Sqrt[(2\*a + b + b\*Cos[2\*x])/(a + b)])

**Maple [A]** time = 0.336, size = 49, normalized size = 1.2

$$-\frac{a}{\sin(x)} \sqrt{(\sin(x))^2} \sqrt{\frac{a + b(\cos(x))^2}{a}} \text{EllipticE}\left(\cos(x), \sqrt{\frac{b}{a}}\right) \frac{1}{\sqrt{a + b(\cos(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((a+b\*cos(x)^2)^(1/2), x)

[Out] -a\*(sin(x)^2)^(1/2)\*((a+b\*cos(x)^2)/a)^(1/2)\*EllipticE(cos(x), (-b/a)^(1/2))/sin(x)/(a+b\*cos(x)^2)^(1/2)

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{b \cos(x)^2 + a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^2)^(1/2), x, algorithm="maxima")

[Out] integrate(sqrt(b\*cos(x)^2 + a), x)

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$\text{integral}\left(\sqrt{b \cos(x)^2 + a}, x\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^2)^(1/2), x, algorithm="fricas")

[Out] integral(sqrt(b\*cos(x)^2 + a), x)

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{a + b \cos^2(x)} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)\*\*2)\*\*(1/2), x)

```
[Out] Integral(sqrt(a + b*cos(x)**2), x)
```

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{b \cos(x)^2 + a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate((a+b*cos(x)^2)^(1/2),x, algorithm="giac")
```

```
[Out] integrate(sqrt(b*cos(x)^2 + a), x)
```



### 3.58 $\int (1 + \cos^2(x))^{3/2} dx$

**Optimal.** Leaf size=43

$$-\frac{2}{3}F\left(x + \frac{\pi}{2} \middle| -1\right) + 2E\left(x + \frac{\pi}{2} \middle| -1\right) + \frac{1}{3}\sin(x)\cos(x)\sqrt{\cos^2(x) + 1}$$

[Out] 2\*EllipticE[Pi/2 + x, -1] - (2\*EllipticF[Pi/2 + x, -1])/3 + (Cos[x]\*Sqrt[1 + Cos[x]^2]\*Sin[x])/3

**Rubi [A]** time = 0.054289, antiderivative size = 43, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.4$ , Rules used = {3180, 3172, 3177, 3182}

$$-\frac{2}{3}F\left(x + \frac{\pi}{2} \middle| -1\right) + 2E\left(x + \frac{\pi}{2} \middle| -1\right) + \frac{1}{3}\sin(x)\cos(x)\sqrt{\cos^2(x) + 1}$$

Antiderivative was successfully verified.

[In] Int[(1 + Cos[x]^2)^(3/2), x]

[Out] 2\*EllipticE[Pi/2 + x, -1] - (2\*EllipticF[Pi/2 + x, -1])/3 + (Cos[x]\*Sqrt[1 + Cos[x]^2]\*Sin[x])/3

#### Rule 3180

```
Int[((a_) + (b_)*sin[(e_) + (f_)*(x_)]^2)^(p_), x_Symbol] :> -Simp[(b*Cos[e + f*x]*Sin[e + f*x]*(a + b*Sin[e + f*x]^2)^(p - 1))/(2*f*p), x] + Dist[1/(2*p), Int[(a + b*Sin[e + f*x]^2)^(p - 2)*Simp[a*(b + 2*a*p) + b*(2*a + b)*(2*p - 1)*Sin[e + f*x]^2, x], x], x] /; FreeQ[{a, b, e, f}, x] && NeQ[a + b, 0] && GtQ[p, 1]
```

#### Rule 3172

```
Int[((A_) + (B_)*sin[(e_) + (f_)*(x_)]^2)/Sqrt[(a_) + (b_)*sin[(e_) + (f_)*(x_)]^2], x_Symbol] :> Dist[B/b, Int[Sqrt[a + b*Sin[e + f*x]^2], x], x] + Dist[(A*b - a*B)/b, Int[1/Sqrt[a + b*Sin[e + f*x]^2], x], x] /; FreeQ[{a, b, e, f, A, B}, x]
```

#### Rule 3177

```
Int[Sqrt[(a_) + (b_)*sin[(e_) + (f_)*(x_)]^2], x_Symbol] :> Simp[(Sqrt[a]*EllipticE[e + f*x, -(b/a)])/f, x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]
```

#### Rule 3182

```
Int[1/Sqrt[(a_) + (b_)*sin[(e_) + (f_)*(x_)]^2], x_Symbol] :> Simp[(1*EllipticF[e + f*x, -(b/a)]/(Sqrt[a]*f), x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]
```

#### Rubi steps

$$\begin{aligned}
\int (1 + \cos^2(x))^{3/2} dx &= \frac{1}{3} \cos(x) \sqrt{1 + \cos^2(x)} \sin(x) + \frac{1}{3} \int \frac{4 + 6 \cos^2(x)}{\sqrt{1 + \cos^2(x)}} dx \\
&= \frac{1}{3} \cos(x) \sqrt{1 + \cos^2(x)} \sin(x) - \frac{2}{3} \int \frac{1}{\sqrt{1 + \cos^2(x)}} dx + 2 \int \sqrt{1 + \cos^2(x)} dx \\
&= 2E\left(\frac{\pi}{2} + x \mid -1\right) - \frac{2}{3} F\left(\frac{\pi}{2} + x \mid -1\right) + \frac{1}{3} \cos(x) \sqrt{1 + \cos^2(x)} \sin(x)
\end{aligned}$$

**Mathematica [A]** time = 0.047725, size = 39, normalized size = 0.91

$$\frac{-4F\left(x \mid \frac{1}{2}\right) + 24E\left(x \mid \frac{1}{2}\right) + \sin(2x)\sqrt{\cos(2x) + 3}}{6\sqrt{2}}$$

Antiderivative was successfully verified.

[In] Integrate[(1 + Cos[x]^2)^(3/2), x]

[Out] (24\*EllipticE[x, 1/2] - 4\*EllipticF[x, 1/2] + Sqrt[3 + Cos[2\*x]]\*Sin[2\*x])/(6\*Sqrt[2])

**Maple [B]** time = 1.055, size = 101, normalized size = 2.4

$$\frac{1}{3 \sin(x)} \sqrt{(1 + (\cos(x))^2) (\sin(x))^2} \left( -\cos(x) (\sin(x))^4 + 2 \sqrt{(\sin(x))^2} \sqrt{-(\sin(x))^2 + 2} \text{EllipticF}(\cos(x), i) - 6 \sqrt{(\sin(x))^2} \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((1+cos(x)^2)^(3/2), x)

[Out] 1/3\*((1+cos(x)^2)\*sin(x)^2)^(1/2)\*(-cos(x)\*sin(x)^4+2\*(sin(x)^2)^(1/2)\*(-sin(x)^2+2)^(1/2)\*EllipticF(cos(x), I)-6\*(sin(x)^2)^(1/2)\*(-sin(x)^2+2)^(1/2)\*EllipticE(cos(x), I)+2\*cos(x)\*sin(x)^2)/(1-cos(x)^4)^(1/2)/sin(x)/(1+cos(x)^2)^(1/2)

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int (\cos(x)^2 + 1)^{3/2} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((1+cos(x)^2)^(3/2), x, algorithm="maxima")

[Out] integrate((cos(x)^2 + 1)^(3/2), x)

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$\text{integral}\left(\left(\cos(x)^2 + 1\right)^{3/2}, x\right)$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate((1+cos(x)^2)^(3/2),x, algorithm="fricas")
```

```
[Out] integral((cos(x)^2 + 1)^(3/2), x)
```

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate((1+cos(x)**2)**(3/2),x)
```

```
[Out] Timed out
```

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int (\cos(x)^2 + 1)^{\frac{3}{2}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate((1+cos(x)^2)^(3/2),x, algorithm="giac")
```

```
[Out] integrate((cos(x)^2 + 1)^(3/2), x)
```

### 3.59 $\int (-1 - \cos^2(x))^{3/2} dx$

**Optimal.** Leaf size=89

$$-\frac{1}{3} \sin(x) \cos(x) \sqrt{-\cos^2(x) - 1} - \frac{2\sqrt{\cos^2(x) + 1} F\left(x + \frac{\pi}{2} \middle| -1\right)}{3\sqrt{-\cos^2(x) - 1}} - \frac{2\sqrt{-\cos^2(x) - 1} E\left(x + \frac{\pi}{2} \middle| -1\right)}{\sqrt{\cos^2(x) + 1}}$$

[Out]  $(-2\sqrt{-1 - \cos[x]^2} \text{EllipticE}[\text{Pi}/2 + x, -1])/\sqrt{1 + \cos[x]^2} - (2\sqrt{1 + \cos[x]^2} \text{EllipticF}[\text{Pi}/2 + x, -1])/(3\sqrt{-1 - \cos[x]^2}) - (\cos[x] \sqrt{-1 - \cos[x]^2} \sin[x])/3$

**Rubi [A]** time = 0.0941136, antiderivative size = 89, normalized size of antiderivative = 1., number of steps used = 6, number of rules used = 6, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.5$ , Rules used = {3180, 3172, 3178, 3177, 3183, 3182}

$$-\frac{1}{3} \sin(x) \cos(x) \sqrt{-\cos^2(x) - 1} - \frac{2\sqrt{\cos^2(x) + 1} F\left(x + \frac{\pi}{2} \middle| -1\right)}{3\sqrt{-\cos^2(x) - 1}} - \frac{2\sqrt{-\cos^2(x) - 1} E\left(x + \frac{\pi}{2} \middle| -1\right)}{\sqrt{\cos^2(x) + 1}}$$

Antiderivative was successfully verified.

[In]  $\text{Int}[(-1 - \cos[x]^2)^{(3/2)}, x]$

[Out]  $(-2\sqrt{-1 - \cos[x]^2} \text{EllipticE}[\text{Pi}/2 + x, -1])/\sqrt{1 + \cos[x]^2} - (2\sqrt{1 + \cos[x]^2} \text{EllipticF}[\text{Pi}/2 + x, -1])/(3\sqrt{-1 - \cos[x]^2}) - (\cos[x] \sqrt{-1 - \cos[x]^2} \sin[x])/3$

#### Rule 3180

$\text{Int}[(a + (b \sin(e + f x))^2)^p, x\_Symbol] \rightarrow -\text{Simp}[b \cos[e + f x] \sin[e + f x] (a + b \sin[e + f x]^2)^{p-1} / (2 f p), x] + \text{Dist}[1 / (2 p), \text{Int}[(a + b \sin[e + f x]^2)^{p-2} \text{Simp}[a (b + 2 a p) + b (2 a + b) (2 p - 1) \sin[e + f x]^2, x], x] /; \text{FreeQ}\{a, b, e, f, x\} \&\& \text{NeQ}[a + b, 0] \&\& \text{GtQ}[p, 1]$

#### Rule 3172

$\text{Int}[(A + (B \sin(e + f x))^2) / \sqrt{(a + (b \sin(e + f x))^2)}, x\_Symbol] \rightarrow \text{Dist}[B/b, \text{Int}[\sqrt{a + b \sin[e + f x]^2}, x], x] + \text{Dist}[(A b - a B) / b, \text{Int}[1 / \sqrt{a + b \sin[e + f x]^2}, x], x] /; \text{FreeQ}\{a, b, e, f, A, B, x\}$

#### Rule 3178

$\text{Int}[\sqrt{(a + (b \sin(e + f x))^2)}, x\_Symbol] \rightarrow \text{Dist}[\sqrt{a + b \sin[e + f x]^2} / \sqrt{1 + (b \sin[e + f x]^2) / a}, \text{Int}[\sqrt{1 + (b \sin[e + f x]^2) / a}, x], x] /; \text{FreeQ}\{a, b, e, f, x\} \&\& !\text{GtQ}[a, 0]$

#### Rule 3177

$\text{Int}[\sqrt{(a + (b \sin(e + f x))^2)}, x\_Symbol] \rightarrow \text{Simp}[(\sqrt{a + b \sin[e + f x]^2} \text{EllipticE}[e + f x, -(b/a)]) / f, x] /; \text{FreeQ}\{a, b, e, f, x\} \&\& \text{GtQ}[a, 0]$

#### Rule 3183

$\text{Int}[1 / \sqrt{(a + (b \sin(e + f x))^2)}, x\_Symbol] \rightarrow \text{Dist}[\sqrt{1 + (b \sin[e + f x]^2) / a} / \sqrt{a + b \sin[e + f x]^2}, \text{Int}[1 / \sqrt{1 + (b \sin[e + f x]^2) / a}, x], x] /; \text{FreeQ}\{a, b, e, f, x\} \&\& \text{GtQ}[a, 0]$

$[e + f*x]^2/a], x], x] /; \text{FreeQ}[\{a, b, e, f\}, x] \ \&\amp; \ !\text{GtQ}[a, 0]$

### Rule 3182

$\text{Int}[1/\text{Sqrt}[(a_) + (b_)*\sin[(e_) + (f_)*(x_)]^2], x\_Symbol] \rightarrow \text{Simp}[(1*\text{EllipticF}[e + f*x, -(b/a)])/(\text{Sqrt}[a]*f), x] /; \text{FreeQ}[\{a, b, e, f\}, x] \ \&\amp; \ \text{GtQ}[a, 0]$

### Rubi steps

$$\begin{aligned} \int (-1 - \cos^2(x))^{3/2} dx &= -\frac{1}{3} \cos(x) \sqrt{-1 - \cos^2(x)} \sin(x) + \frac{1}{3} \int \frac{4 + 6 \cos^2(x)}{\sqrt{-1 - \cos^2(x)}} dx \\ &= -\frac{1}{3} \cos(x) \sqrt{-1 - \cos^2(x)} \sin(x) - \frac{2}{3} \int \frac{1}{\sqrt{-1 - \cos^2(x)}} dx - 2 \int \sqrt{-1 - \cos^2(x)} dx \\ &= -\frac{1}{3} \cos(x) \sqrt{-1 - \cos^2(x)} \sin(x) - \frac{(2\sqrt{-1 - \cos^2(x)}) \int \sqrt{1 + \cos^2(x)} dx}{\sqrt{1 + \cos^2(x)}} - \frac{(2\sqrt{1 + \cos^2(x)})}{3\sqrt{-1 - \cos^2(x)}} \\ &= -\frac{2\sqrt{-1 - \cos^2(x)} E\left(\frac{\pi}{2} + x \mid -1\right)}{\sqrt{1 + \cos^2(x)}} - \frac{2\sqrt{1 + \cos^2(x)} F\left(\frac{\pi}{2} + x \mid -1\right)}{3\sqrt{-1 - \cos^2(x)}} - \frac{1}{3} \cos(x) \sqrt{-1 - \cos^2(x)} \sin(x) \end{aligned}$$

**Mathematica [A]** time = 0.0680792, size = 66, normalized size = 0.74

$$\frac{6 \sin(2x) + \sin(4x) - 8\sqrt{\cos(2x) + 3} F\left(x \mid \frac{1}{2}\right) + 48\sqrt{\cos(2x) + 3} E\left(x \mid \frac{1}{2}\right)}{12\sqrt{2}\sqrt{-\cos(2x) - 3}}$$

Antiderivative was successfully verified.

[In] Integrate[(-1 - Cos[x]^2)^(3/2), x]

[Out] (48\*Sqrt[3 + Cos[2\*x]]\*EllipticE[x, 1/2] - 8\*Sqrt[3 + Cos[2\*x]]\*EllipticF[x, 1/2] + 6\*Sin[2\*x] + Sin[4\*x])/(12\*Sqrt[2]\*Sqrt[-3 - Cos[2\*x]])

**Maple [A]** time = 1.364, size = 110, normalized size = 1.2

$$\frac{1}{3 \sin(x)} \sqrt{-(1 + (\cos(x))^2)} (\sin(x))^2 \left( -\cos(x) (\sin(x))^4 + 10i \sqrt{-(\sin(x))^2} + 2\sqrt{(\sin(x))^2} \text{EllipticF}(i \cos(x), i) - \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((-1-cos(x)^2)^(3/2), x)

[Out] 1/3\*(-(1+cos(x)^2)\*sin(x)^2)^(1/2)\*(-cos(x)\*sin(x)^4+10\*I\*(-sin(x)^2+2)\*sqrt(-sin(x)^2)+2\*sqrt(sin(x)^2)\*EllipticF(I\*cos(x), I)-6\*I\*(-sin(x)^2+2)\*sqrt(-sin(x)^2)\*sin(x)^2)^(1/2)\*EllipticE(I\*cos(x), I)+2\*cos(x)\*sin(x)^2)/(cos(x)^4-1)^(1/2)/sin(x)/(-1-cos(x)^2)^(1/2)

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int (-\cos(x)^2 - 1)^{3/2} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1-cos(x)^2)^(3/2),x, algorithm="maxima")

[Out] integrate((-cos(x)^2 - 1)^(3/2), x)

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$24 \left( e^{4ix} - e^{3ix} \right) \operatorname{integral} \left( -\frac{4 \sqrt{e^{4ix} + 6e^{2ix} + 1} (5e^{2ix} + 2e^{ix} + 5)}{3(e^{6ix} - 2e^{5ix} + 7e^{4ix} - 12e^{3ix} + 7e^{2ix} - 2e^{ix} + 1)}, x \right) - \frac{(e^{5ix} - e^{4ix} + 24e^{3ix} + 24e^{2ix} - e^{ix} + 1) \sqrt{e^{4ix} + 6e^{2ix} + 1}}{24(e^{4ix} - e^{3ix})}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1-cos(x)^2)^(3/2),x, algorithm="fricas")

[Out] 1/24\*(24\*(e^(4\*I\*x) - e^(3\*I\*x))\*integral(-4/3\*sqrt(e^(4\*I\*x) + 6\*e^(2\*I\*x) + 1)\*(5\*e^(2\*I\*x) + 2\*e^(I\*x) + 5)/(e^(6\*I\*x) - 2\*e^(5\*I\*x) + 7\*e^(4\*I\*x) - 12\*e^(3\*I\*x) + 7\*e^(2\*I\*x) - 2\*e^(I\*x) + 1), x) - (e^(5\*I\*x) - e^(4\*I\*x) + 24\*e^(3\*I\*x) + 24\*e^(2\*I\*x) - e^(I\*x) + 1)\*sqrt(e^(4\*I\*x) + 6\*e^(2\*I\*x) + 1)/(e^(4\*I\*x) - e^(3\*I\*x))

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1-cos(x)\*\*2)\*\*(3/2),x)

[Out] Timed out

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int (-\cos(x)^2 - 1)^{\frac{3}{2}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((-1-cos(x)^2)^(3/2),x, algorithm="giac")

[Out] integrate((-cos(x)^2 - 1)^(3/2), x)

### 3.60 $\int (a + b \cos^2(x))^{3/2} dx$

**Optimal.** Leaf size=121

$$\frac{1}{3} b \sin(x) \cos(x) \sqrt{a + b \cos^2(x)} - \frac{a(a+b) \sqrt{\frac{b \cos^2(x)}{a}} + 1 F\left(x + \frac{\pi}{2} \mid -\frac{b}{a}\right)}{3 \sqrt{a + b \cos^2(x)}} + \frac{2(2a+b) \sqrt{a + b \cos^2(x)} E\left(x + \frac{\pi}{2} \mid -\frac{b}{a}\right)}{3 \sqrt{\frac{b \cos^2(x)}{a}} + 1}$$

[Out] (2\*(2\*a + b)\*Sqrt[a + b\*Cos[x]^2]\*EllipticE[Pi/2 + x, -(b/a)])/(3\*Sqrt[1 + (b\*Cos[x]^2)/a]) - (a\*(a + b)\*Sqrt[1 + (b\*Cos[x]^2)/a]\*EllipticF[Pi/2 + x, -(b/a)])/(3\*Sqrt[a + b\*Cos[x]^2]) + (b\*Cos[x]\*Sqrt[a + b\*Cos[x]^2]\*Sin[x])/3

**Rubi [A]** time = 0.161739, antiderivative size = 121, normalized size of antiderivative = 1., number of steps used = 6, number of rules used = 6, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.5$ , Rules used = {3180, 3172, 3178, 3177, 3183, 3182}

$$\frac{1}{3} b \sin(x) \cos(x) \sqrt{a + b \cos^2(x)} - \frac{a(a+b) \sqrt{\frac{b \cos^2(x)}{a}} + 1 F\left(x + \frac{\pi}{2} \mid -\frac{b}{a}\right)}{3 \sqrt{a + b \cos^2(x)}} + \frac{2(2a+b) \sqrt{a + b \cos^2(x)} E\left(x + \frac{\pi}{2} \mid -\frac{b}{a}\right)}{3 \sqrt{\frac{b \cos^2(x)}{a}} + 1}$$

Antiderivative was successfully verified.

[In] Int[(a + b\*Cos[x]^2)^(3/2), x]

[Out] (2\*(2\*a + b)\*Sqrt[a + b\*Cos[x]^2]\*EllipticE[Pi/2 + x, -(b/a)])/(3\*Sqrt[1 + (b\*Cos[x]^2)/a]) - (a\*(a + b)\*Sqrt[1 + (b\*Cos[x]^2)/a]\*EllipticF[Pi/2 + x, -(b/a)])/(3\*Sqrt[a + b\*Cos[x]^2]) + (b\*Cos[x]\*Sqrt[a + b\*Cos[x]^2]\*Sin[x])/3

#### Rule 3180

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^(p\_), x\_Symbol] :> -Simp[(b\*Cos[e + f\*x]\*Sin[e + f\*x]\*(a + b\*Sin[e + f\*x]^2)^(p - 1))/(2\*f\*p), x] + Dist[1/(2\*p), Int[(a + b\*Sin[e + f\*x]^2)^(p - 2)\*Simp[a\*(b + 2\*a\*p) + b\*(2\*a + b)\*(2\*p - 1)\*Sin[e + f\*x]^2, x], x], x] /; FreeQ[{a, b, e, f}, x] && NeQ[a + b, 0] && GtQ[p, 1]

#### Rule 3172

Int[((A\_) + (B\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)/Sqrt[(a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2], x\_Symbol] :> Dist[B/b, Int[Sqrt[a + b\*Sin[e + f\*x]^2], x], x] + Dist[(A\*b - a\*B)/b, Int[1/Sqrt[a + b\*Sin[e + f\*x]^2], x], x] /; FreeQ[{a, b, e, f, A, B}, x]

#### Rule 3178

Int[Sqrt[(a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2], x\_Symbol] :> Dist[Sqrt[a + b\*Sin[e + f\*x]^2]/Sqrt[1 + (b\*Sin[e + f\*x]^2)/a], Int[Sqrt[1 + (b\*Sin[e + f\*x]^2)/a], x], x] /; FreeQ[{a, b, e, f}, x] && !GtQ[a, 0]

#### Rule 3177

Int[Sqrt[(a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2], x\_Symbol] :> Simp[(Sqrt[a]\*EllipticE[e + f\*x, -(b/a)])/f, x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]

Rule 3183

```
Int[1/Sqrt[(a_) + (b_)*sin[(e_) + (f_)*(x_)]^2], x_Symbol] := Dist[Sqrt[1 + (b*Sin[e + f*x]^2)/a]/Sqrt[a + b*Sin[e + f*x]^2], Int[1/Sqrt[1 + (b*Sin[e + f*x]^2)/a], x], x] /; FreeQ[{a, b, e, f}, x] && !GtQ[a, 0]
```

Rule 3182

```
Int[1/Sqrt[(a_) + (b_)*sin[(e_) + (f_)*(x_)]^2], x_Symbol] := Simp[(1*EllipticF[e + f*x, -(b/a)])/(Sqrt[a]*f), x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]
```

Rubi steps

$$\begin{aligned} \int (a + b \cos^2(x))^{3/2} dx &= \frac{1}{3} b \cos(x) \sqrt{a + b \cos^2(x)} \sin(x) + \frac{1}{3} \int \frac{a(3a + b) + 2b(2a + b) \cos^2(x)}{\sqrt{a + b \cos^2(x)}} dx \\ &= \frac{1}{3} b \cos(x) \sqrt{a + b \cos^2(x)} \sin(x) - \frac{1}{3} (a(a + b)) \int \frac{1}{\sqrt{a + b \cos^2(x)}} dx + \frac{1}{3} (2(2a + b)) \int \sqrt{a + b \cos^2(x)} dx \\ &= \frac{1}{3} b \cos(x) \sqrt{a + b \cos^2(x)} \sin(x) + \frac{(2(2a + b) \sqrt{a + b \cos^2(x)}) \int \sqrt{1 + \frac{b \cos^2(x)}{a}} dx}{3 \sqrt{1 + \frac{b \cos^2(x)}{a}}} - \frac{(a(a + b) \sqrt{1 + \frac{b \cos^2(x)}{a}})}{3 \sqrt{1 + \frac{b \cos^2(x)}{a}}} \\ &= \frac{2(2a + b) \sqrt{a + b \cos^2(x)} E\left(\frac{\pi}{2} + x \mid -\frac{b}{a}\right)}{3 \sqrt{1 + \frac{b \cos^2(x)}{a}}} - \frac{a(a + b) \sqrt{1 + \frac{b \cos^2(x)}{a}} F\left(\frac{\pi}{2} + x \mid -\frac{b}{a}\right)}{3 \sqrt{a + b \cos^2(x)}} + \frac{1}{3} b \cos(x) \sqrt{a + b \cos^2(x)} \sin(x) \end{aligned}$$

**Mathematica [A]** time = 0.451918, size = 123, normalized size = 1.02

$$\frac{8(2a^2 + 3ab + b^2) \sqrt{\frac{2a+b \cos(2x)+b}{a+b}} E\left(x \mid \frac{b}{a+b}\right) + \sqrt{2} b \sin(2x)(2a + b \cos(2x) + b) - 4a(a + b) \sqrt{\frac{2a+b \cos(2x)+b}{a+b}} F\left(x \mid \frac{b}{a+b}\right)}{12 \sqrt{2a + b \cos(2x) + b}}$$

Antiderivative was successfully verified.

```
[In] Integrate[(a + b*Cos[x]^2)^(3/2), x]
```

```
[Out] (8*(2*a^2 + 3*a*b + b^2)*Sqrt[(2*a + b + b*Cos[2*x])/(a + b)]*EllipticE[x, b/(a + b)] - 4*a*(a + b)*Sqrt[(2*a + b + b*Cos[2*x])/(a + b)]*EllipticF[x, b/(a + b)] + Sqrt[2]*b*(2*a + b + b*Cos[2*x])*Sin[2*x])/(12*Sqrt[2*a + b + b*Cos[2*x]])
```

**Maple [A]** time = 0.783, size = 192, normalized size = 1.6

$$-\frac{1}{\sin(x)} \left( -\frac{a^2}{3} \sqrt{(\sin(x))^2} \sqrt{\frac{a + b(\cos(x))^2}{a}} \text{EllipticF}\left(\cos(x), \sqrt{-\frac{b}{a}}\right) - \frac{ab}{3} \sqrt{(\sin(x))^2} \sqrt{\frac{a + b(\cos(x))^2}{a}} \text{EllipticF}\left(\cos(x), \sqrt{-\frac{b}{a}}\right) \right)$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] int((a+b*cos(x)^2)^(3/2), x)
```

```
[Out] -(-1/3*(sin(x)^2)^(1/2)*((a+b*cos(x)^2)/a)^(1/2)*EllipticF(cos(x), (-b/a)^(1/2)))*a^2-1/3*a*(sin(x)^2)^(1/2)*((a+b*cos(x)^2)/a)^(1/2)*EllipticF(cos(x), (-b/a)^(1/2))
```



$$-b/a)^{(1/2)} * b + 4/3 * (\sin(x)^2)^{(1/2)} * ((a+b*\cos(x)^2)/a)^{(1/2)} * \text{EllipticE}(\cos(x), (-b/a)^{(1/2)}) * a^2 + 2/3 * (\sin(x)^2)^{(1/2)} * ((a+b*\cos(x)^2)/a)^{(1/2)} * \text{EllipticE}(\cos(x), (-b/a)^{(1/2)}) * a * b + 1/3 * \cos(x)^5 * b^2 + 1/3 * \cos(x)^3 * b * a - 1/3 * \cos(x)^3 * b^2 - 1/3 * a * b * \cos(x)) / \sin(x) / (a+b*\cos(x)^2)^{(1/2)}$$

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int (b \cos(x)^2 + a)^{\frac{3}{2}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^2)^(3/2),x, algorithm="maxima")

[Out] integrate((b\*cos(x)^2 + a)^(3/2), x)

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$\text{integral}\left(\left(b \cos(x)^2 + a\right)^{\frac{3}{2}}, x\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^2)^(3/2),x, algorithm="fricas")

[Out] integral((b\*cos(x)^2 + a)^(3/2), x)

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)\*\*2)\*\*(3/2),x)

[Out] Timed out

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int (b \cos(x)^2 + a)^{\frac{3}{2}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^2)^(3/2),x, algorithm="giac")

[Out] integrate((b\*cos(x)^2 + a)^(3/2), x)

$$3.61 \quad \int \frac{1}{\sqrt{1+\cos^2(x)}} dx$$

**Optimal.** Leaf size=9

$$F\left(x + \frac{\pi}{2} \middle| -1\right)$$

[Out] EllipticF[Pi/2 + x, -1]

**Rubi [A]** time = 0.0077743, antiderivative size = 9, normalized size of antiderivative = 1., number of steps used = 1, number of rules used = 1, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.1$ , Rules used = {3182}

$$F\left(x + \frac{\pi}{2} \middle| -1\right)$$

Antiderivative was successfully verified.

[In] Int[1/Sqrt[1 + Cos[x]^2], x]

[Out] EllipticF[Pi/2 + x, -1]

#### Rule 3182

Int[1/Sqrt[(a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2], x\_Symbol] :> Simp[(1\*EllipticF[e + f\*x, -(b/a)])/(Sqrt[a]\*f), x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]

#### Rubi steps

$$\int \frac{1}{\sqrt{1+\cos^2(x)}} dx = F\left(\frac{\pi}{2} + x \middle| -1\right)$$

**Mathematica [A]** time = 0.0330313, size = 11, normalized size = 1.22

$$\frac{F\left(x \middle| \frac{1}{2}\right)}{\sqrt{2}}$$

Antiderivative was successfully verified.

[In] Integrate[1/Sqrt[1 + Cos[x]^2], x]

[Out] EllipticF[x, 1/2]/Sqrt[2]

**Maple [B]** time = 0.683, size = 41, normalized size = 4.6

$$-\frac{\text{EllipticF}(\cos(x), i)}{\sin(x)} \sqrt{(1 + (\cos(x))^2) (\sin(x))^2} \sqrt{(\sin(x))^2} \frac{1}{\sqrt{1 - (\cos(x))^4}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1+cos(x)^2)^(1/2),x)

[Out] -((1+cos(x)^2)\*sin(x)^2)^(1/2)\*(sin(x)^2)^(1/2)/(1-cos(x)^4)^(1/2)\*Elliptic  
F(cos(x),1)/sin(x)

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{\cos(x)^2 + 1}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^(1/2),x, algorithm="maxima")

[Out] integrate(1/sqrt(cos(x)^2 + 1), x)

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$\text{integral}\left(\frac{1}{\sqrt{\cos(x)^2 + 1}}, x\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^(1/2),x, algorithm="fricas")

[Out] integral(1/sqrt(cos(x)^2 + 1), x)

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{\cos^2(x) + 1}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)\*\*2)\*\*(1/2),x)

[Out] Integral(1/sqrt(cos(x)\*\*2 + 1), x)

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{\cos(x)^2 + 1}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^(1/2),x, algorithm="giac")

[Out] integrate(1/sqrt(cos(x)^2 + 1), x)

$$3.62 \quad \int \frac{1}{\sqrt{-1-\cos^2(x)}} dx$$

**Optimal.** Leaf size=32

$$\frac{\sqrt{\cos^2(x)+1}F\left(x+\frac{\pi}{2}\middle|-1\right)}{\sqrt{-\cos^2(x)-1}}$$

[Out] (Sqrt[1 + Cos[x]^2]\*EllipticF[Pi/2 + x, -1])/Sqrt[-1 - Cos[x]^2]

**Rubi [A]** time = 0.0183404, antiderivative size = 32, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.167$ , Rules used = {3183, 3182}

$$\frac{\sqrt{\cos^2(x)+1}F\left(x+\frac{\pi}{2}\middle|-1\right)}{\sqrt{-\cos^2(x)-1}}$$

Antiderivative was successfully verified.

[In] Int[1/Sqrt[-1 - Cos[x]^2], x]

[Out] (Sqrt[1 + Cos[x]^2]\*EllipticF[Pi/2 + x, -1])/Sqrt[-1 - Cos[x]^2]

#### Rule 3183

Int[1/Sqrt[(a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2], x\_Symbol] :> Dist[Sqrt[1 + (b\*Sin[e + f\*x]^2)/a]/Sqrt[a + b\*Sin[e + f\*x]^2], Int[1/Sqrt[1 + (b\*Sin[e + f\*x]^2)/a], x], x] /; FreeQ[{a, b, e, f}, x] && !GtQ[a, 0]

#### Rule 3182

Int[1/Sqrt[(a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2], x\_Symbol] :> Simp[(1\*EllipticF[e + f\*x, -(b/a)])/(Sqrt[a]\*f), x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]

#### Rubi steps

$$\begin{aligned} \int \frac{1}{\sqrt{-1-\cos^2(x)}} dx &= \frac{\sqrt{1+\cos^2(x)} \int \frac{1}{\sqrt{1+\cos^2(x)}} dx}{\sqrt{-1-\cos^2(x)}} \\ &= \frac{\sqrt{1+\cos^2(x)}F\left(\frac{\pi}{2}+x\middle|-1\right)}{\sqrt{-1-\cos^2(x)}} \end{aligned}$$

**Mathematica [A]** time = 0.0403404, size = 33, normalized size = 1.03

$$\frac{\sqrt{\cos(2x)+3}F\left(x\middle|\frac{1}{2}\right)}{\sqrt{2}\sqrt{-\cos(2x)-3}}$$

Antiderivative was successfully verified.

[In] Integrate[1/Sqrt[-1 - Cos[x]^2], x]

[Out] (Sqrt[3 + Cos[2\*x]]\*EllipticF[x, 1/2])/(Sqrt[2]\*Sqrt[-3 - Cos[2\*x]])

**Maple [A]** time = 0.943, size = 62, normalized size = 1.9

$$\frac{i\text{EllipticF}(i\cos(x), i)}{\sin(x)} \sqrt{-(1+(\cos(x))^2)(\sin(x))^2} \sqrt{1+(\cos(x))^2} \sqrt{(\sin(x))^2} \frac{1}{\sqrt{(\cos(x))^4-1}} \frac{1}{\sqrt{-1-(\cos(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(-1-cos(x)^2)^(1/2), x)

[Out] I\*(-(1+cos(x)^2)\*sin(x)^2)^(1/2)\*(1+cos(x)^2)^(1/2)\*(sin(x)^2)^(1/2)/(cos(x)^4-1)^(1/2)\*EllipticF(I\*cos(x), I)/sin(x)/(-1-cos(x)^2)^(1/2)

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{-\cos(x)^2-1}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1-cos(x)^2)^(1/2), x, algorithm="maxima")

[Out] integrate(1/sqrt(-cos(x)^2 - 1), x)

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$\text{integral}\left(-\frac{2}{\sqrt{e^{(4ix)}+6e^{(2ix)}+1}}, x\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1-cos(x)^2)^(1/2), x, algorithm="fricas")

[Out] integral(-2/sqrt(e^(4\*I\*x) + 6\*e^(2\*I\*x) + 1), x)

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{-\cos^2(x)-1}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1-cos(x)\*\*2)\*\*(1/2), x)

[Out] Integral(1/sqrt(-cos(x)\*\*2 - 1), x)

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{-\cos(x)^2 - 1}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(-1-cos(x)^2)^(1/2),x, algorithm="giac")
```

```
[Out] integrate(1/sqrt(-cos(x)^2 - 1), x)
```

$$3.63 \quad \int \frac{1}{\sqrt{a+b \cos^2(x)}} dx$$

**Optimal.** Leaf size=42

$$\frac{\sqrt{\frac{b \cos^2(x)}{a}} + 1F\left(x + \frac{\pi}{2} \middle| -\frac{b}{a}\right)}{\sqrt{a + b \cos^2(x)}}$$

[Out] (Sqrt[1 + (b\*Cos[x]^2)/a]\*EllipticF[Pi/2 + x, -(b/a)])/Sqrt[a + b\*Cos[x]^2]

**Rubi [A]** time = 0.0289905, antiderivative size = 42, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.167$ , Rules used = {3183, 3182}

$$\frac{\sqrt{\frac{b \cos^2(x)}{a}} + 1F\left(x + \frac{\pi}{2} \middle| -\frac{b}{a}\right)}{\sqrt{a + b \cos^2(x)}}$$

Antiderivative was successfully verified.

[In] Int[1/Sqrt[a + b\*Cos[x]^2], x]

[Out] (Sqrt[1 + (b\*Cos[x]^2)/a]\*EllipticF[Pi/2 + x, -(b/a)])/Sqrt[a + b\*Cos[x]^2]

#### Rule 3183

Int[1/Sqrt[(a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2], x\_Symbol] := Dist[Sqrt[1 + (b\*Sin[e + f\*x]^2)/a]/Sqrt[a + b\*Sin[e + f\*x]^2], Int[1/Sqrt[1 + (b\*Sin[e + f\*x]^2)/a], x], x] /; FreeQ[{a, b, e, f}, x] && !GtQ[a, 0]

#### Rule 3182

Int[1/Sqrt[(a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2], x\_Symbol] := Simp[(1\*EllipticF[e + f\*x, -(b/a)])/(Sqrt[a]\*f), x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]

#### Rubi steps

$$\begin{aligned} \int \frac{1}{\sqrt{a + b \cos^2(x)}} dx &= \frac{\sqrt{1 + \frac{b \cos^2(x)}{a}} \int \frac{1}{\sqrt{1 + \frac{b \cos^2(x)}{a}}} dx}{\sqrt{a + b \cos^2(x)}} \\ &= \frac{\sqrt{1 + \frac{b \cos^2(x)}{a}} F\left(\frac{\pi}{2} + x \middle| -\frac{b}{a}\right)}{\sqrt{a + b \cos^2(x)}} \end{aligned}$$

**Mathematica [A]** time = 0.0641081, size = 46, normalized size = 1.1

$$\frac{\sqrt{\frac{2a+b \cos(2x)+b}{a+b}} F\left(x \middle| \frac{b}{a+b}\right)}{\sqrt{2a + b \cos(2x) + b}}$$

Antiderivative was successfully verified.

[In] Integrate[1/Sqrt[a + b\*Cos[x]^2],x]

[Out] (Sqrt[(2\*a + b + b\*Cos[2\*x])/(a + b)]\*EllipticF[x, b/(a + b)]/Sqrt[2\*a + b + b\*Cos[2\*x]])

**Maple [A]** time = 0.37, size = 48, normalized size = 1.1

$$-\frac{1}{\sin(x)}\sqrt{(\sin(x))^2}\sqrt{\frac{a+b(\cos(x))^2}{a}}\text{EllipticF}\left(\cos(x),\sqrt{-\frac{b}{a}}\right)\frac{1}{\sqrt{a+b(\cos(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(a+b\*cos(x)^2)^(1/2),x)

[Out] -(sin(x)^2)^(1/2)\*((a+b\*cos(x)^2)/a)^(1/2)\*EllipticF(cos(x),(-b/a)^(1/2))/sin(x)/(a+b\*cos(x)^2)^(1/2)

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{b \cos(x)^2 + a}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2)^(1/2),x, algorithm="maxima")

[Out] integrate(1/sqrt(b\*cos(x)^2 + a), x)

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$\text{integral}\left(\frac{1}{\sqrt{b \cos(x)^2 + a}}, x\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2)^(1/2),x, algorithm="fricas")

[Out] integral(1/sqrt(b\*cos(x)^2 + a), x)

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{a + b \cos^2(x)}} dx$$

Verification of antiderivative is not currently implemented for this CAS.



```
[In] integrate(1/(a+b*cos(x)**2)**(1/2),x)
```

```
[Out] Integral(1/sqrt(a + b*cos(x)**2), x)
```

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\sqrt{b \cos(x)^2 + a}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(a+b*cos(x)^2)^(1/2),x, algorithm="giac")
```

```
[Out] integrate(1/sqrt(b*cos(x)^2 + a), x)
```

$$3.64 \quad \int \frac{1}{(1+\cos^2(x))^{3/2}} dx$$

**Optimal.** Leaf size=32

$$\frac{1}{2}E\left(x + \frac{\pi}{2} \middle| -1\right) - \frac{\sin(x)\cos(x)}{2\sqrt{\cos^2(x)+1}}$$

[Out] EllipticE[Pi/2 + x, -1]/2 - (Cos[x]\*Sin[x])/(2\*Sqrt[1 + Cos[x]^2])

**Rubi [A]** time = 0.0182579, antiderivative size = 32, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.3$ , Rules used = {3184, 21, 3177}

$$\frac{1}{2}E\left(x + \frac{\pi}{2} \middle| -1\right) - \frac{\sin(x)\cos(x)}{2\sqrt{\cos^2(x)+1}}$$

Antiderivative was successfully verified.

[In] Int[(1 + Cos[x]^2)^(-3/2), x]

[Out] EllipticE[Pi/2 + x, -1]/2 - (Cos[x]\*Sin[x])/(2\*Sqrt[1 + Cos[x]^2])

#### Rule 3184

```
Int[((a_) + (b_)*sin[(e_) + (f_)*(x_)]^2)^(p_), x_Symbol] :> -Simp[(b*Cos[e + f*x]*Sin[e + f*x]*(a + b*Ssin[e + f*x]^2)^(p + 1))/(2*a*f*(p + 1)*(a + b)), x] + Dist[1/(2*a*(p + 1)*(a + b)), Int[(a + b*Ssin[e + f*x]^2)^(p + 1)*Simp[2*a*(p + 1) + b*(2*p + 3) - 2*b*(p + 2)*Sin[e + f*x]^2, x], x], x] /; FreeQ[{a, b, e, f}, x] && NeQ[a + b, 0] && LtQ[p, -1]
```

#### Rule 21

```
Int[(u_)*((a_) + (b_)*(v_))^(m_)*((c_) + (d_)*(v_))^(n_), x_Symbol] :> Dist[(b/d)^m, Int[u*(c + d*v)^(m + n), x], x] /; FreeQ[{a, b, c, d, n}, x] && EqQ[b*c - a*d, 0] && IntegerQ[m] && (!IntegerQ[n] || SimplerQ[c + d*x, a + b*x])
```

#### Rule 3177

