

# UNIT #3 REVIEW PROBLEMS ANSWERS

1.  $m_1 = m_2 = 300\,000\text{ kg}$   
 $r = 1.0\text{ km}$   
 $= 1.0 \times 10^3\text{ m}$   
 $F_g = ?$

$$F_g = \frac{G m_1 m_2}{r^2}$$

$$F_g = \frac{(6.67 \times 10^{-11}\text{ N m}^2/\text{kg}^2)(300\,000\text{ kg})^2}{(1.0 \times 10^3\text{ m})^2}$$

$$F_g = 6.0 \times 10^{-6}\text{ N}$$

2. a)  $m = 2m_E$   
 $= 2(5.98 \times 10^{24}\text{ kg})$   
 $g = ?$   
 $r = r_E = 6.38 \times 10^6\text{ m}$

$$g = \frac{G m}{r^2}$$

$$g = \frac{(6.67 \times 10^{-2}\text{ N m}^2/\text{kg}^2)(2(5.98 \times 10^{24}\text{ kg}))}{(6.38 \times 10^6\text{ m})^2}$$

$$g = 19.6\text{ N/kg}$$

b)  $v_e = ?$

$$v_e = \sqrt{\frac{2GM}{r}}$$

$$v_e = \sqrt{\frac{2(6.67 \times 10^{-11}\text{ N m}^2/\text{kg}^2)(2(5.98 \times 10^{24}\text{ kg}))}{6.38 \times 10^6\text{ m}}}$$

$$v_e = 1.58 \times 10^4\text{ m/s}$$

c)  $v_{\text{orbital}} = ?$

$$v = \sqrt{\frac{Gm}{r}}$$

$$v = \sqrt{\frac{(6.67 \times 10^{-11}\text{ N m}^2/\text{kg}^2)(2(5.98 \times 10^{24}\text{ kg}))}{6.38 \times 10^6\text{ m}}}$$

$$v = 1.12 \times 10^4\text{ m/s}$$

# UNIT #3 REVIEW PROBLEMS - ANSWERS

3.  $F_e = 1.4 \times 10^{-2} \text{ N}$

a)  $F_e = \frac{kq_1q_2}{(4r)^2} = \frac{1}{16} F_e = 8.75 \times 10^{-4} \text{ N}$   
 $= 8.8 \times 10^{-4} \text{ N}$

b)  $F_e = G \frac{2q_1 2q_2}{r^2} = 4 F_e = 5.6 \times 10^{-2} \text{ N}$

c)  $F_e = \frac{4}{16} F_e = \frac{1}{4} F_e = 3.5 \times 10^{-3} \text{ N}$

4.



\* looking at the electric field lines, the field will add  
 $\therefore$  use  $q_2 = |-1.0 \times 10^{-6} \text{ C}|$

- $q_1 = 4.0 \times 10^{-6} \text{ C}$
- $q_2 = -1.0 \times 10^{-6} \text{ C}$
- $r_1 = 40.0 \text{ cm}$   
 $= 0.400 \text{ m}$
- $r_2 = 30.0 \text{ cm}$   
 $= 0.300 \text{ m}$
- $E_T = ?$

$$E_T = E_1 + E_2$$

$$E_T = \frac{kq_1}{r_1^2} + \frac{kq_2}{r_2^2}$$

$$E_T = (9.0 \times 10^9 \text{ Nm}^2/\text{C}^2) \left[ \frac{4.0 \times 10^{-6} \text{ C}}{0.400 \text{ m}^2} + \frac{1.0 \times 10^{-6} \text{ C}}{0.300 \text{ m}^2} \right]$$

$$E_T = 3.2 \times 10^5 \text{ N/C}$$

## UNIT #3 REVIEW PROBLEMS ANSWERS

$$5a) q = 1 \times 10^{-5} \text{ C}$$

$$E = 50 \text{ N/C}$$

$$F_e = ?$$

$$F_e = qE$$

$$F_e = (1 \times 10^{-5} \text{ C})(50 \text{ N/C})$$

$$F_e = 5 \times 10^{-4} \text{ N}$$

$$b) Ad = 1.0 \text{ m}$$

$$E_{k2} = ?$$

$$\Delta E_k = W = F_e \Delta d$$

$$\Delta E_k = (5 \times 10^{-4} \text{ N})(1.0 \text{ m})$$

$$\Delta E_k = 5 \times 10^{-4} \text{ J}$$

$$\text{But } E_{k1} = 0 \text{ J} \therefore E_{k2} = 5 \times 10^{-4} \text{ J}$$

