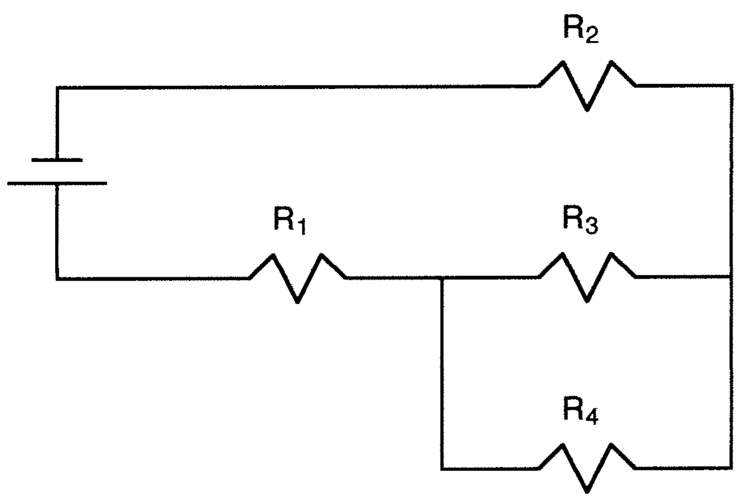
Physics 10164 - Exam 2B

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 and remember to include correct units and significant figures.

1. (40 pts) In the circuit below, the battery has an EMF of 12 Volts, and the resistors are R_1 = 1.0 Ohm, R_2 = 2.0 Ohm, R_3 = 3.0 Ohm, R_4 = 4.0 Ohm.

Find the voltage drop across each of the four resistors.



$$\frac{1}{R_{34}} = \frac{1}{3} + \frac{1}{4} \qquad R_{34} = 1.7\,\Omega$$

$$R_{TOT} = 1.0 + 1.7 + 2.0 = 4.7\,\Omega$$

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

So $\Delta V_1 = (2.55)(1) = 2.55\,V$

$\Delta V_2 = (2.55)(2) = 5.10\,V$

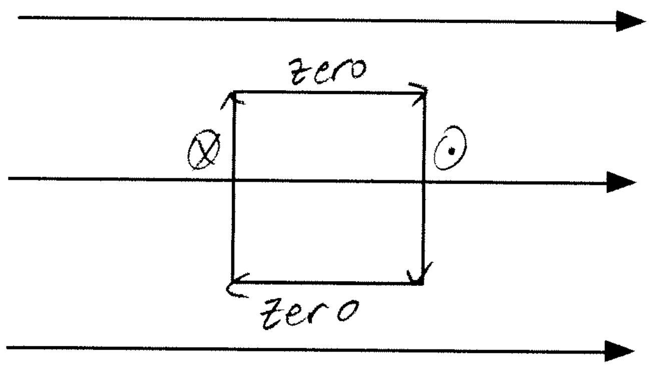
$$\Delta V_{34} = (2.55)(1.7) = 4.34\,V$$

so $\Delta V_3 = \Delta V_4 = 4.34\,V$

2. (30 pts) A single-turn square loop 2.5 cm on a side has a clockwise current of 3.0 Amps. The loop is placed in a uniform 15 Tesla magnetic field that is parallel to the plane of the loop.

a) Find the magnitude of the magnetic torque on the loop.

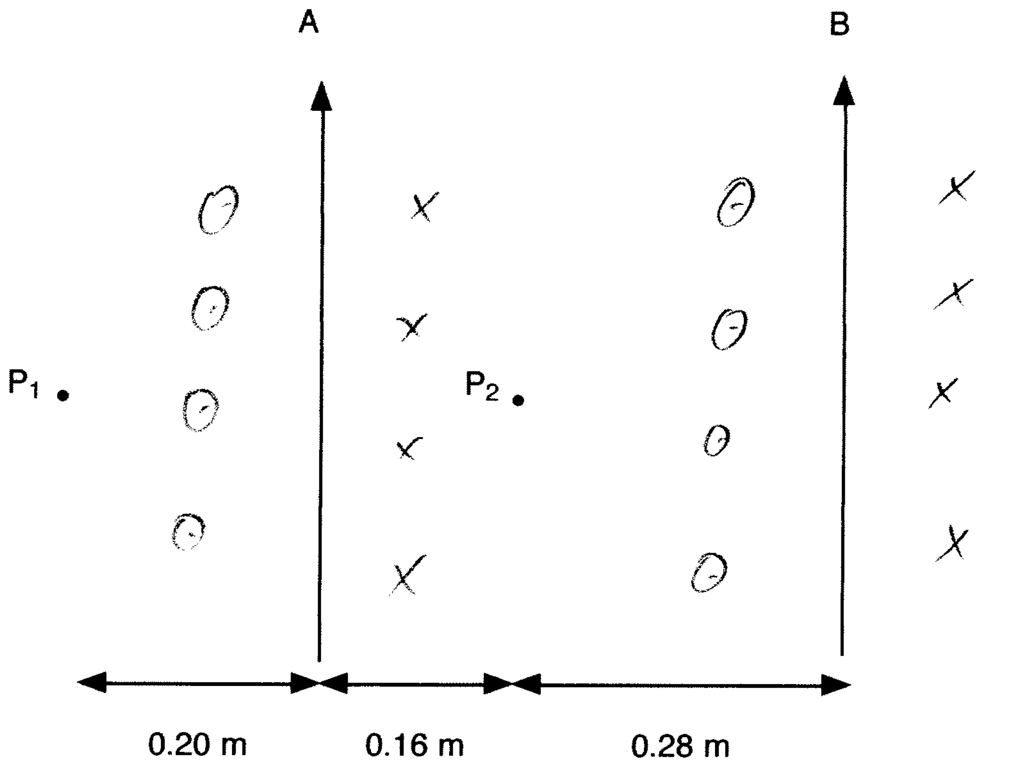
b) For each of the four sides of the loop, indicate the direction of magnetic force the loop fields (or write zero if there is no force).



$$\tau = NIAB \sin \theta$$

$$= (1)(3.0)(.025)^2(15) \sin 90 = \boxed{.028 \text{ N-m}}$$

3. (30 pts) Wire A below has a current of 3.0 Amps. Wire B has a current of 7.0 Amps. Find the magnitude and direction of the total magnetic field at points P_1 and P_2 below.



P_1: $B_A = \frac{\mu_0 I_A}{2\pi(.20)} = 3.0 \times 10^{-6}, \odot$

$B_B = \frac{\mu_0 I_B}{2\pi(.64)} = 2.19 \times 10^{-6}, \odot$

$B_{TOT} = B_A + B_B = \boxed{5.2 \times 10^{-6}\ T, \odot}$

P_2: $B_A = \frac{\mu_0 I_A}{2\pi(.16)} = 3.75 \times 10^{-6}, \otimes$

$B_B = \frac{\mu_0 I_B}{2\pi(.28)} = 5.0 \times 10^{-6}, \odot$

$B_{TOT} = -B_A + B_B = \boxed{1.25 \times 10^{-6}, \odot}$