```
Int[Sqrt[(a_) + (b_)*sin[(e_) + (f_)*(x_)]^2], x_Symbol] :> Simp[(Sqrt[a]*EllipticE[e + f*x, -(b/a)])/f, x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]
```

#### Rubi steps

$$\begin{aligned} \int \frac{1}{(1+\cos^2(x))^{3/2}} dx &= -\frac{\cos(x)\sin(x)}{2\sqrt{1+\cos^2(x)}} - \frac{1}{2} \int \frac{-1-\cos^2(x)}{\sqrt{1+\cos^2(x)}} dx \\ &= -\frac{\cos(x)\sin(x)}{2\sqrt{1+\cos^2(x)}} + \frac{1}{2} \int \sqrt{1+\cos^2(x)} dx \\ &= \frac{1}{2}E\left(\frac{\pi}{2} + x \middle| -1\right) - \frac{\cos(x)\sin(x)}{2\sqrt{1+\cos^2(x)}} \end{aligned}$$

**Mathematica [A]** time = 0.0599886, size = 35, normalized size = 1.09

$$\frac{E\left(x\left|\frac{1}{2}\right.\right)}{\sqrt{2}} - \frac{\sin(2x)}{2\sqrt{2}\sqrt{\cos(2x)+3}}$$

Antiderivative was successfully verified.

[In] Integrate[(1 + Cos[x]^2)^(-3/2), x]

[Out] EllipticE[x, 1/2]/Sqrt[2] - Sin[2\*x]/(2\*Sqrt[2]\*Sqrt[3 + Cos[2\*x]])

**Maple [B]** time = 1.058, size = 70, normalized size = 2.2

$$-\frac{1}{2\sin(x)}\sqrt{-(\sin(x))^4+2(\sin(x))^2}\left(\sqrt{(\sin(x))^2}\sqrt{-(\sin(x))^2+2}\operatorname{EllipticE}(\cos(x),i)+\cos(x)(\sin(x))^2)\right)\frac{1}{\sqrt{1-(\sin(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1+cos(x)^2)^(3/2), x)

[Out] -1/2\*(-sin(x)^4+2\*sin(x)^2)^(1/2)\*((sin(x)^2)^(1/2)\*(-sin(x)^2+2)^(1/2)\*EllipticE(cos(x), I)+cos(x)\*sin(x)^2)/(1-cos(x)^4)^(1/2)/sin(x)/(1+cos(x)^2)^(1/2)

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{(\cos(x)^2 + 1)^{\frac{3}{2}}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^(3/2), x, algorithm="maxima")

[Out] integrate((cos(x)^2 + 1)^(-3/2), x)

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$\operatorname{integral}\left(\frac{\sqrt{\cos(x)^2+1}}{\cos(x)^4+2\cos(x)^2+1}, x\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^(3/2), x, algorithm="fricas")

[Out] integral(sqrt(cos(x)^2 + 1)/(cos(x)^4 + 2\*cos(x)^2 + 1), x)

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)\*\*2)\*\*(3/2), x)

[Out] Timed out

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{(\cos(x)^2 + 1)^{\frac{3}{2}}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^2)^(3/2), x, algorithm="giac")

[Out] integrate((cos(x)^2 + 1)^(-3/2), x)

$$3.65 \quad \int \frac{1}{(-1 - \cos^2(x))^{3/2}} dx$$

**Optimal.** Leaf size=56

$$\frac{\sin(x) \cos(x)}{2\sqrt{-\cos^2(x) - 1}} + \frac{\sqrt{-\cos^2(x) - 1} E\left(x + \frac{\pi}{2} \middle| -1\right)}{2\sqrt{\cos^2(x) + 1}}$$

[Out] (Sqrt[-1 - Cos[x]^2]\*EllipticE[Pi/2 + x, -1])/(2\*Sqrt[1 + Cos[x]^2]) + (Cos[x]\*Sin[x])/(2\*Sqrt[-1 - Cos[x]^2])

**Rubi [A]** time = 0.03296, antiderivative size = 56, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3184, 21, 3178, 3177}

$$\frac{\sin(x) \cos(x)}{2\sqrt{-\cos^2(x) - 1}} + \frac{\sqrt{-\cos^2(x) - 1} E\left(x + \frac{\pi}{2} \middle| -1\right)}{2\sqrt{\cos^2(x) + 1}}$$

Antiderivative was successfully verified.

[In] Int[(-1 - Cos[x]^2)^(-3/2), x]

[Out] (Sqrt[-1 - Cos[x]^2]\*EllipticE[Pi/2 + x, -1])/(2\*Sqrt[1 + Cos[x]^2]) + (Cos[x]\*Sin[x])/(2\*Sqrt[-1 - Cos[x]^2])

#### Rule 3184

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^(p\_), x\_Symbol] :> -Simp[(b\*Cos[e + f\*x]\*Sin[e + f\*x]\*(a + b\*Ssin[e + f\*x]^2)^(p + 1))/(2\*a\*f\*(p + 1)\*(a + b)), x] + Dist[1/(2\*a\*(p + 1)\*(a + b)), Int[(a + b\*Ssin[e + f\*x]^2)^(p + 1)\*Simp[2\*a\*(p + 1) + b\*(2\*p + 3) - 2\*b\*(p + 2)\*Sin[e + f\*x]^2, x], x], x] /; FreeQ[{a, b, e, f}, x] && NeQ[a + b, 0] && LtQ[p, -1]

#### Rule 21

Int[(u\_)\*((a\_) + (b\_)\*(v\_))^(m\_)\*((c\_) + (d\_)\*(v\_))^(n\_), x\_Symbol] :> Dist[(b/d)^m, Int[u\*(c + d\*v)^(m + n), x], x] /; FreeQ[{a, b, c, d, n}, x] && EqQ[b\*c - a\*d, 0] && IntegerQ[m] && (!IntegerQ[n] || SimplerQ[c + d\*x, a + b\*x])

#### Rule 3178

Int[Sqrt[(a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2], x\_Symbol] :> Dist[Sqrt[a + b\*Ssin[e + f\*x]^2]/Sqrt[1 + (b\*Ssin[e + f\*x]^2)/a], Int[Sqrt[1 + (b\*Ssin[e + f\*x]^2)/a], x], x] /; FreeQ[{a, b, e, f}, x] && !GtQ[a, 0]

#### Rule 3177

Int[Sqrt[(a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2], x\_Symbol] :> Simp[(Sqrt[a]\*EllipticE[e + f\*x, -(b/a)])/f, x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]

#### Rubi steps

$$\begin{aligned}
\int \frac{1}{(-1 - \cos^2(x))^{3/2}} dx &= \frac{\cos(x) \sin(x)}{2\sqrt{-1 - \cos^2(x)}} - \frac{1}{2} \int \frac{1 + \cos^2(x)}{\sqrt{-1 - \cos^2(x)}} dx \\
&= \frac{\cos(x) \sin(x)}{2\sqrt{-1 - \cos^2(x)}} + \frac{1}{2} \int \sqrt{-1 - \cos^2(x)} dx \\
&= \frac{\cos(x) \sin(x)}{2\sqrt{-1 - \cos^2(x)}} + \frac{\sqrt{-1 - \cos^2(x)} \int \sqrt{1 + \cos^2(x)} dx}{2\sqrt{1 + \cos^2(x)}} \\
&= \frac{\sqrt{-1 - \cos^2(x)} E\left(\frac{\pi}{2} + x \mid -1\right)}{2\sqrt{1 + \cos^2(x)}} + \frac{\cos(x) \sin(x)}{2\sqrt{-1 - \cos^2(x)}}
\end{aligned}$$

**Mathematica [A]** time = 0.0413073, size = 43, normalized size = 0.77

$$\frac{\sin(2x) - 2\sqrt{\cos(2x) + 3} E\left(x \mid \frac{1}{2}\right)}{2\sqrt{2}\sqrt{-\cos(2x) - 3}}$$

Antiderivative was successfully verified.

[In] Integrate[(-1 - Cos[x]^2)^(-3/2), x]

[Out] (-2\*Sqrt[3 + Cos[2\*x]]\*EllipticE[x, 1/2] + Sin[2\*x])/(2\*Sqrt[2]\*Sqrt[-3 - Cos[2\*x]])

**Maple [A]** time = 1.184, size = 101, normalized size = 1.8

$$-\frac{1}{2 \sin(x)} \sqrt{(\sin(x))^4 - 2(\sin(x))^2} \left( 2i\sqrt{(\sin(x))^2} \sqrt{-(\sin(x))^2} + 2\text{EllipticF}(i \cos(x), i) - i\sqrt{(\sin(x))^2} \sqrt{-(\sin(x))^2} + \dots \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(-1-cos(x)^2)^(3/2), x)

[Out] -1/2\*(sin(x)^4-2\*sin(x)^2)^(1/2)\*(2\*I\*(sin(x)^2)^(1/2)\*(-sin(x)^2+2)^(1/2)\*EllipticF(I\*cos(x), I)-I\*(sin(x)^2)^(1/2)\*(-sin(x)^2+2)^(1/2)\*EllipticE(I\*cos(x), I)-cos(x)\*sin(x)^2)/(cos(x)^4-1)^(1/2)/sin(x)/(-1-cos(x)^2)^(1/2)

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{(-\cos(x)^2 - 1)^{3/2}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1-cos(x)^2)^(3/2), x, algorithm="maxima")

[Out] integrate((-cos(x)^2 - 1)^(-3/2), x)

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$\frac{2(e^{4ix} + 6e^{2ix} + 1) \operatorname{integral}\left(\frac{e^{2ix} + 3}{2\sqrt{e^{4ix} + 6e^{2ix} + 1}}, x\right) - \sqrt{e^{4ix} + 6e^{2ix} + 1}(e^{3ix} + 3e^{ix})}{2(e^{4ix} + 6e^{2ix} + 1)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1-cos(x)^2)^(3/2), x, algorithm="fricas")

[Out] 1/2\*(2\*(e^(4\*I\*x) + 6\*e^(2\*I\*x) + 1)\*integral(1/2\*(e^(2\*I\*x) + 3)/sqrt(e^(4\*I\*x) + 6\*e^(2\*I\*x) + 1), x) - sqrt(e^(4\*I\*x) + 6\*e^(2\*I\*x) + 1)\*(e^(3\*I\*x) + 3\*e^(I\*x)))/(e^(4\*I\*x) + 6\*e^(2\*I\*x) + 1)

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1-cos(x)\*\*2)\*\*(3/2), x)

[Out] Timed out

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{(-\cos(x)^2 - 1)^{\frac{3}{2}}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(-1-cos(x)^2)^(3/2), x, algorithm="giac")

[Out] integrate((-cos(x)^2 - 1)^(-3/2), x)

$$3.66 \quad \int \frac{1}{(a+b \cos^2(x))^{3/2}} dx$$

**Optimal.** Leaf size=78

$$\frac{\sqrt{a+b \cos^2(x)} E\left(x + \frac{\pi}{2} \middle| -\frac{b}{a}\right)}{a(a+b) \sqrt{\frac{b \cos^2(x)}{a} + 1}} - \frac{b \sin(x) \cos(x)}{a(a+b) \sqrt{a+b \cos^2(x)}}$$

[Out] (Sqrt[a + b\*Cos[x]^2]\*EllipticE[Pi/2 + x, -(b/a)])/(a\*(a + b)\*Sqrt[1 + (b\*Cos[x]^2)/a]) - (b\*Cos[x]\*Sin[x])/(a\*(a + b)\*Sqrt[a + b\*Cos[x]^2])

**Rubi [A]** time = 0.0474696, antiderivative size = 78, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 12,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3184, 21, 3178, 3177}

$$\frac{\sqrt{a+b \cos^2(x)} E\left(x + \frac{\pi}{2} \middle| -\frac{b}{a}\right)}{a(a+b) \sqrt{\frac{b \cos^2(x)}{a} + 1}} - \frac{b \sin(x) \cos(x)}{a(a+b) \sqrt{a+b \cos^2(x)}}$$

Antiderivative was successfully verified.

[In] Int[(a + b\*Cos[x]^2)^(-3/2), x]

[Out] (Sqrt[a + b\*Cos[x]^2]\*EllipticE[Pi/2 + x, -(b/a)])/(a\*(a + b)\*Sqrt[1 + (b\*Cos[x]^2)/a]) - (b\*Cos[x]\*Sin[x])/(a\*(a + b)\*Sqrt[a + b\*Cos[x]^2])

#### Rule 3184

```
Int[((a_) + (b_)*sin[(e_) + (f_)*(x_)]^2)^(p_), x_Symbol] :> -Simp[(b*Cos[e + f*x]*Sin[e + f*x]*(a + b*Sin[e + f*x]^2)^(p + 1))/(2*a*f*(p + 1)*(a + b)), x] + Dist[1/(2*a*(p + 1)*(a + b)), Int[(a + b*Sin[e + f*x]^2)^(p + 1)*Simp[2*a*(p + 1) + b*(2*p + 3) - 2*b*(p + 2)*Sin[e + f*x]^2, x], x] /; FreeQ[{a, b, e, f}, x] && NeQ[a + b, 0] && LtQ[p, -1]
```

#### Rule 21

```
Int[(u_)*((a_) + (b_)*(v_))^(m_)*((c_) + (d_)*(v_))^(n_), x_Symbol] :> Dist[(b/d)^m, Int[u*(c + d*v)^(m + n), x], x] /; FreeQ[{a, b, c, d, n}, x] && EqQ[b*c - a*d, 0] && IntegerQ[m] && (!IntegerQ[n] || SimplerQ[c + d*x, a + b*x])
```

#### Rule 3178

```
Int[Sqrt[(a_) + (b_)*sin[(e_) + (f_)*(x_)]^2], x_Symbol] :> Dist[Sqrt[a + b*Sin[e + f*x]^2]/Sqrt[1 + (b*Sin[e + f*x]^2)/a], Int[Sqrt[1 + (b*Sin[e + f*x]^2)/a], x], x] /; FreeQ[{a, b, e, f}, x] && !GtQ[a, 0]
```

#### Rule 3177

```
Int[Sqrt[(a_) + (b_)*sin[(e_) + (f_)*(x_)]^2], x_Symbol] :> Simp[(Sqrt[a]*EllipticE[e + f*x, -(b/a)]/f, x] /; FreeQ[{a, b, e, f}, x] && GtQ[a, 0]
```

#### Rubi steps



$$\begin{aligned}
\int \frac{1}{(a+b\cos^2(x))^{3/2}} dx &= -\frac{b\cos(x)\sin(x)}{a(a+b)\sqrt{a+b\cos^2(x)}} - \frac{\int \frac{-a-b\cos^2(x)}{\sqrt{a+b\cos^2(x)}} dx}{a(a+b)} \\
&= -\frac{b\cos(x)\sin(x)}{a(a+b)\sqrt{a+b\cos^2(x)}} + \frac{\int \sqrt{a+b\cos^2(x)} dx}{a(a+b)} \\
&= -\frac{b\cos(x)\sin(x)}{a(a+b)\sqrt{a+b\cos^2(x)}} + \frac{\sqrt{a+b\cos^2(x)} \int \sqrt{1+\frac{b\cos^2(x)}{a}} dx}{a(a+b)\sqrt{1+\frac{b\cos^2(x)}{a}}} \\
&= \frac{\sqrt{a+b\cos^2(x)} E\left(\frac{\pi}{2} + x \mid -\frac{b}{a}\right)}{a(a+b)\sqrt{1+\frac{b\cos^2(x)}{a}}} - \frac{b\cos(x)\sin(x)}{a(a+b)\sqrt{a+b\cos^2(x)}}
\end{aligned}$$

**Mathematica [A]** time = 0.175397, size = 75, normalized size = 0.96

$$\frac{2(a+b)\sqrt{\frac{2a+b\cos(2x)+b}{a+b}} E\left(x \mid \frac{b}{a+b}\right) - \sqrt{2}b\sin(2x)}{2a(a+b)\sqrt{2a+b\cos(2x)+b}}$$

Antiderivative was successfully verified.

[In] Integrate[(a + b\*Cos[x]^2)^(-3/2), x]

[Out] (2\*(a + b)\*Sqrt[(2\*a + b + b\*Cos[2\*x])/(a + b)]\*EllipticE[x, b/(a + b)] - Sqrt[2]\*b\*Sin[2\*x])/(2\*a\*(a + b)\*Sqrt[2\*a + b + b\*Cos[2\*x]])

**Maple [A]** time = 0.798, size = 73, normalized size = 0.9

$$-\frac{1}{(a+b)a\sin(x)} \left( \sqrt{(\sin(x))^2} \sqrt{-\frac{b(\sin(x))^2}{a} + \frac{a+b}{a}} a \text{EllipticE}\left(\cos(x), \sqrt{-\frac{b}{a}}\right) + b\cos(x)(\sin(x))^2 \right) \frac{1}{\sqrt{a+b(\cos(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(a+b\*cos(x)^2)^(3/2), x)

[Out] -((sin(x)^2)^(1/2)\*(-b/a\*sin(x)^2+(a+b)/a)^(1/2)\*a\*EllipticE(cos(x), (-b/a)^(1/2))+b\*cos(x)\*sin(x)^2/a/(a+b)/sin(x)/(a+b\*cos(x)^2)^(1/2))

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{(b\cos(x)^2 + a)^{3/2}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2)^(3/2), x, algorithm="maxima")

[Out] integrate((b\*cos(x)^2 + a)^(-3/2), x)

---

**Fricas [F]** time = 0., size = 0, normalized size = 0.

$$\text{integral} \left( \frac{\sqrt{b \cos(x)^2 + a}}{b^2 \cos(x)^4 + 2ab \cos(x)^2 + a^2}, x \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2)^(3/2),x, algorithm="fricas")

[Out] integral(sqrt(b\*cos(x)^2 + a)/(b^2\*cos(x)^4 + 2\*a\*b\*cos(x)^2 + a^2), x)

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)\*\*2)\*\*(3/2),x)

[Out] Timed out

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{(b \cos(x)^2 + a)^{\frac{3}{2}}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^2)^(3/2),x, algorithm="giac")

[Out] integrate((b\*cos(x)^2 + a)^(-3/2), x)

$$3.67 \quad \int \frac{\cos(x)}{\sqrt{1+\cos^2(x)}} dx$$

**Optimal.** Leaf size=9

$$\sin^{-1}\left(\frac{\sin(x)}{\sqrt{2}}\right)$$

[Out] ArcSin[Sin[x]/Sqrt[2]]

**Rubi [A]** time = 0.0211736, antiderivative size = 9, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 13,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.154$ , Rules used = {3186, 216}

$$\sin^{-1}\left(\frac{\sin(x)}{\sqrt{2}}\right)$$

Antiderivative was successfully verified.

[In] Int[Cos[x]/Sqrt[1 + Cos[x]^2], x]

[Out] ArcSin[Sin[x]/Sqrt[2]]

#### Rule 3186

Int[sin[(e\_.) + (f\_.)\*(x\_.)]^(m\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^(p\_.), x\_Symbol] := With[{ff = FreeFactors[Cos[e + f\*x], x]}, -Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b - b\*ff^2\*x^2)^p, x], x, Cos[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 216

Int[1/Sqrt[(a\_.) + (b\_.)\*(x\_.)^2], x\_Symbol] := Simp[ArcSin[(Rt[-b, 2]\*x)/Sqrt[a]]/Rt[-b, 2], x] /; FreeQ[{a, b}, x] && GtQ[a, 0] && NegQ[b]

#### Rubi steps

$$\begin{aligned} \int \frac{\cos(x)}{\sqrt{1+\cos^2(x)}} dx &= \text{Subst}\left(\int \frac{1}{\sqrt{2-x^2}} dx, x, \sin(x)\right) \\ &= \sin^{-1}\left(\frac{\sin(x)}{\sqrt{2}}\right) \end{aligned}$$

**Mathematica [A]** time = 0.0073821, size = 9, normalized size = 1.

$$\sin^{-1}\left(\frac{\sin(x)}{\sqrt{2}}\right)$$

Antiderivative was successfully verified.

[In] Integrate[Cos[x]/Sqrt[1 + Cos[x]^2], x]

[Out] ArcSin[Sin[x]/Sqrt[2]]

---

**Maple [B]** time = 0.377, size = 33, normalized size = 3.7

$$-\frac{\arcsin\left(\frac{(\cos(x))^2}{2\sin(x)}\right)\sqrt{(1+(\cos(x))^2)(\sin(x))^2}}{\sqrt{1+(\cos(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(cos(x)/(1+cos(x)^2)^(1/2),x)`

[Out] `-1/2*((1+cos(x)^2)*sin(x)^2)^(1/2)*arcsin(cos(x)^2/sin(x)/(1+cos(x)^2)^(1/2))`

---

**Maxima [A]** time = 1.42654, size = 11, normalized size = 1.22

$$\arcsin\left(\frac{1}{2}\sqrt{2}\sin(x)\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(cos(x)/(1+cos(x)^2)^(1/2),x, algorithm="maxima")`

[Out] `arcsin(1/2*sqrt(2)*sin(x))`

---

**Fricas [B]** time = 1.716, size = 162, normalized size = 18.

$$\frac{1}{2}\arctan\left(\frac{\sqrt{\cos(x)^2+1}\cos(x)^2\sin(x)-\cos(x)\sin(x)}{\cos(x)^4+\cos(x)^2-1}\right)+\frac{1}{2}\arctan\left(\frac{\sin(x)}{\cos(x)}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(cos(x)/(1+cos(x)^2)^(1/2),x, algorithm="fricas")`

[Out] `1/2*arctan((sqrt(cos(x)^2+1)*cos(x)^2*sin(x)-cos(x)*sin(x))/(cos(x)^4+cos(x)^2-1))+1/2*arctan(sin(x)/cos(x))`

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(cos(x)/(1+cos(x)**2)**(1/2),x)`

[Out] Timed out

---

**Giac [A]** time = 1.33444, size = 11, normalized size = 1.22

$$\arcsin\left(\frac{1}{2}\sqrt{2}\sin(x)\right)$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(cos(x)/(1+cos(x)^2)^(1/2),x, algorithm="giac")
```

```
[Out] arcsin(1/2*sqrt(2)*sin(x))
```

$$3.68 \quad \int \frac{\cos(5+3x)}{\sqrt{3+\cos^2(5+3x)}} dx$$

Optimal. Leaf size=15

$$\frac{1}{3} \sin^{-1} \left( \frac{1}{2} \sin(3x + 5) \right)$$

[Out] ArcSin[Sin[5 + 3\*x]/2]/3

**Rubi [A]** time = 0.0272563, antiderivative size = 15, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 21,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.095$ , Rules used = {3186, 216}

$$\frac{1}{3} \sin^{-1} \left( \frac{1}{2} \sin(3x + 5) \right)$$

Antiderivative was successfully verified.

[In] Int[Cos[5 + 3\*x]/Sqrt[3 + Cos[5 + 3\*x]^2], x]

[Out] ArcSin[Sin[5 + 3\*x]/2]/3

#### Rule 3186

Int[sin[(e\_.) + (f\_.)\*(x\_)]^(m\_.)\*((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_.), x\_Symbol] :> With[{ff = FreeFactors[Cos[e + f\*x], x]}, -Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b - b\*ff^2\*x^2)^p, x], x, Cos[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 216

Int[1/Sqrt[(a\_) + (b\_.)\*(x\_)^2], x\_Symbol] :> Simp[ArcSin[(Rt[-b, 2]\*x)/Sqrt[a]]/Rt[-b, 2], x] /; FreeQ[{a, b}, x] && GtQ[a, 0] && NegQ[b]

#### Rubi steps

$$\begin{aligned} \int \frac{\cos(5+3x)}{\sqrt{3+\cos^2(5+3x)}} dx &= \frac{1}{3} \text{Subst} \left( \int \frac{1}{\sqrt{4-x^2}} dx, x, \sin(5+3x) \right) \\ &= \frac{1}{3} \sin^{-1} \left( \frac{1}{2} \sin(5+3x) \right) \end{aligned}$$

**Mathematica [A]** time = 0.0239926, size = 15, normalized size = 1.

$$\frac{1}{3} \sin^{-1} \left( \frac{1}{2} \sin(3x + 5) \right)$$

Antiderivative was successfully verified.

[In] Integrate[Cos[5 + 3\*x]/Sqrt[3 + Cos[5 + 3\*x]^2], x]

[Out] ArcSin[Sin[5 + 3\*x]/2]/3

---

**Maple [B]** time = 0.484, size = 57, normalized size = 3.8

$$\frac{1}{6 \sin(5+3x)} \sqrt{(3 + (\cos(5+3x))^2) (\sin(5+3x))^2} \arcsin\left(-1 + \frac{(\sin(5+3x))^2}{2}\right) \frac{1}{\sqrt{3 + (\cos(5+3x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(cos(5+3\*x)/(3+cos(5+3\*x)^2)^(1/2), x)

[Out] 1/6\*((3+cos(5+3\*x)^2)\*sin(5+3\*x)^2)^(1/2)\*arcsin(-1+1/2\*sin(5+3\*x)^2)/sin(5+3\*x)/(3+cos(5+3\*x)^2)^(1/2)

---

**Maxima [A]** time = 1.45339, size = 15, normalized size = 1.

$$\frac{1}{3} \arcsin\left(\frac{1}{2} \sin(3x+5)\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(5+3\*x)/(3+cos(5+3\*x)^2)^(1/2), x, algorithm="maxima")

[Out] 1/3\*arcsin(1/2\*sin(3\*x + 5))

---

**Fricas [B]** time = 1.72898, size = 248, normalized size = 16.53

$$\frac{1}{6} \arctan\left(\frac{\sqrt{\cos(3x+5)^2 + 3}(\cos(3x+5)^2 + 1)\sin(3x+5) - 4\cos(3x+5)\sin(3x+5)}{\cos(3x+5)^4 + 6\cos(3x+5)^2 - 3}\right) + \frac{1}{6} \arctan\left(\frac{\sin(3x+5)}{\cos(3x+5)}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(5+3\*x)/(3+cos(5+3\*x)^2)^(1/2), x, algorithm="fricas")

[Out] 1/6\*arctan((sqrt(cos(3\*x + 5)^2 + 3)\*(cos(3\*x + 5)^2 + 1)\*sin(3\*x + 5) - 4\*cos(3\*x + 5)\*sin(3\*x + 5))/(cos(3\*x + 5)^4 + 6\*cos(3\*x + 5)^2 - 3)) + 1/6\*arctan(sin(3\*x + 5)/cos(3\*x + 5))

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(5+3\*x)/(3+cos(5+3\*x)\*\*2)\*\*(1/2), x)

[Out] Timed out

---

**Giac [A]** time = 1.41556, size = 15, normalized size = 1.

$$\frac{1}{3} \arcsin\left(\frac{1}{2} \sin(3x + 5)\right)$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(cos(5+3*x)/(3+cos(5+3*x)^2)^(1/2),x, algorithm="giac")
```

```
[Out] 1/3*arcsin(1/2*sin(3*x + 5))
```



$$3.69 \quad \int \frac{\cos(x)}{\sqrt{4-\cos^2(x)}} dx$$

**Optimal.** Leaf size=9

$$\sinh^{-1}\left(\frac{\sin(x)}{\sqrt{3}}\right)$$

[Out] ArcSinh[Sin[x]/Sqrt[3]]

**Rubi [A]** time = 0.0257469, antiderivative size = 9, normalized size of antiderivative = 1., number of steps used = 2, number of rules used = 2, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.133$ , Rules used = {3186, 215}

$$\sinh^{-1}\left(\frac{\sin(x)}{\sqrt{3}}\right)$$

Antiderivative was successfully verified.

[In] Int[Cos[x]/Sqrt[4 - Cos[x]^2], x]

[Out] ArcSinh[Sin[x]/Sqrt[3]]

**Rule 3186**

Int[sin[(e\_.) + (f\_.)\*(x\_.)]^(m\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^(p\_.), x\_Symbol] := With[{ff = FreeFactors[Cos[e + f\*x], x]}, -Dist[ff/f, Subst[Int[(1 - ff^2\*x^2)^((m - 1)/2)\*(a + b - b\*ff^2\*x^2)^p, x], x, Cos[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

**Rule 215**

Int[1/Sqrt[(a\_.) + (b\_.)\*(x\_.)^2], x\_Symbol] := Simp[ArcSinh[(Rt[b, 2]\*x)/Sqrt[a]]/Rt[b, 2], x] /; FreeQ[{a, b}, x] && GtQ[a, 0] && PosQ[b]

**Rubi steps**

$$\begin{aligned} \int \frac{\cos(x)}{\sqrt{4-\cos^2(x)}} dx &= \text{Subst}\left(\int \frac{1}{\sqrt{3+x^2}} dx, x, \sin(x)\right) \\ &= \sinh^{-1}\left(\frac{\sin(x)}{\sqrt{3}}\right) \end{aligned}$$

**Mathematica [A]** time = 0.0093868, size = 9, normalized size = 1.

$$\sinh^{-1}\left(\frac{\sin(x)}{\sqrt{3}}\right)$$

Antiderivative was successfully verified.

[In] Integrate[Cos[x]/Sqrt[4 - Cos[x]^2], x]

[Out] ArcSinh[Sin[x]/Sqrt[3]]

---

**Maple [B]** time = 0.897, size = 53, normalized size = 5.9

$$-\frac{1}{2 \sin(x)} \sqrt{-(-4 + (\cos(x))^2) (\sin(x))^2} \ln\left(-(\sin(x))^2 + \sqrt{(\sin(x))^4 + 3 (\sin(x))^2} - \frac{3}{2}\right) \frac{1}{\sqrt{4 - (\cos(x))^2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(cos(x)/(4-cos(x)^2)^(1/2), x)

[Out] -1/2\*(-(-4+cos(x)^2)\*sin(x)^2)^(1/2)\*ln(-sin(x)^2+(sin(x)^4+3\*sin(x)^2)^(1/2)-3/2)/sin(x)/(4-cos(x)^2)^(1/2)

---

**Maxima [A]** time = 1.52196, size = 11, normalized size = 1.22

$$\operatorname{arsinh}\left(\frac{1}{3} \sqrt{3} \sin(x)\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)/(4-cos(x)^2)^(1/2), x, algorithm="maxima")

[Out] arcsinh(1/3\*sqrt(3)\*sin(x))

---

**Fricas [B]** time = 1.66927, size = 119, normalized size = 13.22

$$\frac{1}{4} \log\left(8 \cos(x)^4 - 4(2 \cos(x)^2 - 5) \sqrt{-\cos(x)^2 + 4 \sin(x)} - 40 \cos(x)^2 + 41\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)/(4-cos(x)^2)^(1/2), x, algorithm="fricas")

[Out] 1/4\*log(8\*cos(x)^4 - 4\*(2\*cos(x)^2 - 5)\*sqrt(-cos(x)^2 + 4)\*sin(x) - 40\*cos(x)^2 + 41)

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(cos(x)/(4-cos(x)\*\*2)\*\*(1/2), x)

[Out] Timed out

---

**Giac [A]** time = 1.23394, size = 22, normalized size = 2.44

$$-\log\left(\sqrt{\sin(x)^2 + 3} - \sin(x)\right)$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(cos(x)/(4-cos(x)^2)^(1/2),x, algorithm="giac")
```

```
[Out] -log(sqrt(sin(x)^2 + 3) - sin(x))
```

### 3.70 $\int \frac{1}{a+b \cos^4(x)} dx$

**Optimal.** Leaf size=487

$$\frac{(\sqrt{a} - \sqrt{a+b}) \log\left((a+b)^{3/4} \cot^2(x) - \sqrt{2} \sqrt[4]{a} \sqrt{-\sqrt{a}\sqrt{a+b} + a + b} \cot(x) + \sqrt{a} \sqrt[4]{a+b}\right)}{4\sqrt{2} a^{3/4} \sqrt[4]{a+b} \sqrt{-\sqrt{a}\sqrt{a+b} + a + b}} + \frac{(\sqrt{a} - \sqrt{a+b}) \log\left((a+b)^{3/4} \cot^2(x) - \sqrt{2} \sqrt[4]{a} \sqrt{-\sqrt{a}\sqrt{a+b} + a + b} \cot(x) + \sqrt{a} \sqrt[4]{a+b}\right)}{4\sqrt{2} a^{3/4} \sqrt[4]{a+b} \sqrt{-\sqrt{a}\sqrt{a+b} + a + b}}$$

```
[Out] ((Sqrt[a] + Sqrt[a + b])*ArcTan[(a^(1/4)*Sqrt[a + b] - Sqrt[a]*Sqrt[a + b]]
- Sqrt[2]*(a + b)^(3/4)*Cot[x])/(a^(1/4)*Sqrt[a + b] + Sqrt[a]*Sqrt[a + b]])
)/(2*Sqrt[2]*a^(3/4)*(a + b)^(1/4)*Sqrt[a + b] + Sqrt[a]*Sqrt[a + b])) - ((
Sqrt[a] + Sqrt[a + b])*ArcTan[(a^(1/4)*Sqrt[a + b] - Sqrt[a]*Sqrt[a + b]] +
Sqrt[2]*(a + b)^(3/4)*Cot[x])/(a^(1/4)*Sqrt[a + b] + Sqrt[a]*Sqrt[a + b]))
)/(2*Sqrt[2]*a^(3/4)*(a + b)^(1/4)*Sqrt[a + b] + Sqrt[a]*Sqrt[a + b])) - ((Sqrt
[a] - Sqrt[a + b])*Log[Sqrt[a]*(a + b)^(1/4) - Sqrt[2]*a^(1/4)*Sqrt[a + b]
- Sqrt[a]*Sqrt[a + b]]*Cot[x] + (a + b)^(3/4)*Cot[x]^2))/(4*Sqrt[2]*a^(3/4)
*(a + b)^(1/4)*Sqrt[a + b] - Sqrt[a]*Sqrt[a + b])) + ((Sqrt[a] - Sqrt[a + b]
])*Log[Sqrt[a]*(a + b)^(1/4) + Sqrt[2]*a^(1/4)*Sqrt[a + b] - Sqrt[a]*Sqrt[a
+ b]]*Cot[x] + (a + b)^(3/4)*Cot[x]^2))/(4*Sqrt[2]*a^(3/4)*(a + b)^(1/4)*Sqr
t[a + b] - Sqrt[a]*Sqrt[a + b]])
```

**Rubi [A]** time = 1.10087, antiderivative size = 487, normalized size of antiderivative = 1., number of steps used = 10, number of rules used = 6, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.6$ , Rules used = {3209, 1169, 634, 618, 204, 628}

$$\frac{(\sqrt{a} - \sqrt{a+b}) \log\left((a+b)^{3/4} \cot^2(x) - \sqrt{2} \sqrt[4]{a} \sqrt{-\sqrt{a}\sqrt{a+b} + a + b} \cot(x) + \sqrt{a} \sqrt[4]{a+b}\right)}{4\sqrt{2} a^{3/4} \sqrt[4]{a+b} \sqrt{-\sqrt{a}\sqrt{a+b} + a + b}} + \frac{(\sqrt{a} - \sqrt{a+b}) \log\left((a+b)^{3/4} \cot^2(x) - \sqrt{2} \sqrt[4]{a} \sqrt{-\sqrt{a}\sqrt{a+b} + a + b} \cot(x) + \sqrt{a} \sqrt[4]{a+b}\right)}{4\sqrt{2} a^{3/4} \sqrt[4]{a+b} \sqrt{-\sqrt{a}\sqrt{a+b} + a + b}}$$

Antiderivative was successfully verified.

```
[In] Int[(a + b*cos[x]^4)^(-1), x]
```

```
[Out] ((Sqrt[a] + Sqrt[a + b])*ArcTan[(a^(1/4)*Sqrt[a + b] - Sqrt[a]*Sqrt[a + b]]
- Sqrt[2]*(a + b)^(3/4)*Cot[x])/(a^(1/4)*Sqrt[a + b] + Sqrt[a]*Sqrt[a + b]])
)/(2*Sqrt[2]*a^(3/4)*(a + b)^(1/4)*Sqrt[a + b] + Sqrt[a]*Sqrt[a + b])) - ((
Sqrt[a] + Sqrt[a + b])*ArcTan[(a^(1/4)*Sqrt[a + b] - Sqrt[a]*Sqrt[a + b]] +
Sqrt[2]*(a + b)^(3/4)*Cot[x])/(a^(1/4)*Sqrt[a + b] + Sqrt[a]*Sqrt[a + b]))
)/(2*Sqrt[2]*a^(3/4)*(a + b)^(1/4)*Sqrt[a + b] + Sqrt[a]*Sqrt[a + b])) - ((Sqrt
[a] - Sqrt[a + b])*Log[Sqrt[a]*(a + b)^(1/4) - Sqrt[2]*a^(1/4)*Sqrt[a + b]
- Sqrt[a]*Sqrt[a + b]]*Cot[x] + (a + b)^(3/4)*Cot[x]^2))/(4*Sqrt[2]*a^(3/4)
*(a + b)^(1/4)*Sqrt[a + b] - Sqrt[a]*Sqrt[a + b])) + ((Sqrt[a] - Sqrt[a + b]
])*Log[Sqrt[a]*(a + b)^(1/4) + Sqrt[2]*a^(1/4)*Sqrt[a + b] - Sqrt[a]*Sqrt[a
+ b]]*Cot[x] + (a + b)^(3/4)*Cot[x]^2))/(4*Sqrt[2]*a^(3/4)*(a + b)^(1/4)*Sqr
t[a + b] - Sqrt[a]*Sqrt[a + b]])
```

#### Rule 3209

```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^4)^(p_.), x_Symbol] := With[{ff =
FreeFactors[Tan[e + f*x], x]}, Dist[ff/f, Subst[Int[(a + 2*a*ff^2*x^2 + (a
+ b)*ff^4*x^4)^p/(1 + ff^2*x^2)^(2*p + 1), x], x, Tan[e + f*x]/ff], x] /;
FreeQ[{a, b, e, f}, x] && IntegerQ[p]
```

#### Rule 1169

Int[((d\_) + (e\_)\*(x\_)^2)/((a\_) + (b\_)\*(x\_)^2 + (c\_)\*(x\_)^4), x\_Symbol] :> With[{q = Rt[a/c, 2]}, With[{r = Rt[2\*q - b/c, 2]}, Dist[1/(2\*c\*q\*r), Int[(d\*r - (d - e\*q)\*x)/(q - r\*x + x^2), x], x] + Dist[1/(2\*c\*q\*r), Int[(d\*r + (d - e\*q)\*x)/(q + r\*x + x^2), x], x]]] /; FreeQ[{a, b, c, d, e}, x] && NeQ[b^2 - 4\*a\*c, 0] && NeQ[c\*d^2 - b\*d\*e + a\*e^2, 0] && NegQ[b^2 - 4\*a\*c]

#### Rule 634

Int[((d\_) + (e\_)\*(x\_))/((a\_) + (b\_)\*(x\_) + (c\_)\*(x\_)^2), x\_Symbol] :> Dist[(2\*c\*d - b\*e)/(2\*c), Int[1/(a + b\*x + c\*x^2), x], x] + Dist[e/(2\*c), Int[(b + 2\*c\*x)/(a + b\*x + c\*x^2), x], x] /; FreeQ[{a, b, c, d, e}, x] && NeQ[2\*c\*d - b\*e, 0] && NeQ[b^2 - 4\*a\*c, 0] && !NiceSqrtQ[b^2 - 4\*a\*c]

#### Rule 618

Int[((a\_) + (b\_)\*(x\_) + (c\_)\*(x\_)^2)^(-1), x\_Symbol] :> Dist[-2, Subst[Int[1/Simp[b^2 - 4\*a\*c - x^2, x], x], x, b + 2\*c\*x], x] /; FreeQ[{a, b, c}, x] && NeQ[b^2 - 4\*a\*c, 0]

#### Rule 204

Int[((a\_) + (b\_)\*(x\_)^2)^(-1), x\_Symbol] :> -Simp[ArcTan[(Rt[-b, 2]\*x)/Rt[-a, 2]]/(Rt[-a, 2]\*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (LtQ[a, 0] || LtQ[b, 0])

#### Rule 628

Int[((d\_) + (e\_)\*(x\_))/((a\_) + (b\_)\*(x\_) + (c\_)\*(x\_)^2), x\_Symbol] :> Simp[(d\*Log[RemoveContent[a + b\*x + c\*x^2, x]])/b, x] /; FreeQ[{a, b, c, d, e}, x] && EqQ[2\*c\*d - b\*e, 0]

#### Rubi steps

$$\begin{aligned} \int \frac{1}{a + b \cos^4(x)} dx &= -\text{Subst} \left( \int \frac{1 + x^2}{a + 2ax^2 + (a + b)x^4} dx, x, \cot(x) \right) \\ &= \frac{\sqrt[4]{a+b} \text{Subst} \left( \int \frac{\frac{\sqrt{2} \sqrt[4]{a} \sqrt{a+b-\sqrt{a}\sqrt{a+b}}}{(a+b)^{3/4}} - \left(1 - \frac{\sqrt{a}}{\sqrt{a+b}}\right)x}{\frac{\sqrt{a}}{\sqrt{a+b}} - \frac{\sqrt{2} \sqrt[4]{a} \sqrt{a+b-\sqrt{a}\sqrt{a+b}}}{(a+b)^{3/4}} + x^2} dx, x, \cot(x) \right)}{2\sqrt{2}a^{3/4}\sqrt{a+b-\sqrt{a}\sqrt{a+b}}} - \frac{\sqrt[4]{a+b} \text{Subst} \left( \int \frac{\frac{\sqrt{2} \sqrt[4]{a} \sqrt{a+b-\sqrt{a}\sqrt{a+b}}}{(a+b)^{3/4}} + \left(1 - \frac{\sqrt{a}}{\sqrt{a+b}}\right)x}{\frac{\sqrt{a}}{\sqrt{a+b}} + \frac{\sqrt{2} \sqrt[4]{a} \sqrt{a+b-\sqrt{a}\sqrt{a+b}}}{(a+b)^{3/4}} + x^2} dx, x, \cot(x) \right)}{2\sqrt{2}a^{3/4}\sqrt{a+b-\sqrt{a}\sqrt{a+b}}} \\ &= \frac{\left(1 + \frac{\sqrt{a+b}}{\sqrt{a}}\right) \text{Subst} \left( \int \frac{1}{\frac{\sqrt{a}}{\sqrt{a+b}} - \frac{\sqrt{2} \sqrt[4]{a} \sqrt{a+b-\sqrt{a}\sqrt{a+b}}}{(a+b)^{3/4}} + x^2} dx, x, \cot(x) \right)}{4(a+b)} - \frac{\left(1 + \frac{\sqrt{a+b}}{\sqrt{a}}\right) \text{Subst} \left( \int \frac{1}{\frac{\sqrt{a}}{\sqrt{a+b}} + \frac{\sqrt{2} \sqrt[4]{a} \sqrt{a+b-\sqrt{a}\sqrt{a+b}}}{(a+b)^{3/4}} + x^2} dx, x, \cot(x) \right)}{4(a+b)} \\ &= \frac{\sqrt[4]{a+b} \left(1 - \frac{\sqrt{a}}{\sqrt{a+b}}\right) \log \left( \sqrt{a} \sqrt[4]{a+b} - \sqrt{2} \sqrt[4]{a} \sqrt{a+b-\sqrt{a}\sqrt{a+b}} \cot(x) + (a+b)^{3/4} \cot^2(x) \right)}{4\sqrt{2}a^{3/4}\sqrt{a+b-\sqrt{a}\sqrt{a+b}}} + \frac{\sqrt[4]{a+b} \left(1 + \frac{\sqrt{a}}{\sqrt{a+b}}\right) \log \left( \sqrt{a} \sqrt[4]{a+b} + \sqrt{2} \sqrt[4]{a} \sqrt{a+b-\sqrt{a}\sqrt{a+b}} \cot(x) + (a+b)^{3/4} \cot^2(x) \right)}{4\sqrt{2}a^{3/4}\sqrt{a+b-\sqrt{a}\sqrt{a+b}}} \\ &= \frac{(\sqrt{a} + \sqrt{a+b}) \tan^{-1} \left( \frac{(a+b)^{3/4} \left( \frac{\sqrt[4]{a} \sqrt{a+b-\sqrt{a}\sqrt{a+b}}}{(a+b)^{3/4}} - \sqrt{2} \cot(x) \right)}{\sqrt[4]{a} \sqrt{a+b+\sqrt{a}\sqrt{a+b}}} \right)}{2\sqrt{2}a^{3/4}\sqrt[4]{a+b}\sqrt{a+b+\sqrt{a}\sqrt{a+b}}} - \frac{(\sqrt{a} + \sqrt{a+b}) \tan^{-1} \left( \frac{(a+b)^{3/4} \left( \frac{\sqrt[4]{a} \sqrt{a+b-\sqrt{a}\sqrt{a+b}}}{(a+b)^{3/4}} + \sqrt{2} \cot(x) \right)}{\sqrt[4]{a} \sqrt{a+b+\sqrt{a}\sqrt{a+b}}} \right)}{2\sqrt{2}a^{3/4}\sqrt[4]{a+b}\sqrt{a+b+\sqrt{a}\sqrt{a+b}}} \end{aligned}$$

**Mathematica [C]** time = 0.222464, size = 121, normalized size = 0.25

$$\frac{\tan^{-1}\left(\frac{\sqrt{a}\tan(x)}{\sqrt{a+i\sqrt{a}\sqrt{b}}}\right)}{2\sqrt{a}\sqrt{a+i\sqrt{a}\sqrt{b}}} - \frac{\tanh^{-1}\left(\frac{\sqrt{a}\tan(x)}{\sqrt{-a+i\sqrt{a}\sqrt{b}}}\right)}{2\sqrt{a}\sqrt{-a+i\sqrt{a}\sqrt{b}}}$$

Antiderivative was successfully verified.