$$c) v = 2.5 \times 10^4 \text{ m/s}$$

$$m = ?$$

$$E_{k2} = \frac{1}{2}mv^2 \Rightarrow m = \frac{2E_{k2}}{v^2}$$

$$m = \frac{2(5 \times 10^{-4} \text{ J})}{(2.5 \times 10^4 \text{ m/s})^2}$$

$$m = 1.6 \times 10^{-12} \text{ kg}$$

$$= 2 \times 10^{-12} \text{ kg}$$

$$6. V = 120 \text{ V}$$

$$d = ?$$

$$E = 450 \text{ N/C}$$

$$2V = qEd \Rightarrow d = \frac{V}{E}$$

$$d = \frac{120 \text{ V}}{450 \text{ N/C}}$$

$$d = 2.67 \times 10^{-1} \text{ m}$$

# UNIT #3 REVIEW PROBLEMS - ANSWERS

7.  $d = 12\text{m}$   
 $I = 4.5 \times 10^3 \text{A}$   
 $B = ?$

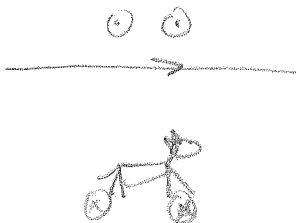
$$B = \frac{\mu_0 I}{2\pi d}$$

$$B = \frac{(4\pi \times 10^{-7} \text{Tm/A})(4.5 \times 10^3 \text{A})}{2\pi (12\text{m})}$$

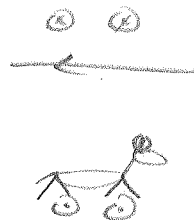
$$B = 7.5 \times 10^{-5} \text{T}$$

\* direction depends on current flow

Scenario 1



Scenario 2



8.  $N = 12$   
 $r = 2.5\text{cm}$   
 $= 0.025\text{m}$   
 $I = 0.52\text{A}$   
 $B = ?$

$$B = \frac{\mu_0 NI}{2r}$$

$$B = \frac{(4\pi \times 10^{-7} \text{Tm/A})(12)(0.52\text{A})}{2(0.025\text{m})}$$

$$B = 1.6 \times 10^{-4} \text{T}$$

9.  $F = ?$   
 $d = 3.5\text{m}$   
 $I_1 = I_2 = 1.5 \times 10^4 \text{A}$   
 $L = 190\text{m}$

$$F = \frac{\mu_0 I_1 I_2 L}{2\pi r}$$

$$F = \frac{(4\pi \times 10^{-7} \text{Tm/A})(1.5 \times 10^4 \text{A})^2 (190\text{m})}{2\pi (3.5\text{m})}$$

$$F = 2.4 \times 10^3 \text{N}$$

# UNIT #3 REVIEW PROBLEMS - ANSWERS.

10.  $r = ?$

$$m = 6.64 \times 10^{-27} \text{ kg}$$

$$v = 2.0 \times 10^6 \text{ m/s}$$

$$B = 2.9 \times 10^{-5} \text{ T}$$

$$q = +2$$

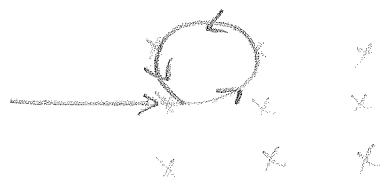
$$= 2(1.602 \times 10^{-19} \text{ C})$$

$$r = \frac{mv}{qB}$$

$$r = \frac{(6.64 \times 10^{-27} \text{ kg})(2.0 \times 10^6 \text{ m/s})}{2(1.602 \times 10^{-19} \text{ C})(2.9 \times 10^{-5} \text{ T})}$$

$$r = 1.4 \times 10^3 \text{ m}$$

Direction? Assume  $\vec{B}$  into page



$\alpha$  particle has +2 charge

$\therefore$  counterclockwise.