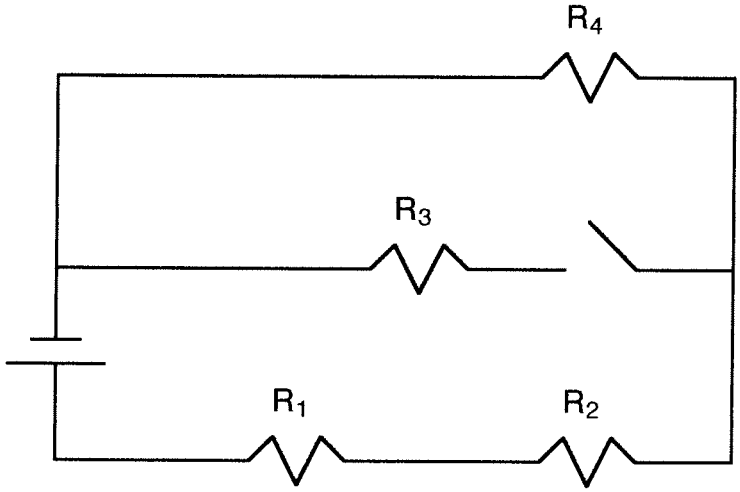
Physics 10164 - Exam #2B

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. If you give more than one answer without indicating which is correct, you will definitely lose points, even if one answer is correct.

1. (40 pts) In the circuit below, the battery has a voltage of 12 V. R_1 = 1.0 Ohms, R_2 = 2.0 Ohms, R_3 = 3.0 Ohms, R_4 = 4.0 Ohms.

a) When the switch is closed, what is the power dissipated by the resistor R_2?

b) When the switch is opened, does the power dissipated by R_1 increase, decrease or stay the same? Justify your answer either mathematically or with an explanation.



If S closed, R_3 is parallel to R_4, so $\frac{1}{R_{34}} = \frac{1}{3} + \frac{1}{4} = \frac{7}{12}$

$R_{34} = 1.7\,\Omega$

$R_{TOT} = R_1 + R_2 + R_{34} = 4.7\,\Omega$

$I_{TOT} = \frac{12}{4.7} = 2.55\ A$

$I_2 = I_{TOT}$ so $P_2 = I_2^2 R_2 = (2.55)^2(2) = \boxed{13\ W}$

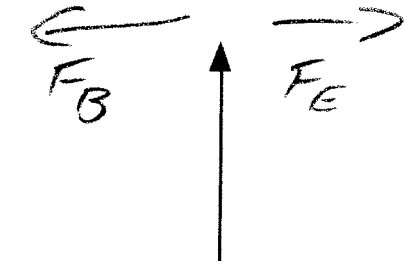
b) If S opens R_{TOT} is now $R_1 + R_2 + R_4 = 7$

so I_{TOT} decreases to $\frac{12}{7} = 1.7\ A$

and P_1 also $\boxed{P_2 \text{ decreases}}$ to $(1.7)^2(2) = 6\ W$ 5

2. (30 pts) An alpha particle with a mass of 6.65×10^{-27} kg and a charge of +2e is accelerated through a potential of 750 Volts. The particle is travelling in the +y direction as shown below and enters a uniform magnetic field of 3.5 Tesla pointing into the page.

What is the magnitude and direction of the uniform electric field that would be needed in order to ensure the particle continues to travel in a straight line?



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

$$-(3.2\times10^{-19})(-750) = \frac{1}{2}(6.65\times10^{-27})v^2$$

$$v^2 = 7.218\times10^{10}$$

$$\boxed{v = 2.7\times10^5 \text{ m/s}}$$

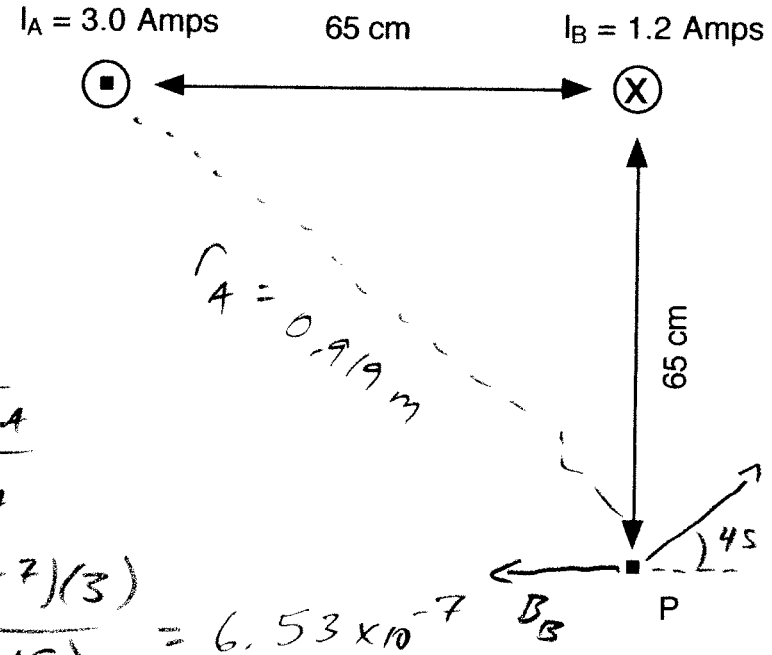
Using right hand rule F_B points toward $-x$

So F_E (and E) must point toward $+x$

$$qvB = qE$$

$$E = vB = \boxed{9.4\times10^5 \frac{V}{m}, +x}$$

3. (30 pts) What is the magnitude and direction of the magnetic field at point P due to wires A and B shown in the diagram below?



$r_A = 0.919$ m

$|B_A| = \frac{\mu_0 I_A}{2\pi r_A}$

$= \frac{(2\times10^{-7})(3)}{(.919)} = 6.53\times10^{-7}$

$|B_B| = \frac{(2\times10^{-7})(1.2)}{.65} = 3.69\times10^{-7}$

$B_{A,x} = 6.53 \cos 45 = 4.62$

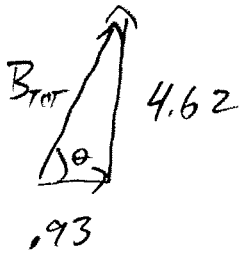
$B_{B,x} = -3.69$

0.93

$B_{A,y} = 6.53 \sin 45 = 4.62$

$B_{B,y} = 0$

4.62



$|B_{tot}| = \sqrt{.93^2 + 4.62^2} = 4.7\times10^{-7}$ T

$\theta = \tan^{-1}\left(\frac{4.62}{.93}\right) = 79°$ above +x