[In] Integrate[(a + b\*cos[x]^4)^(-1), x]

[Out] ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + I\*Sqrt[a]\*Sqrt[b]]]/(2\*Sqrt[a]\*Sqrt[a + I\*Sqrt[a]\*Sqrt[b]]) - ArcTanh[(Sqrt[a]\*Tan[x])/Sqrt[-a + I\*Sqrt[a]\*Sqrt[b]]]/(2\*Sqrt[a]\*Sqrt[-a + I\*Sqrt[a]\*Sqrt[b]])

**Maple [B]** time = 0.153, size = 3348, normalized size = 6.9

output too large to display

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(a+b\*cos(x)^4), x)

[Out] 
$$\begin{aligned} & -1/4/a/(a+b)^{(3/2)}/(4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)})*\arctan\left(\frac{2*a^{(1/2)}*\tan(x)+2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \\ & + 2*((a+b)*a)^{(1/2)}-2*a^{(1/2)})*\left(\frac{2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \\ & + \frac{1/4*a/b/(a+b)^{(3/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}* \\ & \arctan\left(\frac{-2*a^{(1/2)}*\tan(x)+2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \\ & + \frac{2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}* \\ & \left(\frac{2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \\ & + \frac{1/4/b/(a+b)^{(3/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}* \\ & \arctan\left(\frac{-2*a^{(1/2)}*\tan(x)+2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \\ & + \frac{2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}* \\ & \left(\frac{2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \\ & + \frac{1/4/a/(a+b)^{(3/2)}}{(a+b)}/(4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)})* \\ & \arctan\left(\frac{2*a^{(1/2)}*\tan(x)+2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \\ & + \frac{2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}* \\ & \left(\frac{2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \\ & + \frac{1/4*a^{(1/2)}/b/(a+b)}/(4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)})* \\ & \arctan\left(\frac{-2*a^{(1/2)}*\tan(x)+2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \\ & + \frac{2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}* \\ & \left(\frac{2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \\ & + \frac{1/4*a^{(1/2)}/b/(a+b)}/(4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)})* \\ & \arctan\left(\frac{-2*a^{(1/2)}*\tan(x)+2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \\ & + \frac{2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}* \\ & \left(\frac{2*((a+b)*a)^{(1/2)}-2*a^{(1/2)}}{4*a^{(1/2)}*(a+b)^{(1/2)}-2*((a+b)*a)^{(1/2)}+2*a^{(1/2)}}\right) \end{aligned}$$



**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{b \cos(x)^4 + a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^4),x, algorithm="maxima")

[Out] integrate(1/(b\*cos(x)^4 + a), x)

**Fricas [B]** time = 2.44499, size = 1796, normalized size = 3.69

result too large to display

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^4),x, algorithm="fricas")

[Out] 
$$\begin{aligned} & -1/8*\sqrt{-((a^2 + a*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} + 1)/(a^2 + a*b)} \\ & )*\log(b*\cos(x)^2 + 2*(a*b*\cos(x)*\sin(x) + (a^4 + a^3*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)})*\cos(x)*\sin(x))*\sqrt{-((a^2 + a*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} + 1)/(a^2 + a*b)} - (a^3 + a^2*b - 2*(a^3 + a^2*b)*\cos(x)^2)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} + 1/8*\sqrt{-((a^2 + a*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} + 1)/(a^2 + a*b)}*\log(b*\cos(x)^2 - 2*(a*b*\cos(x)*\sin(x) + (a^4 + a^3*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)})*\cos(x)*\sin(x))*\sqrt{-((a^2 + a*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} + 1)/(a^2 + a*b)} - (a^3 + a^2*b - 2*(a^3 + a^2*b)*\cos(x)^2)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} + 1/8*\sqrt{((a^2 + a*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} - 1)/(a^2 + a*b)}*\log(-b*\cos(x)^2 + 2*(a*b*\cos(x)*\sin(x) - (a^4 + a^3*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)})*\cos(x)*\sin(x))*\sqrt{((a^2 + a*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} - 1)/(a^2 + a*b)} - (a^3 + a^2*b - 2*(a^3 + a^2*b)*\cos(x)^2)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} - 1/8*\sqrt{((a^2 + a*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} - 1)/(a^2 + a*b)}*\log(-b*\cos(x)^2 - 2*(a*b*\cos(x)*\sin(x) - (a^4 + a^3*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)})*\cos(x)*\sin(x))*\sqrt{((a^2 + a*b)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} - 1)/(a^2 + a*b)} - (a^3 + a^2*b - 2*(a^3 + a^2*b)*\cos(x)^2)*\sqrt{-b/(a^5 + 2*a^4*b + a^3*b^2)} \end{aligned}$$

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)\*\*4),x)

[Out] Timed out

**Giac [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: NotImplementedError



Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(a+b*cos(x)^4),x, algorithm="giac")
```

```
[Out] Exception raised: NotImplementedError
```

### 3.71 $\int \frac{1}{a-b \cos^4(x)} dx$

**Optimal.** Leaf size=101

$$\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt{a}-\sqrt{b}} \cot(x)}{\sqrt[4]{a}}\right)}{2a^{3/4}\sqrt{\sqrt{a}-\sqrt{b}}} - \frac{\tan^{-1}\left(\frac{\sqrt{\sqrt{a}+\sqrt{b}} \cot(x)}{\sqrt[4]{a}}\right)}{2a^{3/4}\sqrt{\sqrt{a}+\sqrt{b}}}$$

[Out] -ArcTan[(Sqrt[Sqrt[a] - Sqrt[b]]\*Cot[x])/a^(1/4)]/(2\*a^(3/4)\*Sqrt[Sqrt[a] - Sqrt[b]]) - ArcTan[(Sqrt[Sqrt[a] + Sqrt[b]]\*Cot[x])/a^(1/4)]/(2\*a^(3/4)\*Sqrt[Sqrt[a] + Sqrt[b]])

**Rubi [A]** time = 0.115908, antiderivative size = 101, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 3, integrand size = 11,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.273$ , Rules used = {3209, 1166, 205}

$$\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt{a}-\sqrt{b}} \cot(x)}{\sqrt[4]{a}}\right)}{2a^{3/4}\sqrt{\sqrt{a}-\sqrt{b}}} - \frac{\tan^{-1}\left(\frac{\sqrt{\sqrt{a}+\sqrt{b}} \cot(x)}{\sqrt[4]{a}}\right)}{2a^{3/4}\sqrt{\sqrt{a}+\sqrt{b}}}$$

Antiderivative was successfully verified.

[In] Int[(a - b\*Cos[x]^4)^(-1), x]

[Out] -ArcTan[(Sqrt[Sqrt[a] - Sqrt[b]]\*Cot[x])/a^(1/4)]/(2\*a^(3/4)\*Sqrt[Sqrt[a] - Sqrt[b]]) - ArcTan[(Sqrt[Sqrt[a] + Sqrt[b]]\*Cot[x])/a^(1/4)]/(2\*a^(3/4)\*Sqrt[Sqrt[a] + Sqrt[b]])

#### Rule 3209

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^4)^(p\_), x\_Symbol] :> With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[(a + 2\*a\*ff^2\*x^2 + (a + b)\*ff^4\*x^4)^p/(1 + ff^2\*x^2)^(2\*p + 1), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[p]

#### Rule 1166

Int[((d\_) + (e\_)\*(x\_)^2)/((a\_) + (b\_)\*(x\_)^2 + (c\_)\*(x\_)^4), x\_Symbol] :> With[{q = Rt[b^2 - 4\*a\*c, 2]}, Dist[e/2 + (2\*c\*d - b\*e)/(2\*q), Int[1/(b/2 - q/2 + c\*x^2), x], x] + Dist[e/2 - (2\*c\*d - b\*e)/(2\*q), Int[1/(b/2 + q/2 + c\*x^2), x], x] /; FreeQ[{a, b, c, d, e}, x] && NeQ[b^2 - 4\*a\*c, 0] && NeQ[c\*d^2 - a\*e^2, 0] && PosQ[b^2 - 4\*a\*c]

#### Rule 205

Int[((a\_) + (b\_)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

#### Rubi steps

$$\begin{aligned} \int \frac{1}{a - b \cos^4(x)} dx &= -\text{Subst} \left( \int \frac{1 + x^2}{a + 2ax^2 + (a - b)x^4} dx, x, \cot(x) \right) \\ &= -\left( \frac{1}{2} \left( 1 - \frac{\sqrt{b}}{\sqrt{a}} \right) \text{Subst} \left( \int \frac{1}{a - \sqrt{a}\sqrt{b} + (a - b)x^2} dx, x, \cot(x) \right) \right) - \frac{1}{2} \left( 1 + \frac{\sqrt{b}}{\sqrt{a}} \right) \text{Subst} \left( \int \frac{1}{a + \sqrt{a}\sqrt{b} + (a - b)x^2} dx, x, \cot(x) \right) \\ &= -\frac{\tan^{-1} \left( \frac{\sqrt{\sqrt{a}-\sqrt{b}} \cot(x)}{\sqrt[4]{a}} \right)}{2a^{3/4} \sqrt{\sqrt{a}-\sqrt{b}}} - \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt{a}+\sqrt{b}} \cot(x)}{\sqrt[4]{a}} \right)}{2a^{3/4} \sqrt{\sqrt{a}+\sqrt{b}}} \end{aligned}$$

**Mathematica [A]** time = 0.188843, size = 109, normalized size = 1.08

$$\frac{\tan^{-1} \left( \frac{\sqrt{a} \tan(x)}{\sqrt{\sqrt{a}\sqrt{b+a}}} \right)}{2\sqrt{a}\sqrt{\sqrt{a}\sqrt{b}+a}} - \frac{\tanh^{-1} \left( \frac{\sqrt{a} \tan(x)}{\sqrt{\sqrt{a}\sqrt{b-a}}} \right)}{2\sqrt{a}\sqrt{\sqrt{a}\sqrt{b}-a}}$$

Antiderivative was successfully verified.

[In] Integrate[(a - b\*cos[x]^4)^(-1), x]

[Out] ArcTan[(Sqrt[a]\*Tan[x])/Sqrt[a + Sqrt[a]\*Sqrt[b]]]/(2\*Sqrt[a]\*Sqrt[a + Sqrt[a]\*Sqrt[b]]) - ArcTanh[(Sqrt[a]\*Tan[x])/Sqrt[-a + Sqrt[a]\*Sqrt[b]]]/(2\*Sqrt[a]\*Sqrt[-a + Sqrt[a]\*Sqrt[b]])

**Maple [A]** time = 0.035, size = 64, normalized size = 0.6

$$-\frac{1}{2} \text{Arctanh} \left( a \tan(x) \frac{1}{\sqrt{(\sqrt{ab}-a)a}} \right) \frac{1}{\sqrt{(\sqrt{ab}-a)a}} + \frac{1}{2} \arctan \left( a \tan(x) \frac{1}{\sqrt{(\sqrt{ab}+a)a}} \right) \frac{1}{\sqrt{(\sqrt{ab}+a)a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(a-b\*cos(x)^4), x)

[Out] -1/2/(((a\*b)^(1/2)-a)\*a)^(1/2)\*arctanh(a\*tan(x)/(((a\*b)^(1/2)-a)\*a)^(1/2))+ 1/2/(((a\*b)^(1/2)+a)\*a)^(1/2)\*arctan(a\*tan(x)/(((a\*b)^(1/2)+a)\*a)^(1/2))

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$-\int \frac{1}{b \cos(x)^4 - a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a-b\*cos(x)^4), x, algorithm="maxima")

[Out] -integrate(1/(b\*cos(x)^4 - a), x)

**Fricas [B]** time = 2.52538, size = 1774, normalized size = 17.56

result too large to display

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a-b\*cos(x)^4),x, algorithm="fricas")

[Out] 
$$\begin{aligned} & -1/8*\sqrt{-((a^2 - a*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} + 1)/(a^2 - a*b)} \\ & * \log(b*\cos(x)^2 + 2*(a*b*\cos(x)*\sin(x) - (a^4 - a^3*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)})*\cos(x)*\sin(x))*\sqrt{-((a^2 - a*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} + 1)/(a^2 - a*b)} \\ & + (a^3 - a^2*b - 2*(a^3 - a^2*b)*\cos(x)^2)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} + 1/8*\sqrt{-((a^2 - a*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} + 1)/(a^2 - a*b)} \\ & * \log(b*\cos(x)^2 - 2*(a*b*\cos(x)*\sin(x) - (a^4 - a^3*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)})*\cos(x)*\sin(x))*\sqrt{-((a^2 - a*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} + 1)/(a^2 - a*b)} \\ & + (a^3 - a^2*b - 2*(a^3 - a^2*b)*\cos(x)^2)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} + 1/8*\sqrt{((a^2 - a*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} - 1)/(a^2 - a*b)} \\ & * \log(-b*\cos(x)^2 + 2*(a*b*\cos(x)*\sin(x) + (a^4 - a^3*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)})*\cos(x)*\sin(x))*\sqrt{((a^2 - a*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} - 1)/(a^2 - a*b)} \\ & + (a^3 - a^2*b - 2*(a^3 - a^2*b)*\cos(x)^2)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} - 1/8*\sqrt{((a^2 - a*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} - 1)/(a^2 - a*b)} \\ & * \log(-b*\cos(x)^2 - 2*(a*b*\cos(x)*\sin(x) + (a^4 - a^3*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)})*\cos(x)*\sin(x))*\sqrt{((a^2 - a*b)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} - 1)/(a^2 - a*b)} \\ & + (a^3 - a^2*b - 2*(a^3 - a^2*b)*\cos(x)^2)*\sqrt{b/(a^5 - 2*a^4*b + a^3*b^2)} \end{aligned}$$

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a-b\*cos(x)\*\*4),x)

[Out] Timed out

**Giac [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: NotImplementedError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a-b\*cos(x)^4),x, algorithm="giac")

[Out] Exception raised: NotImplementedError

### 3.72 $\int \frac{1}{1+\cos^4(x)} dx$

**Optimal.** Leaf size=292

$$\frac{x}{2\sqrt{\sqrt{2}-1}} + \frac{1}{8}\sqrt{\sqrt{2}-1} \log\left(2\cot^2(x) - 2\sqrt{\sqrt{2}-1}\cot(x) + \sqrt{2}\right) - \frac{1}{8}\sqrt{\sqrt{2}-1} \log\left(\sqrt{2}\cot^2(x) + \sqrt{2(\sqrt{2}-1)}\cot(x)\right)$$

```
[Out] x/(2*Sqrt[-1 + Sqrt[2]]) + ArcTan[((-2 + Sqrt[2])*Cos[x]*Sin[x] + Sqrt[-1 + Sqrt[2]]*(1 - 2*Sin[x]^2))/(2 + Sqrt[1 + Sqrt[2]] + 2*Sqrt[-1 + Sqrt[2]]*Cos[x]*Sin[x] + (-2 + Sqrt[2])*Sin[x]^2)]/(4*Sqrt[-1 + Sqrt[2]]) + ArcTan[((-2 + Sqrt[2])*Cos[x]*Sin[x] + Sqrt[-1 + Sqrt[2]]*(-1 + 2*Sin[x]^2))/(2 + Sqrt[1 + Sqrt[2]] - 2*Sqrt[-1 + Sqrt[2]]*Cos[x]*Sin[x] + (-2 + Sqrt[2])*Sin[x]^2)]/(4*Sqrt[-1 + Sqrt[2]]) + (Sqrt[-1 + Sqrt[2]]*Log[Sqrt[2] - 2*Sqrt[-1 + Sqrt[2]]*Cot[x] + 2*Cot[x]^2])/8 - (Sqrt[-1 + Sqrt[2]]*Log[1 + Sqrt[2*(-1 + Sqrt[2])]*Cot[x] + Sqrt[2]*Cot[x]^2])/8
```

**Rubi [A]** time = 0.19086, antiderivative size = 292, normalized size of antiderivative = 1., number of steps used = 10, number of rules used = 6, integrand size = 8,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.75$ , Rules used = {3209, 1169, 634, 618, 204, 628}

$$\frac{x}{2\sqrt{\sqrt{2}-1}} + \frac{1}{8}\sqrt{\sqrt{2}-1} \log\left(2\cot^2(x) - 2\sqrt{\sqrt{2}-1}\cot(x) + \sqrt{2}\right) - \frac{1}{8}\sqrt{\sqrt{2}-1} \log\left(\sqrt{2}\cot^2(x) + \sqrt{2(\sqrt{2}-1)}\cot(x)\right)$$

Antiderivative was successfully verified.

```
[In] Int[(1 + Cos[x]^4)^(-1), x]
```

```
[Out] x/(2*Sqrt[-1 + Sqrt[2]]) + ArcTan[((-2 + Sqrt[2])*Cos[x]*Sin[x] + Sqrt[-1 + Sqrt[2]]*(1 - 2*Sin[x]^2))/(2 + Sqrt[1 + Sqrt[2]] + 2*Sqrt[-1 + Sqrt[2]]*Cos[x]*Sin[x] + (-2 + Sqrt[2])*Sin[x]^2)]/(4*Sqrt[-1 + Sqrt[2]]) + ArcTan[((-2 + Sqrt[2])*Cos[x]*Sin[x] + Sqrt[-1 + Sqrt[2]]*(-1 + 2*Sin[x]^2))/(2 + Sqrt[1 + Sqrt[2]] - 2*Sqrt[-1 + Sqrt[2]]*Cos[x]*Sin[x] + (-2 + Sqrt[2])*Sin[x]^2)]/(4*Sqrt[-1 + Sqrt[2]]) + (Sqrt[-1 + Sqrt[2]]*Log[Sqrt[2] - 2*Sqrt[-1 + Sqrt[2]]*Cot[x] + 2*Cot[x]^2])/8 - (Sqrt[-1 + Sqrt[2]]*Log[1 + Sqrt[2*(-1 + Sqrt[2])]*Cot[x] + Sqrt[2]*Cot[x]^2])/8
```

#### Rule 3209

```
Int[((a_) + (b_)*sin[(e_) + (f_)*(x_)^4]^(p_), x_Symbol] := With[{ff = FreeFactors[Tan[e + f*x], x]}, Dist[ff/f, Subst[Int[(a + 2*a*ff^2*x^2 + (a + b)*ff^4*x^4)^p/(1 + ff^2*x^2)^(2*p + 1), x], x, Tan[e + f*x]/ff], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[p]
```

#### Rule 1169

```
Int[((d_) + (e_)*(x_)^2)/((a_) + (b_)*(x_)^2 + (c_)*(x_)^4), x_Symbol] := With[{q = Rt[a/c, 2]}, With[{r = Rt[2*q - b/c, 2]}, Dist[1/(2*c*q*r), Int[(d*r - (d - e*q)*x)/(q - r*x + x^2), x], x] + Dist[1/(2*c*q*r), Int[(d*r + (d - e*q)*x)/(q + r*x + x^2), x], x]] /; FreeQ[{a, b, c, d, e}, x] && NeQ[b^2 - 4*a*c, 0] && NeQ[c*d^2 - b*d*e + a*e^2, 0] && NegQ[b^2 - 4*a*c]
```

Rule 634

```
Int[((d_.) + (e_.)*(x_))/((a_.) + (b_.)*(x_) + (c_.)*(x_)^2), x_Symbol] := Dist[(2*c*d - b*e)/(2*c), Int[1/(a + b*x + c*x^2), x], x] + Dist[e/(2*c), Int[(b + 2*c*x)/(a + b*x + c*x^2), x], x] /; FreeQ[{a, b, c, d, e}, x] && NeQ[2*c*d - b*e, 0] && NeQ[b^2 - 4*a*c, 0] && !NiceSqrtQ[b^2 - 4*a*c]
```

Rule 618

```
Int[((a_.) + (b_.)*(x_) + (c_.)*(x_)^2)^(-1), x_Symbol] := Dist[-2, Subst[Int[1/Simp[b^2 - 4*a*c - x^2, x], x], x, b + 2*c*x], x] /; FreeQ[{a, b, c}, x] && NeQ[b^2 - 4*a*c, 0]
```

Rule 204

```
Int[((a_.) + (b_.)*(x_)^2)^(-1), x_Symbol] := -Simp[ArcTan[(Rt[-b, 2]*x)/Rt[-a, 2]]/(Rt[-a, 2]*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (LtQ[a, 0] || LtQ[b, 0])
```

Rule 628

```
Int[((d_.) + (e_.)*(x_))/((a_.) + (b_.)*(x_) + (c_.)*(x_)^2), x_Symbol] := Simp[(d*Log[RemoveContent[a + b*x + c*x^2, x]])/b, x] /; FreeQ[{a, b, c, d, e}, x] && EqQ[2*c*d - b*e, 0]
```

Rubi steps

$$\begin{aligned} \int \frac{1}{1 + \cos^4(x)} dx &= -\text{Subst} \left( \int \frac{1 + x^2}{1 + 2x^2 + 2x^4} dx, x, \cot(x) \right) \\ &= -\frac{\text{Subst} \left( \int \frac{\sqrt{-1+\sqrt{2}} - \left(1 - \frac{1}{\sqrt{2}}\right)x}{\frac{1}{\sqrt{2}} - \sqrt{-1+\sqrt{2}x+x^2}} dx, x, \cot(x) \right)}{2\sqrt{2}(-1 + \sqrt{2})} - \frac{\text{Subst} \left( \int \frac{\sqrt{-1+\sqrt{2}} + \left(1 - \frac{1}{\sqrt{2}}\right)x}{\frac{1}{\sqrt{2}} + \sqrt{-1+\sqrt{2}x+x^2}} dx, x, \cot(x) \right)}{2\sqrt{2}(-1 + \sqrt{2})} \\ &= \frac{1}{8}\sqrt{-1 + \sqrt{2}} \text{Subst} \left( \int \frac{-\sqrt{-1 + \sqrt{2}} + 2x}{\frac{1}{\sqrt{2}} - \sqrt{-1 + \sqrt{2}x + x^2}} dx, x, \cot(x) \right) - \frac{1}{8}\sqrt{-1 + \sqrt{2}} \text{Subst} \left( \int \frac{\sqrt{-1 + \sqrt{2}}}{\frac{1}{\sqrt{2}} + \sqrt{-1 + \sqrt{2}x + x^2}} dx, x, \cot(x) \right) \\ &= \frac{1}{8}\sqrt{-1 + \sqrt{2}} \log \left( \sqrt{2} - 2\sqrt{-1 + \sqrt{2}} \cot(x) + 2 \cot^2(x) \right) - \frac{1}{8}\sqrt{-1 + \sqrt{2}} \log \left( 1 + \sqrt{2}(-1 + \sqrt{2}) \cot(x) \right) \\ &= \frac{1}{2}\sqrt{1 + \sqrt{2}}x - \frac{1}{4}\sqrt{1 + \sqrt{2}} \tan^{-1} \left( \frac{(2 - \sqrt{2}) \cos(x) \sin(x) - \sqrt{-1 + \sqrt{2}}(1 - 2 \sin^2(x))}{2 + \sqrt{1 + \sqrt{2}} + 2\sqrt{-1 + \sqrt{2}} \cos(x) \sin(x) - (2 - \sqrt{2}) \sin^2(x)} \right) - \frac{1}{4} \end{aligned}$$

**Mathematica [C]** time = 0.0698497, size = 45, normalized size = 0.15

$$\frac{\tan^{-1} \left( \frac{\tan(x)}{\sqrt{1-i}} \right)}{2\sqrt{1-i}} + \frac{\tan^{-1} \left( \frac{\tan(x)}{\sqrt{1+i}} \right)}{2\sqrt{1+i}}$$

Antiderivative was successfully verified.

```
[In] Integrate[(1 + Cos[x]^4)^(-1), x]
```

```
[Out] ArcTan[Tan[x]/Sqrt[1 - I]]/(2*Sqrt[1 - I]) + ArcTan[Tan[x]/Sqrt[1 + I]]/(2*Sqrt[1 + I])
```

---

**Maple [A]** time = 0.099, size = 227, normalized size = 0.8

$$\frac{\sqrt{2}\sqrt{-2+2\sqrt{2}}\ln\left((\tan(x))^2-\tan(x)\sqrt{-2+2\sqrt{2}+\sqrt{2}}\right)}{16} + \frac{\sqrt{2}}{4\sqrt{2\sqrt{2}+2}}\arctan\left(\frac{2\tan(x)-\sqrt{-2+2\sqrt{2}}}{\sqrt{2\sqrt{2}+2}}\right) + \frac{1}{2\sqrt{2}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1+cos(x)^4),x)

[Out] 1/16\*2^(1/2)\*(-2+2\*2^(1/2))^(1/2)\*ln(tan(x)^2-tan(x)\*(-2+2\*2^(1/2))^(1/2)+2^(1/2))+1/4/(2\*2^(1/2)+2)^(1/2)\*arctan((2\*tan(x)-(-2+2\*2^(1/2))^(1/2))/(2\*2^(1/2)+2)^(1/2))+1/2/(2\*2^(1/2)+2)^(1/2)\*arctan((2\*tan(x)-(-2+2\*2^(1/2))^(1/2))/(2\*2^(1/2)+2)^(1/2))-1/16\*2^(1/2)\*(-2+2\*2^(1/2))^(1/2)\*ln(tan(x)^2+tan(x)\*(-2+2\*2^(1/2))^(1/2)+2^(1/2))+1/4/(2\*2^(1/2)+2)^(1/2)\*arctan((2\*tan(x)+(-2+2\*2^(1/2))^(1/2))/(2\*2^(1/2)+2)^(1/2))+1/2/(2\*2^(1/2)+2)^(1/2)\*arctan((2\*tan(x)+(-2+2\*2^(1/2))^(1/2))/(2\*2^(1/2)+2)^(1/2))

---

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\cos(x)^4 + 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^4),x, algorithm="maxima")

[Out] integrate(1/(cos(x)^4 + 1), x)

---

**Fricas [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^4),x, algorithm="fricas")

[Out] Timed out

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)\*\*4),x)

[Out] Timed out

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\cos(x)^4 + 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^4),x, algorithm="giac")

[Out] integrate(1/(cos(x)^4 + 1), x)



### 3.73 $\int \frac{1}{1-\cos^4(x)} dx$

**Optimal.** Leaf size=45

$$\frac{x}{2\sqrt{2}} - \frac{\cot(x)}{2} - \frac{\tan^{-1}\left(\frac{\sin(x)\cos(x)}{\cos^2(x)+\sqrt{2}+1}\right)}{2\sqrt{2}}$$

[Out] x/(2\*sqrt[2]) - ArcTan[(Cos[x]\*Sin[x])/(1 + Sqrt[2] + Cos[x]^2)]/(2\*sqrt[2]) - Cot[x]/2

**Rubi [A]** time = 0.0183842, antiderivative size = 45, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.3$ , Rules used = {3209, 388, 203}

$$\frac{x}{2\sqrt{2}} - \frac{\cot(x)}{2} - \frac{\tan^{-1}\left(\frac{\sin(x)\cos(x)}{\cos^2(x)+\sqrt{2}+1}\right)}{2\sqrt{2}}$$

Antiderivative was successfully verified.

[In] Int[(1 - Cos[x]^4)^(-1), x]

[Out] x/(2\*sqrt[2]) - ArcTan[(Cos[x]\*Sin[x])/(1 + Sqrt[2] + Cos[x]^2)]/(2\*sqrt[2]) - Cot[x]/2

#### Rule 3209

Int[((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^4)^(p\_.), x\_Symbol] := With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[(a + 2\*a\*ff^2\*x^2 + (a + b)\*ff^4\*x^4)^p/(1 + ff^2\*x^2)^(2\*p + 1), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[p]

#### Rule 388

Int[((a\_) + (b\_.)\*(x\_)^(n\_))^(p\_)\*((c\_) + (d\_.)\*(x\_)^(n\_)), x\_Symbol] := Simp[(d\*x\*(a + b\*x^n)^(p + 1))/(b\*(n\*(p + 1) + 1)), x] - Dist[(a\*d - b\*c\*(n\*(p + 1) + 1))/(b\*(n\*(p + 1) + 1)), Int[(a + b\*x^n)^p, x], x] /; FreeQ[{a, b, c, d, n}, x] && NeQ[b\*c - a\*d, 0] && NeQ[n\*(p + 1) + 1, 0]

#### Rule 203

Int[((a\_) + (b\_.)\*(x\_)^2)^(p\_), x\_Symbol] := Simp[(1\*ArcTan[(Rt[b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])

#### Rubi steps

$$\begin{aligned} \int \frac{1}{1-\cos^4(x)} dx &= -\text{Subst}\left(\int \frac{1+x^2}{1+2x^2} dx, x, \cot(x)\right) \\ &= -\frac{\cot(x)}{2} - \frac{1}{2} \text{Subst}\left(\int \frac{1}{1+2x^2} dx, x, \cot(x)\right) \\ &= \frac{x}{2\sqrt{2}} - \frac{\tan^{-1}\left(\frac{\cos(x)\sin(x)}{1+\sqrt{2}+\cos^2(x)}\right)}{2\sqrt{2}} - \frac{\cot(x)}{2} \end{aligned}$$

**Mathematica [A]** time = 0.0543841, size = 24, normalized size = 0.53

$$\frac{1}{4} \left( \sqrt{2} \tan^{-1} \left( \frac{\tan(x)}{\sqrt{2}} \right) - 2 \cot(x) \right)$$

Antiderivative was successfully verified.

[In] Integrate[(1 - Cos[x]^4)^(-1), x]

[Out] (Sqrt[2]\*ArcTan[Tan[x]/Sqrt[2]] - 2\*Cot[x])/4

**Maple [A]** time = 0.02, size = 21, normalized size = 0.5

$$-\frac{1}{2 \tan(x)} + \frac{\sqrt{2}}{4} \arctan\left(\frac{\tan(x) \sqrt{2}}{2}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1-cos(x)^4), x)

[Out] -1/2/tan(x)+1/4\*arctan(1/2\*tan(x)\*2^(1/2))\*2^(1/2)

**Maxima [A]** time = 1.4547, size = 27, normalized size = 0.6

$$\frac{1}{4} \sqrt{2} \arctan\left(\frac{1}{2} \sqrt{2} \tan(x)\right) - \frac{1}{2 \tan(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^4), x, algorithm="maxima")

[Out] 1/4\*sqrt(2)\*arctan(1/2\*sqrt(2)\*tan(x)) - 1/2/tan(x)

**Fricas [A]** time = 2.18423, size = 135, normalized size = 3.

$$\frac{\sqrt{2} \arctan\left(\frac{3\sqrt{2}\cos(x)^2-\sqrt{2}}{4\cos(x)\sin(x)}\right) \sin(x) + 4 \cos(x)}{8 \sin(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^4), x, algorithm="fricas")

[Out] -1/8\*(sqrt(2)\*arctan(1/4\*(3\*sqrt(2)\*cos(x)^2 - sqrt(2))/(cos(x)\*sin(x)))\*sin(x) + 4\*cos(x))/sin(x)

**Sympy [A]** time = 4.63275, size = 78, normalized size = 1.73

$$\frac{\sqrt{2} \left( \operatorname{atan}\left(\sqrt{2} \tan\left(\frac{x}{2}\right) - 1\right) + \pi \left\lfloor \frac{\frac{x}{2} - \frac{\pi}{2}}{\pi} \right\rfloor \right)}{4} + \frac{\sqrt{2} \left( \operatorname{atan}\left(\sqrt{2} \tan\left(\frac{x}{2}\right) + 1\right) + \pi \left\lfloor \frac{\frac{x}{2} - \frac{\pi}{2}}{\pi} \right\rfloor \right)}{4} + \frac{\tan\left(\frac{x}{2}\right)}{4} - \frac{1}{4 \tan\left(\frac{x}{2}\right)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)\*\*4),x)

[Out] sqrt(2)\*(atan(sqrt(2)\*tan(x/2) - 1) + pi\*floor((x/2 - pi/2)/pi))/4 + sqrt(2)\*atan(sqrt(2)\*tan(x/2) + 1) + pi\*floor((x/2 - pi/2)/pi))/4 + tan(x/2)/4 - 1/(4\*tan(x/2))

**Giac [A]** time = 1.23848, size = 72, normalized size = 1.6

$$\frac{1}{4} \sqrt{2} \left( x + \arctan \left( -\frac{\sqrt{2} \sin(2x) - \sin(2x)}{\sqrt{2} \cos(2x) + \sqrt{2} - \cos(2x) + 1} \right) \right) - \frac{1}{2 \tan(x)}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^4),x, algorithm="giac")

[Out] 1/4\*sqrt(2)\*(x + arctan(-(sqrt(2)\*sin(2\*x) - sin(2\*x))/(sqrt(2)\*cos(2\*x) + sqrt(2) - cos(2\*x) + 1))) - 1/2/tan(x)

$$3.74 \quad \int \frac{1}{a+b \cos^5(x)} dx$$

**Optimal.** Leaf size=494

$$\frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}-\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}+\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}+\sqrt[5]{-1}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}-\sqrt[5]{-1}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-\sqrt[5]{-1}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+\sqrt[5]{-1}\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}-(-1)^{2/5}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}+(-1)^{2/5}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-(-1)^{2/5}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+(-1)^{2/5}\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}+(-1)^{3/5}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}-(-1)^{3/5}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-(-1)^{3/5}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}-(-1)^{3/5}\sqrt[5]{b}}}$$

[Out] (2\*ArcTan[(Sqrt[a^(1/5) - b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) + b^(1/5)]])/(5\*a^(4/5)\*Sqrt[a^(1/5) - b^(1/5)]\*Sqrt[a^(1/5) + b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) + (-1)^(1/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) - (-1)^(1/5)\*b^(1/5)]])/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(1/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(1/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) - (-1)^(2/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) + (-1)^(2/5)\*b^(1/5)]])/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(2/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(2/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) + (-1)^(3/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) - (-1)^(3/5)\*b^(1/5)]])/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(3/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(3/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) - (-1)^(4/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) + (-1)^(4/5)\*b^(1/5)]])/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(4/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(4/5)\*b^(1/5)])

**Rubi [A]** time = 0.9185, antiderivative size = 494, normalized size of antiderivative = 1., number of steps used = 12, number of rules used = 3, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.3$ , Rules used = {3213, 2659, 205}

$$\frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}-\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}+\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}+\sqrt[5]{-1}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}-\sqrt[5]{-1}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-\sqrt[5]{-1}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+\sqrt[5]{-1}\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}-(-1)^{2/5}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}+(-1)^{2/5}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-(-1)^{2/5}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+(-1)^{2/5}\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}+(-1)^{3/5}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}-(-1)^{3/5}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-(-1)^{3/5}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}-(-1)^{3/5}\sqrt[5]{b}}}$$

Antiderivative was successfully verified.

[In] Int[(a + b\*Cos[x]^5)^(-1), x]

[Out] (2\*ArcTan[(Sqrt[a^(1/5) - b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) + b^(1/5)]])/(5\*a^(4/5)\*Sqrt[a^(1/5) - b^(1/5)]\*Sqrt[a^(1/5) + b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) + (-1)^(1/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) - (-1)^(1/5)\*b^(1/5)]])/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(1/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(1/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) - (-1)^(2/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) + (-1)^(2/5)\*b^(1/5)]])/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(2/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(2/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) + (-1)^(3/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) - (-1)^(3/5)\*b^(1/5)]])/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(3/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(3/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) - (-1)^(4/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) + (-1)^(4/5)\*b^(1/5)]])/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(4/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(4/5)\*b^(1/5)])

### Rule 3213

Int[((a\_) + (b\_.)\*((c\_.)\*sin[(e\_.) + (f\_.)\*(x\_)])^(n\_))^(p\_), x\_Symbol] :>  
Int[ExpandTrig[(a + b\*(c\*sin[e + f\*x])^n)^p, x], x] /; FreeQ[{a, b, c, e, f, n}, x] && (IGtQ[p, 0] || (EqQ[p, -1] && IntegerQ[n]))

### Rule 2659

```
Int[((a_) + (b_)*sin[Pi/2 + (c_) + (d_)*(x_)])^(-1), x_Symbol] := With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Dist[(2*e)/d, Subst[Int[1/(a + b + (
a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
&& NeQ[a^2 - b^2, 0]
```

### Rule 205

```
Int[((a_) + (b_)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[a/b, 2]*ArcTan[x/Rt[a
/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]
```

### Rubi steps

$$\begin{aligned} \int \frac{1}{a + b \cos^5(x)} dx &= \int \left( -\frac{1}{5a^{4/5}(-\sqrt[5]{a} - \sqrt[5]{b} \cos(x))} - \frac{1}{5a^{4/5}(-\sqrt[5]{a} + \sqrt[5]{-1}\sqrt[5]{b} \cos(x))} - \frac{1}{5a^{4/5}(-\sqrt[5]{a} - (-1)^{2/5}\sqrt[5]{b} \cos(x))} \right) dx \\ &= -\frac{\int \frac{1}{-\sqrt[5]{a} - \sqrt[5]{b} \cos(x)} dx}{5a^{4/5}} - \frac{\int \frac{1}{-\sqrt[5]{a} + \sqrt[5]{-1}\sqrt[5]{b} \cos(x)} dx}{5a^{4/5}} - \frac{\int \frac{1}{-\sqrt[5]{a} - (-1)^{2/5}\sqrt[5]{b} \cos(x)} dx}{5a^{4/5}} - \frac{\int \frac{1}{-\sqrt[5]{a} - (-1)^{3/5}\sqrt[5]{b} \cos(x)} dx}{5a^{4/5}} \\ &= -\frac{2 \operatorname{Subst}\left(\int \frac{1}{-\sqrt[5]{a} - \sqrt[5]{b} + (-\sqrt[5]{a} + \sqrt[5]{b})x^2} dx, x, \tan\left(\frac{x}{2}\right)\right)}{5a^{4/5}} - \frac{2 \operatorname{Subst}\left(\int \frac{1}{-\sqrt[5]{a} + \sqrt[5]{-1}\sqrt[5]{b} + (-\sqrt[5]{a} - \sqrt[5]{-1}\sqrt[5]{b})x^2} dx, x, \tan\left(\frac{x}{2}\right)\right)}{5a^{4/5}} \\ &= \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a} - \sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a} + \sqrt[5]{b}}}\right)}{5a^{4/5} \sqrt{\sqrt[5]{a} - \sqrt[5]{b}} \sqrt{\sqrt[5]{a} + \sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a} + \sqrt[5]{-1}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a} - \sqrt[5]{-1}\sqrt[5]{b}}}\right)}{5a^{4/5} \sqrt{\sqrt[5]{a} - \sqrt[5]{-1}\sqrt[5]{b}} \sqrt{\sqrt[5]{a} + \sqrt[5]{-1}\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a} - (-1)^{2/5}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a} - (-1)^{3/5}\sqrt[5]{b}}}\right)}{5a^{4/5} \sqrt{\sqrt[5]{a} - (-1)^{2/5}\sqrt[5]{b}} \sqrt{\sqrt[5]{a} - (-1)^{3/5}\sqrt[5]{b}}} \end{aligned}$$

**Mathematica [C]** time = 0.203678, size = 130, normalized size = 0.26

$$\frac{8}{5} \operatorname{RootSum} \left[ 32\#1^5 a + \#1^{10} b + 5\#1^8 b + 10\#1^6 b + 10\#1^4 b + 5\#1^2 b + b \&, \frac{2\#1^3 \tan^{-1}\left(\frac{\sin(x)}{\cos(x) - \#1}\right) - i\#1^3 \log(\#1^2 - 2\#1 \cos(x) + \#1^2)}{16\#1^3 a + \#1^8 b + 4\#1^6 b + 6\#1^4 b + 4\#1^2 b + b} \right]$$

Warning: Unable to verify antiderivative.

```
[In] Integrate[(a + b*Cos[x]^5)^(-1), x]
```

```
[Out] (8*RootSum[b + 5*b*#1^2 + 10*b*#1^4 + 32*a*#1^5 + 10*b*#1^6 + 5*b*#1^8 + b*
#1^10 &, (2*ArcTan[Sin[x]/(Cos[x] - #1)]*#1^3 - I*Log[1 - 2*Cos[x]*#1 + #1
^2]*#1^3)/(b + 4*b*#1^2 + 16*a*#1^3 + 6*b*#1^4 + 4*b*#1^6 + b*#1^8) & ])/5
```

**Maple [C]** time = 0.027, size = 150, normalized size = 0.3

$$\frac{1}{5} \sum_{_R=\operatorname{RootOf}((a-b)_Z^{10}+(5a+5b)_Z^8+(10a-10b)_Z^6+(10a+10b)_Z^4+(5a-5b)_Z^2+a+b)} \frac{-_R^8 + 4\_R^6 + 6\_R^4 - 4\_R^2 + 5}{-_R^9 a - \_R^9 b + 4\_R^7 a + 4\_R^7 b + 6\_R^5 a - 6\_R^5 b - 4\_R^3 a - 4\_R^3 b + \_R a - \_R b} \ln(\tan(1/2*x) - \_R), \_R=\operatorname{RootOf}((a-b)_Z^{10}+(5a+5b)_Z^8+(10a-10b)_Z^6+(10a+10b)_Z^4+(5a-5b)_Z^2+a+b)$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] int(1/(a+b*cos(x)^5), x)
```

```
[Out] 1/5*sum((_R^8+4*_R^6+6*_R^4+4*_R^2+1)/(_R^9*a-_R^9*b+4*_R^7*a+4*_R^7*b+6*_R
^5*a-6*_R^5*b+4*_R^3*a+4*_R^3*b+_R*a-_R*b)*ln(tan(1/2*x)-_R),_R=RootOf((a-b
)*_Z^10+(5*a+5*b)*_Z^8+(10*a-10*b)*_Z^6+(10*a+10*b)*_Z^4+(5*a-5*b)*_Z^2+a+b)
```

))

---

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{b \cos(x)^5 + a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^5),x, algorithm="maxima")

[Out] integrate(1/(b\*cos(x)^5 + a), x)

---

**Fricas [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: UnboundLocalError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^5),x, algorithm="fricas")

[Out] Exception raised: UnboundLocalError

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)\*\*5),x)

[Out] Timed out

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{b \cos(x)^5 + a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^5),x, algorithm="giac")

[Out] integrate(1/(b\*cos(x)^5 + a), x)

$$3.75 \quad \int \frac{1}{a+b \cos^6(x)} dx$$

**Optimal.** Leaf size=171

$$\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}+\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}+\sqrt[3]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}-\sqrt[3]{-1}\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}-\sqrt[3]{-1}\sqrt[3]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}+(-1)^{2/3}\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}+(-1)^{2/3}\sqrt[3]{b}}}$$

[Out] -ArcTan[(Sqrt[a^(1/3) + b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) + b^(1/3)]) - ArcTan[(Sqrt[a^(1/3) - (-1)^(1/3)\*b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) - (-1)^(1/3)\*b^(1/3)]) - ArcTan[(Sqrt[a^(1/3) + (-1)^(2/3)\*b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) + (-1)^(2/3)\*b^(1/3)])]

**Rubi [A]** time = 0.238246, antiderivative size = 171, normalized size of antiderivative = 1., number of steps used = 7, number of rules used = 3, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.3$ , Rules used = {3211, 3181, 203}

$$\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}+\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}+\sqrt[3]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}-\sqrt[3]{-1}\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}-\sqrt[3]{-1}\sqrt[3]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}+(-1)^{2/3}\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}+(-1)^{2/3}\sqrt[3]{b}}}$$

Antiderivative was successfully verified.

[In] Int[(a + b\*cos[x]^6)^(-1), x]

[Out] -ArcTan[(Sqrt[a^(1/3) + b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) + b^(1/3)]) - ArcTan[(Sqrt[a^(1/3) - (-1)^(1/3)\*b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) - (-1)^(1/3)\*b^(1/3)]) - ArcTan[(Sqrt[a^(1/3) + (-1)^(2/3)\*b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) + (-1)^(2/3)\*b^(1/3)])]

#### Rule 3211

Int[((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^(n\_))^(m\_), x\_Symbol] := Module[{k}, Dist[2/(a\*n), Sum[Int[1/(1 - Sin[e + f\*x]^2/((-1)^((4\*k)/n)\*Rt[-(a/b), n/2])), x], {k, 1, n/2}], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[n/2]

#### Rule 3181

Int[((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(m\_), x\_Symbol] := With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x]

#### Rule 203

Int[((a\_) + (b\_.)\*(x\_)^2)^(m\_), x\_Symbol] := Simp[(1\*ArcTan[(Rt[b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])

#### Rubi steps

$$\int \frac{1}{a + b \cos^6(x)} dx = \frac{\int \frac{1}{1 + \frac{\sqrt[3]{b} \cos^2(x)}{\sqrt[3]{a}}} dx}{3a} + \frac{\int \frac{1}{1 - \frac{\sqrt[3]{-1} \sqrt[3]{b} \cos^2(x)}{\sqrt[3]{a}}} dx}{3a} + \frac{\int \frac{1}{1 + \frac{(-1)^{2/3} \sqrt[3]{b} \cos^2(x)}{\sqrt[3]{a}}} dx}{3a}$$

$$= \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 + \frac{\sqrt[3]{b}}{\sqrt[3]{a}}\right) x^2} dx, x, \cot(x) \right)}{3a} - \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 - \frac{\sqrt[3]{-1} \sqrt[3]{b}}{\sqrt[3]{a}}\right) x^2} dx, x, \cot(x) \right)}{3a} - \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 + \frac{(-1)^{2/3} \sqrt[3]{b}}{\sqrt[3]{a}}\right) x^2} dx, x, \cot(x) \right)}{3a}$$

$$= \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[3]{a} + \sqrt[3]{b}} \cot(x)}{\sqrt[6]{a}} \right)}{3a^{5/6} \sqrt{\sqrt[3]{a} + \sqrt[3]{b}}} - \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[3]{a} - \sqrt[3]{-1} \sqrt[3]{b}} \cot(x)}{\sqrt[6]{a}} \right)}{3a^{5/6} \sqrt{\sqrt[3]{a} - \sqrt[3]{-1} \sqrt[3]{b}}} - \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[3]{a} + (-1)^{2/3} \sqrt[3]{b}} \cot(x)}{\sqrt[6]{a}} \right)}{3a^{5/6} \sqrt{\sqrt[3]{a} + (-1)^{2/3} \sqrt[3]{b}}}$$

**Mathematica [C]** time = 0.225047, size = 146, normalized size = 0.85

$$\frac{8}{3} \text{RootSum} \left[ 64\#1^3 a + \#1^6 b + 6\#1^5 b + 15\#1^4 b + 20\#1^3 b + 15\#1^2 b + 6\#1 b + b \&, \frac{2\#1^2 \tan^{-1} \left( \frac{\sin(2x)}{\cos(2x) - \#1} \right) - i\#1^2 \log(\#1^2 \cos[2*x] \#1 + \#1^2) \#1^2 / (b + 5*b*\#1 + 32*a*\#1^2 + 10*b*\#1^2 + 10*b*\#1^3 + 5*b*\#1^4 + b*\#1^5) \& ] / 3$$

Antiderivative was successfully verified.

