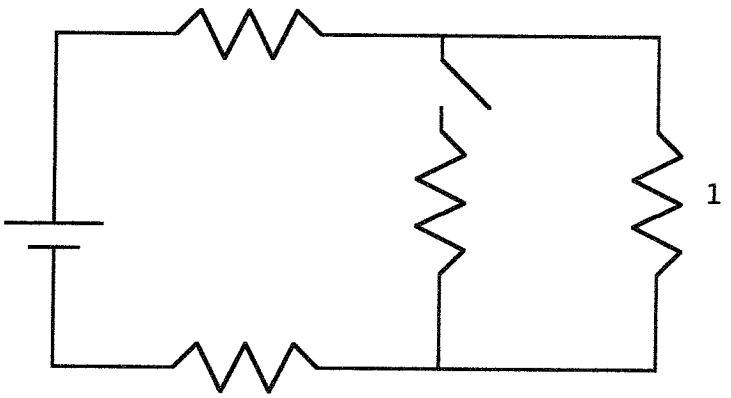
Physics 10164 - Exam 2B

Each problem is worth 25 points. 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 of a box and remember to include correct units and significant figures.

1. In the circuit below, there are four identical light bulbs represented as resistors. When the switch is closed, what happens to the light bulb marked as "1"? Does it get brighter, dimmer or stay the same? Justify your answer.



Assume $\mathcal{E} = 12\ V$, $R_1 = R_2 = R_3 = R_4 = 1\ \Omega$

S open $R_{TOT} = 3\ \Omega$

$I_{TOT} = \frac{12}{3} = 4.0\ A$ (I_{TOT}) $P_1 = I_1^2 R = 16\ W$

S closed $R_{TOT} = 2.5$

$I_{TOT} = \frac{12}{2.5} = 4.8\ A$

$I_1 = \frac{1}{2} I_{TOT} = 2.4\ A$ $P_1 = I_1^2 R = 5.8\ W$

dimmer

2. A circuit contains a 18-Volt battery, a 3.0 Ohm resistor, 6.0 μF capacitor and a switch. The capacitor is initially uncharged, and the switch is closed at time t = 0. After how much time is the voltage drop across the resistor 13.0 Volts?

$$\Delta V_R = \mathcal{E} e^{-t/\tau}$$

$$13 = 18 e^{-t/RC}$$

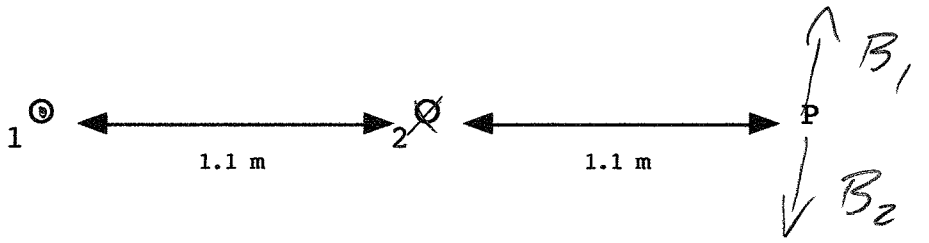
$$0.72 = e^{-t/RC}$$

$$-0.325 = -t/RC$$

$$t = (0.325)(3.0)(6.0 \times 10^{-6})$$

$$= 5.9 \times 10^{-6} \text{ s}$$

3. In the diagram below, wire 1's current is 2.0 Amps out of the page, wire 2's current is 3.0 Amps into the page. What is the magnitude and direction of the magnetic field at point P? All three are along the x-axis.



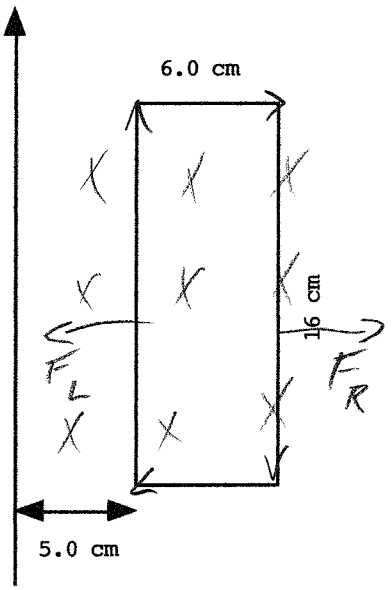
$$|B_1| = \frac{(2\times10^{-7})(2.0)}{2.2} = 1.82\times10^{-7},\ +y$$

$$|B_2| = \frac{(2\times10^{-7})(3.0)}{1.1} = 5.45\times10^{-7},\ -y$$

$$B_{TOT} = 1.82 - 5.45$$

$$= \boxed{3.6\times10^{-7},\ -y \text{ dir}}$$

4. A long straight wire carries a 5.0 Amp current. Adjacent to the wire is a square loop carrying a clockwise current of 3.0 Amps. What is the magnitude and direction of the net force on the current loop due to the long straight wire?



$|F_{TOP}| = |F_{BOT}|$ cancels

$$|F_L| = \frac{\mu_0 \ell I_1 I_2}{2\pi r}$$

$$= \frac{(2\times10^{-7})(.16)(5)(3)}{.05}$$

$$= 9.60\times10^{-6}, -x$$

$$|F_R| = \frac{(2\times10^{-7})(0.16)(5)(3)}{.11}$$

$$= 4.36\times10^{-6}, +x$$

$$F_{Net} = 4.36 - 9.60$$

$$= 5.24\times10^{-6}\ N, -x$$