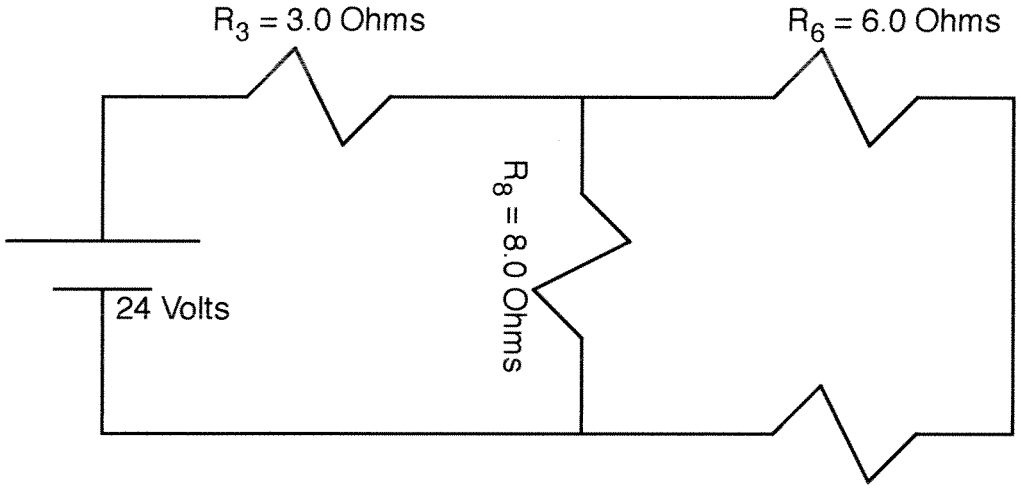
Physics 10164 - Exam 2C

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. (35 pts) For the circuit below, answer the following:

a) What is the power dissipated by the resistor R_8?

b) If resistor R_3 is replaced by a plain wire, what happens to the power dissipated by R_8? Increase, decrease or remain the same? Justify your answer logically or mathematically.



$R_{26} = 2 + 6$

$= 8.0\ \Omega$

$\frac{1}{R_{286}} = \frac{1}{R_{26}} + \frac{1}{R_8}$

$\frac{1}{R_{268}} = \frac{1}{8} + \frac{1}{8}$

$R_{268} = 4\ \Omega$

$R_{TOT} = 7\ \Omega$

$I_{TOT} = \frac{24}{7} = 3.43\,A$

$I_{268} = 3.43\,A$

$R_{268} = 4\ \Omega$

$\Delta V_{268} = IR = 13.7\,V$

$\Delta V_8 = 13.7\,V$

$P_8 = \frac{\Delta V^2}{R} =$ (24 Watts)

b) If $R_3 = 0$, then $R_{TOT} = 4\ \Omega$

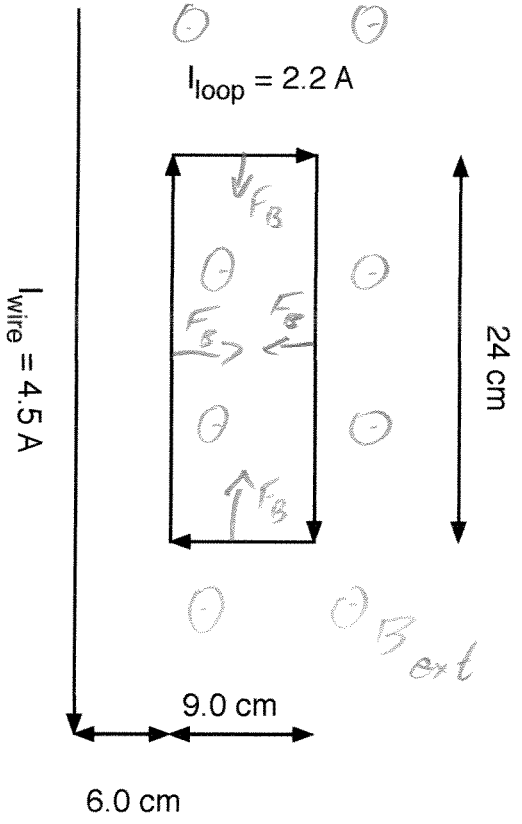
ΔV_{268} now 24 V, not 13.7 V

So (P_{268} increases)

2. (35 pts) A long straight wire is next to a wire loop.

a) Determine the magnitude and direction of the net force on the current loop due to the long straight wire?

b) Does the current loop experience any torque? If yes, then calculate the magnitude of the torque? If no, then explain why not.