[In] Integrate[(a + b\*Cos[x]^6)^(-1), x]

[Out] (8\*RootSum[b + 6\*b\*#1 + 15\*b\*#1^2 + 64\*a\*#1^3 + 20\*b\*#1^3 + 15\*b\*#1^4 + 6\*b\*#1^5 + b\*#1^6 & , (2\*ArcTan[Sin[2\*x]/(Cos[2\*x] - #1)]\*#1^2 - I\*Log[1 - 2\*Cos[2\*x]\*#1 + #1^2]\*#1^2)/(b + 5\*b\*#1 + 32\*a\*#1^2 + 10\*b\*#1^2 + 10\*b\*#1^3 + 5\*b\*#1^4 + b\*#1^5) & ])/3

**Maple [C]** time = 0.152, size = 60, normalized size = 0.4

$$\frac{1}{6a} \sum_{_R=\text{RootOf}(a_Z^6+3a_Z^4+3a_Z^2+a+b)} \frac{(-R^4 + 2_R^2 + 1) \ln(\tan(x) - _R)}{-R^5 + 2_R^3 + _R}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(a+b\*cos(x)^6), x)

[Out] 1/6/a\*sum(((\_R^4+2\*\_R^2+1)/(\_R^5+2\*\_R^3+\_R))\*ln(tan(x)-\_R), \_R=RootOf(\_Z^6\*a+3\*\_Z^4\*a+3\*\_Z^2\*a+a+b))

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{b \cos(x)^6 + a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^6), x, algorithm="maxima")



[Out] integrate(1/(b\*cos(x)^6 + a), x)

---

**Fricas [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^6),x, algorithm="fricas")

[Out] Timed out

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)\*\*6),x)

[Out] Timed out

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{b \cos(x)^6 + a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^6),x, algorithm="giac")

[Out] integrate(1/(b\*cos(x)^6 + a), x)

$$3.76 \quad \int \frac{1}{a+b \cos^8(x)} dx$$

**Optimal.** Leaf size=245

$$\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{-a}-\sqrt[4]{b}} \cot(x)}{\sqrt[8]{-a}}\right)}{4(-a)^{7/8}\sqrt{\sqrt[4]{-a}-\sqrt[4]{b}}} + \frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{-a}-i\sqrt[4]{b}} \cot(x)}{\sqrt[8]{-a}}\right)}{4(-a)^{7/8}\sqrt{\sqrt[4]{-a}-i\sqrt[4]{b}}} + \frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{-a}+i\sqrt[4]{b}} \cot(x)}{\sqrt[8]{-a}}\right)}{4(-a)^{7/8}\sqrt{\sqrt[4]{-a}+i\sqrt[4]{b}}} + \frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{-a}+\sqrt[4]{b}} \cot(x)}{\sqrt[8]{-a}}\right)}{4(-a)^{7/8}\sqrt{\sqrt[4]{-a}+\sqrt[4]{b}}}$$

[Out] ArcTan[(Sqrt[(-a)^(1/4) - b^(1/4)]\*Cot[x])/(-a)^(1/8)]/(4\*(-a)^(7/8)\*Sqrt[(-a)^(1/4) - b^(1/4)]) + ArcTan[(Sqrt[(-a)^(1/4) - I\*b^(1/4)]\*Cot[x])/(-a)^(1/8)]/(4\*(-a)^(7/8)\*Sqrt[(-a)^(1/4) - I\*b^(1/4)]) + ArcTan[(Sqrt[(-a)^(1/4) + I\*b^(1/4)]\*Cot[x])/(-a)^(1/8)]/(4\*(-a)^(7/8)\*Sqrt[(-a)^(1/4) + I\*b^(1/4)]) + ArcTan[(Sqrt[(-a)^(1/4) + b^(1/4)]\*Cot[x])/(-a)^(1/8)]/(4\*(-a)^(7/8)\*Sqrt[(-a)^(1/4) + b^(1/4)])

**Rubi [A]** time = 0.486312, antiderivative size = 245, normalized size of antiderivative = 1., number of steps used = 9, number of rules used = 3, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.3$ , Rules used = {3211, 3181, 203}

$$\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{-a}-i\sqrt[4]{b}} \cot(x)}{\sqrt[8]{-a}}\right)}{4(-a)^{7/8}\sqrt{\sqrt[4]{-a}-i\sqrt[4]{b}}} + \frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{-a}+i\sqrt[4]{b}} \cot(x)}{\sqrt[8]{-a}}\right)}{4(-a)^{7/8}\sqrt{\sqrt[4]{-a}+i\sqrt[4]{b}}} + \frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{-a}+\sqrt[4]{b}} \cot(x)}{\sqrt[8]{-a}}\right)}{4(-a)^{7/8}\sqrt{\sqrt[4]{-a}+\sqrt[4]{b}}} + \frac{\tan^{-1}\left(\frac{\sqrt{a\sqrt[4]{b}+(-a)^{5/4}} \cot(x)}{(-a)^{5/8}}\right)}{4(-a)^{3/8}\sqrt{a\sqrt[4]{b}+(-a)^{5/4}}}$$

Antiderivative was successfully verified.

[In] Int[(a + b\*cos[x]^8)^(-1), x]

[Out] ArcTan[(Sqrt[(-a)^(1/4) - I\*b^(1/4)]\*Cot[x])/(-a)^(1/8)]/(4\*(-a)^(7/8)\*Sqrt[(-a)^(1/4) - I\*b^(1/4)]) + ArcTan[(Sqrt[(-a)^(1/4) + I\*b^(1/4)]\*Cot[x])/(-a)^(1/8)]/(4\*(-a)^(7/8)\*Sqrt[(-a)^(1/4) + I\*b^(1/4)]) + ArcTan[(Sqrt[(-a)^(1/4) + b^(1/4)]\*Cot[x])/(-a)^(1/8)]/(4\*(-a)^(7/8)\*Sqrt[(-a)^(1/4) + b^(1/4)]) + ArcTan[(Sqrt[(-a)^(5/4) + a\*b^(1/4)]\*Cot[x])/(-a)^(5/8)]/(4\*(-a)^(3/8)\*Sqrt[(-a)^(5/4) + a\*b^(1/4)])

#### Rule 3211

Int[((a\_) + (b\_)\*sin[(e\_.) + (f\_.)\*(x\_)])^(n\_)]^(-1), x\_Symbol] :> Module[{k}, Dist[2/(a\*n), Sum[Int[1/(1 - Sin[e + f\*x])^2/((-1)^((4\*k)/n)\*Rt[-(a/b), n/2]), x], {k, 1, n/2}], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[n/2]

#### Rule 3181

Int[((a\_) + (b\_)\*sin[(e\_.) + (f\_.)\*(x\_)])^2]^(-1), x\_Symbol] :> With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x]

#### Rule 203

Int[((a\_) + (b\_)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(1\*ArcTan[Rt[b, 2]\*x]/Rt[a, 2])/(Rt[a, 2]\*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])

Rubi steps

$$\int \frac{1}{a + b \cos^8(x)} dx = \frac{\int \frac{1}{1 - \frac{\sqrt[4]{b} \cos^2(x)}{\sqrt[4]{-a}}} dx}{4a} + \frac{\int \frac{1}{1 - \frac{i \sqrt[4]{b} \cos^2(x)}{\sqrt[4]{-a}}} dx}{4a} + \frac{\int \frac{1}{1 + \frac{\sqrt[4]{b} \cos^2(x)}{\sqrt[4]{-a}}} dx}{4a} + \frac{\int \frac{1}{1 + \frac{i \sqrt[4]{b} \cos^2(x)}{\sqrt[4]{-a}}} dx}{4a}$$

$$= \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 - \frac{\sqrt[4]{b}}{\sqrt[4]{-a}}\right) x^2} dx, x, \cot(x) \right)}{4a} - \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 - \frac{i \sqrt[4]{b}}{\sqrt[4]{-a}}\right) x^2} dx, x, \cot(x) \right)}{4a} - \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 + \frac{\sqrt[4]{b}}{\sqrt[4]{-a}}\right) x^2} dx, x, \cot(x) \right)}{4a} + \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 + \frac{i \sqrt[4]{b}}{\sqrt[4]{-a}}\right) x^2} dx, x, \cot(x) \right)}{4a}$$

$$= \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[4]{-a} - i \sqrt[4]{b}} \cot(x)}{\sqrt[8]{-a}} \right)}{4(-a)^{7/8} \sqrt{\sqrt[4]{-a} - i \sqrt[4]{b}}} + \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[4]{-a} + i \sqrt[4]{b}} \cot(x)}{\sqrt[8]{-a}} \right)}{4(-a)^{7/8} \sqrt{\sqrt[4]{-a} + i \sqrt[4]{b}}} + \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[4]{-a} + \sqrt[4]{b}} \cot(x)}{\sqrt[8]{-a}} \right)}{4(-a)^{7/8} \sqrt{\sqrt[4]{-a} + \sqrt[4]{b}}} + \frac{\tan^{-1} \left( \frac{\sqrt{(-a)^{5/4} + i \sqrt[4]{b}} \cot(x)}{\sqrt[8]{-a}} \right)}{4(-a)^{3/8} \sqrt{(-a)^{5/4} + i \sqrt[4]{b}}}$$

**Mathematica [C]** time = 0.260426, size = 172, normalized size = 0.7

$$8\text{RootSum} \left[ 256\#1^4 a + \#1^8 b + 8\#1^7 b + 28\#1^6 b + 56\#1^5 b + 70\#1^4 b + 56\#1^3 b + 28\#1^2 b + 8\#1 b + b \&, \frac{2\#1^3}{128\#1^3 a + \#1^7} \right]$$

Warning: Unable to verify antiderivative.

[In] Integrate[(a + b\*Cos[x]^8)^(-1), x]

[Out] 8\*RootSum[b + 8\*b\*#1 + 28\*b\*#1^2 + 56\*b\*#1^3 + 256\*a\*#1^4 + 70\*b\*#1^4 + 56\*b\*#1^5 + 28\*b\*#1^6 + 8\*b\*#1^7 + b\*#1^8 &, (2\*ArcTan[Sin[2\*x]/(Cos[2\*x] - #1)]\*#1^3 - I\*Log[1 - 2\*Cos[2\*x]\*#1 + #1^2]\*#1^3)/(b + 7\*b\*#1 + 21\*b\*#1^2 + 128\*a\*#1^3 + 35\*b\*#1^3 + 35\*b\*#1^4 + 21\*b\*#1^5 + 7\*b\*#1^6 + b\*#1^7) & ]

**Maple [C]** time = 0.091, size = 76, normalized size = 0.3

$$\frac{1}{8a} \sum_{_R=\text{RootOf}(a_Z^8+4a_Z^6+6a_Z^4+4a_Z^2+a+b)} \frac{(_R^6+3_R^4+3_R^2+1) \ln(\tan(x) - _R)}{-_R^7+3_R^5+3_R^3+_R}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(a+b\*cos(x)^8), x)

[Out] 1/8/a\*sum((\_R^6+3\*\_R^4+3\*\_R^2+1)/(\_R^7+3\*\_R^5+3\*\_R^3+\_R)\*ln(tan(x)-\_R), \_R=RootOf(\_Z^8\*a+4\*\_Z^6\*a+6\*\_Z^4\*a+4\*\_Z^2\*a+a+b))

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{b \cos(x)^8 + a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^8), x, algorithm="maxima")

[Out] integrate(1/(b\*cos(x)^8 + a), x)

---

**Fricas [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^8),x, algorithm="fricas")

[Out] Timed out

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)\*\*8),x)

[Out] Timed out

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{b \cos(x)^8 + a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a+b\*cos(x)^8),x, algorithm="giac")

[Out] integrate(1/(b\*cos(x)^8 + a), x)

$$3.77 \quad \int \frac{1}{a-b \cos^5(x)} dx$$

**Optimal.** Leaf size=494

$$\frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}+\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}-\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}-\sqrt[5]{-1}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}+\sqrt[5]{-1}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-\sqrt[5]{-1}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+\sqrt[5]{-1}\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}+(-1)^{2/5}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}-(-1)^{2/5}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-(-1)^{2/5}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+(-1)^{2/5}\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}-(-1)^{3/5}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}+(-1)^{3/5}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-(-1)^{3/5}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+(-1)^{3/5}\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}+(-1)^{4/5}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}-(-1)^{4/5}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-(-1)^{4/5}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+(-1)^{4/5}\sqrt[5]{b}}}$$

[Out] (2\*ArcTan[(Sqrt[a^(1/5) + b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) - b^(1/5)])]/(5\*a^(4/5)\*Sqrt[a^(1/5) - b^(1/5)]\*Sqrt[a^(1/5) + b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) - (-1)^(1/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) + (-1)^(1/5)\*b^(1/5)])]/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(1/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(1/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) + (-1)^(2/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) - (-1)^(2/5)\*b^(1/5)])]/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(2/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(2/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) - (-1)^(3/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) + (-1)^(3/5)\*b^(1/5)])]/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(3/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(3/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) + (-1)^(4/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) - (-1)^(4/5)\*b^(1/5)])]/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(4/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(4/5)\*b^(1/5)])

**Rubi [A]** time = 0.589042, antiderivative size = 494, normalized size of antiderivative = 1., number of steps used = 12, number of rules used = 3, integrand size = 11,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.273$ , Rules used = {3213, 2659, 205}

$$\frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}+\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}-\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}-\sqrt[5]{-1}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}+\sqrt[5]{-1}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-\sqrt[5]{-1}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+\sqrt[5]{-1}\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}+(-1)^{2/5}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}-(-1)^{2/5}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-(-1)^{2/5}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+(-1)^{2/5}\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}-(-1)^{3/5}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}+(-1)^{3/5}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-(-1)^{3/5}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+(-1)^{3/5}\sqrt[5]{b}}} + \frac{2 \tan^{-1}\left(\frac{\sqrt{\sqrt[5]{a}+(-1)^{4/5}\sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a}-(-1)^{4/5}\sqrt[5]{b}}}\right)}{5a^{4/5}\sqrt{\sqrt[5]{a}-(-1)^{4/5}\sqrt[5]{b}}\sqrt{\sqrt[5]{a}+(-1)^{4/5}\sqrt[5]{b}}}$$

Antiderivative was successfully verified.

[In] Int[(a - b\*Cos[x]^5)^(-1), x]

[Out] (2\*ArcTan[(Sqrt[a^(1/5) + b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) - b^(1/5)])]/(5\*a^(4/5)\*Sqrt[a^(1/5) - b^(1/5)]\*Sqrt[a^(1/5) + b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) - (-1)^(1/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) + (-1)^(1/5)\*b^(1/5)])]/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(1/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(1/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) + (-1)^(2/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) - (-1)^(2/5)\*b^(1/5)])]/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(2/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(2/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) - (-1)^(3/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) + (-1)^(3/5)\*b^(1/5)])]/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(3/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(3/5)\*b^(1/5)]) + (2\*ArcTan[(Sqrt[a^(1/5) + (-1)^(4/5)\*b^(1/5)]\*Tan[x/2])/Sqrt[a^(1/5) - (-1)^(4/5)\*b^(1/5)])]/(5\*a^(4/5)\*Sqrt[a^(1/5) - (-1)^(4/5)\*b^(1/5)]\*Sqrt[a^(1/5) + (-1)^(4/5)\*b^(1/5)])

### Rule 3213

Int[((a\_) + (b\_.)\*((c\_.)\*sin[(e\_.) + (f\_.)\*(x\_)])^(n\_))^(p\_), x\_Symbol] :>  
Int[ExpandTrig[(a + b\*(c\*sin[e + f\*x])^n)^p, x], x] /; FreeQ[{a, b, c, e, f, n}, x] && (IGtQ[p, 0] || (EqQ[p, -1] && IntegerQ[n]))

### Rule 2659

```
Int[((a_) + (b_.)*sin[Pi/2 + (c_.) + (d_.)*(x_)])^(-1), x_Symbol] := With[{
e = FreeFactors[Tan[(c + d*x)/2], x]}, Dist[(2*e)/d, Subst[Int[1/(a + b +
a - b)*e^2*x^2), x], x, Tan[(c + d*x)/2]/e], x]] /; FreeQ[{a, b, c, d}, x]
&& NeQ[a^2 - b^2, 0]
```

Rule 205

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[a/b, 2]*ArcTan[x/Rt[a
/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]
```

Rubi steps

$$\int \frac{1}{a - b \cos^5(x)} dx = \int \left( \frac{1}{5a^{4/5} (\sqrt[5]{a} - \sqrt[5]{b} \cos(x))} + \frac{1}{5a^{4/5} (\sqrt[5]{a} + \sqrt[5]{-1} \sqrt[5]{b} \cos(x))} + \frac{1}{5a^{4/5} (\sqrt[5]{a} - (-1)^{2/5} \sqrt[5]{b} \cos(x))} + \dots \right) dx$$

$$= \frac{\int \frac{1}{\sqrt[5]{a} - \sqrt[5]{b} \cos(x)} dx}{5a^{4/5}} + \frac{\int \frac{1}{\sqrt[5]{a} + \sqrt[5]{-1} \sqrt[5]{b} \cos(x)} dx}{5a^{4/5}} + \frac{\int \frac{1}{\sqrt[5]{a} - (-1)^{2/5} \sqrt[5]{b} \cos(x)} dx}{5a^{4/5}} + \dots$$

$$= \frac{2 \operatorname{Subst} \left( \int \frac{1}{\sqrt[5]{a} - \sqrt[5]{b} + (\sqrt[5]{a} + \sqrt[5]{b}) x^2} dx, x, \tan\left(\frac{x}{2}\right) \right)}{5a^{4/5}} + \frac{2 \operatorname{Subst} \left( \int \frac{1}{\sqrt[5]{a} + \sqrt[5]{-1} \sqrt[5]{b} + (\sqrt[5]{a} - \sqrt[5]{-1} \sqrt[5]{b}) x^2} dx, x, \tan\left(\frac{x}{2}\right) \right)}{5a^{4/5}}$$

$$= \frac{2 \tan^{-1} \left( \frac{\sqrt{\sqrt[5]{a} + \sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a} - \sqrt[5]{b}}} \right)}{5a^{4/5} \sqrt{\sqrt[5]{a} - \sqrt[5]{b}} \sqrt{\sqrt[5]{a} + \sqrt[5]{b}}} + \frac{2 \tan^{-1} \left( \frac{\sqrt{\sqrt[5]{a} - \sqrt[5]{-1} \sqrt[5]{b}} \tan\left(\frac{x}{2}\right)}{\sqrt{\sqrt[5]{a} + \sqrt[5]{-1} \sqrt[5]{b}}} \right)}{5a^{4/5} \sqrt{\sqrt[5]{a} - \sqrt[5]{-1} \sqrt[5]{b}} \sqrt{\sqrt[5]{a} + \sqrt[5]{-1} \sqrt[5]{b}}} + \dots$$

**Mathematica [C]** time = 0.179683, size = 130, normalized size = 0.26

$$-\frac{8}{5} \operatorname{RootSum} \left[ -32\#1^5 a + \#1^{10} b + 5\#1^8 b + 10\#1^6 b + 10\#1^4 b + 5\#1^2 b + b \&, \frac{2\#1^3 \tan^{-1} \left( \frac{\sin(x)}{\cos(x) - \#1} \right) - i\#1^3 \log(\#1^2 - 2\#1 \cos(x) + \cos^2(x))}{-16\#1^3 a + \#1^8 b + 4\#1^6 b + 6\#1^4 b + 4\#1^2 b + b} \right]$$

Warning: Unable to verify antiderivative.

```
[In] Integrate[(a - b*cos[x]^5)^(-1), x]
```

```
[Out] (-8*RootSum[b + 5*b*#1^2 + 10*b*#1^4 - 32*a*#1^5 + 10*b*#1^6 + 5*b*#1^8 + b
*#1^10 &, (2*ArcTan[Sin[x]/(Cos[x] - #1)]*#1^3 - I*Log[1 - 2*Cos[x]*#1 + #
1^2]*#1^3)/(b + 4*b*#1^2 - 16*a*#1^3 + 6*b*#1^4 + 4*b*#1^6 + b*#1^8) & ])/5
```

**Maple [C]** time = 0.027, size = 148, normalized size = 0.3

$$\frac{1}{5} \sum_{_R = \operatorname{RootOf}((a+b)_Z^{10} + (5a-5b)_Z^8 + (10a+10b)_Z^6 + (10a-10b)_Z^4 + (5a+5b)_Z^2 + a-b)} \frac{-_R^8 + 4\_R^6 + 6\_R^4}{-_R^9 a + \_R^9 b + 4\_R^7 a - 4\_R^7 b + 6\_R^5 a + 6\_R^5 b}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] int(1/(a-b*cos(x)^5), x)
```

```
[Out] 1/5*sum((_R^8+4*_R^6+6*_R^4+4*_R^2+1)/(_R^9*a+_R^9*b+4*_R^7*a-4*_R^7*b+6*_R
^5*a+6*_R^5*b+4*_R^3*a-4*_R^3*b+_R*a+_R*b)*ln(tan(1/2*x)-_R), _R=RootOf((a+b
)*_Z^10+(5*a-5*b)*_Z^8+(10*a+10*b)*_Z^6+(10*a-10*b)*_Z^4+(5*a+5*b)*_Z^2+a-b
```

))

---

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$-\int \frac{1}{b \cos(x)^5 - a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a-b\*cos(x)^5),x, algorithm="maxima")

[Out] -integrate(1/(b\*cos(x)^5 - a), x)

---

**Fricas [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: UnboundLocalError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a-b\*cos(x)^5),x, algorithm="fricas")

[Out] Exception raised: UnboundLocalError

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a-b\*cos(x)\*\*5),x)

[Out] Timed out

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int -\frac{1}{b \cos(x)^5 - a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a-b\*cos(x)^5),x, algorithm="giac")

[Out] integrate(-1/(b\*cos(x)^5 - a), x)

$$3.78 \quad \int \frac{1}{a-b \cos^6(x)} dx$$

**Optimal.** Leaf size=175

$$\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}-\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}-\sqrt[3]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}+\sqrt[3]{-1}\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}+\sqrt[3]{-1}\sqrt[3]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}-(-1)^{2/3}\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}-(-1)^{2/3}\sqrt[3]{b}}}$$

[Out] -ArcTan[(Sqrt[a^(1/3) - b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) - b^(1/3)]) - ArcTan[(Sqrt[a^(1/3) + (-1)^(1/3)\*b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) + (-1)^(1/3)\*b^(1/3)]) - ArcTan[(Sqrt[a^(1/3) - (-1)^(2/3)\*b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) - (-1)^(2/3)\*b^(1/3)])]

**Rubi [A]** time = 0.249201, antiderivative size = 175, normalized size of antiderivative = 1., number of steps used = 7, number of rules used = 3, integrand size = 11,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.273$ , Rules used = {3211, 3181, 203}

$$\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}-\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}-\sqrt[3]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}+\sqrt[3]{-1}\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}+\sqrt[3]{-1}\sqrt[3]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[3]{a}-(-1)^{2/3}\sqrt[3]{b}}\cot(x)}{\sqrt[6]{a}}\right)}{3a^{5/6}\sqrt{\sqrt[3]{a}-(-1)^{2/3}\sqrt[3]{b}}}$$

Antiderivative was successfully verified.

[In] Int[(a - b\*Cos[x]^6)^(-1), x]

[Out] -ArcTan[(Sqrt[a^(1/3) - b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) - b^(1/3)]) - ArcTan[(Sqrt[a^(1/3) + (-1)^(1/3)\*b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) + (-1)^(1/3)\*b^(1/3)]) - ArcTan[(Sqrt[a^(1/3) - (-1)^(2/3)\*b^(1/3)]\*Cot[x])/a^(1/6)]/(3\*a^(5/6)\*Sqrt[a^(1/3) - (-1)^(2/3)\*b^(1/3)])]

#### Rule 3211

Int[((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)])^(n\_)]^(-1), x\_Symbol] :> Module[{k}, Dist[2/(a\*n), Sum[Int[1/(1 - Sin[e + f\*x])^2/((-1)^((4\*k)/n)\*Rt[-(a/b), n/2])], x], {k, 1, n/2}], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[n/2]

#### Rule 3181

Int[((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)])^2]^(-1), x\_Symbol] :> With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x]

#### Rule 203

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(1\*ArcTan[Rt[b, 2]\*x]/Rt[a, 2])]/(Rt[a, 2]\*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])

#### Rubi steps



$$\int \frac{1}{a - b \cos^6(x)} dx = \frac{\int \frac{1}{1 - \frac{\sqrt[3]{b} \cos^2(x)}{\sqrt[3]{a}}} dx}{3a} + \frac{\int \frac{1}{1 + \frac{\sqrt[3]{-1} \sqrt[3]{b} \cos^2(x)}{\sqrt[3]{a}}} dx}{3a} + \frac{\int \frac{1}{1 - \frac{(-1)^{2/3} \sqrt[3]{b} \cos^2(x)}{\sqrt[3]{a}}} dx}{3a}$$

$$= \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 - \frac{\sqrt[3]{b}}{\sqrt[3]{a}}\right) x^2} dx, x, \cot(x) \right)}{3a} - \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 + \frac{\sqrt[3]{-1} \sqrt[3]{b}}{\sqrt[3]{a}}\right) x^2} dx, x, \cot(x) \right)}{3a} - \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 - \frac{(-1)^{2/3} \sqrt[3]{b}}{\sqrt[3]{a}}\right) x^2} dx, x, \cot(x) \right)}{3a}$$

$$= -\frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[3]{a} - \sqrt[3]{b}} \cot(x)}{\sqrt[6]{a}} \right)}{3a^{5/6} \sqrt{\sqrt[3]{a} - \sqrt[3]{b}}} - \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[3]{a} + \sqrt[3]{-1} \sqrt[3]{b}} \cot(x)}{\sqrt[6]{a}} \right)}{3a^{5/6} \sqrt{\sqrt[3]{a} + \sqrt[3]{-1} \sqrt[3]{b}}} - \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[3]{a} - (-1)^{2/3} \sqrt[3]{b}} \cot(x)}{\sqrt[6]{a}} \right)}{3a^{5/6} \sqrt{\sqrt[3]{a} - (-1)^{2/3} \sqrt[3]{b}}}$$

**Mathematica [C]** time = 0.176012, size = 146, normalized size = 0.83

$$-\frac{8}{3} \text{RootSum} \left[ -64\#1^3 a + \#1^6 b + 6\#1^5 b + 15\#1^4 b + 20\#1^3 b + 15\#1^2 b + 6\#1 b + b \&, \frac{2\#1^2 \tan^{-1} \left( \frac{\sin(2x)}{\cos(2x) - \#1} \right) - i\#1^2 \log \left( \frac{\cos(2x) - \#1}{\cos(2x) + \#1} \right)}{-32\#1^2 a + \#1^5 b + 5\#1^4 b + 10\#1^3 b + 15\#1^2 b + 6\#1 b + b} \right]$$

Antiderivative was successfully verified.

[In] Integrate[(a - b\*Cos[x]^6)^(-1), x]

[Out] (-8\*RootSum[b + 6\*b\*#1 + 15\*b\*#1^2 - 64\*a\*#1^3 + 20\*b\*#1^3 + 15\*b\*#1^4 + 6\*b\*#1^5 + b\*#1^6 &, (2\*ArcTan[Sin[2\*x]/(Cos[2\*x] - #1)]\*#1^2 - I\*Log[1 - 2\*Cos[2\*x]\*#1 + #1^2]\*#1^2)/(b + 5\*b\*#1 - 32\*a\*#1^2 + 10\*b\*#1^2 + 10\*b\*#1^3 + 5\*b\*#1^4 + b\*#1^5) & ])/3

**Maple [C]** time = 0.121, size = 62, normalized size = 0.4

$$\frac{1}{6a} \sum_{_R=\text{RootOf}(a_Z^6+3a_Z^4+3a_Z^2+a-b)} \frac{(_R^4 + 2_R^2 + 1) \ln(\tan(x) - _R)}{-_R^5 + 2_R^3 + _R}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(a-b\*cos(x)^6), x)

[Out] 1/6/a\*sum((\_R^4+2\*\_R^2+1)/(\_R^5+2\*\_R^3+\_R)\*ln(tan(x)-\_R), \_R=RootOf(\_Z^6\*a+3\*\_Z^4\*a+3\*\_Z^2\*a+b))

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$-\int \frac{1}{b \cos(x)^6 - a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(a-b\*cos(x)^6), x, algorithm="maxima")

[Out] `-integrate(1/(b*cos(x)^6 - a), x)`

---

**Fricas [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(a-b*cos(x)^6),x, algorithm="fricas")`

[Out] Timed out

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(a-b*cos(x)**6),x)`

[Out] Timed out

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int -\frac{1}{b \cos(x)^6 - a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(a-b*cos(x)^6),x, algorithm="giac")`

[Out] `integrate(-1/(b*cos(x)^6 - a), x)`

$$3.79 \quad \int \frac{1}{a-b \cos^8(x)} dx$$

**Optimal.** Leaf size=213

$$\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{a}-\sqrt[4]{b}}\cot(x)}{\sqrt[8]{a}}\right)}{4a^{7/8}\sqrt{\sqrt[4]{a}-\sqrt[4]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{a}-i\sqrt[4]{b}}\cot(x)}{\sqrt[8]{a}}\right)}{4a^{7/8}\sqrt{\sqrt[4]{a}-i\sqrt[4]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{a}+i\sqrt[4]{b}}\cot(x)}{\sqrt[8]{a}}\right)}{4a^{7/8}\sqrt{\sqrt[4]{a}+i\sqrt[4]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{a}+\sqrt[4]{b}}\cot(x)}{\sqrt[8]{a}}\right)}{4a^{7/8}\sqrt{\sqrt[4]{a}+\sqrt[4]{b}}}$$

[Out] -ArcTan[(Sqrt[a^(1/4) - b^(1/4)]\*Cot[x])/a^(1/8)]/(4\*a^(7/8)\*Sqrt[a^(1/4) - b^(1/4)]) - ArcTan[(Sqrt[a^(1/4) - I\*b^(1/4)]\*Cot[x])/a^(1/8)]/(4\*a^(7/8)\*Sqrt[a^(1/4) - I\*b^(1/4)]) - ArcTan[(Sqrt[a^(1/4) + I\*b^(1/4)]\*Cot[x])/a^(1/8)]/(4\*a^(7/8)\*Sqrt[a^(1/4) + I\*b^(1/4)]) - ArcTan[(Sqrt[a^(1/4) + b^(1/4)]\*Cot[x])/a^(1/8)]/(4\*a^(7/8)\*Sqrt[a^(1/4) + b^(1/4)])

**Rubi [A]** time = 0.215615, antiderivative size = 213, normalized size of antiderivative = 1., number of steps used = 9, number of rules used = 3, integrand size = 11,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.273$ , Rules used = {3211, 3181, 203}

$$\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{a}-\sqrt[4]{b}}\cot(x)}{\sqrt[8]{a}}\right)}{4a^{7/8}\sqrt{\sqrt[4]{a}-\sqrt[4]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{a}-i\sqrt[4]{b}}\cot(x)}{\sqrt[8]{a}}\right)}{4a^{7/8}\sqrt{\sqrt[4]{a}-i\sqrt[4]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{a}+i\sqrt[4]{b}}\cot(x)}{\sqrt[8]{a}}\right)}{4a^{7/8}\sqrt{\sqrt[4]{a}+i\sqrt[4]{b}}}-\frac{\tan^{-1}\left(\frac{\sqrt{\sqrt[4]{a}+\sqrt[4]{b}}\cot(x)}{\sqrt[8]{a}}\right)}{4a^{7/8}\sqrt{\sqrt[4]{a}+\sqrt[4]{b}}}$$

Antiderivative was successfully verified.

[In] Int[(a - b\*cos[x]^8)^(-1), x]

[Out] -ArcTan[(Sqrt[a^(1/4) - b^(1/4)]\*Cot[x])/a^(1/8)]/(4\*a^(7/8)\*Sqrt[a^(1/4) - b^(1/4)]) - ArcTan[(Sqrt[a^(1/4) - I\*b^(1/4)]\*Cot[x])/a^(1/8)]/(4\*a^(7/8)\*Sqrt[a^(1/4) - I\*b^(1/4)]) - ArcTan[(Sqrt[a^(1/4) + I\*b^(1/4)]\*Cot[x])/a^(1/8)]/(4\*a^(7/8)\*Sqrt[a^(1/4) + I\*b^(1/4)]) - ArcTan[(Sqrt[a^(1/4) + b^(1/4)]\*Cot[x])/a^(1/8)]/(4\*a^(7/8)\*Sqrt[a^(1/4) + b^(1/4)])

#### Rule 3211

Int[((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^(n\_))^(m\_), x\_Symbol] := Module[{k}, Dist[2/(a\*n), Sum[Int[1/(1 - Sin[e + f\*x]^2/((-1)^((4\*k)/n)\*Rt[-(a/b), n/2]), x], {k, 1, n/2}], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[n/2]

#### Rule 3181

Int[((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(m\_), x\_Symbol] := With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x]

#### Rule 203

Int[((a\_) + (b\_.)\*(x\_)^2)^(m\_), x\_Symbol] := Simp[(1\*ArcTan[(Rt[b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])

#### Rubi steps

$$\int \frac{1}{a - b \cos^8(x)} dx = \frac{\int \frac{1}{1 - \frac{\sqrt[4]{b} \cos^2(x)}{\sqrt[4]{a}}} dx}{4a} + \frac{\int \frac{1}{1 - \frac{i \sqrt[4]{b} \cos^2(x)}{\sqrt[4]{a}}} dx}{4a} + \frac{\int \frac{1}{1 + \frac{i \sqrt[4]{b} \cos^2(x)}{\sqrt[4]{a}}} dx}{4a} + \frac{\int \frac{1}{1 + \frac{\sqrt[4]{b} \cos^2(x)}{\sqrt[4]{a}}} dx}{4a}$$

$$= \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 - \frac{\sqrt[4]{b}}{\sqrt[4]{a}}\right) x^2} dx, x, \cot(x) \right)}{4a} - \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 - \frac{i \sqrt[4]{b}}{\sqrt[4]{a}}\right) x^2} dx, x, \cot(x) \right)}{4a} - \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 + \frac{i \sqrt[4]{b}}{\sqrt[4]{a}}\right) x^2} dx, x, \cot(x) \right)}{4a} - \frac{\text{Subst} \left( \int \frac{1}{1 + \left(1 + \frac{\sqrt[4]{b}}{\sqrt[4]{a}}\right) x^2} dx, x, \cot(x) \right)}{4a}$$

$$= \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[4]{a} - \sqrt[4]{b}} \cot(x)}{\sqrt[8]{a}} \right)}{4a^{7/8} \sqrt{\sqrt[4]{a} - \sqrt[4]{b}}} - \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[4]{a} - i \sqrt[4]{b}} \cot(x)}{\sqrt[8]{a}} \right)}{4a^{7/8} \sqrt{\sqrt[4]{a} - i \sqrt[4]{b}}} - \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[4]{a} + i \sqrt[4]{b}} \cot(x)}{\sqrt[8]{a}} \right)}{4a^{7/8} \sqrt{\sqrt[4]{a} + i \sqrt[4]{b}}} - \frac{\tan^{-1} \left( \frac{\sqrt{\sqrt[4]{a} + \sqrt[4]{b}} \cot(x)}{\sqrt[8]{a}} \right)}{4a^{7/8} \sqrt{\sqrt[4]{a} + \sqrt[4]{b}}}$$

**Mathematica [C]** time = 0.208781, size = 172, normalized size = 0.81

$$-8\text{RootSum} \left[ -256\#1^4 a + \#1^8 b + 8\#1^7 b + 28\#1^6 b + 56\#1^5 b + 70\#1^4 b + 56\#1^3 b + 28\#1^2 b + 8\#1 b + b \&, \frac{2\#1^3}{-128\#1^3 a + \#1} \right]$$

Warning: Unable to verify antiderivative.

```
[In] Integrate[(a - b*cos[x]^8)^(-1), x]
```

```
[Out] -8*RootSum[b + 8*b*#1 + 28*b*#1^2 + 56*b*#1^3 - 256*a*#1^4 + 70*b*#1^4 + 56*b*#1^5 + 28*b*#1^6 + 8*b*#1^7 + b*#1^8 &, (2*ArcTan[Sin[2*x]/(Cos[2*x] - #1)]*#1^3 - I*Log[1 - 2*Cos[2*x]*#1 + #1^2]*#1^3)/(b + 7*b*#1 + 21*b*#1^2 - 128*a*#1^3 + 35*b*#1^3 + 35*b*#1^4 + 21*b*#1^5 + 7*b*#1^6 + b*#1^7) & ]
```

**Maple [C]** time = 0.089, size = 78, normalized size = 0.4

$$\frac{1}{8a} \sum_{_R=\text{RootOf}(a_Z^8+4a_Z^6+6a_Z^4+4a_Z^2+a-b)} \frac{(_R^6 + 3_R^4 + 3_R^2 + 1) \ln(\tan(x) - _R)}{-_R^7 + 3_R^5 + 3_R^3 + _R}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] int(1/(a-b*cos(x)^8), x)
```

```
[Out] 1/8/a*sum((_R^6+3*_R^4+3*_R^2+1)/(_R^7+3*_R^5+3*_R^3+_R)*ln(tan(x)-_R), _R=RootOf(_Z^8*a+4*_Z^6*a+6*_Z^4*a+4*_Z^2*a+a-b))
```

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$- \int \frac{1}{b \cos(x)^8 - a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(a-b*cos(x)^8), x, algorithm="maxima")
```

[Out] `-integrate(1/(b*cos(x)^8 - a), x)`

---

**Fricas [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(a-b*cos(x)^8),x, algorithm="fricas")`

[Out] Timed out

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(a-b*cos(x)**8),x)`

[Out] Timed out

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int -\frac{1}{b \cos(x)^8 - a} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(a-b*cos(x)^8),x, algorithm="giac")`

[Out] `integrate(-1/(b*cos(x)^8 - a), x)`

$$3.80 \quad \int \frac{1}{1+\cos^5(x)} dx$$

**Optimal.** Leaf size=223

$$\frac{2 \tan^{-1}\left(\sqrt{\frac{1-(-1)^{2/5}}{1+(-1)^{2/5}}}\tan\left(\frac{x}{2}\right)\right)}{5\sqrt{1-(-1)^{4/5}}} + \frac{2 \tan^{-1}\left(\sqrt{\frac{1-(-1)^{4/5}}{1+(-1)^{4/5}}}\tan\left(\frac{x}{2}\right)\right)}{5\sqrt{1+(-1)^{3/5}}} + \frac{\sin(x)}{5(\cos(x)+1)} - \frac{2 \tanh^{-1}\left(\frac{\tan\left(\frac{x}{2}\right)}{\sqrt{\frac{1-\sqrt[5]{-1}}{1+\sqrt[5]{-1}}}}\right)}{5\sqrt{(-1)^{2/5}-1}} - \frac{2\sqrt{-\frac{1+(-1)^{3/5}}{1-(-1)^{3/5}}}\tan\left(\frac{x}{2}\right)}{5\sqrt{1-(-1)^{4/5}}}$$

[Out] (2\*ArcTan[Sqrt[(1 - (-1)^(2/5))/(1 + (-1)^(2/5))]\*Tan[x/2]])/(5\*Sqrt[1 - (-1)^(4/5)]) + (2\*ArcTan[Sqrt[(1 - (-1)^(4/5))/(1 + (-1)^(4/5))]\*Tan[x/2]])/(5\*Sqrt[1 + (-1)^(3/5)]) - (2\*ArcTanh[Tan[x/2]/Sqrt[-((1 - (-1)^(1/5))/(1 + (-1)^(1/5))]])/(5\*Sqrt[-1 + (-1)^(2/5)]) - (2\*Sqrt[-((1 + (-1)^(3/5))/(1 - (-1)^(3/5)))]\*ArcTanh[Sqrt[-((1 + (-1)^(3/5))/(1 - (-1)^(3/5)))]\*Tan[x/2]])/(5\*(1 + (-1)^(3/5))) + Sin[x]/(5\*(1 + Cos[x]))

**Rubi [A]** time = 0.562301, antiderivative size = 223, normalized size of antiderivative = 1., number of steps used = 11, number of rules used = 5, integrand size = 8,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.625$ , Rules used = {3213, 2648, 2659, 208, 205}

$$\frac{2 \tan^{-1}\left(\sqrt{\frac{1-(-1)^{2/5}}{1+(-1)^{2/5}}}\tan\left(\frac{x}{2}\right)\right)}{5\sqrt{1-(-1)^{4/5}}} + \frac{2 \tan^{-1}\left(\sqrt{\frac{1-(-1)^{4/5}}{1+(-1)^{4/5}}}\tan\left(\frac{x}{2}\right)\right)}{5\sqrt{1+(-1)^{3/5}}} + \frac{\sin(x)}{5(\cos(x)+1)} - \frac{2 \tanh^{-1}\left(\frac{\tan\left(\frac{x}{2}\right)}{\sqrt{\frac{1-\sqrt[5]{-1}}{1+\sqrt[5]{-1}}}}\right)}{5\sqrt{(-1)^{2/5}-1}} - \frac{2\sqrt{-\frac{1+(-1)^{3/5}}{1-(-1)^{3/5}}}\tan\left(\frac{x}{2}\right)}{5\sqrt{1-(-1)^{4/5}}}$$

Antiderivative was successfully verified.

[In] Int[(1 + Cos[x]^5)^(-1), x]

[Out] (2\*ArcTan[Sqrt[(1 - (-1)^(2/5))/(1 + (-1)^(2/5))]\*Tan[x/2]])/(5\*Sqrt[1 - (-1)^(4/5)]) + (2\*ArcTan[Sqrt[(1 - (-1)^(4/5))/(1 + (-1)^(4/5))]\*Tan[x/2]])/(5\*Sqrt[1 + (-1)^(3/5)]) - (2\*ArcTanh[Tan[x/2]/Sqrt[-((1 - (-1)^(1/5))/(1 + (-1)^(1/5))]])/(5\*Sqrt[-1 + (-1)^(2/5)]) - (2\*Sqrt[-((1 + (-1)^(3/5))/(1 - (-1)^(3/5)))]\*ArcTanh[Sqrt[-((1 + (-1)^(3/5))/(1 - (-1)^(3/5)))]\*Tan[x/2]])/(5\*(1 + (-1)^(3/5))) + Sin[x]/(5\*(1 + Cos[x]))

#### Rule 3213

Int[((a\_) + (b\_.)\*((c\_.)\*sin[(e\_.) + (f\_.)\*(x\_)])^(n\_))^(p\_), x\_Symbol] := Int[ExpandTrig[(a + b\*(c\*sin[e + f\*x])^n)^p, x] /; FreeQ[{a, b, c, e, f, n}, x] && (IGtQ[p, 0] || (EqQ[p, -1] && IntegerQ[n]))

#### Rule 2648

Int[((a\_) + (b\_.)\*sin[(c\_.) + (d\_.)\*(x\_)])^(-1), x\_Symbol] := -Simp[Cos[c + d\*x]/(d\*(b + a\*sin[c + d\*x])), x] /; FreeQ[{a, b, c, d}, x] && EqQ[a^2 - b^2, 0]

#### Rule 2659

Int[((a\_) + (b\_.)\*sin[Pi/2 + (c\_.) + (d\_.)\*(x\_)])^(-1), x\_Symbol] := With[{e = FreeFactors[Tan[(c + d\*x)/2], x]}, Dist[(2\*e)/d, Subst[Int[1/(a + b + (a - b)\*e^2\*x^2), x], x, Tan[(c + d\*x)/2]/e], x] /; FreeQ[{a, b, c, d}, x]

&& NeQ[a^2 - b^2, 0]

### Rule 208

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[-(a/b), 2]\*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]

### Rule 205

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] :> Simp[(Rt[a/b, 2]\*ArcTan[x/Rt[a/b, 2]])/a, x] /; FreeQ[{a, b}, x] && PosQ[a/b]

### Rubi steps

$$\begin{aligned} \int \frac{1}{1 + \cos^5(x)} dx &= \int \left( -\frac{1}{5(-1 - \cos(x))} - \frac{1}{5(-1 + \sqrt[5]{-1} \cos(x))} - \frac{1}{5(-1 - (-1)^{2/5} \cos(x))} - \frac{1}{5(-1 + (-1)^{3/5} \cos(x))} \right) dx \\ &= -\left( \frac{1}{5} \int \frac{1}{-1 - \cos(x)} dx \right) - \frac{1}{5} \int \frac{1}{-1 + \sqrt[5]{-1} \cos(x)} dx - \frac{1}{5} \int \frac{1}{-1 - (-1)^{2/5} \cos(x)} dx - \frac{1}{5} \int \frac{1}{-1 + (-1)^{3/5} \cos(x)} dx \\ &= \frac{\sin(x)}{5(1 + \cos(x))} - \frac{2}{5} \text{Subst} \left( \int \frac{1}{-1 + \sqrt[5]{-1} + (-1 - \sqrt[5]{-1})x^2} dx, x, \tan\left(\frac{x}{2}\right) \right) - \frac{2}{5} \text{Subst} \left( \int \frac{1}{-1 - (-1)^{2/5} + (-1 + (-1)^{3/5})x^2} dx, x, \tan\left(\frac{x}{2}\right) \right) \\ &= \frac{2 \tan^{-1} \left( \sqrt{\frac{1-(-1)^{2/5}}{1+(-1)^{2/5}}} \tan\left(\frac{x}{2}\right) \right)}{5\sqrt{1 - (-1)^{4/5}}} + \frac{2 \tan^{-1} \left( \sqrt{\frac{1-(-1)^{4/5}}{1+(-1)^{4/5}}} \tan\left(\frac{x}{2}\right) \right)}{5\sqrt{1 + (-1)^{3/5}}} - \frac{2 \tanh^{-1} \left( \frac{\tan\left(\frac{x}{2}\right)}{\sqrt{\frac{1-\sqrt[5]{-1}}{1+\sqrt[5]{-1}}}} \right)}{5\sqrt{-1 + (-1)^{2/5}}} - \frac{2 \sqrt{\frac{1+(-1)^{3/5}}{1-(-1)^{3/5}}}}{5\sqrt{-1 + (-1)^{2/5}}} \end{aligned}$$

**Mathematica [C]** time = 0.122576, size = 378, normalized size = 1.7

$$\frac{1}{5} \tan\left(\frac{x}{2}\right) - \frac{1}{10} \text{RootSum} \left[ \#1^8 - 2\#1^7 + 8\#1^6 - 14\#1^5 + 30\#1^4 - 14\#1^3 + 8\#1^2 - 2\#1 + 1 \&, \frac{-i\#1^6 \log(\#1^2 - 2\#1 \cos(x))}{\#1^8 - 2\#1^7 + 8\#1^6 - 14\#1^5 + 30\#1^4 - 14\#1^3 + 8\#1^2 - 2\#1 + 1} \right]$$

Antiderivative was successfully verified.

