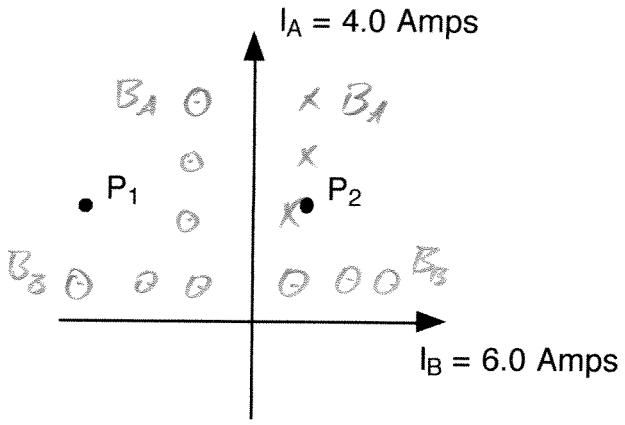
Physics 10164 - Exam 2C

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. (30 pts) The two wires shown below cross at the origin, find the magnitude and direction of the total magnetic field at points P_1 at (x,y) = (-7.0,5.0) meters and P_2 at (x,y) = (2.0,5.0)



P_1: $B_A = \frac{\mu_0 I_A}{2\pi r_A} = \frac{(4\pi \times 10^{-7})(4)}{2\pi(7.0)} = 1.14 \times 10^{-7}$, O

B_B: $\frac{\mu_0 I_B}{2\pi r_B} = \frac{(4\pi \times 10^{-7})(6)}{2\pi(5.0)} = 2.40 \times 10^{-7}$, O

3.5×10^{-7} T, O

P_2: B_A: $\frac{\mu_0 I_A}{2\pi r_A} = \frac{(4\pi \times 10^{-7})(4)}{2\pi(2.0)} = 4.00 \times 10^{-7}$, x

B_B

$= 2.40 \times 10^{-7}$, O

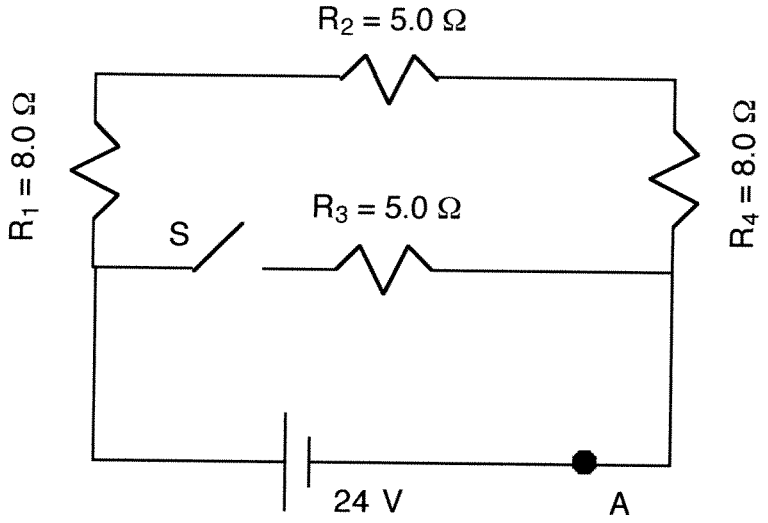
1.60×10^{-7} T, (x)

2. (40 pts) In the circuit below, the switch S is initially open, and there is a 5.0 Amp circuit breaker located at A.

a) When the switch is open, what is the current at A?

b) When the switch is closed, does the circuit breaker activate to break the circuit? Justify your answer.

c) When the switch is closed, does the total power dissipated by the resistor R_2 increase, decrease or remain the same? Justify your answer mathematically or logically.



a) $R_{TOT} = R_1 + R_2 + R_4 = 21\,\Omega$

$I_{TOT} = \frac{24}{21} =$ **1.1 A**

b) $\frac{1}{R_{TOT}} = \frac{1}{R_3} + \frac{1}{R_{124}} = \frac{1}{5} + \frac{1}{21}$

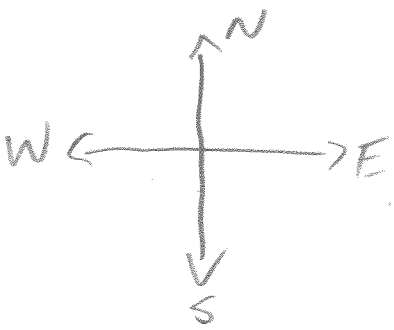
$R_{TOT} = 4.04\,\Omega$

$I_{TOT} = \frac{24}{4.04} =$ **5.94 A, circuit breaks**

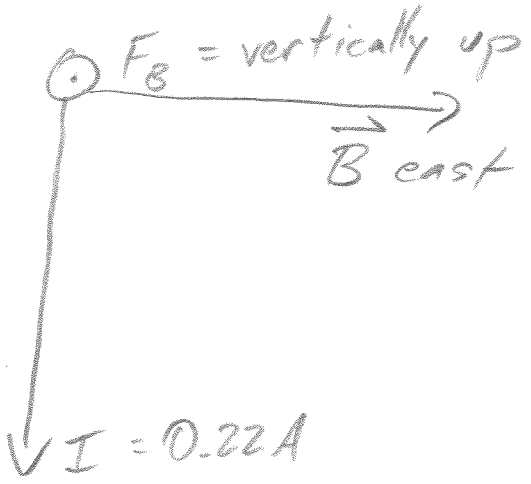
c) S closed, ΔV_{124} unchanged, so I_{124} unchanged

$I_2 = I_{124}$, so same current, **same power**

3. (30 pts) A 3.0 meter length of wire weighs 540 grams. The wire carries a 0.22 Amp current in a direction due south. An experimenter wishes to "levitate" the wire by having the magnetic force on the wire counteract gravity. What must be the magnitude and direction of the external magnetic field in which the wire is immersed?



Due to RHR, $\vec{B}$ must point East



$$|F_B| = |F_{grav}|$$

$$\ell I B = mg$$

$$B = \frac{mg}{\ell I} = \frac{(0.540)(9.8)}{(3.0)(.22)} = \boxed{8.0\ T,\ East}$$