MAGNETIC FIELDS COLLABORATIVE PROBLEMS

1. A wire, whose linear mass density is 0.150 kg/m, carries a current of 40.0 A. This wire lies parallel to, and on top of, another horizontal wire on a table. What current must flow through the bottom wire in order to repel and support the top wire at a height of 4.0 cm above it? Include the direction of the current in the bottom wire (in the same direction as in the top wire or in the opposite direction).

2. A proton and an electron move perpendicular to a uniform magnetic field with the same speed. Determine the ratio of the radii of the circular paths of the proton and electron if $\boldsymbol{m_p = 1840 m_e}$.

3. A charged particle is moving in a circular path under the influence of a uniform magnetic field. Describe how the path will change in response to each of the following factors, considered separately:

   a) The intensity of the magnetic field is increased.

   b) An electric field is added, in the same direction as the magnetic field.

   c) All fields are simultaneously turned off.

1. $D = 0.150\ kg/m$

$I_1 = 40.0A$

$d = 4.0cm = 4.0\times10^{-2}m$

$I_2 = ?$

F_B ↑ □ ↓ F_g $\quad F_{net} = 0N$

$F_B = F_g$

$$\frac{\mu_0 I_1 I_2 L}{2\pi d} = mg$$

$$D = \frac{m}{L} \Rightarrow m = DL$$

$$\frac{\mu_0 I_1 I_2 L}{2\pi d} = DLg$$

$$I_2 = \frac{2\pi d g D}{\mu_0 I_1}$$

$$I_2 = \frac{2\pi (4.0\times10^{-2}m)(9.8 m/s^2)(0.150 kg/m)}{(4\pi\times10^{-7}\ Tm/A)(40.0A)} = 7350A \Rightarrow 7.4\times10^3 A.$$

2. $F_m = F_c$

$qvB = \frac{mv^2}{r}$

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

$\frac{r_p}{r_e} = \frac{\frac{m_p v}{q_p B}}{\frac{m_e v}{q_e B}} = \frac{\frac{m_p}{q_p}}{\frac{m_e}{q_e}}$

$q_e = q_p$

$\therefore \frac{r_p}{r_e} = \frac{m_p}{m_e}$

$m_p = 1840 m_e$

$\therefore \frac{r_p}{r_e} = \frac{1840 m_e}{m_e}$

$\frac{r_p}{r_e} = 1840$

3.a) $r = \frac{mv}{qB}$

As B increases, radius decreases.

b) Increased $\mathcal{E}$ results in greater ΔE_K, $\therefore$ v will increase, which means r will also increase

c) particle will continue in straight line, tangential to circle.