[In] Integrate[(1 + Cos[x]^5)^(-1), x]

[Out] -RootSum[1 - 2\*#1 + 8\*#1^2 - 14\*#1^3 + 30\*#1^4 - 14\*#1^5 + 8\*#1^6 - 2\*#1^7 + #1^8 &, (2\*ArcTan[Sin[x]/(Cos[x] - #1)] - I\*Log[1 - 2\*Cos[x]\*#1 + #1^2] - 8\*ArcTan[Sin[x]/(Cos[x] - #1)]\*#1 + (4\*I)\*Log[1 - 2\*Cos[x]\*#1 + #1^2]\*#1 + 30\*ArcTan[Sin[x]/(Cos[x] - #1)]\*#1^2 - (15\*I)\*Log[1 - 2\*Cos[x]\*#1 + #1^2]\*#1^2 - 80\*ArcTan[Sin[x]/(Cos[x] - #1)]\*#1^3 + (40\*I)\*Log[1 - 2\*Cos[x]\*#1 + #1^2]\*#1^3 + 30\*ArcTan[Sin[x]/(Cos[x] - #1)]\*#1^4 - (15\*I)\*Log[1 - 2\*Cos[x]\*#1 + #1^2]\*#1^4 - 8\*ArcTan[Sin[x]/(Cos[x] - #1)]\*#1^5 + (4\*I)\*Log[1 - 2\*Cos[x]\*#1 + #1^2]\*#1^5 + 2\*ArcTan[Sin[x]/(Cos[x] - #1)]\*#1^6 - I\*Log[1 - 2\*Cos[x]\*#1 + #1^2]\*#1^6)/(-1 + 8\*#1 - 21\*#1^2 + 60\*#1^3 - 35\*#1^4 + 24\*#1^5 - 7\*#1^6 + 4\*#1^7) & ]/10 + Tan[x/2]/5

**Maple [C]** time = 0.023, size = 62, normalized size = 0.3

$$\frac{1}{5} \tan\left(\frac{x}{2}\right) + \frac{1}{50} \sum_{R=\text{RootOf}(5_Z^8+10_Z^4+1)} \frac{5_R^6 + 5_R^4 + 5_R^2 + 1}{-R^7 + R^3} \ln\left(\tan\left(\frac{x}{2}\right) - R\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] `int(1/(1+cos(x)^5),x)`

[Out] `1/5*tan(1/2*x)+1/50*sum((5*_R^6+5*_R^4+5*_R^2+1)/(_R^7+_R^3)*ln(tan(1/2*x)-_R),_R=RootOf(5*_Z^8+10*_Z^4+1))`

**Maxima [F]** time = 0., size = 0, normalized size = 0.

result too large to display

Verification of antiderivative is not currently implemented for this CAS.

[In] `integrate(1/(1+cos(x)^5),x, algorithm="maxima")`

[Out] `-1/5*(5*(cos(x)^2 + sin(x)^2 + 2*cos(x) + 1)*integrate(-2/5*((cos(7*x) - 4*cos(6*x) + 15*cos(5*x) - 40*cos(4*x) + 15*cos(3*x) - 4*cos(2*x) + cos(x))*cos(8*x) + (16*cos(6*x) - 44*cos(5*x) + 110*cos(4*x) - 44*cos(3*x) + 16*cos(2*x) - 4*cos(x) + 1)*cos(7*x) - 2*cos(7*x)^2 + 4*(44*cos(5*x) - 110*cos(4*x) + 44*cos(3*x) - 16*cos(2*x) + 4*cos(x) - 1)*cos(6*x) - 32*cos(6*x)^2 + (1010*cos(4*x) - 420*cos(3*x) + 176*cos(2*x) - 44*cos(x) + 15)*cos(5*x) - 210*cos(5*x)^2 + 10*(101*cos(3*x) - 44*cos(2*x) + 11*cos(x) - 4)*cos(4*x) - 1200*cos(4*x)^2 + (176*cos(2*x) - 44*cos(x) + 15)*cos(3*x) - 210*cos(3*x)^2 + 4*(4*cos(x) - 1)*cos(2*x) - 32*cos(2*x)^2 - 2*cos(x)^2 + (sin(7*x) - 4*sin(6*x) + 15*sin(5*x) - 40*sin(4*x) + 15*sin(3*x) - 4*sin(2*x) + sin(x))*sin(8*x) + 2*(8*sin(6*x) - 22*sin(5*x) + 55*sin(4*x) - 22*sin(3*x) + 8*sin(2*x) - 2*sin(x))*sin(7*x) - 2*sin(7*x)^2 + 8*(22*sin(5*x) - 55*sin(4*x) + 22*sin(3*x) - 8*sin(2*x) + 2*sin(x))*sin(6*x) - 32*sin(6*x)^2 + 2*(505*sin(4*x) - 210*sin(3*x) + 88*sin(2*x) - 22*sin(x))*sin(5*x) - 210*sin(5*x)^2 + 10*(101*sin(3*x) - 44*sin(2*x) + 11*sin(x))*sin(4*x) - 1200*sin(4*x)^2 + 44*(4*sin(2*x) - sin(x))*sin(3*x) - 210*sin(3*x)^2 - 32*sin(2*x)^2 + 16*sin(2*x)*sin(x) - 2*sin(x)^2 + cos(x))/(2*(2*cos(7*x) - 8*cos(6*x) + 14*cos(5*x) - 30*cos(4*x) + 14*cos(3*x) - 8*cos(2*x) + 2*cos(x) - 1)*cos(8*x) - cos(8*x)^2 + 4*(8*cos(6*x) - 14*cos(5*x) + 30*cos(4*x) - 14*cos(3*x) + 8*cos(2*x) - 2*cos(x) + 1)*cos(7*x) - 4*cos(7*x)^2 + 16*(14*cos(5*x) - 30*cos(4*x) + 14*cos(3*x) - 8*cos(2*x) + 2*cos(x) - 1)*cos(6*x) - 64*cos(6*x)^2 + 28*(30*cos(4*x) - 14*cos(3*x) + 8*cos(2*x) - 2*cos(x) + 1)*cos(5*x) - 196*cos(5*x)^2 + 60*(14*cos(3*x) - 8*cos(2*x) + 2*cos(x) - 1)*cos(4*x) - 900*cos(4*x)^2 + 28*(8*cos(2*x) - 2*cos(x) + 1)*cos(3*x) - 196*cos(3*x)^2 + 16*(2*cos(x) - 1)*cos(2*x) - 64*cos(2*x)^2 - 4*cos(x)^2 + 4*(sin(7*x) - 4*sin(6*x) + 7*sin(5*x) - 15*sin(4*x) + 7*sin(3*x) - 4*sin(2*x) + sin(x))*sin(8*x) - sin(8*x)^2 + 8*(4*sin(6*x) - 7*sin(5*x) + 15*sin(4*x) - 7*sin(3*x) + 4*sin(2*x) - sin(x))*sin(7*x) - 4*sin(7*x)^2 + 32*(7*sin(5*x) - 15*sin(4*x) + 7*sin(3*x) - 4*sin(2*x) + sin(x))*sin(6*x) - 64*sin(6*x)^2 + 56*(15*sin(4*x) - 7*sin(3*x) + 4*sin(2*x) - sin(x))*sin(5*x) - 196*sin(5*x)^2 + 120*(7*sin(3*x) - 4*sin(2*x) + sin(x))*sin(4*x) - 900*sin(4*x)^2 + 56*(4*sin(2*x) - sin(x))*sin(3*x) - 196*sin(3*x)^2 - 64*sin(2*x)^2 + 32*sin(2*x)*sin(x) - 4*sin(x)^2 + 4*cos(x) - 1), x) - 2*sin(x))/(cos(x)^2 + sin(x)^2 + 2*cos(x) + 1)`

**Fricas [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.



```
[In] integrate(1/(1+cos(x)^5),x, algorithm="fricas")
```

```
[Out] Timed out
```

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(1+cos(x)**5),x)
```

```
[Out] Timed out
```

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\cos(x)^5 + 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(1+cos(x)^5),x, algorithm="giac")
```

```
[Out] integrate(1/(cos(x)^5 + 1), x)
```

$$3.81 \quad \int \frac{1}{1+\cos^6(x)} dx$$

**Optimal.** Leaf size=83

$$\frac{\tan^{-1}\left(\frac{\tan(x)}{\sqrt{2}}\right)}{3\sqrt{2}} + \frac{\tan^{-1}\left(\frac{\tan(x)}{\sqrt{1-\sqrt[3]{-1}}}\right)}{3\sqrt{1-\sqrt[3]{-1}}} + \frac{\tan^{-1}\left(\frac{\tan(x)}{\sqrt{1+(-1)^{2/3}}}\right)}{3\sqrt{1+(-1)^{2/3}}}$$

[Out] ArcTan[Tan[x]/Sqrt[2]]/(3\*Sqrt[2]) + ArcTan[Tan[x]/Sqrt[1 - (-1)^(1/3)]]/(3\*Sqrt[1 - (-1)^(1/3)]) + ArcTan[Tan[x]/Sqrt[1 + (-1)^(2/3)]]/(3\*Sqrt[1 + (-1)^(2/3)])

**Rubi [A]** time = 0.104056, antiderivative size = 103, normalized size of antiderivative = 1.24, number of steps used = 7, number of rules used = 3, integrand size = 8,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.375$ , Rules used = {3211, 3181, 203}

$$\frac{x}{3\sqrt{2}} - \frac{\tan^{-1}\left(\sqrt{1-\sqrt[3]{-1}} \cot(x)\right)}{3\sqrt{1-\sqrt[3]{-1}}} - \frac{\tan^{-1}\left(\sqrt{1+(-1)^{2/3}} \cot(x)\right)}{3\sqrt{1+(-1)^{2/3}}} - \frac{\tan^{-1}\left(\frac{\sin(x)\cos(x)}{\cos^2(x)+\sqrt{2}+1}\right)}{3\sqrt{2}}$$

Antiderivative was successfully verified.

[In] Int[(1 + Cos[x]^6)^(-1), x]

[Out] x/(3\*Sqrt[2]) - ArcTan[Sqrt[1 - (-1)^(1/3)]\*Cot[x]]/(3\*Sqrt[1 - (-1)^(1/3)]) - ArcTan[Sqrt[1 + (-1)^(2/3)]\*Cot[x]]/(3\*Sqrt[1 + (-1)^(2/3)]) - ArcTan[(Cos[x]\*Sin[x])/(1 + Sqrt[2] + Cos[x]^2)]/(3\*Sqrt[2])

#### Rule 3211

```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^(n_))^(k_)*Rt[-(a/b), n/2]), x], {k, 1, n/2}], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[n/2]
```

#### Rule 3181

```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^2)^(k_)*Rt[-(a/b), n/2]), x], {k, 1, n/2}], x] /; FreeQ[{a, b, e, f}, x]
```

#### Rule 203

```
Int[((a_) + (b_.)*(x_)^2)^(k_)*Rt[-(a/b), n/2]), x], {k, 1, n/2}], x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])
```

#### Rubi steps

$$\begin{aligned}
\int \frac{1}{1 + \cos^6(x)} dx &= \frac{1}{3} \int \frac{1}{1 + \cos^2(x)} dx + \frac{1}{3} \int \frac{1}{1 - \sqrt[3]{-1} \cos^2(x)} dx + \frac{1}{3} \int \frac{1}{1 + (-1)^{2/3} \cos^2(x)} dx \\
&= -\left(\frac{1}{3} \text{Subst}\left(\int \frac{1}{1 + 2x^2} dx, x, \cot(x)\right)\right) - \frac{1}{3} \text{Subst}\left(\int \frac{1}{1 + (1 - \sqrt[3]{-1})x^2} dx, x, \cot(x)\right) - \frac{1}{3} \text{Subst}\left(\int \frac{1}{1 + (-1)^{2/3}x^2} dx, x, \cot(x)\right) \\
&= \frac{x}{3\sqrt{2}} - \frac{\tan^{-1}\left(\sqrt{1 - \sqrt[3]{-1}} \cot(x)\right)}{3\sqrt{1 - \sqrt[3]{-1}}} - \frac{\tan^{-1}\left(\sqrt{1 + (-1)^{2/3}} \cot(x)\right)}{3\sqrt{1 + (-1)^{2/3}}} - \frac{\tan^{-1}\left(\frac{\cos(x)\sin(x)}{1 + \sqrt{2} + \cos^2(x)}\right)}{3\sqrt{2}}
\end{aligned}$$

**Mathematica [A]** time = 0.160343, size = 79, normalized size = 0.95

$$\frac{1}{12} \left( -2\sqrt{3} \tan^{-1}\left(\frac{1 - 2 \tan(x)}{\sqrt{3}}\right) + 2\sqrt{2} \tan^{-1}\left(\frac{\tan(x)}{\sqrt{2}}\right) + 2\sqrt{3} \tan^{-1}\left(\frac{2 \tan(x) + 1}{\sqrt{3}}\right) + \log(2 - \sin(2x)) - \log(\sin(2x)) \right)$$

Antiderivative was successfully verified.

[In] Integrate[(1 + Cos[x]^6)^(-1), x]

[Out] (-2\*Sqrt[3]\*ArcTan[(1 - 2\*Tan[x])/Sqrt[3]] + 2\*Sqrt[2]\*ArcTan[Tan[x]/Sqrt[2]] + 2\*Sqrt[3]\*ArcTan[(1 + 2\*Tan[x])/Sqrt[3]] + Log[2 - Sin[2\*x]] - Log[2 + Sin[2\*x]])/12

**Maple [A]** time = 0.02, size = 73, normalized size = 0.9

$$\frac{\ln((\tan(x))^2 - \tan(x) + 1)}{12} + \frac{\sqrt{3}}{6} \arctan\left(\frac{(2 \tan(x) - 1)\sqrt{3}}{3}\right) - \frac{\ln((\tan(x))^2 + \tan(x) + 1)}{12} + \frac{\sqrt{3}}{6} \arctan\left(\frac{(2 \tan(x) + 1)\sqrt{3}}{3}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1+cos(x)^6), x)

[Out] 1/12\*ln(tan(x)^2-tan(x)+1)+1/6\*3^(1/2)\*arctan(1/3\*(2\*tan(x)-1)\*3^(1/2))-1/12\*ln(tan(x)^2+tan(x)+1)+1/6\*3^(1/2)\*arctan(1/3\*(2\*tan(x)+1)\*3^(1/2))+1/6\*arctan(1/2\*tan(x)\*2^(1/2))\*2^(1/2)

**Maxima [A]** time = 1.43096, size = 97, normalized size = 1.17

$$\frac{1}{6} \sqrt{3} \arctan\left(\frac{1}{3} \sqrt{3}(2 \tan(x) + 1)\right) + \frac{1}{6} \sqrt{3} \arctan\left(\frac{1}{3} \sqrt{3}(2 \tan(x) - 1)\right) + \frac{1}{6} \sqrt{2} \arctan\left(\frac{1}{2} \sqrt{2} \tan(x)\right) - \frac{1}{12} \log(\tan(x)^2 + \tan(x) + 1)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^6), x, algorithm="maxima")

[Out] 1/6\*sqrt(3)\*arctan(1/3\*sqrt(3)\*(2\*tan(x) + 1)) + 1/6\*sqrt(3)\*arctan(1/3\*sqrt(3)\*(2\*tan(x) - 1)) + 1/6\*sqrt(2)\*arctan(1/2\*sqrt(2)\*tan(x)) - 1/12\*log(tan(x)^2 + tan(x) + 1)

**Fricas [B]** time = 1.67457, size = 463, normalized size = 5.58

$$\frac{1}{12} \sqrt{3} \arctan\left(\frac{4\sqrt{3}\cos(x)\sin(x) + \sqrt{3}}{3(2\cos(x)^2 - 1)}\right) + \frac{1}{12} \sqrt{3} \arctan\left(\frac{4\sqrt{3}\cos(x)\sin(x) - \sqrt{3}}{3(2\cos(x)^2 - 1)}\right) - \frac{1}{12} \sqrt{2} \arctan\left(\frac{3\sqrt{2}\cos(x)^2 - \sqrt{2}}{4\cos(x)\sin(x)}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^6),x, algorithm="fricas")

[Out] 1/12\*sqrt(3)\*arctan(1/3\*(4\*sqrt(3)\*cos(x)\*sin(x) + sqrt(3))/(2\*cos(x)^2 - 1)) + 1/12\*sqrt(3)\*arctan(1/3\*(4\*sqrt(3)\*cos(x)\*sin(x) - sqrt(3))/(2\*cos(x)^2 - 1)) - 1/12\*sqrt(2)\*arctan(1/4\*(3\*sqrt(2)\*cos(x)^2 - sqrt(2))/(cos(x)\*sin(x))) - 1/24\*log(-cos(x)^4 + cos(x)^2 + 2\*cos(x)\*sin(x) + 1) + 1/24\*log(-cos(x)^4 + cos(x)^2 - 2\*cos(x)\*sin(x) + 1)

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)\*\*6),x)

[Out] Timed out

**Giac [B]** time = 1.172, size = 250, normalized size = 3.01

$$\frac{1}{6} \sqrt{3} \left( x + \arctan\left(-\frac{\sqrt{3}\sin(2x) + \cos(2x) - 2\sin(2x) + 1}{\sqrt{3}\cos(2x) + \sqrt{3} - 2\cos(2x) - \sin(2x) + 2}\right) \right) + \frac{1}{6} \sqrt{3} \left( x + \arctan\left(-\frac{\sqrt{3}\sin(2x) - \cos(2x) - 2\sin(2x) + 1}{\sqrt{3}\cos(2x) + \sqrt{3} - 2\cos(2x) - \sin(2x) + 2}\right) \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^6),x, algorithm="giac")

[Out] 1/6\*sqrt(3)\*(x + arctan(-(sqrt(3)\*sin(2\*x) + cos(2\*x) - 2\*sin(2\*x) + 1)/(sqrt(3)\*cos(2\*x) + sqrt(3) - 2\*cos(2\*x) - sin(2\*x) + 2))) + 1/6\*sqrt(3)\*(x + arctan(-(sqrt(3)\*sin(2\*x) - cos(2\*x) - 2\*sin(2\*x) + 1)/(sqrt(3)\*cos(2\*x) + sqrt(3) - 2\*cos(2\*x) + sin(2\*x) + 2))) + 1/6\*sqrt(2)\*(x + arctan(-(sqrt(2)\*sin(2\*x) - sin(2\*x))/(sqrt(2)\*cos(2\*x) + sqrt(2) - cos(2\*x) + 1))) - 1/12\*log(tan(x)^2 + tan(x) + 1) + 1/12\*log(tan(x)^2 - tan(x) + 1)

$$3.82 \quad \int \frac{1}{1+\cos^8(x)} dx$$

**Optimal.** Leaf size=129

$$\frac{\tan^{-1}\left(\sqrt{1-\sqrt[4]{-1}}\cot(x)\right)}{4\sqrt{1-\sqrt[4]{-1}}}-\frac{\tan^{-1}\left(\sqrt{1+\sqrt[4]{-1}}\cot(x)\right)}{4\sqrt{1+\sqrt[4]{-1}}}-\frac{\tan^{-1}\left(\sqrt{1-(-1)^{3/4}}\cot(x)\right)}{4\sqrt{1-(-1)^{3/4}}}-\frac{\tan^{-1}\left(\sqrt{1+(-1)^{3/4}}\cot(x)\right)}{4\sqrt{1+(-1)^{3/4}}}$$

[Out] -ArcTan[Sqrt[1 - (-1)^(1/4)]\*Cot[x]]/(4\*Sqrt[1 - (-1)^(1/4)]) - ArcTan[Sqrt[1 + (-1)^(1/4)]\*Cot[x]]/(4\*Sqrt[1 + (-1)^(1/4)]) - ArcTan[Sqrt[1 - (-1)^(3/4)]\*Cot[x]]/(4\*Sqrt[1 - (-1)^(3/4)]) - ArcTan[Sqrt[1 + (-1)^(3/4)]\*Cot[x]]/(4\*Sqrt[1 + (-1)^(3/4)])

**Rubi [A]** time = 0.179787, antiderivative size = 129, normalized size of antiderivative = 1., number of steps used = 9, number of rules used = 3, integrand size = 8,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.375$ , Rules used = {3211, 3181, 203}

$$\frac{\tan^{-1}\left(\sqrt{1-\sqrt[4]{-1}}\cot(x)\right)}{4\sqrt{1-\sqrt[4]{-1}}}-\frac{\tan^{-1}\left(\sqrt{1+\sqrt[4]{-1}}\cot(x)\right)}{4\sqrt{1+\sqrt[4]{-1}}}-\frac{\tan^{-1}\left(\sqrt{1-(-1)^{3/4}}\cot(x)\right)}{4\sqrt{1-(-1)^{3/4}}}-\frac{\tan^{-1}\left(\sqrt{1+(-1)^{3/4}}\cot(x)\right)}{4\sqrt{1+(-1)^{3/4}}}$$

Antiderivative was successfully verified.

[In] Int[(1 + Cos[x]^8)^(-1), x]

[Out] -ArcTan[Sqrt[1 - (-1)^(1/4)]\*Cot[x]]/(4\*Sqrt[1 - (-1)^(1/4)]) - ArcTan[Sqrt[1 + (-1)^(1/4)]\*Cot[x]]/(4\*Sqrt[1 + (-1)^(1/4)]) - ArcTan[Sqrt[1 - (-1)^(3/4)]\*Cot[x]]/(4\*Sqrt[1 - (-1)^(3/4)]) - ArcTan[Sqrt[1 + (-1)^(3/4)]\*Cot[x]]/(4\*Sqrt[1 + (-1)^(3/4)])

#### Rule 3211

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^(n\_))^(m\_), x\_Symbol] := Module[{k}, Dist[2/(a\*n), Sum[Int[1/(1 - Sin[e + f\*x]^2/((-1)^((4\*k)/n)\*Rt[-(a/b), n/2]), x], {k, 1, n/2}], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[n/2]

#### Rule 3181

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^(m\_), x\_Symbol] := With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x]

#### Rule 203

Int[((a\_) + (b\_)\*(x\_)^2)^(m\_), x\_Symbol] := Simp[(1\*ArcTan[(Rt[b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])

#### Rubi steps

$$\begin{aligned} \int \frac{1}{1 + \cos^8(x)} dx &= \frac{1}{4} \int \frac{1}{1 - \sqrt[4]{-1} \cos^2(x)} dx + \frac{1}{4} \int \frac{1}{1 + \sqrt[4]{-1} \cos^2(x)} dx + \frac{1}{4} \int \frac{1}{1 - (-1)^{3/4} \cos^2(x)} dx + \frac{1}{4} \int \frac{1}{1 + (-1)^{3/4} \cos^2(x)} dx \\ &= -\left(\frac{1}{4} \text{Subst}\left(\int \frac{1}{1 + (1 - \sqrt[4]{-1})x^2} dx, x, \cot(x)\right)\right) - \frac{1}{4} \text{Subst}\left(\int \frac{1}{1 + (1 + \sqrt[4]{-1})x^2} dx, x, \cot(x)\right) - \frac{1}{4} \text{Subst}\left(\int \frac{1}{1 - (-1)^{3/4}x^2} dx, x, \cot(x)\right) - \frac{1}{4} \text{Subst}\left(\int \frac{1}{1 + (-1)^{3/4}x^2} dx, x, \cot(x)\right) \\ &= -\frac{\tan^{-1}\left(\sqrt{1 - \sqrt[4]{-1}} \cot(x)\right)}{4\sqrt{1 - \sqrt[4]{-1}}} - \frac{\tan^{-1}\left(\sqrt{1 + \sqrt[4]{-1}} \cot(x)\right)}{4\sqrt{1 + \sqrt[4]{-1}}} - \frac{\tan^{-1}\left(\sqrt{1 - (-1)^{3/4}} \cot(x)\right)}{4\sqrt{1 - (-1)^{3/4}}} - \frac{\tan^{-1}\left(\sqrt{1 + (-1)^{3/4}} \cot(x)\right)}{4\sqrt{1 + (-1)^{3/4}}} \end{aligned}$$

**Mathematica [C]** time = 0.141773, size = 141, normalized size = 1.09

$$8\text{RootSum}\left[\#1^8 + 8\#1^7 + 28\#1^6 + 56\#1^5 + 326\#1^4 + 56\#1^3 + 28\#1^2 + 8\#1 + 1\&, \frac{2\#1^3 \tan^{-1}\left(\frac{\sin(2x)}{\cos(2x)-\#1}\right) - i\#1^3 \log(\#1)}{\#1^7 + 7\#1^6 + 21\#1^5 + 35\#1^4 + 163\#1^3 + 28\#1^2 + 8\#1 + 1}\right]$$

Antiderivative was successfully verified.

[In] Integrate[(1 + Cos[x]^8)^(-1), x]

[Out] 8\*RootSum[1 + 8\*#1 + 28\*#1^2 + 56\*#1^3 + 326\*#1^4 + 56\*#1^5 + 28\*#1^6 + 8\*#1^7 + #1^8 & , (2\*ArcTan[Sin[2\*x]/(Cos[2\*x] - #1)]\*#1^3 - I\*Log[1 - 2\*Cos[2\*x]\*#1 + #1^2]\*#1^3)/(1 + 7\*#1 + 21\*#1^2 + 163\*#1^3 + 35\*#1^4 + 21\*#1^5 + 7\*#1^6 + #1^7) & ]

**Maple [C]** time = 0.02, size = 67, normalized size = 0.5

$$\frac{1}{8} \sum_{_R=\text{RootOf}(_Z^8+4_Z^6+6_Z^4+4_Z^2+2)} \frac{(_R^6 + 3_R^4 + 3_R^2 + 1) \ln(\tan(x) - _R)}{-_R^7 + 3_R^5 + 3_R^3 + _R}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1+cos(x)^8), x)

[Out] 1/8\*sum((\_R^6+3\*\_R^4+3\*\_R^2+1)/(\_R^7+3\*\_R^5+3\*\_R^3+\_R)\*ln(tan(x)-\_R), \_R=RootOf(\_Z^8+4\*\_Z^6+6\*\_Z^4+4\*\_Z^2+2))

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{1}{\cos(x)^8 + 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1+cos(x)^8), x, algorithm="maxima")

[Out] integrate(1/(cos(x)^8 + 1), x)

**Fricas [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(1+cos(x)^8),x, algorithm="fricas")
```

```
[Out] Timed out
```

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(1+cos(x)**8),x)
```

```
[Out] Timed out
```

---

**Giac [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: TypeError

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(1+cos(x)^8),x, algorithm="giac")
```

```
[Out] Exception raised: TypeError
```

### 3.83 $\int \frac{1}{1-\cos^5(x)} dx$

**Optimal.** Leaf size=205

$$\frac{2 \tan^{-1}\left(\sqrt{\frac{1-\sqrt[5]{-1}}{1+\sqrt[5]{-1}}}\tan\left(\frac{x}{2}\right)\right)}{5\sqrt{1-(-1)^{2/5}}} + \frac{2 \tan^{-1}\left(\sqrt{\frac{1-(-1)^{3/5}}{1+(-1)^{3/5}}}\tan\left(\frac{x}{2}\right)\right)}{5\sqrt{1+\sqrt[5]{-1}}} - \frac{\sin(x)}{5(1-\cos(x))} - \frac{2 \tanh^{-1}\left(\frac{\tan\left(\frac{x}{2}\right)}{\sqrt{\frac{1-(-1)^{2/5}}{1+(-1)^{2/5}}}}\right)}{5\sqrt{(-1)^{4/5}-1}} + \frac{2 \tanh^{-1}\left(\sqrt{\frac{-1+(-1)^{4/5}}{-1-(-1)^{4/5}}}\right)}{5\sqrt{-1-(-1)^{4/5}}}$$

[Out] (2\*ArcTan[Sqrt[(1 - (-1)^(1/5))/(1 + (-1)^(1/5))]\*Tan[x/2]])/(5\*Sqrt[1 - (-1)^(2/5)]) + (2\*ArcTan[Sqrt[(1 - (-1)^(3/5))/(1 + (-1)^(3/5))]\*Tan[x/2]])/(5\*Sqrt[1 + (-1)^(1/5)]) - (2\*ArcTanh[Tan[x/2]/Sqrt[-((1 - (-1)^(2/5))/(1 + (-1)^(2/5))]])/(5\*Sqrt[-1 + (-1)^(4/5)]) + (2\*ArcTanh[Sqrt[-((1 + (-1)^(4/5))/(1 - (-1)^(4/5)))]\*Tan[x/2]])/(5\*Sqrt[-1 - (-1)^(3/5)]) - Sin[x]/(5\*(1 - Cos[x]))

**Rubi [A]** time = 0.473475, antiderivative size = 205, normalized size of antiderivative = 1., number of steps used = 11, number of rules used = 5, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.5$ , Rules used = {3213, 2648, 2659, 205, 208}

$$\frac{2 \tan^{-1}\left(\sqrt{\frac{1-\sqrt[5]{-1}}{1+\sqrt[5]{-1}}}\tan\left(\frac{x}{2}\right)\right)}{5\sqrt{1-(-1)^{2/5}}} + \frac{2 \tan^{-1}\left(\sqrt{\frac{1-(-1)^{3/5}}{1+(-1)^{3/5}}}\tan\left(\frac{x}{2}\right)\right)}{5\sqrt{1+\sqrt[5]{-1}}} - \frac{\sin(x)}{5(1-\cos(x))} - \frac{2 \tanh^{-1}\left(\frac{\tan\left(\frac{x}{2}\right)}{\sqrt{\frac{1-(-1)^{2/5}}{1+(-1)^{2/5}}}}\right)}{5\sqrt{(-1)^{4/5}-1}} + \frac{2 \tanh^{-1}\left(\sqrt{\frac{-1+(-1)^{4/5}}{-1-(-1)^{4/5}}}\right)}{5\sqrt{-1-(-1)^{4/5}}}$$

Antiderivative was successfully verified.

[In] Int[(1 - Cos[x]^5)^(-1), x]

[Out] (2\*ArcTan[Sqrt[(1 - (-1)^(1/5))/(1 + (-1)^(1/5))]\*Tan[x/2]])/(5\*Sqrt[1 - (-1)^(2/5)]) + (2\*ArcTan[Sqrt[(1 - (-1)^(3/5))/(1 + (-1)^(3/5))]\*Tan[x/2]])/(5\*Sqrt[1 + (-1)^(1/5)]) - (2\*ArcTanh[Tan[x/2]/Sqrt[-((1 - (-1)^(2/5))/(1 + (-1)^(2/5))]])/(5\*Sqrt[-1 + (-1)^(4/5)]) + (2\*ArcTanh[Sqrt[-((1 + (-1)^(4/5))/(1 - (-1)^(4/5)))]\*Tan[x/2]])/(5\*Sqrt[-1 - (-1)^(3/5)]) - Sin[x]/(5\*(1 - Cos[x]))

#### Rule 3213

Int[((a\_) + (b\_.)\*((c\_.)\*sin[(e\_.) + (f\_.)\*(x\_)])^(n\_))^(p\_), x\_Symbol] :> Int[ExpandTrig[(a + b\*(c\*sin[e + f\*x])^n)^p, x], x] /; FreeQ[{a, b, c, e, f, n}, x] && (IGtQ[p, 0] || (EqQ[p, -1] && IntegerQ[n]))

#### Rule 2648

Int[((a\_) + (b\_.)\*sin[(c\_.) + (d\_.)\*(x\_)])^(-1), x\_Symbol] :> -Simp[Cos[c + d\*x]/(d\*(b + a\*SIN[c + d\*x])), x] /; FreeQ[{a, b, c, d}, x] && EqQ[a^2 - b^2, 0]

#### Rule 2659

Int[((a\_) + (b\_.)\*sin[Pi/2 + (c\_.) + (d\_.)\*(x\_)])^(-1), x\_Symbol] :> With[{e = FreeFactors[Tan[(c + d\*x)/2], x]}, Dist[(2\*e)/d, Subst[Int[1/(a + b + (a - b)\*e^2\*x^2), x], x, Tan[(c + d\*x)/2]/e], x] /; FreeQ[{a, b, c, d}, x] && NeQ[a^2 - b^2, 0]



**Rule 205**

$\text{Int}[(a_ + (b_ \cdot)(x_ )^2)^{-1}, x\_Symbol] \rightarrow \text{Simp}[(\text{Rt}[a/b, 2] \cdot \text{ArcTan}[x/\text{Rt}[a/b, 2]])/a, x] /; \text{FreeQ}\{a, b, x\} \ \&\& \ \text{PosQ}[a/b]$

**Rule 208**

$\text{Int}[(a_ + (b_ \cdot)(x_ )^2)^{-1}, x\_Symbol] \rightarrow \text{Simp}[(\text{Rt}[-(a/b), 2] \cdot \text{ArcTanh}[x/\text{Rt}[-(a/b), 2]])/a, x] /; \text{FreeQ}\{a, b, x\} \ \&\& \ \text{NegQ}[a/b]$

**Rubi steps**

$$\begin{aligned} \int \frac{1}{1 - \cos^5(x)} dx &= \int \left( \frac{1}{5(1 - \cos(x))} + \frac{1}{5(1 + \sqrt[5]{-1} \cos(x))} + \frac{1}{5(1 - (-1)^{2/5} \cos(x))} + \frac{1}{5(1 + (-1)^{3/5} \cos(x))} + \frac{1}{5(1 - (-1)^{4/5} \cos(x))} \right) dx \\ &= \frac{1}{5} \int \frac{1}{1 - \cos(x)} dx + \frac{1}{5} \int \frac{1}{1 + \sqrt[5]{-1} \cos(x)} dx + \frac{1}{5} \int \frac{1}{1 - (-1)^{2/5} \cos(x)} dx + \frac{1}{5} \int \frac{1}{1 + (-1)^{3/5} \cos(x)} dx + \frac{1}{5} \int \frac{1}{1 - (-1)^{4/5} \cos(x)} dx \\ &= -\frac{\sin(x)}{5(1 - \cos(x))} + \frac{2}{5} \text{Subst} \left( \int \frac{1}{1 + \sqrt[5]{-1} + (1 - \sqrt[5]{-1})x^2} dx, x, \tan\left(\frac{x}{2}\right) \right) + \frac{2}{5} \text{Subst} \left( \int \frac{1}{1 - (-1)^{2/5} + (-1 - (-1)^{2/5})x^2} dx, x, \tan\left(\frac{x}{2}\right) \right) \\ &= \frac{2 \tan^{-1} \left( \sqrt{\frac{1 - \sqrt[5]{-1}}{1 + \sqrt[5]{-1}}} \tan\left(\frac{x}{2}\right) \right)}{5\sqrt{1 - (-1)^{2/5}}} + \frac{2 \tan^{-1} \left( \sqrt{\frac{1 - (-1)^{3/5}}{1 + (-1)^{3/5}}} \tan\left(\frac{x}{2}\right) \right)}{5\sqrt{1 + \sqrt[5]{-1}}} - \frac{2 \tanh^{-1} \left( \frac{\tan\left(\frac{x}{2}\right)}{\sqrt{\frac{1 - (-1)^{2/5}}{1 + (-1)^{2/5}}}} \right)}{5\sqrt{-1 + (-1)^{4/5}}} + \frac{2 \tanh^{-1} \left( \frac{\tan\left(\frac{x}{2}\right)}{\sqrt{\frac{1 - (-1)^{4/5}}{1 + (-1)^{4/5}}}} \right)}{5\sqrt{-1 + (-1)^{4/5}}} \end{aligned}$$

**Mathematica [C]** time = 0.119013, size = 378, normalized size = 1.84

$$-\frac{1}{5} \cot\left(\frac{x}{2}\right) + \frac{1}{10} \text{RootSum} \left[ \#1^8 + 2\#1^7 + 8\#1^6 + 14\#1^5 + 30\#1^4 + 14\#1^3 + 8\#1^2 + 2\#1 + 1 \&, \frac{-i\#1^6 \log(\#1^2 - 2\#1 + 1)}{\#1^8 + 2\#1^7 + 8\#1^6 + 14\#1^5 + 30\#1^4 + 14\#1^3 + 8\#1^2 + 2\#1 + 1} \right]$$

Antiderivative was successfully verified.

[In] Integrate[(1 - Cos[x]^5)^(-1), x]

[Out]  $-\text{Cot}[x/2]/5 + \text{RootSum}[1 + 2\#1 + 8\#1^2 + 14\#1^3 + 30\#1^4 + 14\#1^5 + 8\#1^6 + 2\#1^7 + \#1^8 \ \& \ , (2\text{ArcTan}[\text{Sin}[x]/(\text{Cos}[x] - \#1)] - \text{I}\text{Log}[1 - 2\text{Cos}[x]\#1 + \#1^2] + 8\text{ArcTan}[\text{Sin}[x]/(\text{Cos}[x] - \#1)]\#1 - (4\text{I})\text{Log}[1 - 2\text{Cos}[x]\#1 + \#1^2]\#1 + 30\text{ArcTan}[\text{Sin}[x]/(\text{Cos}[x] - \#1)]\#1^2 - (15\text{I})\text{Log}[1 - 2\text{Cos}[x]\#1 + \#1^2]\#1^2 + 80\text{ArcTan}[\text{Sin}[x]/(\text{Cos}[x] - \#1)]\#1^3 - (40\text{I})\text{Log}[1 - 2\text{Cos}[x]\#1 + \#1^2]\#1^3 + 30\text{ArcTan}[\text{Sin}[x]/(\text{Cos}[x] - \#1)]\#1^4 - (15\text{I})\text{Log}[1 - 2\text{Cos}[x]\#1 + \#1^2]\#1^4 + 8\text{ArcTan}[\text{Sin}[x]/(\text{Cos}[x] - \#1)]\#1^5 - (4\text{I})\text{Log}[1 - 2\text{Cos}[x]\#1 + \#1^2]\#1^5 + 2\text{ArcTan}[\text{Sin}[x]/(\text{Cos}[x] - \#1)]\#1^6 - \text{I}\text{Log}[1 - 2\text{Cos}[x]\#1 + \#1^2]\#1^6)/(1 + 8\#1 + 21\#1^2 + 60\#1^3 + 35\#1^4 + 24\#1^5 + 7\#1^6 + 4\#1^7) \ \& \ ]/10$

**Maple [C]** time = 0.02, size = 62, normalized size = 0.3

$$-\frac{1}{5} \left( \tan\left(\frac{x}{2}\right) \right)^{-1} + \frac{1}{10} \sum_{\text{R}=\text{RootOf}(-Z^8+10-Z^4+5)} \frac{-\text{R}^6 + 5\text{R}^4 + 5\text{R}^2 + 5}{-\text{R}^7 + 5\text{R}^3} \ln\left(\tan\left(\frac{x}{2}\right) - \text{R}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1-cos(x)^5),x)

[Out]  $-1/5/\tan(1/2*x)+1/10*\text{sum}((\_R^6+5*\_R^4+5*\_R^2+5)/(\_R^7+5*\_R^3)*\ln(\tan(1/2*x)-\_R), \_R=\text{RootOf}(\_Z^8+10*\_Z^4+5))$

**Maxima [F]** time = 0., size = 0, normalized size = 0.

result too large to display

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^5),x, algorithm="maxima")

[Out]  $1/5*(5*(\cos(x)^2 + \sin(x)^2 - 2*\cos(x) + 1)*\text{integrate}(2/5*((\cos(7*x) + 4*\cos(6*x) + 15*\cos(5*x) + 40*\cos(4*x) + 15*\cos(3*x) + 4*\cos(2*x) + \cos(x))*\cos(8*x) + (16*\cos(6*x) + 44*\cos(5*x) + 110*\cos(4*x) + 44*\cos(3*x) + 16*\cos(2*x) + 4*\cos(x) + 1)*\cos(7*x) + 2*\cos(7*x)^2 + 4*(44*\cos(5*x) + 110*\cos(4*x) + 44*\cos(3*x) + 16*\cos(2*x) + 4*\cos(x) + 1)*\cos(6*x) + 32*\cos(6*x)^2 + (1010*\cos(4*x) + 420*\cos(3*x) + 176*\cos(2*x) + 44*\cos(x) + 15)*\cos(5*x) + 210*\cos(5*x)^2 + 10*(101*\cos(3*x) + 44*\cos(2*x) + 11*\cos(x) + 4)*\cos(4*x) + 1200*\cos(4*x)^2 + (176*\cos(2*x) + 44*\cos(x) + 15)*\cos(3*x) + 210*\cos(3*x)^2 + 4*(4*\cos(x) + 1)*\cos(2*x) + 32*\cos(2*x)^2 + 2*\cos(x)^2 + (\sin(7*x) + 4*\sin(6*x) + 15*\sin(5*x) + 40*\sin(4*x) + 15*\sin(3*x) + 4*\sin(2*x) + \sin(x))*\sin(8*x) + 2*(8*\sin(6*x) + 22*\sin(5*x) + 55*\sin(4*x) + 22*\sin(3*x) + 8*\sin(2*x) + 2*\sin(x))*\sin(7*x) + 2*\sin(7*x)^2 + 8*(22*\sin(5*x) + 55*\sin(4*x) + 22*\sin(3*x) + 8*\sin(2*x) + 2*\sin(x))*\sin(6*x) + 32*\sin(6*x)^2 + 2*(505*\sin(4*x) + 210*\sin(3*x) + 88*\sin(2*x) + 22*\sin(x))*\sin(5*x) + 210*\sin(5*x)^2 + 10*(101*\sin(3*x) + 44*\sin(2*x) + 11*\sin(x))*\sin(4*x) + 1200*\sin(4*x)^2 + 44*(4*\sin(2*x) + \sin(x))*\sin(3*x) + 210*\sin(3*x)^2 + 32*\sin(2*x)^2 + 16*\sin(2*x)*\sin(x) + 2*\sin(x)^2 + \cos(x))/(2*(2*\cos(7*x) + 8*\cos(6*x) + 14*\cos(5*x) + 30*\cos(4*x) + 14*\cos(3*x) + 8*\cos(2*x) + 2*\cos(x) + 1)*\cos(8*x) + \cos(8*x)^2 + 4*(8*\cos(6*x) + 14*\cos(5*x) + 30*\cos(4*x) + 14*\cos(3*x) + 8*\cos(2*x) + 2*\cos(x) + 1)*\cos(7*x) + 4*\cos(7*x)^2 + 16*(14*\cos(5*x) + 30*\cos(4*x) + 14*\cos(3*x) + 8*\cos(2*x) + 2*\cos(x) + 1)*\cos(6*x) + 64*\cos(6*x)^2 + 28*(30*\cos(4*x) + 14*\cos(3*x) + 8*\cos(2*x) + 2*\cos(x) + 1)*\cos(5*x) + 196*\cos(5*x)^2 + 60*(14*\cos(3*x) + 8*\cos(2*x) + 2*\cos(x) + 1)*\cos(4*x) + 900*\cos(4*x)^2 + 28*(8*\cos(2*x) + 2*\cos(x) + 1)*\cos(3*x) + 196*\cos(3*x)^2 + 16*(2*\cos(x) + 1)*\cos(2*x) + 64*\cos(2*x)^2 + 4*\cos(x)^2 + 4*(\sin(7*x) + 4*\sin(6*x) + 7*\sin(5*x) + 15*\sin(4*x) + 7*\sin(3*x) + 4*\sin(2*x) + \sin(x))*\sin(8*x) + \sin(8*x)^2 + 8*(4*\sin(6*x) + 7*\sin(5*x) + 15*\sin(4*x) + 7*\sin(3*x) + 4*\sin(2*x) + \sin(x))*\sin(7*x) + 4*\sin(7*x)^2 + 32*(7*\sin(5*x) + 15*\sin(4*x) + 7*\sin(3*x) + 4*\sin(2*x) + \sin(x))*\sin(6*x) + 64*\sin(6*x)^2 + 56*(15*\sin(4*x) + 7*\sin(3*x) + 4*\sin(2*x) + \sin(x))*\sin(5*x) + 196*\sin(5*x)^2 + 120*(7*\sin(3*x) + 4*\sin(2*x) + \sin(x))*\sin(4*x) + 900*\sin(4*x)^2 + 56*(4*\sin(2*x) + \sin(x))*\sin(3*x) + 196*\sin(3*x)^2 + 64*\sin(2*x)^2 + 32*\sin(2*x)*\sin(x) + 4*\sin(x)^2 + 4*\cos(x) + 1), x) - 2*\sin(x))/(\cos(x)^2 + \sin(x)^2 - 2*\cos(x) + 1)$

**Fricas [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^5),x, algorithm="fricas")

[Out] Timed out

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)\*\*5),x)

[Out] Timed out

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int -\frac{1}{\cos(x)^5 - 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^5),x, algorithm="giac")

[Out] integrate(-1/(cos(x)^5 - 1), x)

$$3.84 \quad \int \frac{1}{1-\cos^6(x)} dx$$

**Optimal.** Leaf size=71

$$\frac{\cot(x)}{3} - \frac{\tan^{-1}\left(\sqrt{1+\sqrt[3]{-1}}\cot(x)\right)}{3\sqrt{1+\sqrt[3]{-1}}} - \frac{\tan^{-1}\left(\sqrt{1-(-1)^{2/3}}\cot(x)\right)}{3\sqrt{1-(-1)^{2/3}}}$$

[Out] -ArcTan[Sqrt[1 + (-1)^(1/3)]\*Cot[x]]/(3\*Sqrt[1 + (-1)^(1/3)]) - ArcTan[Sqrt[1 - (-1)^(2/3)]\*Cot[x]]/(3\*Sqrt[1 - (-1)^(2/3)]) - Cot[x]/3

**Rubi [A]** time = 0.118622, antiderivative size = 71, normalized size of antiderivative = 1., number of steps used = 8, number of rules used = 6, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.6$ , Rules used = {3211, 3181, 203, 3175, 3767, 8}

$$\frac{\cot(x)}{3} - \frac{\tan^{-1}\left(\sqrt{1+\sqrt[3]{-1}}\cot(x)\right)}{3\sqrt{1+\sqrt[3]{-1}}} - \frac{\tan^{-1}\left(\sqrt{1-(-1)^{2/3}}\cot(x)\right)}{3\sqrt{1-(-1)^{2/3}}}$$

Antiderivative was successfully verified.

[In] Int[(1 - Cos[x]^6)^(-1), x]

[Out] -ArcTan[Sqrt[1 + (-1)^(1/3)]\*Cot[x]]/(3\*Sqrt[1 + (-1)^(1/3)]) - ArcTan[Sqrt[1 - (-1)^(2/3)]\*Cot[x]]/(3\*Sqrt[1 - (-1)^(2/3)]) - Cot[x]/3

#### Rule 3211