F_B on top & bottom wire are equal in magnitude & oppositely directed, so they cancel.

Left wire:

$B_{ext} = \frac{\mu_0 I_{wire}}{2\pi(.06)} = 15\times10^{-6}\,T,\ \otimes$

$F_{left} = \ell I \times B$

$= (.24)(2.2)(15\times10^{-6}) = 7.92\times10^{-6}$ →

Right wire: $B_{ext} = \frac{\mu_0 I_{wire}}{2\pi(.15)} = 6.0\times10^{-6},\ \otimes$

$F_{right} = \ell I \times B = (.24)(2.2)(6\times10^{-6}) = 3.17\times10^{-6}$ ←

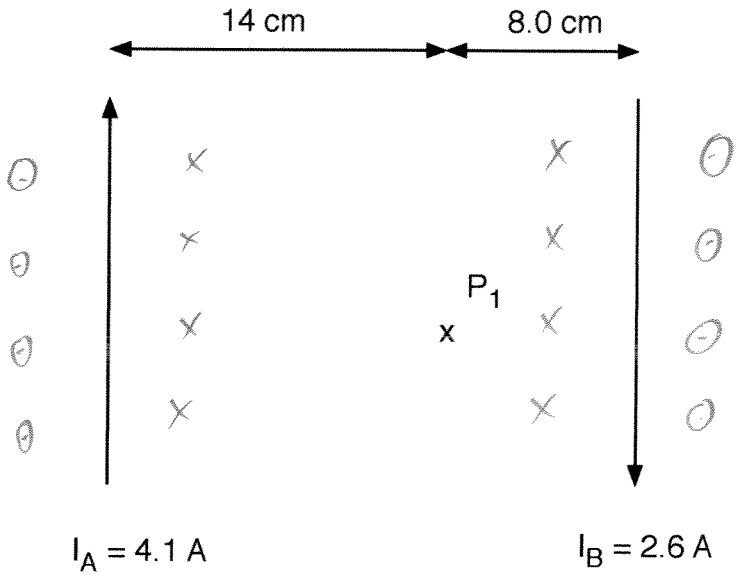
$F_{TOT} = 4.8\times10^{-6}$, +x dir →

b) No torque since $\vec{B}_{loop}$ (or $\vec{\mu}_{loop}$) is parallel to $\vec{B}_{ext}$ so $\tau = |\vec{\mu}||\vec{B}_{ext}|\sin 0° = 0$

3. (30 pts) Two parallel wires are shown below.

a) Determine the magnitude and direction of the total magnetic field at point P1.

b) Determine the distance from wire A (other than infinity) at which the total magnetic field is equal to zero.



a)

$$|B_A| = \frac{\mu_0 I_A}{2\pi r_A} = \frac{\mu_0 (4.1)}{2\pi (.14)}$$

$$= 5.86 \times 10^{-6}\ T, \otimes$$

$$|B_B| = \frac{\mu_0 (2.6)}{2\pi (.08)} = 6.5 \times 10^{-6}, \otimes$$

$$B_{TOT} = 1.2 \times 10^{-5}\ T, \otimes$$

b) Zero point must be right of wire B, since B has smaller current.

$$|B_A| = |B_B|$$

$$\frac{\mu_0 I_A}{2\pi r} = \frac{\mu_0 I_B}{2\pi (r - .22)}$$

$$\frac{4.1}{2.6} = \frac{r}{r - .22}$$

$$4.1r - .902 = 2.6r$$

$$1.5r = .902$$

$$r = .60\ m$$