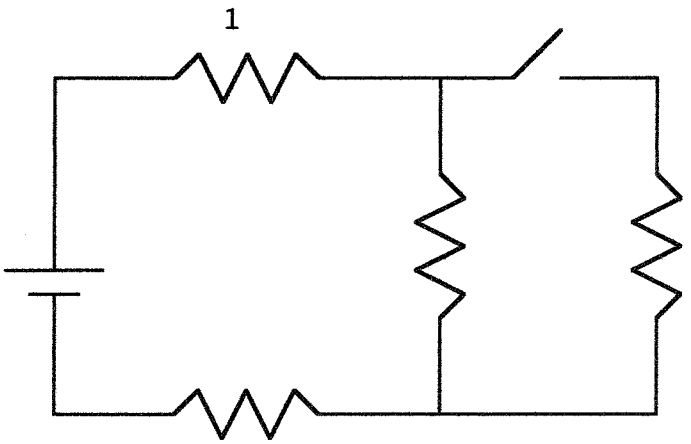
Physics 10164 - Exam 2A

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.



When S closed $R_{TOT} \downarrow$, so $I_{TOT} \uparrow$

Since $I_1 = I_{TOT}$

$P_1 \uparrow$ brighter

2. A circuit contains a 12-Volt battery, a 2.0 Ohm resistor, 5.0 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 capacitor 9.0 Volts?

$$\Delta V_C = \mathcal{E}(1 - e^{-t/RC})$$

$$\frac{9}{12} = 1 - e^{-t/RC}$$

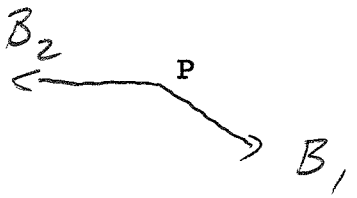
$$-0.25 = -e^{-t/RC}$$

$$-1.39 = -\frac{t}{RC}$$

$$t = (1.39)(2.0)(5.0 \times 10^{-6})$$

$$= 1.4 \times 10^{-5}\ s$$

3. In the diagram below, wire 1's current is 3.0 Amps and points into the page. Wire 2's current is 2.0 Amps and points out of the page. Wire 1 is at the origin. Wire 2 is at coordinate x = 1.0 meters. Point P is the coordinate x = 1.0, y = 1.0. What is the magnitude and direction of the magnetic field at P?



$$|B_1| = \frac{\mu_0 I_1}{2\pi r_1}$$

$$= \frac{(2\times10^{-7})(3.0)}{1.414}$$

$$= 4.24\times10^{-7}$$

1 ⊗ 2 ⊙

$$|B_2| = \frac{(2\times10^{-7})(2.0)}{1}$$

$$= 4.00\times10^{-7}$$

$B_{1,x} = 4.24\times10^{-7}\cos 45^\circ = -30.0\ \mu T$

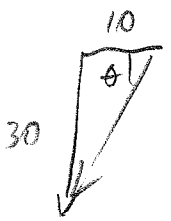
$B_{1,y} = -4.24\times10^{-7}\sin 45 = -30.0\ \mu T$

$B_{2,x} = -4.00\times10^{-7}$

$B_{2,y} = 0$

$B_{TOT,x} = -10.0\ \mu T$

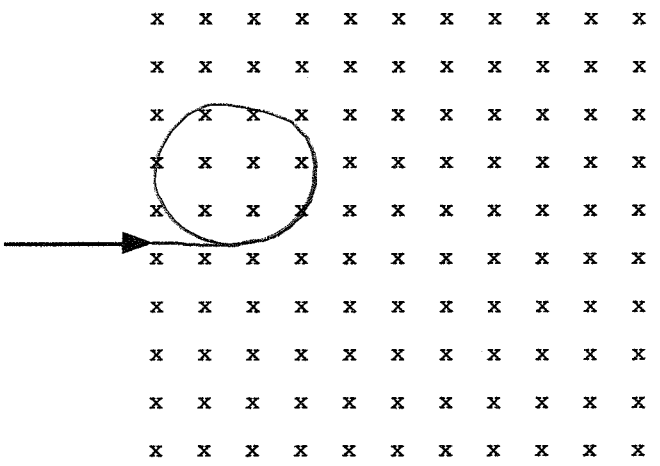
$B_{TOT,y} = -30.0\ \mu T$



$\theta = \tan^{-1}(3)$

$\vec{B} =$ **3.2×10^{-7} T, 72° below −x**

4. A proton is accelerated from rest through a potential of 120 Volts, and it then enters a region of uniform magnetic field of 5.0 Tesla pointing into the page as shown. Sketch the path of the proton on the diagram below, then determine the radius of its circular path.



p t f

$$\vec{F} = q\vec{v} \times \vec{B}$$

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

$$W_E = q\Delta V = \frac{1}{2}mv^2$$

$$(1.60 \times 10^{-19})(120) = \frac{1}{2}(1.67 \times 10^{-27})v^2$$

$$v^2 = 2.3 \times 10^{10}$$

$$v = 1.5 \times 10^5 \ m/s$$

$$r = \frac{(1.67 \times 10^{-27})(1.5 \times 10^5)}{(1.60 \times 10^{-19})(5.0)} = \boxed{3.1 \times 10^{-4} \ m}$$