```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^(n_))^(m_), x_Symbol] := Module[{k}, Dist[2/(a*n), Sum[Int[1/(1 - Sin[e + f*x]^2/((-1)^((4*k)/n)*Rt[-(a/b), n/2])), x], {k, 1, n/2}], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[n/2]
```

#### Rule 3181

```
Int[((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^2)^(m_), x_Symbol] := With[{ff = FreeFactors[Tan[e + f*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)*ff^2*x^2), x], x, Tan[e + f*x]/ff], x] /; FreeQ[{a, b, e, f}, x]
```

#### Rule 203

```
Int[((a_) + (b_.)*(x_)^2)^(m_), x_Symbol] := Simp[(1*ArcTan[(Rt[b, 2]*x)/Rt[a, 2]])/(Rt[a, 2]*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])
```

#### Rule 3175

```
Int[(u_.)*((a_) + (b_.)*sin[(e_.) + (f_.)*(x_)]^2)^(p_), x_Symbol] := Dist[a^p, Int[ActivateTrig[u*cos[e + f*x]^(2*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]
```

#### Rule 3767

```
Int[csc[(c_.) + (d_.)*(x_)]^(n_), x_Symbol] := -Dist[d^(-1), Subst[Int[ExpandIntegrand[(1 + x^2)^(n/2 - 1), x], x], x, Cot[c + d*x]], x] /; FreeQ[{c,
```

d}, x] && IGtQ[n/2, 0]

### Rule 8

Int[a\_, x\_Symbol] := Simp[a\*x, x] /; FreeQ[a, x]

### Rubi steps

$$\begin{aligned} \int \frac{1}{1 - \cos^6(x)} dx &= \frac{1}{3} \int \frac{1}{1 - \cos^2(x)} dx + \frac{1}{3} \int \frac{1}{1 + \sqrt[3]{-1} \cos^2(x)} dx + \frac{1}{3} \int \frac{1}{1 - (-1)^{2/3} \cos^2(x)} dx \\ &= \frac{1}{3} \int \csc^2(x) dx - \frac{1}{3} \operatorname{Subst} \left( \int \frac{1}{1 + (1 + \sqrt[3]{-1}) x^2} dx, x, \cot(x) \right) - \frac{1}{3} \operatorname{Subst} \left( \int \frac{1}{1 + (1 - (-1)^{2/3}) x^2} dx, x, \cot(x) \right) \\ &= -\frac{\tan^{-1} \left( \sqrt{1 + \sqrt[3]{-1}} \cot(x) \right)}{3\sqrt{1 + \sqrt[3]{-1}}} - \frac{\tan^{-1} \left( \sqrt{1 - (-1)^{2/3}} \cot(x) \right)}{3\sqrt{1 - (-1)^{2/3}}} - \frac{1}{3} \operatorname{Subst} \left( \int 1 dx, x, \cot(x) \right) \\ &= -\frac{\tan^{-1} \left( \sqrt{1 + \sqrt[3]{-1}} \cot(x) \right)}{3\sqrt{1 + \sqrt[3]{-1}}} - \frac{\tan^{-1} \left( \sqrt{1 - (-1)^{2/3}} \cot(x) \right)}{3\sqrt{1 - (-1)^{2/3}}} - \frac{\cot(x)}{3} \end{aligned}$$

**Mathematica [C]** time = 0.264715, size = 117, normalized size = 1.65

$$\frac{\sin(x)(8 \cos(2x) + \cos(4x) + 15) \left( 6 \cos(x) + i\sqrt[4]{-3}(\sqrt{3} + 3i) \sin(x) \tan^{-1} \left( \frac{1}{2} \sqrt[4]{-\frac{1}{3}} (\sqrt{3} - i) \tan(x) \right) + \sqrt[4]{-3}(\sqrt{3} - 3i) \sin(x) \right)}{144(\cos^6(x) - 1)}$$

Antiderivative was successfully verified.

[In] Integrate[(1 - Cos[x]^6)^(-1), x]

[Out] ((15 + 8\*Cos[2\*x] + Cos[4\*x])\*Sin[x]\*(6\*Cos[x] + I\*(-3)^(1/4)\*(3\*I + Sqrt[3]))\*ArcTan[(-1/3)^(1/4)\*(-I + Sqrt[3])\*Tan[x])/2]\*Sin[x] + (-3)^(1/4)\*(-3\*I + Sqrt[3])\*ArcTan[(-1)^(3/4)\*(I + Sqrt[3])\*Tan[x]/(2\*3^(1/4))]\*Sin[x]))/(144\*(-1 + Cos[x]^6))

**Maple [B]** time = 0.092, size = 233, normalized size = 3.3

$$\frac{1}{3 \tan(x)} - \frac{\sqrt{3} \sqrt{2\sqrt{3}-3} \ln \left( (\tan(x))^2 + \tan(x) \sqrt{2\sqrt{3}-3} + \sqrt{3} \right)}{36} + \frac{1}{3\sqrt{2\sqrt{3}+3}} \arctan \left( \frac{2 \tan(x) + \sqrt{2\sqrt{3}-3}}{\sqrt{2\sqrt{3}+3}} \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1-cos(x)^6), x)

[Out] -1/3/tan(x)-1/36\*3^(1/2)\*(2\*3^(1/2)-3)^(1/2)\*ln(tan(x)^2+tan(x)\*(2\*3^(1/2)-3)^(1/2)+3^(1/2))+1/3/(2\*3^(1/2)+3)^(1/2)\*arctan((2\*tan(x)+(2\*3^(1/2)-3)^(1/2))/(2\*3^(1/2)+3)^(1/2))+1/6/(2\*3^(1/2)+3)^(1/2)\*arctan((2\*tan(x)+(2\*3^(1/2)-3)^(1/2))/(2\*3^(1/2)+3)^(1/2))\*3^(1/2)+1/36\*3^(1/2)\*(2\*3^(1/2)-3)^(1/2)\*ln(tan(x)^2-tan(x)\*(2\*3^(1/2)-3)^(1/2)+3^(1/2))+1/3/(2\*3^(1/2)+3)^(1/2)\*arctan((2\*tan(x)-(2\*3^(1/2)-3)^(1/2))/(2\*3^(1/2)+3)^(1/2))+1/6/(2\*3^(1/2)+3)^(1/2)\*arctan((2\*tan(x)-(2\*3^(1/2)-3)^(1/2))/(2\*3^(1/2)+3)^(1/2))

$$\frac{1}{2} \arctan\left(\frac{(2 \tan(x) - (2 \cdot 3^{1/2} - 3)^{1/2})}{(2 \cdot 3^{1/2} + 3)^{1/2}}\right) \cdot 3^{1/2}$$

**Maxima [F]** time = 0., size = 0, normalized size = 0.

result too large to display

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^6),x, algorithm="maxima")

[Out]  $\frac{1}{3} \cdot (3 \cdot (\cos(2x)^2 + \sin(2x)^2 - 2 \cos(2x) + 1) \cdot \text{integrate}(1/3 \cdot ((\cos(3x) + 4 \cos(2x) + \cos(x)) \cos(4x) + (14 \cos(2x) + 4 \cos(x) + 1) \cos(3x) + 2 \cos(3x)^2 + 2 \cdot (7 \cos(x) + 2) \cos(2x) + 24 \cos(2x)^2 + 2 \cos(x)^2 + (\sin(3x) + 4 \sin(2x) + \sin(x)) \sin(4x) + 2 \cdot (7 \sin(2x) + 2 \sin(x)) \sin(3x) + 2 \sin(3x)^2 + 24 \sin(2x)^2 + 14 \sin(2x) \sin(x) + 2 \sin(x)^2 + \cos(x)) / (2 \cdot (2 \cos(3x) + 6 \cos(2x) + 2 \cos(x) + 1) \cos(4x) + \cos(4x)^2 + 4 \cdot (6 \cos(2x) + 2 \cos(x) + 1) \cos(3x) + 4 \cos(3x)^2 + 12 \cdot (2 \cos(x) + 1) \cos(2x) + 36 \cos(2x)^2 + 4 \cos(x)^2 + 4 \cdot (\sin(3x) + 3 \sin(2x) + \sin(x)) \sin(4x) + \sin(4x)^2 + 8 \cdot (3 \sin(2x) + \sin(x)) \sin(3x) + 4 \sin(3x)^2 + 36 \sin(2x)^2 + 24 \sin(2x) \sin(x) + 4 \sin(x)^2 + 4 \cos(x) + 1), x) - 3 \cdot (\cos(2x)^2 + \sin(2x)^2 - 2 \cos(2x) + 1) \cdot \text{integrate}(-1/3 \cdot ((\cos(3x) - 4 \cos(2x) + \cos(x)) \cos(4x) + (14 \cos(2x) - 4 \cos(x) + 1) \cos(3x) - 2 \cos(3x)^2 + 2 \cdot (7 \cos(x) - 2) \cos(2x) - 24 \cos(2x)^2 - 2 \cos(x)^2 + (\sin(3x) - 4 \sin(2x) + \sin(x)) \sin(4x) + 2 \cdot (7 \sin(2x) - 2 \sin(x)) \sin(3x) - 2 \sin(3x)^2 - 2 \cdot 4 \sin(2x)^2 + 14 \sin(2x) \sin(x) - 2 \sin(x)^2 + \cos(x)) / (2 \cdot (2 \cos(3x) - 6 \cos(2x) + 2 \cos(x) - 1) \cos(4x) - \cos(4x)^2 + 4 \cdot (6 \cos(2x) - 2 \cos(x) + 1) \cos(3x) - 4 \cos(3x)^2 + 12 \cdot (2 \cos(x) - 1) \cos(2x) - 36 \cos(2x)^2 - 4 \cos(x)^2 + 4 \cdot (\sin(3x) - 3 \sin(2x) + \sin(x)) \sin(4x) - \sin(4x)^2 + 8 \cdot (3 \sin(2x) - \sin(x)) \sin(3x) - 4 \sin(3x)^2 - 36 \sin(2x)^2 + 24 \sin(2x) \sin(x) - 4 \sin(x)^2 + 4 \cos(x) - 1), x) - 2 \sin(2x)) / (\cos(2x)^2 + \sin(2x)^2 - 2 \cos(2x) + 1)$

**Fricas [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^6),x, algorithm="fricas")

[Out] Timed out

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)\*\*6),x)

[Out] Timed out

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int -\frac{1}{\cos(x)^6 - 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(1/(1-cos(x)^6),x, algorithm="giac")
```

```
[Out] integrate(-1/(cos(x)^6 - 1), x)
```

### 3.85 $\int \frac{1}{1-\cos^8(x)} dx$

**Optimal.** Leaf size=89

$$\frac{x}{4\sqrt{2}} - \frac{\cot(x)}{4} - \frac{\tan^{-1}(\sqrt{1-i}\cot(x))}{4\sqrt{1-i}} - \frac{\tan^{-1}(\sqrt{1+i}\cot(x))}{4\sqrt{1+i}} - \frac{\tan^{-1}\left(\frac{\sin(x)\cos(x)}{\cos^2(x)+\sqrt{2}+1}\right)}{4\sqrt{2}}$$

[Out] x/(4\*Sqrt[2]) - ArcTan[Sqrt[1 - I]\*Cot[x]]/(4\*Sqrt[1 - I]) - ArcTan[Sqrt[1 + I]\*Cot[x]]/(4\*Sqrt[1 + I]) - ArcTan[(Cos[x]\*Sin[x])/(1 + Sqrt[2] + Cos[x]^2)]/(4\*Sqrt[2]) - Cot[x]/4

**Rubi [A]** time = 0.0773313, antiderivative size = 89, normalized size of antiderivative = 1., number of steps used = 10, number of rules used = 6, integrand size = 10,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.6$ , Rules used = {3211, 3181, 203, 3175, 3767, 8}

$$\frac{x}{4\sqrt{2}} - \frac{\cot(x)}{4} - \frac{\tan^{-1}(\sqrt{1-i}\cot(x))}{4\sqrt{1-i}} - \frac{\tan^{-1}(\sqrt{1+i}\cot(x))}{4\sqrt{1+i}} - \frac{\tan^{-1}\left(\frac{\sin(x)\cos(x)}{\cos^2(x)+\sqrt{2}+1}\right)}{4\sqrt{2}}$$

Antiderivative was successfully verified.

[In] Int[(1 - Cos[x]^8)^(-1), x]

[Out] x/(4\*Sqrt[2]) - ArcTan[Sqrt[1 - I]\*Cot[x]]/(4\*Sqrt[1 - I]) - ArcTan[Sqrt[1 + I]\*Cot[x]]/(4\*Sqrt[1 + I]) - ArcTan[(Cos[x]\*Sin[x])/(1 + Sqrt[2] + Cos[x]^2)]/(4\*Sqrt[2]) - Cot[x]/4

#### Rule 3211

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^(n\_))^(p\_), x\_Symbol] := Module[{k}, Dist[2/(a\*n), Sum[Int[1/(1 - Sin[e + f\*x]^2/((-1)^((4\*k)/n)\*Rt[-(a/b), n/2])), x], {k, 1, n/2}], x] /; FreeQ[{a, b, e, f}, x] && IntegerQ[n/2]

#### Rule 3181

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^(p\_), x\_Symbol] := With[{ff = FreeFactors[Tan[e + f\*x], x]}, Dist[ff/f, Subst[Int[1/(a + (a + b)\*ff^2\*x^2), x], x, Tan[e + f\*x]/ff], x] /; FreeQ[{a, b, e, f}, x]

#### Rule 203

Int[((a\_) + (b\_)\*(x\_)^2)^(p\_), x\_Symbol] := Simp[(1\*ArcTan[(Rt[b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (GtQ[a, 0] || GtQ[b, 0])

#### Rule 3175

Int[(u\_)\*((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^(p\_), x\_Symbol] := Dist[a^p, Int[ActivateTrig[u\*cos[e + f\*x]^(2\*p)], x], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0] && IntegerQ[p]

#### Rule 3767

Int[csc[(c\_) + (d\_)\*(x\_)]^(n\_), x\_Symbol] := -Dist[d^(-1), Subst[Int[ExpandIntegrand[(1 + x^2)^(n/2 - 1), x], x], x, Cot[c + d\*x]], x] /; FreeQ[{c,



d}, x] && IGtQ[n/2, 0]

### Rule 8

Int[a\_, x\_Symbol] := Simp[a\*x, x] /; FreeQ[a, x]

### Rubi steps

$$\begin{aligned} \int \frac{1}{1 - \cos^8(x)} dx &= \frac{1}{4} \int \frac{1}{1 - \cos^2(x)} dx + \frac{1}{4} \int \frac{1}{1 - i \cos^2(x)} dx + \frac{1}{4} \int \frac{1}{1 + i \cos^2(x)} dx + \frac{1}{4} \int \frac{1}{1 + \cos^2(x)} dx \\ &= \frac{1}{4} \int \csc^2(x) dx - \frac{1}{4} \text{Subst} \left( \int \frac{1}{1 + (1 - i)x^2} dx, x, \cot(x) \right) - \frac{1}{4} \text{Subst} \left( \int \frac{1}{1 + (1 + i)x^2} dx, x, \cot(x) \right) \\ &= \frac{x}{4\sqrt{2}} - \frac{\tan^{-1}(\sqrt{1 - i} \cot(x))}{4\sqrt{1 - i}} - \frac{\tan^{-1}(\sqrt{1 + i} \cot(x))}{4\sqrt{1 + i}} - \frac{\tan^{-1}\left(\frac{\cos(x)\sin(x)}{1 + \sqrt{2} + \cos^2(x)}\right)}{4\sqrt{2}} - \frac{1}{4} \text{Subst} \left( \int 1 dx, \dots \right) \\ &= \frac{x}{4\sqrt{2}} - \frac{\tan^{-1}(\sqrt{1 - i} \cot(x))}{4\sqrt{1 - i}} - \frac{\tan^{-1}(\sqrt{1 + i} \cot(x))}{4\sqrt{1 + i}} - \frac{\tan^{-1}\left(\frac{\cos(x)\sin(x)}{1 + \sqrt{2} + \cos^2(x)}\right)}{4\sqrt{2}} - \frac{\cot(x)}{4} \end{aligned}$$

**Mathematica [A]** time = 0.144539, size = 64, normalized size = 0.72

$$\frac{1}{8} \left( \frac{2 \tan^{-1}\left(\frac{\tan(x)}{\sqrt{1 - i}}\right)}{\sqrt{1 - i}} + \frac{2 \tan^{-1}\left(\frac{\tan(x)}{\sqrt{1 + i}}\right)}{\sqrt{1 + i}} + \sqrt{2} \tan^{-1}\left(\frac{\tan(x)}{\sqrt{2}}\right) - 2 \cot(x) \right)$$

Antiderivative was successfully verified.

[In] Integrate[(1 - Cos[x]^8)^(-1), x]

[Out] ((2\*ArcTan[Tan[x]/Sqrt[1 - I]])/Sqrt[1 - I] + (2\*ArcTan[Tan[x]/Sqrt[1 + I]])/Sqrt[1 + I] + Sqrt[2]\*ArcTan[Tan[x]/Sqrt[2]] - 2\*Cot[x])/8

**Maple [B]** time = 0.034, size = 246, normalized size = 2.8

$$-\frac{1}{4 \tan(x)} + \frac{\sqrt{2} \sqrt{-2 + 2\sqrt{2}} \ln\left((\tan(x))^2 - \tan(x) \sqrt{-2 + 2\sqrt{2}} + \sqrt{2}\right)}{32} + \frac{\sqrt{2}}{8 \sqrt{2\sqrt{2} + 2}} \arctan\left(\frac{2 \tan(x) - \sqrt{-2 + 2\sqrt{2}}}{\sqrt{2\sqrt{2} + 2}}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(1/(1-cos(x)^8), x)

[Out] -1/4/tan(x)+1/32\*2^(1/2)\*(-2+2\*2^(1/2))^(1/2)\*ln(tan(x)^2-tan(x)\*(-2+2\*2^(1/2))^(1/2)+2^(1/2))+1/8/(2\*2^(1/2)+2)^(1/2)\*arctan((2\*tan(x)-(-2+2\*2^(1/2))^(1/2))/(2\*2^(1/2)+2)^(1/2))\*2^(1/2)+1/4/(2\*2^(1/2)+2)^(1/2)\*arctan((2\*tan(x)-(-2+2\*2^(1/2))^(1/2))/(2\*2^(1/2)+2)^(1/2))-1/32\*2^(1/2)\*(-2+2\*2^(1/2))^(1/2)\*ln(tan(x)^2+tan(x)\*(-2+2\*2^(1/2))^(1/2)+2^(1/2))+1/8/(2\*2^(1/2)+2)^(1/2)\*arctan((2\*tan(x)+(-2+2\*2^(1/2))^(1/2))/(2\*2^(1/2)+2)^(1/2))\*2^(1/2)+1/4/(2\*2^(1/2)+2)^(1/2)\*arctan((2\*tan(x)+(-2+2\*2^(1/2))^(1/2))/(2\*2^(1/2)+2)^(1/2))+1/8\*arctan(1/2\*tan(x)\*2^(1/2))\*2^(1/2)

**Maxima [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^8),x, algorithm="maxima")

[Out] Timed out

---

**Fricas [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^8),x, algorithm="fricas")

[Out] Timed out

---

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)\*\*8),x)

[Out] Timed out

---

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int -\frac{1}{\cos(x)^8 - 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(1/(1-cos(x)^8),x, algorithm="giac")

[Out] integrate(-1/(cos(x)^8 - 1), x)

$$3.86 \quad \int \frac{\tan(x)}{1+\cos^2(x)} dx$$

**Optimal.** Leaf size=17

$$\frac{1}{2} \log(\cos^2(x) + 1) - \log(\cos(x))$$

[Out] -Log[Cos[x]] + Log[1 + Cos[x]^2]/2

**Rubi [A]** time = 0.0290009, antiderivative size = 17, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 11,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.364$ , Rules used = {3194, 36, 29, 31}

$$\frac{1}{2} \log(\cos^2(x) + 1) - \log(\cos(x))$$

Antiderivative was successfully verified.

[In] Int[Tan[x]/(1 + Cos[x]^2), x]

[Out] -Log[Cos[x]] + Log[1 + Cos[x]^2]/2

**Rule 3194**

Int[((a\_) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_)]^2)^(p\_.)\*tan[(e\_.) + (f\_.)\*(x\_)]^(m\_.), x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x]^2, x]}, Dist[ff^((m + 1)/2)/(2\*f), Subst[Int[(x^((m - 1)/2)\*(a + b\*ff\*x)^p]/(1 - ff\*x)^((m + 1)/2), x], x, Sin[e + f\*x]^2/ff], x]] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

**Rule 36**

Int[1/(((a\_.) + (b\_.)\*(x\_))\*((c\_.) + (d\_.)\*(x\_))), x\_Symbol] := Dist[b/(b\*c - a\*d), Int[1/(a + b\*x), x], x] - Dist[d/(b\*c - a\*d), Int[1/(c + d\*x), x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0]

**Rule 29**

Int[(x\_)^(-1), x\_Symbol] := Simp[Log[x], x]

**Rule 31**

Int[((a\_) + (b\_.)\*(x\_))^(n\_), x\_Symbol] := Simp[Log[RemoveContent[a + b\*x, x]]/b, x] /; FreeQ[{a, b}, x]

**Rubi steps**

$$\begin{aligned} \int \frac{\tan(x)}{1+\cos^2(x)} dx &= -\left(\frac{1}{2} \text{Subst}\left(\int \frac{1}{x(1+x)} dx, x, \cos^2(x)\right)\right) \\ &= -\left(\frac{1}{2} \text{Subst}\left(\int \frac{1}{x} dx, x, \cos^2(x)\right)\right) + \frac{1}{2} \text{Subst}\left(\int \frac{1}{1+x} dx, x, \cos^2(x)\right) \\ &= -\log(\cos(x)) + \frac{1}{2} \log(1 + \cos^2(x)) \end{aligned}$$

**Mathematica [A]** time = 0.0077098, size = 17, normalized size = 1.

$$\frac{1}{2} \log(\cos^2(x) + 1) - \log(\cos(x))$$

Antiderivative was successfully verified.

[In] Integrate[Tan[x]/(1 + Cos[x]^2), x]

[Out] -Log[Cos[x]] + Log[1 + Cos[x]^2]/2

**Maple [A]** time = 0.032, size = 16, normalized size = 0.9

$$-\ln(\cos(x)) + \frac{\ln(1 + (\cos(x))^2)}{2}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(tan(x)/(1+cos(x)^2), x)

[Out] -ln(cos(x))+1/2\*ln(1+cos(x)^2)

**Maxima [A]** time = 0.93429, size = 26, normalized size = 1.53

$$-\frac{1}{2} \log(\sin(x)^2 - 1) + \frac{1}{2} \log(\sin(x)^2 - 2)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(1+cos(x)^2), x, algorithm="maxima")

[Out] -1/2\*log(sin(x)^2 - 1) + 1/2\*log(sin(x)^2 - 2)

**Fricas [A]** time = 2.24942, size = 59, normalized size = 3.47

$$\frac{1}{2} \log\left(\frac{1}{2} \cos(x)^2 + \frac{1}{2}\right) - \log(-\cos(x))$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(1+cos(x)^2), x, algorithm="fricas")

[Out] 1/2\*log(1/2\*cos(x)^2 + 1/2) - log(-cos(x))

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\tan(x)}{\cos^2(x) + 1} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(tan(x)/(1+cos(x)**2),x)
```

```
[Out] Integral(tan(x)/(cos(x)**2 + 1), x)
```

---

**Giac [A]** time = 1.18429, size = 23, normalized size = 1.35

$$\frac{1}{2} \log(\cos(x)^2 + 1) - \frac{1}{2} \log(\cos(x)^2)$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(tan(x)/(1+cos(x)^2),x, algorithm="giac")
```

```
[Out] 1/2*log(cos(x)^2 + 1) - 1/2*log(cos(x)^2)
```

### 3.87 $\int \sqrt{a + b \cos^2(x)} \tan(x) dx$

**Optimal.** Leaf size=40

$$\sqrt{a} \tanh^{-1} \left( \frac{\sqrt{a + b \cos^2(x)}}{\sqrt{a}} \right) - \sqrt{a + b \cos^2(x)}$$

[Out] Sqrt[a]\*ArcTanh[Sqrt[a + b\*Cos[x]^2]/Sqrt[a]] - Sqrt[a + b\*Cos[x]^2]

**Rubi [A]** time = 0.0627249, antiderivative size = 40, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.267$ , Rules used = {3194, 50, 63, 208}

$$\sqrt{a} \tanh^{-1} \left( \frac{\sqrt{a + b \cos^2(x)}}{\sqrt{a}} \right) - \sqrt{a + b \cos^2(x)}$$

Antiderivative was successfully verified.

[In] Int[Sqrt[a + b\*Cos[x]^2]\*Tan[x], x]

[Out] Sqrt[a]\*ArcTanh[Sqrt[a + b\*Cos[x]^2]/Sqrt[a]] - Sqrt[a + b\*Cos[x]^2]

#### Rule 3194

```
Int[((a_) + (b_)*sin[(e_) + (f_)*(x_)])^(p_)*tan[(e_) + (f_)*(x_)]^(m_), x_Symbol] := With[{ff = FreeFactors[Sin[e + f*x]^2, x]}, Dist[ff^((m + 1)/2)/(2*f), Subst[Int[(x^((m - 1)/2)*(a + b*ff*x)^p]/(1 - ff*x)^((m + 1)/2), x], x, Sin[e + f*x]^2/ff, x]] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]
```

#### Rule 50

```
Int[((a_) + (b_)*(x_))^(m_)*((c_) + (d_)*(x_))^(n_), x_Symbol] := Simp[(a + b*x)^(m + 1)*(c + d*x)^n/(b*(m + n + 1)), x] + Dist[(n*(b*c - a*d))/(b*(m + n + 1)), Int[(a + b*x)^m*(c + d*x)^(n - 1), x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b*c - a*d, 0] && GtQ[n, 0] && NeQ[m + n + 1, 0] && !(IGtQ[m, 0] && (!IntegerQ[n] || (GtQ[m, 0] && LtQ[m - n, 0]))) && !ILtQ[m + n + 2, 0] && IntLinearQ[a, b, c, d, m, n, x]
```

#### Rule 63

```
Int[((a_) + (b_)*(x_))^(m_)*((c_) + (d_)*(x_))^(n_), x_Symbol] := With[{p = Denominator[m]}, Dist[p/b, Subst[Int[x^(p*(m + 1) - 1)*(c - (a*d)/b + (d*x^p)/b)^n, x], x, (a + b*x)^(1/p)], x]] /; FreeQ[{a, b, c, d}, x] && NeQ[b*c - a*d, 0] && LtQ[-1, m, 0] && LeQ[-1, n, 0] && LeQ[Denominator[n], Denominator[m]] && IntLinearQ[a, b, c, d, m, n, x]
```

#### Rule 208

```
Int[((a_) + (b_)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[-(a/b), 2]*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]
```

#### Rubi steps

$$\begin{aligned}
\int \sqrt{a + b \cos^2(x)} \tan(x) dx &= -\left(\frac{1}{2} \text{Subst}\left(\int \frac{\sqrt{a + bx}}{x} dx, x, \cos^2(x)\right)\right) \\
&= -\sqrt{a + b \cos^2(x)} - \frac{1}{2} a \text{Subst}\left(\int \frac{1}{x\sqrt{a + bx}} dx, x, \cos^2(x)\right) \\
&= -\sqrt{a + b \cos^2(x)} - \frac{a \text{Subst}\left(\int \frac{1}{\frac{a}{-b} + \frac{x^2}{b}} dx, x, \sqrt{a + b \cos^2(x)}\right)}{b} \\
&= \sqrt{a} \tanh^{-1}\left(\frac{\sqrt{a + b \cos^2(x)}}{\sqrt{a}}\right) - \sqrt{a + b \cos^2(x)}
\end{aligned}$$

**Mathematica [A]** time = 0.026397, size = 40, normalized size = 1.

$$\sqrt{a} \tanh^{-1}\left(\frac{\sqrt{a + b \cos^2(x)}}{\sqrt{a}}\right) - \sqrt{a + b \cos^2(x)}$$

Antiderivative was successfully verified.

[In] Integrate[Sqrt[a + b\*Cos[x]^2]\*Tan[x], x]

[Out] Sqrt[a]\*ArcTanh[Sqrt[a + b\*Cos[x]^2]/Sqrt[a]] - Sqrt[a + b\*Cos[x]^2]

**Maple [A]** time = 0.018, size = 43, normalized size = 1.1

$$-\sqrt{a + b (\cos(x))^2} + \sqrt{a} \ln\left(\frac{1}{\cos(x)} \left(2a + 2\sqrt{a}\sqrt{a + b (\cos(x))^2}\right)\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((a+b\*cos(x)^2)^(1/2)\*tan(x), x)

[Out] -(a+b\*cos(x)^2)^(1/2)+a^(1/2)\*ln((2\*a+2\*a^(1/2)\*(a+b\*cos(x)^2)^(1/2))/cos(x))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^2)^(1/2)\*tan(x), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 3.37192, size = 243, normalized size = 6.08

$$\left[\frac{1}{2} \sqrt{a} \log\left(\frac{b \cos(x)^2 + 2\sqrt{b \cos(x)^2 + a}\sqrt{a} + 2a}{\cos(x)^2}\right) - \sqrt{b \cos(x)^2 + a}, -\sqrt{-a} \arctan\left(\frac{\sqrt{b \cos(x)^2 + a}\sqrt{-a}}{a}\right) - \sqrt{b \cos(x)^2 + a}\right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^2)^(1/2)\*tan(x),x, algorithm="fricas")

[Out] [1/2\*sqrt(a)\*log((b\*cos(x)^2 + 2\*sqrt(b\*cos(x)^2 + a)\*sqrt(a) + 2\*a)/cos(x)^2) - sqrt(b\*cos(x)^2 + a), -sqrt(-a)\*arctan(sqrt(b\*cos(x)^2 + a)\*sqrt(-a)/a) - sqrt(b\*cos(x)^2 + a)]

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{a + b \cos^2(x)} \tan(x) dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)\*\*2)\*\*(1/2)\*tan(x),x)

[Out] Integral(sqrt(a + b\*cos(x)\*\*2)\*tan(x), x)

**Giac [A]** time = 1.14544, size = 51, normalized size = 1.27

$$-\frac{a \arctan\left(\frac{\sqrt{b \cos(x)^2 + a}}{\sqrt{-a}}\right)}{\sqrt{-a}} - \sqrt{b \cos(x)^2 + a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^2)^(1/2)\*tan(x),x, algorithm="giac")

[Out] -a\*arctan(sqrt(b\*cos(x)^2 + a)/sqrt(-a))/sqrt(-a) - sqrt(b\*cos(x)^2 + a)



### 3.88 $\int \sqrt{1 - \cos^2(x)} \tan(x) dx$

**Optimal.** Leaf size=20

$$\tanh^{-1}\left(\sqrt{\sin^2(x)}\right) - \sqrt{\sin^2(x)}$$

[Out] ArcTanh[Sqrt[Sin[x]^2]] - Sqrt[Sin[x]^2]

**Rubi [A]** time = 0.0505617, antiderivative size = 20, normalized size of antiderivative = 1., number of steps used = 5, number of rules used = 5, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3176, 3205, 50, 63, 206}

$$\tanh^{-1}\left(\sqrt{\sin^2(x)}\right) - \sqrt{\sin^2(x)}$$

Antiderivative was successfully verified.

[In] Int[Sqrt[1 - Cos[x]^2]\*Tan[x], x]

[Out] ArcTanh[Sqrt[Sin[x]^2]] - Sqrt[Sin[x]^2]

#### Rule 3176

Int[(u\_.)\*((a\_.) + (b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^2)^p], x\_Symbol] := Int[ActivateTrig[u\*(a\*cos[e + f\*x]^2)^p], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0]

#### Rule 3205

Int[((b\_.)\*sin[(e\_.) + (f\_.)\*(x\_.)]^n)^p]\*tan[(e\_.) + (f\_.)\*(x\_.)]^m, x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x]^2, x]}, Dist[ff^((m + 1)/2)/(2\*f), Subst[Int[(x^((m - 1)/2)\*(b\*ff^(n/2)\*x^(n/2))^p]/(1 - ff\*x)^((m + 1)/2), x], x, Sin[e + f\*x]^2/ff], x] /; FreeQ[{b, e, f, p}, x] && IntegerQ[(m - 1)/2] && IntegerQ[n/2]

#### Rule 50

Int[((a\_.) + (b\_.)\*(x\_.))^m]\*((c\_.) + (d\_.)\*(x\_.))^n, x\_Symbol] := Simp[(a + b\*x)^(m + 1)\*(c + d\*x)^n/(b\*(m + n + 1)), x] + Dist[(n\*(b\*c - a\*d))/(b\*(m + n + 1)), Int[(a + b\*x)^m\*(c + d\*x)^(n - 1), x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0] && GtQ[n, 0] && NeQ[m + n + 1, 0] && !(IGtQ[m, 0] && (!IntegerQ[n] || (GtQ[m, 0] && LtQ[m - n, 0]))) && !ILtQ[m + n + 2, 0] && IntLinearQ[a, b, c, d, m, n, x]

#### Rule 63

Int[((a\_.) + (b\_.)\*(x\_.))^m]\*((c\_.) + (d\_.)\*(x\_.))^n, x\_Symbol] := With[{p = Denominator[m]}, Dist[p/b, Subst[Int[x^(p\*(m + 1) - 1)\*(c - (a\*d)/b + (d\*x^p)/b)^n, x], x, (a + b\*x)^(1/p)], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0] && LtQ[-1, m, 0] && LeQ[-1, n, 0] && LeQ[Denominator[n], Denominator[m]] && IntLinearQ[a, b, c, d, m, n, x]

#### Rule 206

Int[((a\_.) + (b\_.)\*(x\_.)^2)^(-1), x\_Symbol] := Simp[(1\*ArcTanh[(Rt[-b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (Gt

$Q[a, 0] \parallel LtQ[b, 0]$ )

### Rubi steps

$$\begin{aligned}
 \int \sqrt{1 - \cos^2(x)} \tan(x) dx &= \int \sqrt{\sin^2(x)} \tan(x) dx \\
 &= \frac{1}{2} \text{Subst} \left( \int \frac{\sqrt{x}}{1-x} dx, x, \sin^2(x) \right) \\
 &= -\sqrt{\sin^2(x)} + \frac{1}{2} \text{Subst} \left( \int \frac{1}{(1-x)\sqrt{x}} dx, x, \sin^2(x) \right) \\
 &= -\sqrt{\sin^2(x)} + \text{Subst} \left( \int \frac{1}{1-x^2} dx, x, \sqrt{\sin^2(x)} \right) \\
 &= \tanh^{-1} \left( \sqrt{\sin^2(x)} \right) - \sqrt{\sin^2(x)}
 \end{aligned}$$

**Mathematica [B]** time = 0.0292728, size = 47, normalized size = 2.35

$$\sqrt{\sin^2(x)(-\csc(x))} \left( \sin(x) + \log \left( \cos \left( \frac{x}{2} \right) - \sin \left( \frac{x}{2} \right) \right) - \log \left( \sin \left( \frac{x}{2} \right) + \cos \left( \frac{x}{2} \right) \right) \right)$$

Antiderivative was successfully verified.

[In] Integrate[Sqrt[1 - Cos[x]^2]\*Tan[x], x]

[Out] -(Csc[x]\*Sqrt[Sin[x]^2]\*(Log[Cos[x/2] - Sin[x/2]] - Log[Cos[x/2] + Sin[x/2]] + Sin[x]))

**Maple [A]** time = 0.413, size = 17, normalized size = 0.9

$$-\sqrt{(\sin(x))^2} + \text{Artanh} \left( \frac{1}{\sqrt{(\sin(x))^2}} \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((1-cos(x)^2)^(1/2)\*tan(x), x)

[Out] -(sin(x)^2)^(1/2)+arctanh(1/(sin(x)^2)^(1/2))

**Maxima [B]** time = 1.49755, size = 63, normalized size = 3.15

$$\frac{1}{2} (-1)^{2 \sin(x)} \log \left( -\frac{\sin(x)}{\sin(x)+1} \right) + \frac{1}{2} (-1)^{2 \sin(x)} \log \left( -\frac{\sin(x)}{\sin(x)-1} \right) - \sqrt{\sin(x)^2}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((1-cos(x)^2)^(1/2)\*tan(x), x, algorithm="maxima")

[Out] 1/2\*(-1)^(2\*sin(x))\*log(-sin(x)/(sin(x) + 1)) + 1/2\*(-1)^(2\*sin(x))\*log(-sin(x)/(sin(x) - 1)) - sqrt(sin(x)^2)

---

**Fricas [A]** time = 1.68795, size = 72, normalized size = 3.6

$$\frac{1}{2} \log(\sin(x) + 1) - \frac{1}{2} \log(-\sin(x) + 1) - \sin(x)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((1-cos(x)^2)^(1/2)\*tan(x),x, algorithm="fricas")

[Out] 1/2\*log(sin(x) + 1) - 1/2\*log(-sin(x) + 1) - sin(x)

---

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{-(\cos(x) - 1)(\cos(x) + 1)} \tan(x) dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((1-cos(x)\*\*2)\*\*(1/2)\*tan(x),x)

[Out] Integral(sqrt(-(cos(x) - 1)\*(cos(x) + 1))\*tan(x), x)

---

**Giac [B]** time = 1.15621, size = 61, normalized size = 3.05

$$-\sqrt{-\cos(x)^2 + 1} + \frac{1}{2} \log\left(\sqrt{-\cos(x)^2 + 1} + 1\right) - \frac{1}{2} \log\left(-\sqrt{-\cos(x)^2 + 1} + 1\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((1-cos(x)^2)^(1/2)\*tan(x),x, algorithm="giac")

[Out] -sqrt(-cos(x)^2 + 1) + 1/2\*log(sqrt(-cos(x)^2 + 1) + 1) - 1/2\*log(-sqrt(-cos(x)^2 + 1) + 1)

$$3.89 \quad \int \frac{\tan(x)}{\sqrt{a+b \cos^2(x)}} dx$$

**Optimal.** Leaf size=25

$$\frac{\tanh^{-1}\left(\frac{\sqrt{a+b \cos^2(x)}}{\sqrt{a}}\right)}{\sqrt{a}}$$

[Out] ArcTanh[Sqrt[a + b\*Cos[x]^2]/Sqrt[a]]/Sqrt[a]

**Rubi [A]** time = 0.0599249, antiderivative size = 25, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.2$ , Rules used = {3194, 63, 208}

$$\frac{\tanh^{-1}\left(\frac{\sqrt{a+b \cos^2(x)}}{\sqrt{a}}\right)}{\sqrt{a}}$$

Antiderivative was successfully verified.

[In] Int[Tan[x]/Sqrt[a + b\*Cos[x]^2], x]

[Out] ArcTanh[Sqrt[a + b\*Cos[x]^2]/Sqrt[a]]/Sqrt[a]

#### Rule 3194

```
Int[((a_) + (b_)*sin[(e_) + (f_)*(x_)]^2)^(p_)*tan[(e_) + (f_)*(x_)]^(m_), x_Symbol] := With[{ff = FreeFactors[Sin[e + f*x]^2, x]}, Dist[ff^((m + 1)/2)/(2*f), Subst[Int[(x^((m - 1)/2)*(a + b*ff*x)^p]/(1 - ff*x)^((m + 1)/2), x], x, Sin[e + f*x]^2/ff], x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]
```

#### Rule 63

```
Int[((a_) + (b_)*(x_))^(m_)*((c_) + (d_)*(x_))^(n_), x_Symbol] := With[{p = Denominator[m]}, Dist[p/b, Subst[Int[x^(p*(m + 1) - 1)*(c - (a*d)/b + (d*x^p)/b)^n, x], x, (a + b*x)^(1/p)], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b*c - a*d, 0] && LtQ[-1, m, 0] && LeQ[-1, n, 0] && LeQ[Denominator[n], Denominator[m]] && IntLinearQ[a, b, c, d, m, n, x]
```

#### Rule 208

```
Int[((a_) + (b_)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[-(a/b), 2]*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]
```

#### Rubi steps

$$\begin{aligned} \int \frac{\tan(x)}{\sqrt{a+b\cos^2(x)}} dx &= -\left(\frac{1}{2} \text{Subst}\left(\int \frac{1}{x\sqrt{a+bx}} dx, x, \cos^2(x)\right)\right) \\ &= -\frac{\text{Subst}\left(\int \frac{1}{\frac{-a}{b} + \frac{x^2}{b}} dx, x, \sqrt{a+b\cos^2(x)}\right)}{b} \\ &= \frac{\tanh^{-1}\left(\frac{\sqrt{a+b\cos^2(x)}}{\sqrt{a}}\right)}{\sqrt{a}} \end{aligned}$$

**Mathematica [A]** time = 0.0123528, size = 25, normalized size = 1.

$$\frac{\tanh^{-1}\left(\frac{\sqrt{a+b\cos^2(x)}}{\sqrt{a}}\right)}{\sqrt{a}}$$

Antiderivative was successfully verified.

[In] Integrate[Tan[x]/Sqrt[a + b\*Cos[x]^2], x]

[Out] ArcTanh[Sqrt[a + b\*Cos[x]^2]/Sqrt[a]]/Sqrt[a]

**Maple [A]** time = 0.02, size = 30, normalized size = 1.2

$$\ln\left(\frac{1}{\cos(x)}\left(2a + 2\sqrt{a}\sqrt{a+b(\cos(x))^2}\right)\right) \frac{1}{\sqrt{a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(tan(x)/(a+b\*cos(x)^2)^(1/2), x)

[Out] 1/a^(1/2)\*ln((2\*a+2\*a^(1/2)\*(a+b\*cos(x)^2)^(1/2))/cos(x))

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)^2)^(1/2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 2.12165, size = 184, normalized size = 7.36

$$\left[ \frac{\log\left(\frac{b\cos(x)^2 + 2\sqrt{b\cos(x)^2 + a\sqrt{a} + 2a}}{\cos(x)^2}\right)}{2\sqrt{a}}, -\frac{\sqrt{-a} \arctan\left(\frac{\sqrt{b\cos(x)^2 + a\sqrt{-a}}}{a}\right)}{a} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)^2)^(1/2),x, algorithm="fricas")

[Out] [1/2\*log((b\*cos(x)^2 + 2\*sqrt(b\*cos(x)^2 + a)\*sqrt(a) + 2\*a)/cos(x)^2)/sqrt(a), -sqrt(-a)\*arctan(sqrt(b\*cos(x)^2 + a)\*sqrt(-a)/a)/a]

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\tan(x)}{\sqrt{a + b \cos^2(x)}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)\*\*2)\*\*(1/2),x)

[Out] Integral(tan(x)/sqrt(a + b\*cos(x)\*\*2), x)

**Giac [A]** time = 1.15484, size = 32, normalized size = 1.28

$$\frac{\arctan\left(\frac{\sqrt{b \cos(x)^2 + a}}{\sqrt{-a}}\right)}{\sqrt{-a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)^2)^(1/2),x, algorithm="giac")

[Out] -arctan(sqrt(b\*cos(x)^2 + a)/sqrt(-a))/sqrt(-a)

$$3.90 \quad \int \frac{\tan(x)}{\sqrt{1+\cos^2(x)}} dx$$

Optimal. Leaf size=11

$$\tanh^{-1}\left(\sqrt{\cos^2(x)+1}\right)$$

[Out] ArcTanh[Sqrt[1 + Cos[x]^2]]

**Rubi [A]** time = 0.0352519, antiderivative size = 11, normalized size of antiderivative = 1., number of steps used = 3, number of rules used = 3, integrand size = 13,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.231$ , Rules used = {3194, 63, 207}

$$\tanh^{-1}\left(\sqrt{\cos^2(x)+1}\right)$$

Antiderivative was successfully verified.

