

25.5

$$W = \Delta K = -q\Delta V$$

$$0 - \frac{1}{2}(9.11 \times 10^{-31} \text{ kg})(4.20 \times 10^5 \text{ m/s})^2 = -(-1.60 \times 10^{-19} \text{ C})\Delta V$$

$$\text{From which, } \Delta V = \boxed{-0.502 \text{ V}}$$

*25.7

$$E = \frac{|\Delta V|}{d} = \frac{25.0 \times 10^3 \text{ J/C}}{1.50 \times 10^{-2} \text{ m}} = 1.67 \times 10^6 \text{ N/C} = \boxed{1.67 \text{ MN/C}}$$

$$*25.20 \text{ (a)} \quad U = \frac{qQ}{4\pi\epsilon_0 r} = \frac{(5.00 \times 10^{-9} \text{ C})(-3.00 \times 10^{-9} \text{ C})(8.99 \times 10^9 \text{ V} \cdot \text{m/C})}{(0.350 \text{ m})} = \boxed{-3.86 \times 10^{-7} \text{ J}}$$

The minus sign means it takes $3.86 \times 10^{-7} \text{ J}$ to pull the two charges apart from 35 cm to a much larger separation.

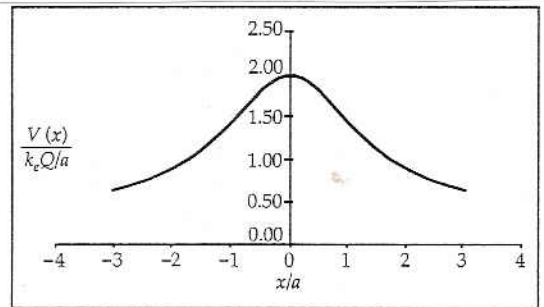
$$\text{(b)} \quad V = \frac{Q_1}{4\pi\epsilon_0 r_1} + \frac{Q_2}{4\pi\epsilon_0 r_2} = \frac{(5.00 \times 10^{-9} \text{ C})(8.99 \times 10^9 \text{ V} \cdot \text{m/C})}{0.175 \text{ m}} + \frac{(-3.00 \times 10^{-9} \text{ C})(8.99 \times 10^9 \text{ V} \cdot \text{m/C})}{0.175 \text{ m}}$$

$$V = \boxed{103 \text{ V}}$$

$$25.30 \text{ (a)} \quad V(x) = \frac{k_e Q_1}{r_1} + \frac{k_e Q_2}{r_2} = \frac{k_e(+Q)}{\sqrt{x^2 + a^2}} + \frac{k_e(+Q)}{\sqrt{x^2 + (-a)^2}}$$

$$V(x) = \frac{2k_e Q}{\sqrt{x^2 + a^2}} = \frac{k_e Q}{a} \left(\frac{2}{\sqrt{(x/a)^2 + 1}} \right)$$

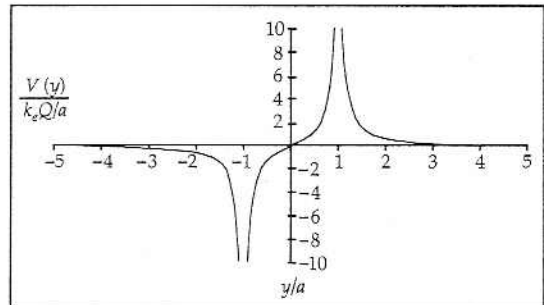
$$\frac{V(x)}{(k_e Q/a)} = \boxed{\frac{2}{\sqrt{(x/a)^2 + 1}}}$$



$$\text{(b)} \quad V(y) = \frac{k_e Q_1}{r_1} + \frac{k_e Q_2}{r_2} = \frac{k_e(+Q)}{|y-a|} + \frac{k_e(-Q)}{|y+a|}$$

$$V(y) = \frac{k_e Q}{a} \left(\frac{1}{|y/a-1|} - \frac{1}{|y/a+1|} \right)$$

$$\frac{V(y)}{(k_e Q/a)} = \boxed{\left(\frac{1}{|y/a-1|} - \frac{1}{|y/a+1|} \right)}$$



25.37

$$V = 5x - 3x^2y + 2yz^2 \quad \text{Evaluate } E \text{ at } (1, 0, -2)$$

$$E_x = -\frac{\partial V}{\partial x} = \boxed{-5 + 6xy} = -5 + 6(1)(0) = -5$$

$$E_y = -\frac{\partial V}{\partial y} = \boxed{+3x^2 - 2z^2} = 3(1)^2 - 2(-2)^2 = -5$$

$$E_z = -\frac{\partial V}{\partial z} = \boxed{-4yz} = -4(0)(-2) = 0$$

$$E = \sqrt{E_x^2 + E_y^2 + E_z^2} = \sqrt{(-5)^2 + (-5)^2 + 0^2} = \boxed{7.07 \text{ N/C}}$$