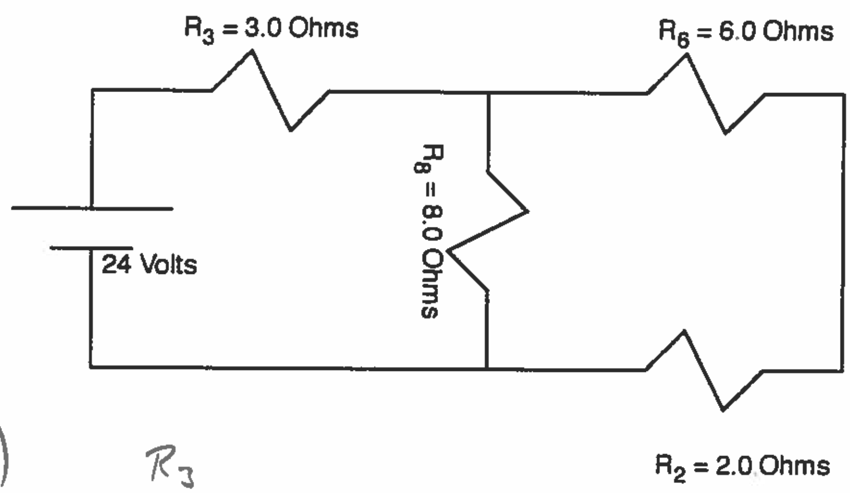
# Physics 10164 - Summer 2018 - Exam #2

**Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work even if you get the right answer. Clearly indicate your answer with a circle or a box and remember to include correct units and significant figures.**

1. (30 pts) For the circuit shown below, answer the following:

a) Determine the power dissipated by the resistors $R_3$ and $R_8$.

b) If the branch containing $R_8$ were eliminated from the diagram, what would happen to the power dissipated by $R_3$? Would it increase, decrease or remain the same? Justify your answer qualitatively or mathematically.



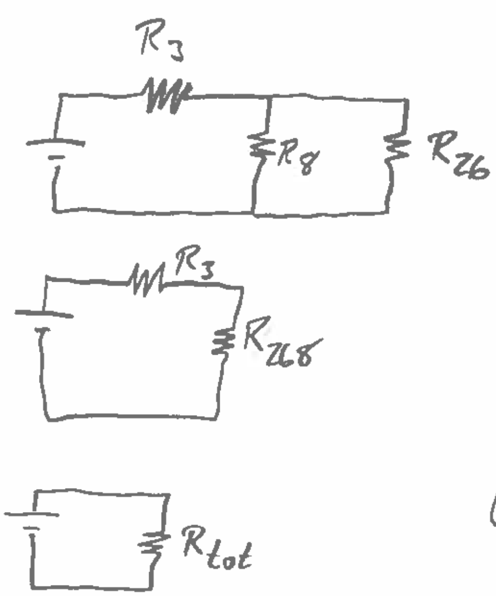

$R_{26} = R_2 + R_6 = 8.0\,\Omega$

$\frac{1}{R_{268}} = \frac{1}{R_{26}} + \frac{1}{R_8}$

$\Rightarrow R_{268} = 4.0\,\Omega$

$R_{tot} = R_3 + R_{268} = 7.0\,\Omega$

a)