[In] Int[Tan[x]/Sqrt[1 + Cos[x]^2], x]

[Out] ArcTanh[Sqrt[1 + Cos[x]^2]]

#### Rule 3194

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^2)^(p\_)\*tan[(e\_) + (f\_)\*(x\_)]^(m\_), x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x]^2, x]}, Dist[ff^((m + 1)/2)/(2\*f), Subst[Int[(x^((m - 1)/2)\*(a + b\*ff\*x)^p)/(1 - ff\*x)^((m + 1)/2), x], x, Sin[e + f\*x]^2/ff], x]] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2]

#### Rule 63

Int[((a\_) + (b\_)\*(x\_)^(m\_))\*((c\_) + (d\_)\*(x\_)^(n\_)), x\_Symbol] := With[{p = Denominator[m]}, Dist[p/b, Subst[Int[x^(p\*(m + 1) - 1)\*(c - (a\*d)/b + (d\*x^p)/b)^n, x], x, (a + b\*x)^(1/p)], x]] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0] && LtQ[-1, m, 0] && LeQ[-1, n, 0] && LeQ[Denominator[n], Denominator[m]] && IntLinearQ[a, b, c, d, m, n, x]

#### Rule 207

Int[((a\_) + (b\_)\*(x\_)^2)^(-1), x\_Symbol] := -Simp[ArcTanh[(Rt[b, 2]\*x)/Rt[-a, 2]]/(Rt[-a, 2]\*Rt[b, 2]), x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (LtQ[a, 0] || GtQ[b, 0])

#### Rubi steps

$$\begin{aligned} \int \frac{\tan(x)}{\sqrt{1+\cos^2(x)}} dx &= -\left(\frac{1}{2} \text{Subst}\left(\int \frac{1}{x\sqrt{1+x}} dx, x, \cos^2(x)\right)\right) \\ &= -\text{Subst}\left(\int \frac{1}{-1+x^2} dx, x, \sqrt{1+\cos^2(x)}\right) \\ &= \tanh^{-1}\left(\sqrt{1+\cos^2(x)}\right) \end{aligned}$$

**Mathematica [A]** time = 0.0103894, size = 11, normalized size = 1.

$$\tanh^{-1}\left(\sqrt{\cos^2(x) + 1}\right)$$

Antiderivative was successfully verified.

[In] Integrate[Tan[x]/Sqrt[1 + Cos[x]^2], x]

[Out] ArcTanh[Sqrt[1 + Cos[x]^2]]

**Maple [A]** time = 0.019, size = 10, normalized size = 0.9

$$\operatorname{Artanh}\left(\frac{1}{\sqrt{1 + (\cos(x))^2}}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(tan(x)/(1+cos(x)^2)^(1/2), x)

[Out] arctanh(1/(1+cos(x)^2)^(1/2))

**Maxima [B]** time = 1.45679, size = 81, normalized size = 7.36

$$\frac{1}{2} \log\left(\frac{\sqrt{-\sin(x)^2 + 2}}{\sin(x) + 1} + \frac{1}{\sin(x) + 1} - 1\right) + \frac{1}{2} \log\left(-\frac{\sqrt{-\sin(x)^2 + 2}}{\sin(x) - 1} - \frac{1}{\sin(x) - 1} + 1\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(1+cos(x)^2)^(1/2), x, algorithm="maxima")

[Out] 1/2\*log(sqrt(-sin(x)^2 + 2)/(sin(x) + 1) + 1/(sin(x) + 1) - 1) + 1/2\*log(-sqrt(-sin(x)^2 + 2)/(sin(x) - 1) - 1/(sin(x) - 1) + 1)

**Fricas [A]** time = 1.87163, size = 51, normalized size = 4.64

$$\log\left(\frac{\sqrt{\cos(x)^2 + 1} + 1}{\cos(x)}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(1+cos(x)^2)^(1/2), x, algorithm="fricas")

[Out] log((sqrt(cos(x)^2 + 1) + 1)/cos(x))



**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\tan(x)}{\sqrt{\cos^2(x) + 1}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(1+cos(x)\*\*2)\*\*(1/2), x)

[Out] Integral(tan(x)/sqrt(cos(x)\*\*2 + 1), x)

**Giac [B]** time = 1.16387, size = 36, normalized size = 3.27

$$\frac{1}{2} \log\left(\sqrt{\cos(x)^2 + 1} + 1\right) - \frac{1}{2} \log\left(\sqrt{\cos(x)^2 + 1} - 1\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(1+cos(x)^2)^(1/2), x, algorithm="giac")

[Out] 1/2\*log(sqrt(cos(x)^2 + 1) + 1) - 1/2\*log(sqrt(cos(x)^2 + 1) - 1)

$$3.91 \quad \int \frac{\tan(x)}{\sqrt{1-\cos^2(x)}} dx$$

**Optimal.** Leaf size=9

$$\tanh^{-1}\left(\sqrt{\sin^2(x)}\right)$$

[Out] ArcTanh[Sqrt[Sin[x]^2]]

**Rubi [A]** time = 0.0529505, antiderivative size = 9, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.267$ , Rules used = {3176, 3205, 63, 206}

$$\tanh^{-1}\left(\sqrt{\sin^2(x)}\right)$$

Antiderivative was successfully verified.

[In] Int[Tan[x]/Sqrt[1 - Cos[x]^2], x]

[Out] ArcTanh[Sqrt[Sin[x]^2]]

#### Rule 3176

Int[(u\_)\*((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)])^2)^(p\_), x\_Symbol] := Int[ActivateTrig[u\*(a\*cos[e + f\*x]^2)^p], x] /; FreeQ[{a, b, e, f, p}, x] && EqQ[a + b, 0]

#### Rule 3205

Int[((b\_)\*sin[(e\_) + (f\_)\*(x\_)])^(n\_))^(p\_)\*tan[(e\_) + (f\_)\*(x\_)]^(m\_), x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x]^2, x]}, Dist[ff^((m + 1)/2)/(2\*f), Subst[Int[(x^((m - 1)/2)\*(b\*ff^(n/2)\*x^(n/2))^p]/(1 - ff\*x)^((m + 1)/2), x], x, Sin[e + f\*x]^2/ff], x] /; FreeQ[{b, e, f, p}, x] && IntegerQ[(m - 1)/2] && IntegerQ[n/2]

#### Rule 63

Int[((a\_) + (b\_)\*(x\_))^(m\_)\*((c\_) + (d\_)\*(x\_))^(n\_), x\_Symbol] := With[{p = Denominator[m]}, Dist[p/b, Subst[Int[x^(p\*(m + 1) - 1)\*(c - (a\*d)/b + (d\*x^p)/b)^n, x], x, (a + b\*x)^(1/p)], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0] && LtQ[-1, m, 0] && LeQ[-1, n, 0] && LeQ[Denominator[n], Denominator[m]] && IntLinearQ[a, b, c, d, m, n, x]

#### Rule 206

Int[((a\_) + (b\_)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(1\*ArcTanh[(Rt[-b, 2]\*x)/Rt[a, 2]])/(Rt[a, 2]\*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && NegQ[a/b] && (GtQ[a, 0] || LtQ[b, 0])

#### Rubi steps

$$\begin{aligned}
\int \frac{\tan(x)}{\sqrt{1-\cos^2(x)}} dx &= \int \frac{\tan(x)}{\sqrt{\sin^2(x)}} dx \\
&= \frac{1}{2} \text{Subst} \left( \int \frac{1}{(1-x)\sqrt{x}} dx, x, \sin^2(x) \right) \\
&= \text{Subst} \left( \int \frac{1}{1-x^2} dx, x, \sqrt{\sin^2(x)} \right) \\
&= \tanh^{-1} \left( \sqrt{\sin^2(x)} \right)
\end{aligned}$$

**Mathematica [B]** time = 0.0211138, size = 44, normalized size = 4.89

$$\frac{\sin(x) \left( \log \left( \sin \left( \frac{x}{2} \right) + \cos \left( \frac{x}{2} \right) \right) - \log \left( \cos \left( \frac{x}{2} \right) - \sin \left( \frac{x}{2} \right) \right) \right)}{\sqrt{\sin^2(x)}}$$

Antiderivative was successfully verified.

[In] Integrate[Tan[x]/Sqrt[1 - Cos[x]^2], x]

[Out] ((-Log[Cos[x/2] - Sin[x/2]] + Log[Cos[x/2] + Sin[x/2]])\*Sin[x])/Sqrt[Sin[x]^2]

**Maple [A]** time = 0.21, size = 8, normalized size = 0.9

$$\text{Artanh} \left( \frac{1}{\sqrt{(\sin(x))^2}} \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(tan(x)/(1-cos(x)^2)^(1/2), x)

[Out] arctanh(1/(sin(x)^2)^(1/2))

**Maxima [B]** time = 1.46874, size = 53, normalized size = 5.89

$$\frac{1}{2} (-1)^{2 \sin(x)} \log \left( -\frac{\sin(x)}{\sin(x)+1} \right) + \frac{1}{2} (-1)^{2 \sin(x)} \log \left( -\frac{\sin(x)}{\sin(x)-1} \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(1-cos(x)^2)^(1/2), x, algorithm="maxima")

[Out] 1/2\*(-1)^(2\*sin(x))\*log(-sin(x)/(sin(x) + 1)) + 1/2\*(-1)^(2\*sin(x))\*log(-sin(x)/(sin(x) - 1))

**Fricas [B]** time = 1.7012, size = 59, normalized size = 6.56

$$\frac{1}{2} \log(\sin(x) + 1) - \frac{1}{2} \log(-\sin(x) + 1)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(1-cos(x)^2)^(1/2),x, algorithm="fricas")

[Out] 1/2\*log(sin(x) + 1) - 1/2\*log(-sin(x) + 1)

---

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\tan(x)}{\sqrt{-(\cos(x) - 1)(\cos(x) + 1)}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(1-cos(x)\*\*2)\*\*(1/2),x)

[Out] Integral(tan(x)/sqrt(-(cos(x) - 1)\*(cos(x) + 1)), x)

---

**Giac [B]** time = 1.17142, size = 45, normalized size = 5.

$$\frac{1}{2} \log\left(\sqrt{-\cos(x)^2 + 1} + 1\right) - \frac{1}{2} \log\left(-\sqrt{-\cos(x)^2 + 1} + 1\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(1-cos(x)^2)^(1/2),x, algorithm="giac")

[Out] 1/2\*log(sqrt(-cos(x)^2 + 1) + 1) - 1/2\*log(-sqrt(-cos(x)^2 + 1) + 1)

### 3.92 $\int \frac{\tan^3(x)}{a+b \cos^3(x)} dx$

**Optimal.** Leaf size=153

$$\frac{b^{2/3} \log(a^{2/3} - \sqrt[3]{a}\sqrt[3]{b} \cos(x) + b^{2/3} \cos^2(x))}{6a^{5/3}} + \frac{b^{2/3} \log(\sqrt[3]{a} + \sqrt[3]{b} \cos(x))}{3a^{5/3}} - \frac{b^{2/3} \tan^{-1}\left(\frac{\sqrt[3]{a}-2\sqrt[3]{b} \cos(x)}{\sqrt{3}\sqrt[3]{a}}\right)}{\sqrt{3}a^{5/3}} - \frac{\log(a + b \cos^3(x))}{3a}$$

[Out]  $-\left(\frac{b^{2/3} \operatorname{ArcTan}\left[\frac{a^{1/3} - 2b^{1/3} \cos[x]}{\sqrt{3}a^{1/3}}\right]}{\sqrt{3}a^{5/3}}\right) + \frac{\log[\cos[x]]}{a} + \frac{b^{2/3} \log[a^{1/3} + b^{1/3} \cos[x]]}{3a^{5/3}} - \frac{b^{2/3} \log[a^{2/3} - a^{1/3}b^{1/3} \cos[x] + b^{2/3} \cos^2[x]]}{6a^{5/3}} - \frac{\log[a + b \cos^3[x]]}{3a} + \frac{\sec^2[x]}{2a}$

**Rubi [A]** time = 0.196729, antiderivative size = 153, normalized size of antiderivative = 1., number of steps used = 11, number of rules used = 10, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.667$ , Rules used = {3230, 1834, 1871, 200, 31, 634, 617, 204, 628, 260}

$$\frac{b^{2/3} \log(a^{2/3} - \sqrt[3]{a}\sqrt[3]{b} \cos(x) + b^{2/3} \cos^2(x))}{6a^{5/3}} + \frac{b^{2/3} \log(\sqrt[3]{a} + \sqrt[3]{b} \cos(x))}{3a^{5/3}} - \frac{b^{2/3} \tan^{-1}\left(\frac{\sqrt[3]{a}-2\sqrt[3]{b} \cos(x)}{\sqrt{3}\sqrt[3]{a}}\right)}{\sqrt{3}a^{5/3}} - \frac{\log(a + b \cos^3(x))}{3a}$$

Antiderivative was successfully verified.

[In]  $\text{Int}[\tan^3(x)/(a + b \cos^3(x)), x]$

[Out]  $-\left(\frac{b^{2/3} \operatorname{ArcTan}\left[\frac{a^{1/3} - 2b^{1/3} \cos[x]}{\sqrt{3}a^{1/3}}\right]}{\sqrt{3}a^{5/3}}\right) + \frac{\log[\cos[x]]}{a} + \frac{b^{2/3} \log[a^{1/3} + b^{1/3} \cos[x]]}{3a^{5/3}} - \frac{b^{2/3} \log[a^{2/3} - a^{1/3}b^{1/3} \cos[x] + b^{2/3} \cos^2[x]]}{6a^{5/3}} - \frac{\log[a + b \cos^3[x]]}{3a} + \frac{\sec^2[x]}{2a}$

#### Rule 3230

$\text{Int}[(a + b \cdot \sin(e + f \cdot x))^n \cdot \tan(e + f \cdot x)^p, x] \rightarrow \text{With}[\{ff = \text{FreeFactors}[\sin[e + f \cdot x], x]\}, \text{Dist}[ff^{m+1}/f, \text{Subst}[\text{Int}[(x^m \cdot (a + b \cdot (c \cdot ff \cdot x)^n)^p]/(1 - ff^2 \cdot x^2)^{(m+1)/2}, x], x, \sin[e + f \cdot x]/ff], x] /; \text{FreeQ}\{a, b, c, e, f, n, p\}, x \} \&\& \text{LtQ}[m - 1/2, 0]$

#### Rule 1834

$\text{Int}[(Pq) \cdot (c \cdot x)^m / (a + b \cdot x^n), x] \rightarrow \text{Int}[\text{ExpandIntegrand}[(c \cdot x)^m \cdot Pq / (a + b \cdot x^n), x], x] /; \text{FreeQ}\{a, b, c, m\}, x \} \&\& \text{PolyQ}[Pq, x] \&\& \text{IntegerQ}[n] \&\& \text{!IGtQ}[m, 0]$

#### Rule 1871

$\text{Int}[P2 / (a + b \cdot x^3), x] \rightarrow \text{With}[\{A = \text{Coeff}[P2, x, 0], B = \text{Coeff}[P2, x, 1], C = \text{Coeff}[P2, x, 2]\}, \text{Int}[(A + B \cdot x) / (a + b \cdot x^3), x] + \text{Dist}[C, \text{Int}[x^2 / (a + b \cdot x^3), x], x] /; \text{EqQ}[a \cdot B^3 - b \cdot A^3, 0] \} \&\& \text{RationalQ}[a/b] /; \text{FreeQ}\{a, b\}, x \} \&\& \text{PolyQ}[P2, x, 2]$

#### Rule 200

$\text{Int}[(a + b \cdot x^3)^{-1}, x] \rightarrow \text{Dist}[1/(3 \cdot \text{Rt}[a, 3]^2), \text{Int}[1/(\text{Rt}[a, 3] + \text{Rt}[b, 3] \cdot x), x], x] + \text{Dist}[1/(3 \cdot \text{Rt}[a, 3]^2), \text{Int}[(2 \cdot \text{Rt}[a, 3] - \text{Rt}[b, 3] \cdot x) / (\text{Rt}[a, 3]^2 - \text{Rt}[a, 3] \cdot \text{Rt}[b, 3] \cdot x + \text{Rt}[b, 3]^2 \cdot x^2), x], x] /; \text{FreeQ}\{a, b\}, x \}$

reeQ[{a, b}, x]

### Rule 31

Int[((a\_) + (b\_)\*(x\_))<sup>(-1)</sup>, x\_Symbol] := Simp[Log[RemoveContent[a + b\*x, x]]/b, x] /; FreeQ[{a, b}, x]

### Rule 634

Int[((d\_) + (e\_)\*(x\_))/((a\_) + (b\_)\*(x\_) + (c\_)\*(x\_)^2), x\_Symbol] := Dist[(2\*c\*d - b\*e)/(2\*c), Int[1/(a + b\*x + c\*x^2), x], x] + Dist[e/(2\*c), Int[(b + 2\*c\*x)/(a + b\*x + c\*x^2), x], x] /; FreeQ[{a, b, c, d, e}, x] && NeQ[2\*c\*d - b\*e, 0] && NeQ[b^2 - 4\*a\*c, 0] && !NiceSqrtQ[b^2 - 4\*a\*c]

### Rule 617

Int[((a\_) + (b\_)\*(x\_) + (c\_)\*(x\_)^2)<sup>(-1)</sup>, x\_Symbol] := With[{q = 1 - 4\*Simplify[(a\*c)/b^2]}, Dist[-2/b, Subst[Int[1/(q - x^2), x], x, 1 + (2\*c\*x)/b], x] /; RationalQ[q] && (EqQ[q^2, 1] || !RationalQ[b^2 - 4\*a\*c])] /; FreeQ[{a, b, c}, x] && NeQ[b^2 - 4\*a\*c, 0]

### Rule 204

Int[((a\_) + (b\_)\*(x\_)^2)<sup>(-1)</sup>, x\_Symbol] := -Simp[ArcTan[(Rt[-b, 2]\*x)/Rt[-a, 2]]/(Rt[-a, 2]\*Rt[-b, 2]), x] /; FreeQ[{a, b}, x] && PosQ[a/b] && (LtQ[a, 0] || LtQ[b, 0])

### Rule 628

Int[((d\_) + (e\_)\*(x\_))/((a\_) + (b\_)\*(x\_) + (c\_)\*(x\_)^2), x\_Symbol] := Simp[(d\*Log[RemoveContent[a + b\*x + c\*x^2, x]])/b, x] /; FreeQ[{a, b, c, d, e}, x] && EqQ[2\*c\*d - b\*e, 0]

### Rule 260

Int[(x\_)^(m\_)/((a\_) + (b\_)\*(x\_)^(n\_)), x\_Symbol] := Simp[Log[RemoveContent[a + b\*x^n, x]]/(b\*n), x] /; FreeQ[{a, b, m, n}, x] && EqQ[m, n - 1]

### Rubi steps

$$\begin{aligned}
\int \frac{\tan^3(x)}{a + b \cos^3(x)} dx &= -\text{Subst} \left( \int \frac{1 - x^2}{x^3 (a + bx^3)} dx, x, \cos(x) \right) \\
&= -\text{Subst} \left( \int \left( \frac{1}{ax^3} - \frac{1}{ax} + \frac{b(-1 + x^2)}{a(a + bx^3)} \right) dx, x, \cos(x) \right) \\
&= \frac{\log(\cos(x))}{a} + \frac{\sec^2(x)}{2a} - \frac{b \text{Subst} \left( \int \frac{-1+x^2}{a+bx^3} dx, x, \cos(x) \right)}{a} \\
&= \frac{\log(\cos(x))}{a} + \frac{\sec^2(x)}{2a} + \frac{b \text{Subst} \left( \int \frac{1}{a+bx^3} dx, x, \cos(x) \right)}{a} - \frac{b \text{Subst} \left( \int \frac{x^2}{a+bx^3} dx, x, \cos(x) \right)}{a} \\
&= \frac{\log(\cos(x))}{a} - \frac{\log(a + b \cos^3(x))}{3a} + \frac{\sec^2(x)}{2a} + \frac{b \text{Subst} \left( \int \frac{1}{\sqrt[3]{a} + \sqrt[3]{bx}} dx, x, \cos(x) \right)}{3a^{5/3}} + \frac{b \text{Subst} \left( \int \frac{-x^2}{a^2/3 + bx} dx, x, \cos(x) \right)}{3a^{5/3}} \\
&= \frac{\log(\cos(x))}{a} + \frac{b^{2/3} \log(\sqrt[3]{a} + \sqrt[3]{b} \cos(x))}{3a^{5/3}} - \frac{\log(a + b \cos^3(x))}{3a} + \frac{\sec^2(x)}{2a} - \frac{b^{2/3} \text{Subst} \left( \int \frac{-x^2}{a^2/3 + bx} dx, x, \cos(x) \right)}{3a^{5/3}} \\
&= \frac{\log(\cos(x))}{a} + \frac{b^{2/3} \log(\sqrt[3]{a} + \sqrt[3]{b} \cos(x))}{3a^{5/3}} - \frac{b^{2/3} \log(a^{2/3} - \sqrt[3]{a}\sqrt[3]{b} \cos(x) + b^{2/3} \cos^2(x))}{6a^{5/3}} - \frac{\log(a + b \cos^3(x))}{3a} \\
&= -\frac{b^{2/3} \tan^{-1} \left( \frac{1 - \frac{2\sqrt[3]{b} \cos(x)}{\sqrt[3]{a}}}{\sqrt{3}} \right)}{\sqrt{3}a^{5/3}} + \frac{\log(\cos(x))}{a} + \frac{b^{2/3} \log(\sqrt[3]{a} + \sqrt[3]{b} \cos(x))}{3a^{5/3}} - \frac{b^{2/3} \log(a^{2/3} - \sqrt[3]{a}\sqrt[3]{b} \cos(x) + b^{2/3} \cos^2(x))}{6a^{5/3}}
\end{aligned}$$

**Mathematica [C]** time = 0.258771, size = 217, normalized size = 1.42

$$-2\text{RootSum} \left[ \#1^3 a + 3\#1^2 a - \#1^3 b + 3\#1^2 b + 3\#1 a - 3\#1 b + a + b \&, \frac{\#1^2 a \log(\tan^2(\frac{x}{2}) - \#1) - \#1^2 b \log(\tan^2(\frac{x}{2}) - \#1) + 2\#1 a \log(\tan^2(\frac{x}{2}) - \#1) - \#1^2 a - \#1^2 b}{6a} \right]$$

Antiderivative was successfully verified.

[In] Integrate[Tan[x]^3/(a + b\*Cos[x]^3), x]

[Out] (6\*(Log[Cos[x]] + Log[Sec[x/2]^2]) - 2\*RootSum[a + b + 3\*a\*#1 - 3\*b\*#1 + 3\*a\*#1^2 + 3\*b\*#1^2 + a\*#1^3 - b\*#1^3 &, (a\*Log[-#1 + Tan[x/2]^2] + b\*Log[-#1 + Tan[x/2]^2] + 2\*a\*Log[-#1 + Tan[x/2]^2]\*#1 + 4\*b\*Log[-#1 + Tan[x/2]^2]\*#1 + a\*Log[-#1 + Tan[x/2]^2]\*#1^2 - b\*Log[-#1 + Tan[x/2]^2]\*#1^2)/(a - b + 2\*a\*#1 + 2\*b\*#1 + a\*#1^2 - b\*#1^2) & ] + 3\*Sec[x]^2)/(6\*a)

**Maple [A]** time = 0.032, size = 125, normalized size = 0.8

$$\frac{1}{3a} \ln \left( \cos(x) + \sqrt[3]{\frac{a}{b}} \right) \left( \frac{a}{b} \right)^{-\frac{2}{3}} - \frac{1}{6a} \ln \left( (\cos(x))^2 - \sqrt[3]{\frac{a}{b}} \cos(x) + \left( \frac{a}{b} \right)^{\frac{2}{3}} \right) \left( \frac{a}{b} \right)^{-\frac{2}{3}} + \frac{\sqrt{3}}{3a} \arctan \left( \frac{\sqrt{3}}{3} \left( 2 \cos(x) \frac{1}{\sqrt[3]{\frac{a}{b}}} - 1 \right) \right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(tan(x)^3/(a+b\*cos(x)^3), x)

[Out] 1/3/a/(1/b\*a)^(2/3)\*ln(cos(x)+(1/b\*a)^(1/3))-1/6/a/(1/b\*a)^(2/3)\*ln(cos(x)^2-(1/b\*a)^(1/3)\*cos(x)+(1/b\*a)^(2/3))+1/3/a/(1/b\*a)^(2/3)\*3^(1/2)\*arctan(1/

$$3 \cdot 3^{1/2} \cdot (2 / (1/b \cdot a)^{1/3} \cdot \cos(x) - 1) - 1/3 \cdot \ln(a + b \cdot \cos(x)^3) / a + \ln(\cos(x)) / a + 1/2 \cdot a / \cos(x)^2$$

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)^3/(a+b\*cos(x)^3),x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)^3/(a+b\*cos(x)^3),x, algorithm="fricas")

[Out] Timed out

**Sympy [F(-1)]** time = 0., size = 0, normalized size = 0.

Timed out

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)\*\*3/(a+b\*cos(x)\*\*3),x)

[Out] Timed out

**Giac [A]** time = 1.20408, size = 193, normalized size = 1.26

$$-\frac{b \left(-\frac{a}{b}\right)^{\frac{1}{3}} \log\left(\left|-\left(-\frac{a}{b}\right)^{\frac{1}{3}} + \cos(x)\right|\right)}{3 a^2} - \frac{\log\left(\left|b \cos(x)^3 + a\right|\right)}{3 a} + \frac{\log(|\cos(x)|)}{a} + \frac{\sqrt{3} (-ab^2)^{\frac{1}{3}} \arctan\left(\frac{\sqrt{3} \left(-\frac{a}{b}\right)^{\frac{1}{3}} + 2 \cos(x)}{3 \left(-\frac{a}{b}\right)^{\frac{1}{3}}}\right)}{3 a^2} +$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)^3/(a+b\*cos(x)^3),x, algorithm="giac")

[Out]  $-1/3 \cdot b \cdot (-a/b)^{1/3} \cdot \log(\text{abs}(-(-a/b)^{1/3} + \cos(x))) / a^2 - 1/3 \cdot \log(\text{abs}(b \cdot \cos(x)^3 + a)) / a + \log(\text{abs}(\cos(x))) / a + 1/3 \cdot \sqrt{3} \cdot (-a \cdot b^2)^{1/3} \cdot \arctan(1/3 \cdot \sqrt{3} \cdot ((-a/b)^{1/3} + 2 \cdot \cos(x)) / (-a/b)^{1/3}) / a^2 + 1/6 \cdot (-a \cdot b^2)^{1/3} \cdot \log(\cos(x)^2 + (-a/b)^{1/3} \cdot \cos(x) + (-a/b)^{2/3}) / a^2 + 1/2 / (a \cdot \cos(x)^2)$



### 3.93 $\int \sqrt{a + b \cos^3(x)} \tan(x) dx$

**Optimal.** Leaf size=45

$$\frac{2}{3}\sqrt{a} \tanh^{-1}\left(\frac{\sqrt{a + b \cos^3(x)}}{\sqrt{a}}\right) - \frac{2}{3}\sqrt{a + b \cos^3(x)}$$

[Out] (2\*Sqrt[a]\*ArcTanh[Sqrt[a + b\*Cos[x]^3]/Sqrt[a]])/3 - (2\*Sqrt[a + b\*Cos[x]^3])/3

**Rubi [A]** time = 0.0729281, antiderivative size = 45, normalized size of antiderivative = 1., number of steps used = 5, number of rules used = 5, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3230, 266, 50, 63, 208}

$$\frac{2}{3}\sqrt{a} \tanh^{-1}\left(\frac{\sqrt{a + b \cos^3(x)}}{\sqrt{a}}\right) - \frac{2}{3}\sqrt{a + b \cos^3(x)}$$

Antiderivative was successfully verified.

[In] Int[Sqrt[a + b\*Cos[x]^3]\*Tan[x], x]

[Out] (2\*Sqrt[a]\*ArcTanh[Sqrt[a + b\*Cos[x]^3]/Sqrt[a]])/3 - (2\*Sqrt[a + b\*Cos[x]^3])/3

#### Rule 3230

Int[((a\_) + (b\_.)\*((c\_.)\*sin[(e\_.) + (f\_.)\*(x\_)])^(n\_))^(p\_.)\*tan[(e\_.) + (f\_.)\*(x\_)]^(m\_), x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x], x]}, Dist[ff^(m + 1)/f, Subst[Int[(x^m\*(a + b\*(c\*ff\*x)^n)^p]/(1 - ff^2\*x^2)^(m + 1)/2), x], x, Sin[e + f\*x]/ff, x] /; FreeQ[{a, b, c, e, f, n, p}, x] && IntegerQ[(m - 1)/2, 0]

#### Rule 266

Int[(x\_)^(m\_.)\*((a\_) + (b\_.)\*(x\_)^(n\_))^(p\_), x\_Symbol] := Dist[1/n, Subst[Int[x^(Simplify[(m + 1)/n] - 1)\*(a + b\*x)^p, x], x, x^n], x] /; FreeQ[{a, b, m, n, p}, x] && IntegerQ[Simplify[(m + 1)/n]]

#### Rule 50

Int[((a\_.) + (b\_.)\*(x\_))^(m\_.)\*((c\_.) + (d\_.)\*(x\_))^(n\_), x\_Symbol] := Simp[(a + b\*x)^(m + 1)\*(c + d\*x)^n/(b\*(m + n + 1)), x] + Dist[(n\*(b\*c - a\*d))/(b\*(m + n + 1)), Int[(a + b\*x)^m\*(c + d\*x)^(n - 1), x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0] && GtQ[n, 0] && NeQ[m + n + 1, 0] && !(IGtQ[m, 0] && (!IntegerQ[n] || (GtQ[m, 0] && LtQ[m - n, 0]))) && !ILtQ[m + n + 2, 0] && IntLinearQ[a, b, c, d, m, n, x]

#### Rule 63

Int[((a\_.) + (b\_.)\*(x\_))^(m\_.)\*((c\_.) + (d\_.)\*(x\_))^(n\_), x\_Symbol] := With[{p = Denominator[m]}, Dist[p/b, Subst[Int[x^(p\*(m + 1) - 1)\*(c - (a\*d)/b + (d\*x^p)/b)^n, x], x, (a + b\*x)^(1/p)], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0] && LtQ[-1, m, 0] && LeQ[-1, n, 0] && LeQ[Denominator[n], Denominator[m]] && IntLinearQ[a, b, c, d, m, n, x]

#### Rule 208

Int[((a\_) + (b\_.)\*(x\_)^2)^(-1), x\_Symbol] := Simp[(Rt[-(a/b), 2]\*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]

### Rubi steps

$$\begin{aligned}
 \int \sqrt{a + b \cos^3(x)} \tan(x) dx &= -\text{Subst} \left( \int \frac{\sqrt{a + bx^3}}{x} dx, x, \cos(x) \right) \\
 &= -\left( \frac{1}{3} \text{Subst} \left( \int \frac{\sqrt{a + bx}}{x} dx, x, \cos^3(x) \right) \right) \\
 &= -\frac{2}{3} \sqrt{a + b \cos^3(x)} - \frac{1}{3} a \text{Subst} \left( \int \frac{1}{x \sqrt{a + bx}} dx, x, \cos^3(x) \right) \\
 &= -\frac{2}{3} \sqrt{a + b \cos^3(x)} - \frac{(2a) \text{Subst} \left( \int \frac{1}{\frac{-a}{b} + \frac{x^2}{b}} dx, x, \sqrt{a + b \cos^3(x)} \right)}{3b} \\
 &= \frac{2}{3} \sqrt{a} \tanh^{-1} \left( \frac{\sqrt{a + b \cos^3(x)}}{\sqrt{a}} \right) - \frac{2}{3} \sqrt{a + b \cos^3(x)}
 \end{aligned}$$

**Mathematica [A]** time = 0.0249099, size = 45, normalized size = 1.

$$\frac{2}{3} \sqrt{a} \tanh^{-1} \left( \frac{\sqrt{a + b \cos^3(x)}}{\sqrt{a}} \right) - \frac{2}{3} \sqrt{a + b \cos^3(x)}$$

Antiderivative was successfully verified.

[In] Integrate[Sqrt[a + b\*Cos[x]^3]\*Tan[x], x]

[Out] (2\*Sqrt[a]\*ArcTanh[Sqrt[a + b\*Cos[x]^3]/Sqrt[a]])/3 - (2\*Sqrt[a + b\*Cos[x]^3])/3

**Maple [A]** time = 0.179, size = 34, normalized size = 0.8

$$\frac{2}{3} \text{Arctanh} \left( \sqrt{a + b (\cos(x))^3} \frac{1}{\sqrt{a}} \right) \sqrt{a} - \frac{2}{3} \sqrt{a + b (\cos(x))^3}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int((a+b\*cos(x)^3)^(1/2)\*tan(x), x)

[Out] 2/3\*arctanh((a+b\*cos(x)^3)^(1/2)/a^(1/2))\*a^(1/2)-2/3\*(a+b\*cos(x)^3)^(1/2)

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^3)^(1/2)\*tan(x), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 26.9559, size = 340, normalized size = 7.56

$$\left[ \frac{1}{6} \sqrt{a} \log \left( -\frac{b^2 \cos(x)^6 + 8ab \cos(x)^3 + 4(b \cos(x)^3 + 2a) \sqrt{b \cos(x)^3 + a} \sqrt{a + 8a^2}}{\cos(x)^6} \right) - \frac{2}{3} \sqrt{b \cos(x)^3 + a}, -\frac{1}{3} \sqrt{-a} \arctan \left( \frac{2 \sqrt{b \cos(x)^3 + a} \sqrt{-a}}{b \cos(x)^3 + 2a} \right) - \frac{2}{3} \sqrt{b \cos(x)^3 + a} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^3)^(1/2)\*tan(x),x, algorithm="fricas")

[Out] [1/6\*sqrt(a)\*log(-(b^2\*cos(x)^6 + 8\*a\*b\*cos(x)^3 + 4\*(b\*cos(x)^3 + 2\*a)\*sqrt(b\*cos(x)^3 + a)\*sqrt(a + 8\*a^2)/cos(x)^6) - 2/3\*sqrt(b\*cos(x)^3 + a), -1/3\*sqrt(-a)\*arctan(2\*sqrt(b\*cos(x)^3 + a)\*sqrt(-a)/(b\*cos(x)^3 + 2\*a)) - 2/3\*sqrt(b\*cos(x)^3 + a)]

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{a + b \cos^3(x)} \tan(x) dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)\*\*3)\*\*(1/2)\*tan(x),x)

[Out] Integral(sqrt(a + b\*cos(x)\*\*3)\*tan(x), x)

**Giac [A]** time = 1.17278, size = 51, normalized size = 1.13

$$-\frac{2a \arctan \left( \frac{\sqrt{b \cos(x)^3 + a}}{\sqrt{-a}} \right)}{3 \sqrt{-a}} - \frac{2}{3} \sqrt{b \cos(x)^3 + a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^3)^(1/2)\*tan(x),x, algorithm="giac")

[Out] -2/3\*a\*arctan(sqrt(b\*cos(x)^3 + a)/sqrt(-a))/sqrt(-a) - 2/3\*sqrt(b\*cos(x)^3 + a)

$$3.94 \quad \int \frac{\tan(x)}{\sqrt{a+b \cos^3(x)}} dx$$

Optimal. Leaf size=28

$$\frac{2 \tanh^{-1}\left(\frac{\sqrt{a+b \cos^3(x)}}{\sqrt{a}}\right)}{3\sqrt{a}}$$

[Out] (2\*ArcTanh[Sqrt[a + b\*Cos[x]^3]/Sqrt[a]])/(3\*Sqrt[a])

**Rubi [A]** time = 0.0673431, antiderivative size = 28, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.267$ , Rules used = {3230, 266, 63, 208}

$$\frac{2 \tanh^{-1}\left(\frac{\sqrt{a+b \cos^3(x)}}{\sqrt{a}}\right)}{3\sqrt{a}}$$

Antiderivative was successfully verified.

[In] Int[Tan[x]/Sqrt[a + b\*Cos[x]^3], x]

[Out] (2\*ArcTanh[Sqrt[a + b\*Cos[x]^3]/Sqrt[a]])/(3\*Sqrt[a])

#### Rule 3230

```
Int[((a_) + (b_.)*((c_.)*sin[(e_.) + (f_.)*(x_)])^(n_))^(p_.)*tan[(e_.) + (f_.)*(x_)]^(m_.), x_Symbol] :> With[{ff = FreeFactors[Sin[e + f*x], x]}, Dist[ff^(m + 1)/f, Subst[Int[(x^m*(a + b*(c*ff*x)^n)^p]/(1 - ff^2*x^2)^(m + 1)/2), x], x, Sin[e + f*x]/ff, x] /; FreeQ[{a, b, c, e, f, n, p}, x] && IntegerQ[(m - 1)/2, 0]
```

#### Rule 266

```
Int[(x_)^(m_.)*((a_) + (b_.)*(x_)^(n_))^(p_), x_Symbol] :> Dist[1/n, Subst[Int[x^(Simplify[(m + 1)/n] - 1)*(a + b*x)^p, x], x, x^n], x] /; FreeQ[{a, b, m, n, p}, x] && IntegerQ[Simplify[(m + 1)/n]]
```

#### Rule 63

```
Int[((a_.) + (b_.)*(x_)^(m_))*((c_.) + (d_.)*(x_)^(n_)), x_Symbol] :> With[{p = Denominator[m]}, Dist[p/b, Subst[Int[x^(p*(m + 1) - 1)*(c - (a*d)/b + (d*x^p)/b)^n, x], x, (a + b*x)^(1/p)], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b*c - a*d, 0] && LtQ[-1, m, 0] && LeQ[-1, n, 0] && LeQ[Denominator[n], Denominator[m]] && IntLinearQ[a, b, c, d, m, n, x]
```

#### Rule 208

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(Rt[-(a/b), 2]*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]
```

#### Rubi steps

$$\begin{aligned}
\int \frac{\tan(x)}{\sqrt{a+b\cos^3(x)}} dx &= -\text{Subst}\left(\int \frac{1}{x\sqrt{a+bx^3}} dx, x, \cos(x)\right) \\
&= -\left(\frac{1}{3}\text{Subst}\left(\int \frac{1}{x\sqrt{a+bx}} dx, x, \cos^3(x)\right)\right) \\
&\quad - 2\text{Subst}\left(\int \frac{1}{-\frac{a}{b}+\frac{x^2}{b}} dx, x, \sqrt{a+b\cos^3(x)}\right) \\
&= -\frac{3b}{3b} \\
&= \frac{2 \tanh^{-1}\left(\frac{\sqrt{a+b\cos^3(x)}}{\sqrt{a}}\right)}{3\sqrt{a}}
\end{aligned}$$

**Mathematica [A]** time = 0.0164719, size = 28, normalized size = 1.

$$\frac{2 \tanh^{-1}\left(\frac{\sqrt{a+b\cos^3(x)}}{\sqrt{a}}\right)}{3\sqrt{a}}$$

Antiderivative was successfully verified.

[In] Integrate[Tan[x]/Sqrt[a + b\*Cos[x]^3], x]

[Out] (2\*ArcTanh[Sqrt[a + b\*Cos[x]^3]/Sqrt[a]])/(3\*Sqrt[a])

**Maple [A]** time = 0.03, size = 21, normalized size = 0.8

$$\frac{2}{3} \text{Artanh}\left(\sqrt{a+b(\cos(x))^3} \frac{1}{\sqrt{a}}\right) \frac{1}{\sqrt{a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(tan(x)/(a+b\*cos(x)^3)^(1/2), x)

[Out] 2/3\*arctanh((a+b\*cos(x)^3)^(1/2)/a^(1/2))/a^(1/2)

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)^3)^(1/2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: UnboundLocalError

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(tan(x)/(a+b*cos(x)^3)^(1/2),x, algorithm="fricas")
```

```
[Out] Exception raised: UnboundLocalError
```

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\tan(x)}{\sqrt{a + b \cos^3(x)}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(tan(x)/(a+b*cos(x)**3)**(1/2),x)
```

```
[Out] Integral(tan(x)/sqrt(a + b*cos(x)**3), x)
```

**Giac [A]** time = 1.17449, size = 32, normalized size = 1.14

$$-\frac{2 \arctan\left(\frac{\sqrt{b \cos^3(x) + a}}{\sqrt{-a}}\right)}{3 \sqrt{-a}}$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate(tan(x)/(a+b*cos(x)^3)^(1/2),x, algorithm="giac")
```

```
[Out] -2/3*arctan(sqrt(b*cos(x)^3 + a)/sqrt(-a))/sqrt(-a)
```

### 3.95 $\int \sqrt{a + b \cos^4(x)} \tan(x) dx$

**Optimal.** Leaf size=45

$$\frac{1}{2}\sqrt{a} \tanh^{-1}\left(\frac{\sqrt{a + b \cos^4(x)}}{\sqrt{a}}\right) - \frac{1}{2}\sqrt{a + b \cos^4(x)}$$

[Out] (Sqrt[a]\*ArcTanh[Sqrt[a + b\*Cos[x]^4]/Sqrt[a]])/2 - Sqrt[a + b\*Cos[x]^4]/2

**Rubi [A]** time = 0.0765254, antiderivative size = 45, normalized size of antiderivative = 1., number of steps used = 5, number of rules used = 5, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3229, 266, 50, 63, 208}

$$\frac{1}{2}\sqrt{a} \tanh^{-1}\left(\frac{\sqrt{a + b \cos^4(x)}}{\sqrt{a}}\right) - \frac{1}{2}\sqrt{a + b \cos^4(x)}$$

Antiderivative was successfully verified.

[In] Int[Sqrt[a + b\*Cos[x]^4]\*Tan[x], x]

[Out] (Sqrt[a]\*ArcTanh[Sqrt[a + b\*Cos[x]^4]/Sqrt[a]])/2 - Sqrt[a + b\*Cos[x]^4]/2

#### Rule 3229

Int[((a\_) + (b\_)\*sin[(e\_) + (f\_)\*(x\_)]^(n\_))^(p\_)\*tan[(e\_) + (f\_)\*(x\_)]^(m\_), x\_Symbol] := With[{ff = FreeFactors[Sin[e + f\*x]^2, x]}, Dist[ff^((m + 1)/2)/(2\*f), Subst[Int[(x^((m - 1)/2)\*(a + b\*ff^(n/2)\*x^(n/2))]^(p)/(1 - ff\*x)^((m + 1)/2), x], x, Sin[e + f\*x]^2/ff, x] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2] && IntegerQ[n/2]

#### Rule 266

Int[(x\_)^(m\_)\*((a\_) + (b\_)\*(x\_)^(n\_))^(p\_), x\_Symbol] := Dist[1/n, Subst[Int[x^(Simplify[(m + 1)/n] - 1)\*(a + b\*x)^p, x], x, x^n], x] /; FreeQ[{a, b, m, n, p}, x] && IntegerQ[Simplify[(m + 1)/n]]

#### Rule 50

Int[((a\_) + (b\_)\*(x\_))^(m\_)\*((c\_) + (d\_)\*(x\_))^(n\_), x\_Symbol] := Simp[(a + b\*x)^(m + 1)\*(c + d\*x)^n/(b\*(m + n + 1)), x] + Dist[(n\*(b\*c - a\*d))/(b\*(m + n + 1)), Int[(a + b\*x)^m\*(c + d\*x)^(n - 1), x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0] && GtQ[n, 0] && NeQ[m + n + 1, 0] && !(IGtQ[m, 0] && (!IntegerQ[n] || (GtQ[m, 0] && LtQ[m - n, 0]))) && !ILtQ[m + n + 2, 0] && IntLinearQ[a, b, c, d, m, n, x]

#### Rule 63

Int[((a\_) + (b\_)\*(x\_))^(m\_)\*((c\_) + (d\_)\*(x\_))^(n\_), x\_Symbol] := With[{p = Denominator[m]}, Dist[p/b, Subst[Int[x^(p\*(m + 1) - 1)\*(c - (a\*d)/b + (d\*x^p)/b)^n, x], x, (a + b\*x)^(1/p)], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b\*c - a\*d, 0] && LtQ[-1, m, 0] && LeQ[-1, n, 0] && LeQ[Denominator[n], Denominator[m]] && IntLinearQ[a, b, c, d, m, n, x]

#### Rule 208

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[-(a/b), 2]*ArcTanh[x/
Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]
```

### Rubi steps

$$\begin{aligned}
\int \sqrt{a + b \cos^4(x)} \tan(x) dx &= -\left(\frac{1}{2} \text{Subst}\left(\int \frac{\sqrt{a + bx^2}}{x} dx, x, \cos^2(x)\right)\right) \\
&= -\left(\frac{1}{4} \text{Subst}\left(\int \frac{\sqrt{a + bx}}{x} dx, x, \cos^4(x)\right)\right) \\
&= -\frac{1}{2}\sqrt{a + b \cos^4(x)} - \frac{1}{4}a \text{Subst}\left(\int \frac{1}{x\sqrt{a + bx}} dx, x, \cos^4(x)\right) \\
&= -\frac{1}{2}\sqrt{a + b \cos^4(x)} - \frac{a \text{Subst}\left(\int \frac{1}{\frac{-a}{b} + \frac{x^2}{b}} dx, x, \sqrt{a + b \cos^4(x)}\right)}{2b} \\
&= \frac{1}{2}\sqrt{a} \tanh^{-1}\left(\frac{\sqrt{a + b \cos^4(x)}}{\sqrt{a}}\right) - \frac{1}{2}\sqrt{a + b \cos^4(x)}
\end{aligned}$$

**Mathematica [A]** time = 0.0314078, size = 45, normalized size = 1.

$$\frac{1}{2}\sqrt{a} \tanh^{-1}\left(\frac{\sqrt{a + b \cos^4(x)}}{\sqrt{a}}\right) - \frac{1}{2}\sqrt{a + b \cos^4(x)}$$

Antiderivative was successfully verified.

