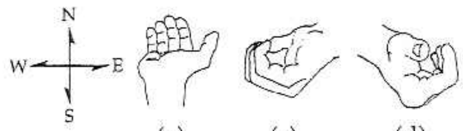
29.2 At the equator, the Earth's magnetic field is horizontally north. Because an electron has negative charge, $\mathbf{F} = q\mathbf{v} \times \mathbf{B}$ is opposite in direction to $\mathbf{v} \times \mathbf{B}$. Figures are drawn looking down.

(a) Down × North = East, so the force is directed $\boxed{\text{West}}$

(b) North × North = $\sin 0° = 0$: $\boxed{\text{Zero deflection}}$

(c) West × North = Down, so the force is directed $\boxed{\text{Up}}$

(d) Southeast × North = Up, so the force is $\boxed{\text{Down}}$



(a) (c) (d)

***29.6** First find the speed of the electron: $\Delta K = \frac{1}{2}mv^2 = e(\Delta V) = \Delta U$

$$v = \sqrt{\frac{2e(\Delta V)}{m}} = \sqrt{\frac{2\left(1.60 \times 10^{-19}\text{ C}\right)(2400\text{ J/C})}{\left(9.11 \times 10^{-31}\text{ kg}\right)}} = 2.90 \times 10^7 \text{ m/s}$$

(a) $F_{B,\,\max} = qvB = (1.60 \times 10^{-19}\text{ C})(2.90 \times 10^7\text{ m/s})(1.70\text{ T}) = \boxed{7.90 \times 10^{-12}\text{ N}}$

(b) $F_{B,\,\min} = \boxed{0}$ occurs when v is either parallel to or anti-parallel to B

29.15 (a) $F_B = ILB \sin\theta = (5.00\text{ A})(2.80\text{ m})(0.390\text{ T}) \sin 60.0° = \boxed{4.73\text{ N}}$

(b) $F_B = (5.00\text{ A})(2.80\text{ m})(0.390\text{ T}) \sin 90.0° = \boxed{5.46\text{ N}}$

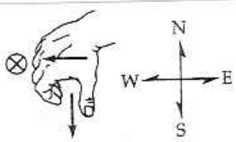
(c) $F_B = (5.00\text{ A})(2.80\text{ m})(0.390\text{ T}) \sin 120° = \boxed{4.73\text{ N}}$

29.23 (a) $2\pi r = 2.00$ m so $r = 0.318$ m

$$\mu = IA = (17.0 \times 10^{-3}\text{ A})\left[\pi(0.318)^2\text{ m}^2\right] = \boxed{5.41\text{ mA} \cdot \text{m}^2}$$

(b) $\tau = \mu \times \mathbf{B}$ so $\tau = (5.41 \times 10^{-3}\text{ A} \cdot \text{m}^2)(0.800\text{ T}) = \boxed{4.33\text{ mN} \cdot \text{m}}$

29.31 (a) $B = 50.0 \times 10^{-6}$ T; $v = 6.20 \times 10^6$ m/s



Direction is given by the right-hand-rule: $\boxed{\text{southward}}$

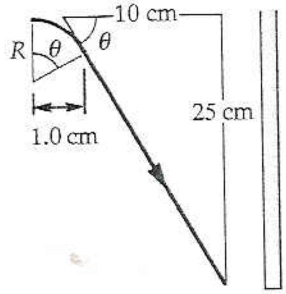
$F_B = qvB \sin\theta$

$$F_B = (1.60 \times 10^{-19}\text{ C})(6.20 \times 10^6\text{ m/s})(50.0 \times 10^{-6}\text{ T}) \sin 90.0° = \boxed{4.96 \times 10^{-17}\text{ N}}$$

(b) $F = \frac{mv^2}{r}$ so $r = \frac{mv^2}{F} = \frac{(1.67 \times 10^{-27}\text{ kg})(6.20 \times 10^6\text{ m/s})^2}{4.96 \times 10^{-17}\text{ N}} = \boxed{1.29\text{ km}}$

29.43 In the velocity selector: $v = \frac{E}{B} = \frac{2500 \text{ V/m}}{0.0350 \text{ T}} = 7.14 \times 10^4 \text{ m/s}$

In the deflection chamber: $r = \frac{mv}{qB} = \frac{\left(2.18 \times 10^{-26} \text{ kg}\right)\left(7.14 \times 10^4 \text{ m/s}\right)}{\left(1.60 \times 10^{-19} \text{ C}\right)(0.0350 \text{ T})} = \boxed{0.278 \text{ m}}$



29.47 $\theta = \tan^{-1}\frac{25.0}{10.0} = 68.2°$ and $R = \frac{1.00 \text{ cm}}{\sin 68.2°} = 1.08 \text{ cm}$

Ignoring relativistic correction, the kinetic energy of the electrons is

$\frac{1}{2} mv^2 = q(\Delta V)$ so $v = \sqrt{\frac{2q(\Delta V)}{m}} = 1.33 \times 10^8 \text{ m / s}$

From the centripetal force $\frac{mv^2}{R} = qvB$, we find the magnetic field

$$B = \frac{mv}{|q|R} = \frac{(9.11 \times 10^{-31} \text{ kg})(1.33 \times 10^8 \text{ m / s})}{(1.60 \times 10^{-19} \text{ C})(1.08 \times 10^{-2} \text{ m})} = \boxed{70.1 \text{ mT}}$$

29.48 (a) $R_H \equiv \frac{1}{nq}$ so $n = \frac{1}{qR_H} = \frac{1}{\left(1.60 \times 10^{-19} \text{ C}\right)\left(0.840 \times 10^{-10} \text{ m}^3/\text{C}\right)} = \boxed{7.44 \times 10^{28} \text{ m}^{-3}}$

(b) $\Delta V_H = \frac{IB}{nqt}$

$$B = \frac{nqt(\Delta V_H)}{I} = \frac{\left(7.44 \times 10^{28} \text{ m}^{-3}\right)\left(1.60 \times 10^{-19} \text{ C}\right)\left(0.200 \times 10^{-3} \text{ m}\right)\left(15.0 \times 10^{-6} \text{ V}\right)}{20.0 \text{ A}} = \boxed{1.79 \text{ T}}$$