$R_{tot} = 7.0\,\Omega \rightarrow I_{tot} = \frac{24}{7} = 3.43\,A$

(series) $\Rightarrow I_{tot} = I_3 = I_{268} = 3.43\,A$

$\hookrightarrow$ $\boxed{P_3 = (3.43)^2(3) = 35\,W}$

$\Delta V_{268} = I_{268} R_{268} = (3.43)(4) = 13.71$ Volts

(parallel) $\Rightarrow \Delta V_{268} = \Delta V_8 = 13.71$ Volts

$\hookrightarrow$ $\boxed{P_8 = \frac{(13.71)^2}{8} = 24\,W}$

---

b) If $R_8$ branch removed $R_{tot} \uparrow$, so $I_{tot}$ & $I_3 \downarrow$

Since $I_3 \downarrow$, $\boxed{P_3 \downarrow}$

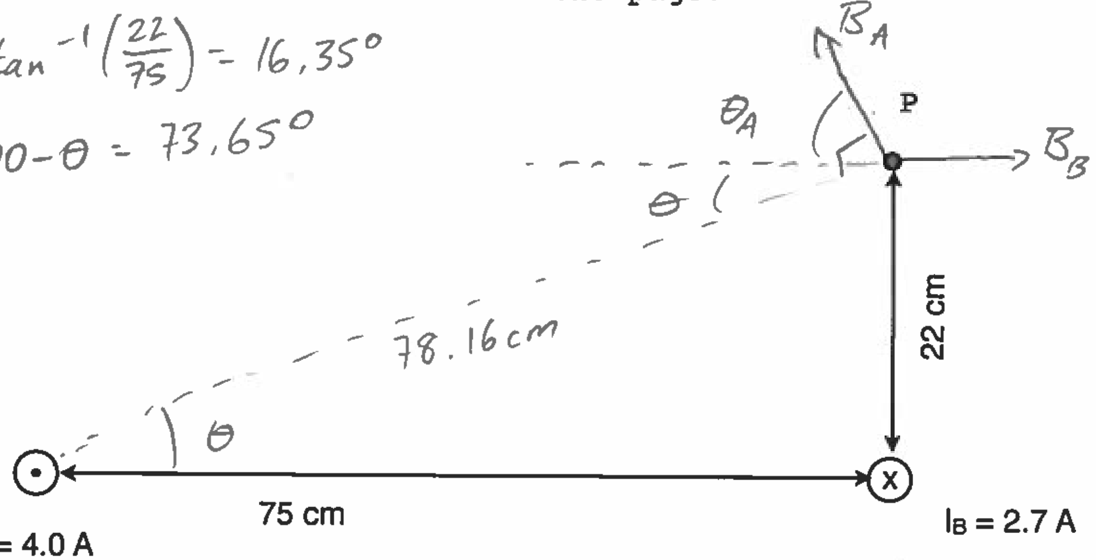
2. (35 pts) Two parallel wires carry currents in opposite directions, as shown below. Wire A crosses through the origin. Wire B crosses through the x-axis 75 cm from the origin.

a) Find the magnitude and direction of the total magnetic field due to the two wires at point P (x = 75 cm, y = 22 cm).

b) Find the magnitude and direction of the magnetic force on a 25 μC charge moving through point P with a velocity of 4.4 x $10^6$ m/s in a direction out of the page.

$\theta = \tan^{-1}\left(\frac{22}{75}\right) = 16.35°$

$\theta_A = 90 - \theta = 73.65°$

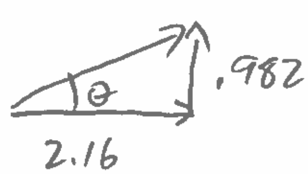



a) $|B_A| = \frac{\mu_0 (4)}{2\pi (.7816)} = 1.024\ \mu T$ $\quad B_{Ax} = -1.024 \cos 73.65° = -0.288$

$|B_B| = \frac{\mu_0 (2.7)}{2\pi (.22)} = 2.45\ \mu T, +x$ $\quad B_{Ay} = +1.024 \sin 73.65° = 0.982$

$B_{TOT,x} = B_{Ax} + B_{Bx} = -0.288 + 2.45 = +2.16\ \mu T$

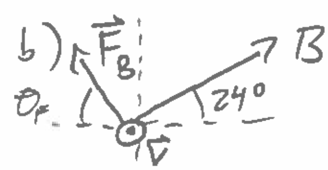
$B_{TOT,y} = B_{Ay} + B_{By} = 0.982 + 0 = 0.982\ \mu T$




$B_{TOT} = \sqrt{2.16^2 + .982^2} =$ **$2.4\ \mu T$**

$\theta = \tan^{-1}\left(\frac{.982}{2.16}\right) =$ **24° above +x**

b)

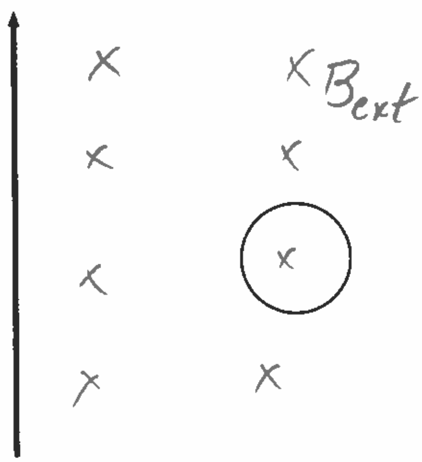



$|F_B| = qvB \sin 90 =$ **$2.6 \times 10^{-4}$ N**

$\theta_F = 90 - 24° =$ **66° above −x**

#3. (35 pts) A single-turn circular wire loop of radius 5.5 cm is located near a long straight wire carrying a current of 5.0 Amps towards the top of the page. The center of the loop is 28 cm away from the straight wire. Assume that the magnetic field due to the straight wire is uniform throughout the loop and has a magnitude equal to the magnetic field strength where the loop is centered.

If the current in the straight wire is increased from 5.0 Amps to 8.0 Amps in a time interval of 0.35 sec, determine (a) the magnitude of the average induced EMF in the loop during that time and (b) the direction of the induced current in the loop. Be sure to show all work and/or explain your logic for each part.




$$B_{ext} = \frac{\mu_0 I_{wire}}{2\pi(.28)} = 3.57\ \mu T \text{ (initial)}$$

$$= 5.71\ \mu T \text{ (final)}$$

$$\Delta B = 2.14\ \mu T$$

$$\mathcal{E}_{ind} = \frac{N \Delta B A \cos\theta}{\Delta t}$$

$$= \frac{(1)(2.14 \times 10^{-6})\pi(.055)^2(1)}{.35}$$

$$= \boxed{5.82 \times 10^{-8} \text{ Volts}}$$

Since $B_{ext} = \otimes$

$\Phi_B = \otimes$, increasing

$B_{ind} = \odot$

$\boxed{I_{ind} = \text{ccw}}$ according to RHR #3