```
[In] Integrate[Sqrt[a + b*Cos[x]^4]*Tan[x], x]
```

```
[Out] (Sqrt[a]*ArcTanh[Sqrt[a + b*Cos[x]^4]/Sqrt[a]])/2 - Sqrt[a + b*Cos[x]^4]/2
```

**Maple [A]** time = 0.032, size = 44, normalized size = 1.

$$-\frac{1}{2}\sqrt{a + b(\cos(x))^4} + \frac{1}{2}\sqrt{a} \ln\left(\frac{1}{(\cos(x))^2} \left(2a + 2\sqrt{a}\sqrt{a + b(\cos(x))^4}\right)\right)$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] int((a+b*cos(x)^4)^(1/2)*tan(x), x)
```

```
[Out] -1/2*(a+b*cos(x)^4)^(1/2)+1/2*a^(1/2)*ln((2*a+2*a^(1/2)*(a+b*cos(x)^4)^(1/2)
)/cos(x)^2)
```

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate((a+b*cos(x)^4)^(1/2)*tan(x), x, algorithm="maxima")
```



[Out] Exception raised: ValueError

**Fricas [A]** time = 3.21236, size = 259, normalized size = 5.76

$$\left[ \frac{1}{4} \sqrt{a} \log \left( \frac{b \cos(x)^4 + 2 \sqrt{b \cos(x)^4 + a} \sqrt{a} + 2a}{\cos(x)^4} \right) - \frac{1}{2} \sqrt{b \cos(x)^4 + a}, -\frac{1}{2} \sqrt{-a} \arctan \left( \frac{\sqrt{b \cos(x)^4 + a} \sqrt{-a}}{a} \right) - \frac{1}{2} \sqrt{-a} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^4)^(1/2)\*tan(x),x, algorithm="fricas")

[Out] [1/4\*sqrt(a)\*log((b\*cos(x)^4 + 2\*sqrt(b\*cos(x)^4 + a)\*sqrt(a) + 2\*a)/cos(x)^4) - 1/2\*sqrt(b\*cos(x)^4 + a), -1/2\*sqrt(-a)\*arctan(sqrt(b\*cos(x)^4 + a)\*sqrt(-a)/a) - 1/2\*sqrt(b\*cos(x)^4 + a)]

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{a + b \cos^4(x)} \tan(x) dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)\*\*4)\*\*(1/2)\*tan(x),x)

[Out] Integral(sqrt(a + b\*cos(x)\*\*4)\*tan(x), x)

**Giac [A]** time = 1.15677, size = 51, normalized size = 1.13

$$-\frac{a \arctan \left( \frac{\sqrt{b \cos(x)^4 + a}}{\sqrt{-a}} \right)}{2 \sqrt{-a}} - \frac{1}{2} \sqrt{b \cos(x)^4 + a}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate((a+b\*cos(x)^4)^(1/2)\*tan(x),x, algorithm="giac")

[Out] -1/2\*a\*arctan(sqrt(b\*cos(x)^4 + a)/sqrt(-a))/sqrt(-a) - 1/2\*sqrt(b\*cos(x)^4 + a)

$$3.96 \quad \int \frac{\tan(x)}{\sqrt{a+b \cos^4(x)}} dx$$

**Optimal.** Leaf size=28

$$\frac{\tanh^{-1}\left(\frac{\sqrt{a+b \cos^4(x)}}{\sqrt{a}}\right)}{2\sqrt{a}}$$

[Out] ArcTanh[Sqrt[a + b\*Cos[x]^4]/Sqrt[a]]/(2\*Sqrt[a])

**Rubi [A]** time = 0.0709482, antiderivative size = 28, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.267$ , Rules used = {3229, 266, 63, 208}

$$\frac{\tanh^{-1}\left(\frac{\sqrt{a+b \cos^4(x)}}{\sqrt{a}}\right)}{2\sqrt{a}}$$

Antiderivative was successfully verified.

[In] Int[Tan[x]/Sqrt[a + b\*Cos[x]^4], x]

[Out] ArcTanh[Sqrt[a + b\*Cos[x]^4]/Sqrt[a]]/(2\*Sqrt[a])

#### Rule 3229

```
Int[((a_) + (b_)*sin[(e_) + (f_)*(x_)^(n_)])^(p_)*tan[(e_) + (f_)*(x_)^(m_)], x_Symbol] := With[{ff = FreeFactors[Sin[e + f*x]^2, x]}, Dist[ff^((m + 1)/2)/(2*f), Subst[Int[(x^((m - 1)/2)*(a + b*ff^(n/2)*x^(n/2))^p]/(1 - ff*x)^((m + 1)/2), x], x, Sin[e + f*x]^2/ff], x]] /; FreeQ[{a, b, e, f, p}, x] && IntegerQ[(m - 1)/2] && IntegerQ[n/2]
```

#### Rule 266

```
Int[(x_)^(m_)*((a_) + (b_)*(x_)^(n_))^(p_), x_Symbol] := Dist[1/n, Subst[Int[x^(Simplify[(m + 1)/n] - 1)*(a + b*x)^p, x], x, x^n], x] /; FreeQ[{a, b, m, n, p}, x] && IntegerQ[Simplify[(m + 1)/n]]
```

#### Rule 63

```
Int[((a_) + (b_)*(x_)^(m_))*((c_) + (d_)*(x_)^(n_)), x_Symbol] := With[{p = Denominator[m]}, Dist[p/b, Subst[Int[x^(p*(m + 1) - 1)*(c - (a*d)/b + (d*x^p)/b)^n, x], x, (a + b*x)^(1/p)], x]] /; FreeQ[{a, b, c, d}, x] && NeQ[b*c - a*d, 0] && LtQ[-1, m, 0] && LeQ[-1, n, 0] && LeQ[Denominator[n], Denominator[m]] && IntLinearQ[a, b, c, d, m, n, x]
```

#### Rule 208

```
Int[((a_) + (b_)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[-(a/b), 2]*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]
```

#### Rubi steps

$$\begin{aligned}
\int \frac{\tan(x)}{\sqrt{a+b\cos^4(x)}} dx &= -\left(\frac{1}{2} \text{Subst}\left(\int \frac{1}{x\sqrt{a+bx^2}} dx, x, \cos^2(x)\right)\right) \\
&= -\left(\frac{1}{4} \text{Subst}\left(\int \frac{1}{x\sqrt{a+bx}} dx, x, \cos^4(x)\right)\right) \\
&= -\frac{\text{Subst}\left(\int \frac{1}{-\frac{a}{b}+\frac{x^2}{b}} dx, x, \sqrt{a+b\cos^4(x)}\right)}{2b} \\
&= \frac{\tanh^{-1}\left(\frac{\sqrt{a+b\cos^4(x)}}{\sqrt{a}}\right)}{2\sqrt{a}}
\end{aligned}$$

**Mathematica [A]** time = 0.0162997, size = 28, normalized size = 1.

$$\frac{\tanh^{-1}\left(\frac{\sqrt{a+b\cos^4(x)}}{\sqrt{a}}\right)}{2\sqrt{a}}$$

Antiderivative was successfully verified.

[In] Integrate[Tan[x]/Sqrt[a + b\*Cos[x]^4], x]

[Out] ArcTanh[Sqrt[a + b\*Cos[x]^4]/Sqrt[a]]/(2\*Sqrt[a])

**Maple [A]** time = 0.033, size = 31, normalized size = 1.1

$$\frac{1}{2} \ln\left(\frac{1}{(\cos(x))^2} \left(2a + 2\sqrt{a}\sqrt{a+b(\cos(x))^4}\right)\right) \frac{1}{\sqrt{a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(tan(x)/(a+b\*cos(x)^4)^(1/2), x)

[Out] 1/2/a^(1/2)\*ln((2\*a+2\*a^(1/2)\*(a+b\*cos(x)^4)^(1/2))/cos(x)^2)

**Maxima [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\tan(x)}{\sqrt{b\cos^4(x)+a}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)^4)^(1/2), x, algorithm="maxima")

[Out] integrate(tan(x)/sqrt(b\*cos(x)^4 + a), x)

**Fricas [A]** time = 2.88549, size = 189, normalized size = 6.75

$$\left[ \frac{\log\left(\frac{b \cos(x)^4 + 2\sqrt{b \cos(x)^4 + a}\sqrt{a} + 2a}{\cos(x)^4}\right)}{4\sqrt{a}}, -\frac{\sqrt{-a} \arctan\left(\frac{\sqrt{b \cos(x)^4 + a}\sqrt{-a}}{a}\right)}{2a} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)^4)^(1/2),x, algorithm="fricas")

[Out] [1/4\*log((b\*cos(x)^4 + 2\*sqrt(b\*cos(x)^4 + a)\*sqrt(a) + 2\*a)/cos(x)^4)/sqrt(a), -1/2\*sqrt(-a)\*arctan(sqrt(b\*cos(x)^4 + a)\*sqrt(-a)/a)/a]

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\tan(x)}{\sqrt{a + b \cos^4(x)}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)\*\*4)\*\*(1/2),x)

[Out] Integral(tan(x)/sqrt(a + b\*cos(x)\*\*4), x)

**Giac [A]** time = 1.15093, size = 32, normalized size = 1.14

$$-\frac{\arctan\left(\frac{\sqrt{b \cos(x)^4 + a}}{\sqrt{-a}}\right)}{2\sqrt{-a}}$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)^4)^(1/2),x, algorithm="giac")

[Out] -1/2\*arctan(sqrt(b\*cos(x)^4 + a)/sqrt(-a))/sqrt(-a)

### 3.97 $\int \sqrt{a + b \cos^n(x)} \tan(x) dx$

**Optimal.** Leaf size=47

$$\frac{2\sqrt{a} \tanh^{-1}\left(\frac{\sqrt{a+b \cos^n(x)}}{\sqrt{a}}\right)}{n} - \frac{2\sqrt{a + b \cos^n(x)}}{n}$$

[Out] (2\*Sqrt[a]\*ArcTanh[Sqrt[a + b\*Cos[x]^n]/Sqrt[a]])/n - (2\*Sqrt[a + b\*Cos[x]^n])/n

**Rubi [A]** time = 0.0788629, antiderivative size = 47, normalized size of antiderivative = 1., number of steps used = 5, number of rules used = 5, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.333$ , Rules used = {3230, 266, 50, 63, 208}

$$\frac{2\sqrt{a} \tanh^{-1}\left(\frac{\sqrt{a+b \cos^n(x)}}{\sqrt{a}}\right)}{n} - \frac{2\sqrt{a + b \cos^n(x)}}{n}$$

Antiderivative was successfully verified.

[In] Int[Sqrt[a + b\*Cos[x]^n]\*Tan[x], x]

[Out] (2\*Sqrt[a]\*ArcTanh[Sqrt[a + b\*Cos[x]^n]/Sqrt[a]])/n - (2\*Sqrt[a + b\*Cos[x]^n])/n

#### Rule 3230

```
Int[((a_) + (b_.)*((c_.)*sin[(e_.) + (f_.)*(x_)])^(n_))^(p_.)*tan[(e_.) + (f_.)*(x_)]^(m_.), x_Symbol] := With[{ff = FreeFactors[Sin[e + f*x], x]}, Dist[ff^(m + 1)/f, Subst[Int[(x^m*(a + b*(c*ff*x)^n)^p]/(1 - ff^2*x^2)^((m + 1)/2), x], x, Sin[e + f*x]/ff, x] /; FreeQ[{a, b, c, e, f, n, p}, x] && IntegerQ[(m - 1)/2, 0]
```

#### Rule 266

```
Int[(x_)^(m_.)*((a_) + (b_.)*(x_)^(n_))^(p_), x_Symbol] := Dist[1/n, Subst[Int[x^(Simplify[(m + 1)/n] - 1)*(a + b*x)^p, x], x, x^n], x] /; FreeQ[{a, b, m, n, p}, x] && IntegerQ[Simplify[(m + 1)/n]]
```

#### Rule 50

```
Int[((a_.) + (b_.)*(x_))^(m_.)*((c_.) + (d_.)*(x_))^(n_), x_Symbol] := Simp[((a + b*x)^(m + 1)*(c + d*x)^n)/(b*(m + n + 1)), x] + Dist[(n*(b*c - a*d))/(b*(m + n + 1)), Int[(a + b*x)^m*(c + d*x)^(n - 1), x], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b*c - a*d, 0] && GtQ[n, 0] && NeQ[m + n + 1, 0] && !(IGtQ[m, 0] && (!IntegerQ[n] || (GtQ[m, 0] && LtQ[m - n, 0]))) && !ILtQ[m + n + 2, 0] && IntLinearQ[a, b, c, d, m, n, x]
```

#### Rule 63

```
Int[((a_.) + (b_.)*(x_))^(m_.)*((c_.) + (d_.)*(x_))^(n_), x_Symbol] := With[{p = Denominator[m]}, Dist[p/b, Subst[Int[x^(p*(m + 1) - 1)*(c - (a*d)/b + (d*x^p)/b)^n, x], x, (a + b*x)^(1/p)], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b*c - a*d, 0] && LtQ[-1, m, 0] && LeQ[-1, n, 0] && LeQ[Denominator[n], Denominator[m]] && IntLinearQ[a, b, c, d, m, n, x]
```

**Rule 208**

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] := Simp[(Rt[-(a/b), 2]*ArcTanh[x/
Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]
```

**Rubi steps**

$$\begin{aligned}
\int \sqrt{a + b \cos^n(x)} \tan(x) dx &= -\text{Subst} \left( \int \frac{\sqrt{a + bx^n}}{x} dx, x, \cos(x) \right) \\
&= -\frac{\text{Subst} \left( \int \frac{\sqrt{a+bx}}{x} dx, x, \cos^n(x) \right)}{n} \\
&= -\frac{2\sqrt{a + b \cos^n(x)}}{n} - \frac{a \text{Subst} \left( \int \frac{1}{x\sqrt{a+bx}} dx, x, \cos^n(x) \right)}{n} \\
&= -\frac{2\sqrt{a + b \cos^n(x)}}{n} - \frac{(2a) \text{Subst} \left( \int \frac{1}{-\frac{a}{b} + \frac{x^2}{b}} dx, x, \sqrt{a + b \cos^n(x)} \right)}{bn} \\
&= \frac{2\sqrt{a} \tanh^{-1} \left( \frac{\sqrt{a+b \cos^n(x)}}{\sqrt{a}} \right)}{n} - \frac{2\sqrt{a + b \cos^n(x)}}{n}
\end{aligned}$$

**Mathematica [A]** time = 0.0303867, size = 46, normalized size = 0.98

$$-\frac{2\sqrt{a + b \cos^n(x)} - 2\sqrt{a} \tanh^{-1} \left( \frac{\sqrt{a+b \cos^n(x)}}{\sqrt{a}} \right)}{n}$$

Antiderivative was successfully verified.

```
[In] Integrate[Sqrt[a + b*Cos[x]^n]*Tan[x], x]
```

```
[Out] -((-2*Sqrt[a]*ArcTanh[Sqrt[a + b*Cos[x]^n]/Sqrt[a]] + 2*Sqrt[a + b*Cos[x]^n
])/n)
```

**Maple [A]** time = 0.02, size = 39, normalized size = 0.8

$$-\frac{1}{n} \left( 2\sqrt{a + b (\cos(x))^n} - 2\sqrt{a} \text{Artanh} \left( \frac{\sqrt{a + b (\cos(x))^n}}{\sqrt{a}} \right) \right)$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] int((a+b*cos(x)^n)^(1/2)*tan(x), x)
```

```
[Out] -1/n*(2*(a+b*cos(x)^n)^(1/2)-2*a^(1/2)*arctanh((a+b*cos(x)^n)^(1/2)/a^(1/2)
))
```

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate((a+b*cos(x)^n)^(1/2)*tan(x),x, algorithm="maxima")
```

```
[Out] Exception raised: ValueError
```

**Fricas [A]** time = 2.10222, size = 254, normalized size = 5.4

$$\left[ \frac{\sqrt{a} \log\left(\frac{b \cos(x)^n + 2\sqrt{b \cos(x)^n + a}\sqrt{a} + 2a}{\cos(x)^n}\right) - 2\sqrt{b \cos(x)^n + a}}{n}, -\frac{2\left(\sqrt{-a} \arctan\left(\frac{\sqrt{b \cos(x)^n + a}\sqrt{-a}}{a}\right) + \sqrt{b \cos(x)^n + a}\right)}{n} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate((a+b*cos(x)^n)^(1/2)*tan(x),x, algorithm="fricas")
```

```
[Out] [(sqrt(a)*log((b*cos(x)^n + 2*sqrt(b*cos(x)^n + a)*sqrt(a) + 2*a)/cos(x)^n)
- 2*sqrt(b*cos(x)^n + a))/n, -2*(sqrt(-a)*arctan(sqrt(b*cos(x)^n + a)*sqrt
(-a)/a) + sqrt(b*cos(x)^n + a))/n]
```

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{a + b \cos^n(x)} \tan(x) dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate((a+b*cos(x)**n)**(1/2)*tan(x),x)
```

```
[Out] Integral(sqrt(a + b*cos(x)**n)*tan(x), x)
```

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \sqrt{b \cos(x)^n + a} \tan(x) dx$$

Verification of antiderivative is not currently implemented for this CAS.

```
[In] integrate((a+b*cos(x)^n)^(1/2)*tan(x),x, algorithm="giac")
```

```
[Out] integrate(sqrt(b*cos(x)^n + a)*tan(x), x)
```

$$3.98 \quad \int \frac{\tan(x)}{\sqrt{a+b \cos^n(x)}} dx$$

**Optimal.** Leaf size=29

$$\frac{2 \tanh^{-1}\left(\frac{\sqrt{a+b \cos^n(x)}}{\sqrt{a}}\right)}{\sqrt{an}}$$

[Out] (2\*ArcTanh[Sqrt[a + b\*Cos[x]^n]/Sqrt[a]])/(Sqrt[a]\*n)

**Rubi [A]** time = 0.0769956, antiderivative size = 29, normalized size of antiderivative = 1., number of steps used = 4, number of rules used = 4, integrand size = 15,  $\frac{\text{number of rules}}{\text{integrand size}} = 0.267$ , Rules used = {3230, 266, 63, 208}

$$\frac{2 \tanh^{-1}\left(\frac{\sqrt{a+b \cos^n(x)}}{\sqrt{a}}\right)}{\sqrt{an}}$$

Antiderivative was successfully verified.

[In] Int[Tan[x]/Sqrt[a + b\*Cos[x]^n], x]

[Out] (2\*ArcTanh[Sqrt[a + b\*Cos[x]^n]/Sqrt[a]])/(Sqrt[a]\*n)

#### Rule 3230

```
Int[((a_) + (b_.)*((c_.)*sin[(e_.) + (f_.)*(x_)])^(n_))^(p_.)*tan[(e_.) + (f_.)*(x_)]^(m_.), x_Symbol] :> With[{ff = FreeFactors[Sin[e + f*x], x]}, Dist[ff^(m + 1)/f, Subst[Int[(x^m*(a + b*(c*ff*x)^n)^p]/(1 - ff^2*x^2)^(m + 1)/2), x], x, Sin[e + f*x]/ff, x] /; FreeQ[{a, b, c, e, f, n, p}, x] && IntegerQ[(m - 1)/2, 0]
```

#### Rule 266

```
Int[(x_)^(m_.)*((a_) + (b_.)*(x_)^(n_))^(p_), x_Symbol] :> Dist[1/n, Subst[Int[x^(Simplify[(m + 1)/n] - 1)*(a + b*x)^p], x, x^n], x] /; FreeQ[{a, b, m, n, p}, x] && IntegerQ[Simplify[(m + 1)/n]]
```

#### Rule 63

```
Int[((a_.) + (b_.)*(x_))^(m_.)*((c_.) + (d_.)*(x_))^(n_.), x_Symbol] :> With[{p = Denominator[m]}, Dist[p/b, Subst[Int[x^(p*(m + 1) - 1)*(c - (a*d)/b + (d*x^p)/b)^n], x, (a + b*x)^(1/p)], x] /; FreeQ[{a, b, c, d}, x] && NeQ[b*c - a*d, 0] && LtQ[-1, m, 0] && LeQ[-1, n, 0] && LeQ[Denominator[n], Denominator[m]] && IntLinearQ[a, b, c, d, m, n, x]
```

#### Rule 208

```
Int[((a_) + (b_.)*(x_)^2)^(-1), x_Symbol] :> Simp[(Rt[-(a/b), 2]*ArcTanh[x/Rt[-(a/b), 2]])/a, x] /; FreeQ[{a, b}, x] && NegQ[a/b]
```

#### Rubi steps



$$\begin{aligned}
\int \frac{\tan(x)}{\sqrt{a+b\cos^n(x)}} dx &= -\text{Subst}\left(\int \frac{1}{x\sqrt{a+bx^n}} dx, x, \cos(x)\right) \\
&= -\frac{\text{Subst}\left(\int \frac{1}{x\sqrt{a+bx}} dx, x, \cos^n(x)\right)}{n} \\
&= -\frac{2\text{Subst}\left(\int \frac{1}{-\frac{a}{b}+\frac{x^2}{b}} dx, x, \sqrt{a+b\cos^n(x)}\right)}{bn} \\
&= \frac{2\text{tanh}^{-1}\left(\frac{\sqrt{a+b\cos^n(x)}}{\sqrt{a}}\right)}{\sqrt{an}}
\end{aligned}$$

**Mathematica [A]** time = 0.0152863, size = 29, normalized size = 1.

$$\frac{2\text{tanh}^{-1}\left(\frac{\sqrt{a+b\cos^n(x)}}{\sqrt{a}}\right)}{\sqrt{an}}$$

Antiderivative was successfully verified.

[In] Integrate[Tan[x]/Sqrt[a + b\*Cos[x]^n], x]

[Out] (2\*ArcTanh[Sqrt[a + b\*Cos[x]^n]/Sqrt[a]])/(Sqrt[a]\*n)

**Maple [A]** time = 0.02, size = 24, normalized size = 0.8

$$2\frac{1}{n\sqrt{a}}\text{Artanh}\left(\frac{\sqrt{a+b(\cos(x))^n}}{\sqrt{a}}\right)$$

Verification of antiderivative is not currently implemented for this CAS.

[In] int(tan(x)/(a+b\*cos(x)^n)^(1/2), x)

[Out] 2\*arctanh((a+b\*cos(x)^n)^(1/2)/a^(1/2))/n/a^(1/2)

**Maxima [F(-2)]** time = 0., size = 0, normalized size = 0.

Exception raised: ValueError

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)^n)^(1/2), x, algorithm="maxima")

[Out] Exception raised: ValueError

**Fricas [A]** time = 1.96476, size = 192, normalized size = 6.62

$$\left[ \frac{\log\left(\frac{b\cos(x)^n+2\sqrt{b\cos(x)^n+a}\sqrt{a+2a}}{\cos(x)^n}\right)}{\sqrt{an}}, -\frac{2\sqrt{-a}\arctan\left(\frac{\sqrt{b\cos(x)^n+a}\sqrt{-a}}{a}\right)}{an} \right]$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)^n)^(1/2),x, algorithm="fricas")

[Out] [log((b\*cos(x)^n + 2\*sqrt(b\*cos(x)^n + a)\*sqrt(a) + 2\*a)/cos(x)^n)/(sqrt(a)\*n), -2\*sqrt(-a)\*arctan(sqrt(b\*cos(x)^n + a)\*sqrt(-a)/a)/(a\*n)]

**Sympy [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\tan(x)}{\sqrt{a + b \cos^n(x)}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)\*\*n)\*\*(1/2),x)

[Out] Integral(tan(x)/sqrt(a + b\*cos(x)\*\*n), x)

**Giac [F]** time = 0., size = 0, normalized size = 0.

$$\int \frac{\tan(x)}{\sqrt{b \cos(x)^n + a}} dx$$

Verification of antiderivative is not currently implemented for this CAS.

[In] integrate(tan(x)/(a+b\*cos(x)^n)^(1/2),x, algorithm="giac")

[Out] integrate(tan(x)/sqrt(b\*cos(x)^n + a), x)

# Chapter 4

## Listing of Grading functions

The following are the current version of the grading functions used for grading the quality of the antiderivative with reference to the optimal antiderivative included in the test suite.

There is a version for Maple and for Mathematica/Rubi. There is a version for grading Sympy and version for use with Sagemath.

The following are links to the current source code.

The following are the listings of source code of the grading functions.

### 4.0.1 Mathematica and Rubi grading function

```
1 (* Original version thanks to Albert Rich emailed on 03/21/2017 *)
2 (* ::Package:: *)
3
4 (* ::Subsection:: *)
5 (*GradeAntiderivative[result,optimal]*)
6
7
8 (* ::Text:: *)
9 (*If result and optimal are mathematical expressions, *)
10 (*      GradeAntiderivative[result,optimal] returns*)
11 (* "F" if the result fails to integrate an expression that*)
12 (*   is integrable*)
13 (* "C" if result involves higher level functions than necessary*)
14 (* "B" if result is more than twice the size of the optimal*)
15 (*   antiderivative*)
16 (* "A" if result can be considered optimal*)
17
18
19 GradeAntiderivative[result_,optimal_] :=
20   If[ExpnType[result]<=ExpnType[optimal],
21     If[FreeQ[result,Complex] || Not[FreeQ[optimal,Complex]],
22       If[LeafCount[result]<=2*LeafCount[optimal],
23         "A",
24         "B"],
25       "C"],
26     If[FreeQ[result,Integrate] && FreeQ[result,Int],
27       "C",
28       "F"]]
29
30
31 (* ::Text:: *)
32 (*The following summarizes the type number assigned an *)
33 (*expression based on the functions it involves*)
34 (*1 = rational function*)
35 (*2 = algebraic function*)
36 (*3 = elementary function*)
37 (*4 = special function*)
```



```

101 AppellFunctionQ[func_] :=
102   MemberQ[{AppellF1},func]

```

## 4.0.2 Maple grading function

```

1 # File: GradeAntiderivative.mpl
2 # Original version thanks to Albert Rich emailed on 03/21/2017
3
4 #Nasser 03/22/2017 Use Maple leaf count instead since buildin
5 #Nasser 03/23/2017 missing 'ln' for ElementaryFunctionQ added
6 #Nasser 03/24/2017 corrected the check for complex result
7 #Nasser 10/27/2017 check for leafsize and do not call ExpnType()
8 # if leaf size is "too large". Set at 500,000
9 #Nasser 12/22/2019 Added debug flag, added 'dilog' to special functions
10 # see problem 156, file Apostol_Problems
11
12 GradeAntiderivative := proc(result,optimal)
13 local leaf_count_result, leaf_count_optimal,ExpnType_result,ExpnType_optimal,
14     debug:=false;
15
16     leaf_count_result:=leafcount(result);
17     #do NOT call ExpnType() if leaf size is too large. Recursion problem
18     if leaf_count_result > 500000 then
19         return "B";
20     fi;
21
22     leaf_count_optimal:=leafcount(optimal);
23
24     ExpnType_result:=ExpnType(result);
25     ExpnType_optimal:=ExpnType(optimal);
26
27     if debug then
28         print("ExpnType_result",ExpnType_result," ExpnType_optimal=",
29             ExpnType_optimal);
30     fi;
31
32 # If result and optimal are mathematical expressions,
33 # GradeAntiderivative[result,optimal] returns
34 # "F" if the result fails to integrate an expression that
35 # is integrable
36 # "C" if result involves higher level functions than necessary
37 # "B" if result is more than twice the size of the optimal
38 # antiderivative
39 # "A" if result can be considered optimal
40
41 #This check below actually is not needed, since I only
42 #call this grading only for passed integrals. i.e. I check
43 #for "F" before calling this. But no harm of keeping it here.
44 #just in case.
45
46 if not type(result,freeof('int')) then
47     return "F";
48 end if;
49
50 if ExpnType_result<=ExpnType_optimal then
51     if debug then
52         print("ExpnType_result<=ExpnType_optimal");
53     fi;
54     if is_contains_complex(result) then
55         if is_contains_complex(optimal) then
56             if debug then

```

```

57         print("both result and optimal complex");
58         fi;
59         #both result and optimal complex
60         if leaf_count_result<=2*leaf_count_optimal then
61             return "A";
62         else
63             return "B";
64         end if
65     else #result contains complex but optimal is not
66         if debug then
67             print("result contains complex but optimal is not");
68         fi;
69         return "C";
70     end if
71 else # result do not contain complex
72     # this assumes optimal do not as well
73     if debug then
74         print("result do not contain complex, this assumes optimal do
not as well");
75     fi;
76     if leaf_count_result<=2*leaf_count_optimal then
77         if debug then
78             print("leaf_count_result<=2*leaf_count_optimal");
79         fi;
80         return "A";
81     else
82         if debug then
83             print("leaf_count_result>2*leaf_count_optimal");
84         fi;
85         return "B";
86     end if
87 end if
88 else #ExpnType(result) > ExpnType(optimal)
89     if debug then
90         print("ExpnType(result) > ExpnType(optimal)");
91     fi;
92     return "C";
93 end if
94
95 end proc:
96
97 #
98 # is_contains_complex(result)
99 # takes expressions and returns true if it contains "I" else false
100 #
101 #Nasser 032417
102 is_contains_complex:= proc(expression)
103     return (has(expression,I));
104 end proc:
105
106 # The following summarizes the type number assigned an expression
107 # based on the functions it involves
108 # 1 = rational function
109 # 2 = algebraic function
110 # 3 = elementary function
111 # 4 = special function
112 # 5 = hyperpergeometric function
113 # 6 = appell function
114 # 7 = rootsum function
115 # 8 = integrate function
116 # 9 = unknown function
117
118 ExpnType := proc(expn)

```

```

119   if type(expn,'atomic') then
120     1
121   elif type(expn,'list') then
122     apply(max,map(ExpnType,expn))
123   elif type(expn,'sqrt') then
124     if type(op(1,expn),'rational') then
125       1
126     else
127       max(2,ExpnType(op(1,expn)))
128     end if
129   elif type(expn,'`^`') then
130     if type(op(2,expn),'integer') then
131       ExpnType(op(1,expn))
132     elif type(op(2,expn),'rational') then
133       if type(op(1,expn),'rational') then
134         1
135       else
136         max(2,ExpnType(op(1,expn)))
137       end if
138     else
139       max(3,ExpnType(op(1,expn)),ExpnType(op(2,expn)))
140     end if
141   elif type(expn,'`+`') or type(expn,'`*`') then
142     max(ExpnType(op(1,expn)),max(ExpnType(rest(expn))))
143   elif ElementaryFunctionQ(op(0,expn)) then
144     max(3,ExpnType(op(1,expn)))
145   elif SpecialFunctionQ(op(0,expn)) then
146     max(4,apply(max,map(ExpnType,[op(expn)])))
147   elif HypergeometricFunctionQ(op(0,expn)) then
148     max(5,apply(max,map(ExpnType,[op(expn)])))
149   elif AppellFunctionQ(op(0,expn)) then
150     max(6,apply(max,map(ExpnType,[op(expn)])))
151   elif op(0,expn)='int' then
152     max(8,apply(max,map(ExpnType,[op(expn)]))) else
153     9
154   end if
155 end proc:
156
157
158 ElementaryFunctionQ := proc(func)
159   member(func,[
160     exp,log,ln,
161     sin,cos,tan,cot,sec,csc,
162     arcsin,arccos,arctan,arccot,arcsec,arccsc,
163     sinh,cosh,tanh,coth,sech,csch,
164     arcsinh,arccosh,arctanh,arccoth,arcsech,arccsch])
165 end proc:
166
167 SpecialFunctionQ := proc(func)
168   member(func,[
169     erf,erfc,erfi,
170     FresnelS,FresnelC,
171     Ei,Ei,Li,Si,Ci,Shi,Chi,
172     GAMMA,lnGAMMA,Psi,Zeta,polylog,dilog,LambertW,
173     EllipticF,EllipticE,EllipticPi])
174 end proc:
175
176 HypergeometricFunctionQ := proc(func)
177   member(func,[Hypergeometric1F1,hypergeom,HypergeometricPFQ])
178 end proc:
179
180 AppellFunctionQ := proc(func)
181   member(func,[AppellF1])

```

```

182 end proc:
183
184 # u is a sum or product. rest(u) returns all but the
185 # first term or factor of u.
186 rest := proc(u) local v;
187     if nops(u)=2 then
188         op(2,u)
189     else
190         apply(op(0,u),op(2..nops(u),u))
191     end if
192 end proc:
193
194 #leafcount(u) returns the number of nodes in u.
195 #Nasser 3/23/17 Replaced by build-in leafCount from package in Maple
196 leafcount := proc(u)
197     MmaTranslator[Mma][LeafCount](u);
198 end proc:

```

### 4.0.3 Sympy grading function

```

1 #Dec 24, 2019. Nasser M. Abbasi:
2 #           Port of original Maple grading function by
3 #           Albert Rich to use with Sympy/Python
4 #Dec 27, 2019 Nasser. Added `RootSum`. See problem 177, Timofeev file
5 #           added 'exp_polar'
6 from sympy import *
7
8 def leaf_count(expr):
9     #sympy do not have leaf count function. This is approximation
10    return round(1.7*count_ops(expr))
11
12 def is_sqrt(expr):
13     if isinstance(expr,Pow):
14         if expr.args[1] == Rational(1,2):
15             return True
16         else:
17             return False
18     else:
19         return False
20
21 def is_elementary_function(func):
22     return func in [exp,log,ln,sin,cos,tan,cot,sec,csc,
23                    asin,acos,atan,acot,asec,acsc,sinh,cosh,tanh,coth,sech,csch,
24                    asinh,acosh,atanh,acoth,asech,acsch
25                    ]
26
27 def is_special_function(func):
28     return func in [ erf,erfc,erfi,
29                    fresnels,fresnelc,Ei,Ei,Li,Si,Ci,Shi,Chi,
30                    gamma,loggamma,digamma,zeta,polylog,LambertW,
31                    elliptic_f,elliptic_e,elliptic_pi,exp_polar
32                    ]
33
34 def is_hypergeometric_function(func):
35     return func in [hyper]
36
37 def is_appell_function(func):
38     return func in [appellf1]
39
40 def is_atom(expn):
41     try:
42         if expn.isAtom or isinstance(expn,int) or isinstance(expn,float):
43             return True

```



```

44     else:
45         return False
46
47     except AttributeError as error:
48         return False
49
50 def expnType(expn):
51     debug=False
52     if debug:
53         print("expn=",expn,"type(expn)=",type(expn))
54
55     if is_atom(expn):
56         return 1
57     elif isinstance(expn,list):
58         return max(map(expnType, expn)) #apply(max,map(ExpnType,expn))
59     elif is_sqrt(expn):
60         if isinstance(expn.args[0],Rational): #type(op(1,expn),'rational')
61             return 1
62         else:
63             return max(2,expnType(expn.args[0])) #max(2,ExpnType(op(1,expn)))
64     elif isinstance(expn,Pow): #type(expn,``^`)
65         if isinstance(expn.args[1],Integer): #type(op(2,expn),'integer')
66             return expnType(expn.args[0]) #ExpnType(op(1,expn))
67         elif isinstance(expn.args[1],Rational): #type(op(2,expn),'rational')
68             if isinstance(expn.args[0],Rational): #type(op(1,expn),'rational')
69                 return 1
70             else:
71                 return max(2,expnType(expn.args[0])) #max(2,ExpnType(op(1,expn
72 )))
73     else:
74         return max(3,expnType(expn.args[0]),expnType(expn.args[1])) #max(3,
75 ExpnType(op(1,expn)),ExpnType(op(2,expn)))
76     elif isinstance(expn,Add) or isinstance(expn,Mul): #type(expn,``+`) or
77 type(expn,``*`)
78     m1 = expnType(expn.args[0])
79     m2 = expnType(list(expn.args[1:]))
80     return max(m1,m2) #max(ExpnType(op(1,expn)),max(ExpnType(rest(expn))))
81     elif is_elementary_function(expn.func): #ElementaryFunctionQ(op(0,expn))
82     return max(3,expnType(expn.args[0])) #max(3,ExpnType(op(1,expn)))
83     elif is_special_function(expn.func): #SpecialFunctionQ(op(0,expn))
84     m1 = max(map(expnType, list(expn.args)))
85     return max(4,m1) #max(4,apply(max,map(ExpnType,[op(expn)])))
86     elif is_hypergeometric_function(expn.func): #HypergeometricFunctionQ(op(0,
87 expn))
88     m1 = max(map(expnType, list(expn.args)))
89     return max(5,m1) #max(5,apply(max,map(ExpnType,[op(expn)])))
90     elif is_appell_function(expn.func):
91     m1 = max(map(expnType, list(expn.args)))
92     return max(6,m1) #max(5,apply(max,map(ExpnType,[op(expn)])))
93     elif isinstance(expn,RootSum):
94     m1 = max(map(expnType, list(expn.args))) #Apply[Max,Append[Map[ExpnType
95 ,Apply[List,expn]],7]],
96     return max(7,m1)
97     elif str(expn).find("Integral") != -1:
98     m1 = max(map(expnType, list(expn.args)))
99     return max(8,m1) #max(5,apply(max,map(ExpnType,[op(expn)])))
100     else:
101     return 9
102
103 #main function
104 def grade_antiderivative(result,optimal):
105
106     leaf_count_result = leaf_count(result)

```

```

102 leaf_count_optimal = leaf_count(optimal)
103
104 expnType_result = expnType(result)
105 expnType_optimal = expnType(optimal)
106
107 if str(result).find("Integral") != -1:
108     return "F"
109
110 if expnType_result <= expnType_optimal:
111     if result.has(I):
112         if optimal.has(I): #both result and optimal complex
113             if leaf_count_result <= 2*leaf_count_optimal:
114                 return "A"
115             else:
116                 return "B"
117         else: #result contains complex but optimal is not
118             return "C"
119     else: # result do not contain complex, this assumes optimal do not as
well
120         if leaf_count_result <= 2*leaf_count_optimal:
121             return "A"
122         else:
123             return "B"
124 else:
125     return "C"

```

#### 4.0.4 SageMath grading function

```

1 #Dec 24, 2019. Nasser: Ported original Maple grading function by
2 #     Albert Rich to use with Sagemath. This is used to
3 #     grade Fracas, Giac and Maxima results.
4 #Dec 24, 2019. Nasser: Added 'exp_integral_e' and 'sng', 'sin_integral'
5 #     'arctan2','floor','abs','log_integral'
6
7 from sage.all import *
8 from sage.symbolic.operators import add_vararg, mul_vararg
9
10 def tree(expr):
11     debug=False;
12     if debug:
13         print ("Enter tree(expr), expr=",expr)
14         print ("expr.operator()=",expr.operator())
15         print ("expr.operands()=",expr.operands())
16         print ("map(tree, expr.operands()=",map(tree, expr.operands()))
17
18     if expr.operator() is None:
19         return expr
20     else:
21         return [expr.operator()+list(map(tree, expr.operands()))
22
23 def leaf_count(anti):
24     debug=False;
25
26     if debug: print ("Enter leaf_count, anti=", anti, " len(anti)=", len(anti))
27
28     if len(anti) == 0: #special check for optimal being 0 for some test cases.
29         if debug: print ("len(anti) == 0")
30         return 1
31     else:
32         if debug: print ("round(1.35*len(flatten(tree(anti))))=",round(1.35*len
(flatten(tree(anti))))
33         return round(1.35*len(flatten(tree(anti)))) #fudge factor
34             #since this estimate of leaf count is bit lower than

```

```

35         #what it should be compared to Mathematica's
36
37 def is_sqrt(expr):
38     debug=False;
39     if expr.operator() == operator.pow: #isinstance(expr,Pow):
40         if expr.operands()[1]==1/2: #expr.args[1] == Rational(1,2):
41             if debug: print ("expr is sqrt")
42             return True
43         else:
44             return False
45     else:
46         return False
47
48 def is_elementary_function(func):
49     debug = False
50
51     m = func.name() in ['exp','log','ln',
52         'sin','cos','tan','cot','sec','csc',
53         'arcsin','arccos','arctan','arccot','arcsec','arccsc',
54         'sinh','cosh','tanh','coth','sech','csch',
55         'arcsinh','arccosh','arctanh','arccoth','arcsech','arccsch','sgn',
56         'arctan2','floor','abs'
57     ]
58     if debug:
59         if m:
60             print ("func ", func , " is elementary_function")
61         else:
62             print ("func ", func , " is NOT elementary_function")
63
64
65     return m
66
67 def is_special_function(func):
68     debug = False
69
70     if debug: print ("type(func)=", type(func))
71
72     m= func.name() in ['erf','erfc','erfi','fresnel_sin','fresnel_cos','Ei',
73         'Ei','Li','Si','sin_integral','Ci','cos_integral','Shi','
74     sinh_integral'
75         'Chi','cosh_integral','gamma','log_gamma','psi,zeta',
76         'polylog','lambert_w','elliptic_f','elliptic_e',
77         'elliptic_pi','exp_integral_e','log_integral']
78
79     if debug:
80         print ("m=",m)
81         if m:
82             print ("func ", func , " is special_function")
83         else:
84             print ("func ", func , " is NOT special_function")
85
86     return m
87
88
89 def is_hypergeometric_function(func):
90     return func.name() in ['hypergeometric','hypergeometric_M','
91     hypergeometric_U']
92
93 def is_appell_function(func):
94     return func.name() in ['hypergeometric'] #[appellf1] can't find this in
95     sagemath

```

```

95 def is_atom(expn):
96
97     #thanks to answer at https://ask.sagemath.org/question/49179/what-is-
sagemath-equivalent-to-atomic-type-in-maple/
98     try:
99         if expn.parent() is SR:
100             return expn.operator() is None
101         if expn.parent() in (ZZ, QQ, AA, QQbar):
102             return expn in expn.parent() # Should always return True
103         if hasattr(expn.parent(),"base_ring") and hasattr(expn.parent(),"gens")
:
104             return expn in expn.parent().base_ring() or expn in expn.parent().
gens()
105         return False
106
107     except AttributeError as error:
108         return False
109
110
111 def expnType(expn):
112     debug=False
113
114     if debug:
115         print(">>>>Enter expnType, expn=", expn)
116         print(">>>>is_atom(expn)=", is_atom(expn))
117
118     if is_atom(expn):
119         return 1
120     elif type(expn)==list: #isinstance(expn,list):
121         return max(map(expnType, expn)) #apply(max,map(ExpnType,expn))
122     elif is_sqrt(expn):
123         if type(expn.operands()[0])==Rational: #type(isinstance(expn.args[0],
Rational):
124             return 1
125         else:
126             return max(2,expnType(expn.operands()[0])) #max(2,expnType(expn.
args[0]))
127     elif expn.operator() == operator.pow: #isinstance(expn,Pow)
128         if type(expn.operands()[1])==Integer: #isinstance(expn.args[1],Integer
)
129             return expnType(expn.operands()[0]) #expnType(expn.args[0])
130         elif type(expn.operands()[1])==Rational: #isinstance(expn.args[1],
Rational)
131             if type(expn.operands()[0])==Rational: #isinstance(expn.args[0],
Rational)
132                 return 1
133             else:
134                 return max(2,expnType(expn.operands()[0])) #max(2,expnType(
expn.args[0]))
135         else:
136             return max(3,expnType(expn.operands()[0]),expnType(expn.operands()
[1])) #max(3,expnType(expn.operands()[0]),expnType(expn.operands()[1]))
137     elif expn.operator() == add_vararg or expn.operator() == mul_vararg: #
isinstance(expn,Add) or isinstance(expn,Mul)
138         m1 = expnType(expn.operands()[0]) #expnType(expn.args[0])
139         m2 = expnType(expn.operands()[1:]) #expnType(list(expn.args[1:]))
140         return max(m1,m2) #max(ExpnType(op(1,expn)),max(ExpnType(rest(expn)))
141     elif is_elementary_function(expn.operator()): #is_elementary_function(expn
.func)
142         return max(3,expnType(expn.operands()[0]))
143     elif is_special_function(expn.operator()): #is_special_function(expn.func)
144         m1 = max(map(expnType, expn.operands())) #max(map(expnType, list(
expn.args)))

```

```

145     return max(4,m1)    #max(4,m1)
146     elif is_hypergeometric_function(expn.operator()): #
is_hypergeometric_function(expn.func)
147         m1 = max(map(expnType, expn.operands()))    #max(map(expnType, list(
expn.args)))
148         return max(5,m1)    #max(5,m1)
149     elif is_appell_function(expn.operator()):
150         m1 = max(map(expnType, expn.operands()))    #max(map(expnType, list(
expn.args)))
151         return max(6,m1)    #max(6,m1)
152     elif str(expn).find("Integral") != -1: #this will never happen, since it
153         #is checked before calling the grading function that is passed.
154         #but kept it here.
155         m1 = max(map(expnType, expn.operands()))    #max(map(expnType, list(
expn.args)))
156         return max(8,m1)    #max(5,apply(max,map(ExpnType,[op(expn)])))
157     else:
158         return 9
159
160 #main function
161 def grade_antiderivative(result,optimal):
162     debug = False;
163
164     if debug: print ("Enter grade_antiderivative for sagemath")
165
166     leaf_count_result = leaf_count(result)
167     leaf_count_optimal = leaf_count(optimal)
168
169     if debug: print ("leaf_count_result=", leaf_count_result, "
leaf_count_optimal=",leaf_count_optimal)
170
171
172     expnType_result = expnType(result)
173     expnType_optimal = expnType(optimal)
174
175     if debug: print ("expnType_result=", expnType_result, "expnType_optimal=",
expnType_optimal)
176
177     if expnType_result <= expnType_optimal:
178         if result.has(I):
179             if optimal.has(I): #both result and optimal complex
180                 if leaf_count_result <= 2*leaf_count_optimal:
181                     return "A"
182                 else:
183                     return "B"
184             else: #result contains complex but optimal is not
185                 return "C"
186         else: # result do not contain complex, this assumes optimal do not as
well
187             if leaf_count_result <= 2*leaf_count_optimal:
188                 return "A"
189             else:
190                 return "B"
191     else:
192         return "C"

```