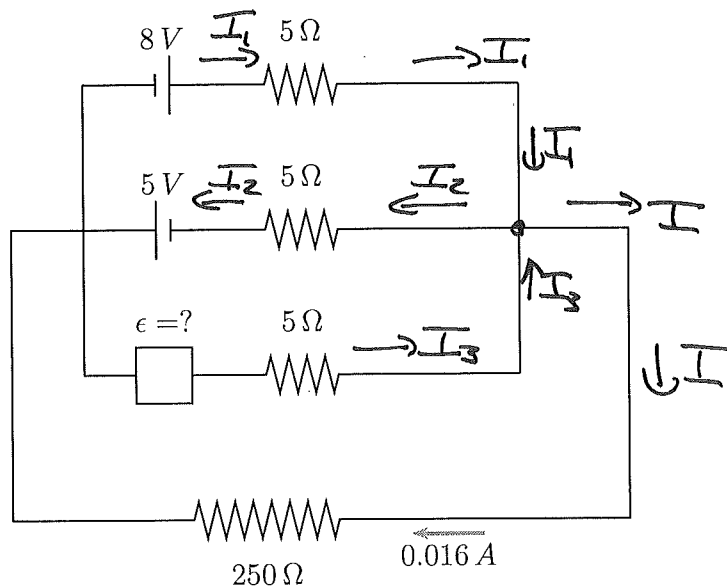# PHYSICS 161 TEST 5

Three batteries, each with internal resistance $5\,\Omega$ are connected in parallel to each other, and then to a $250\,\Omega$ resistor as shown.


(a) If the current flowing through the $250\,\Omega$ resistor is $0.016\,A$ in the direction shown and two of the batteries have emf values of $8\,V$ and $5\,V$ (and polarities shown), what is the emf of the third battery? Which end of the third battery is at higher potential?   *(6pts)*

GIVEN POLARITIES LABEL I_1, I_2, I_3 AS SHOWN (I_3 IS A GUESS). LET $I = .016A$

JUNCTION RULE $\Rightarrow I_1 + I_3 = I_2 + I \Rightarrow I_3 = I + I_2 - I_1$
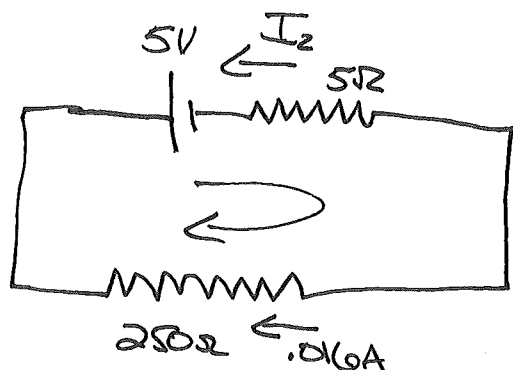
TO FIND I_1 & I_2 DO LOOPS WITH BATTERIES AND 250Ω

I_1

5Ω

$8V$

LOOP
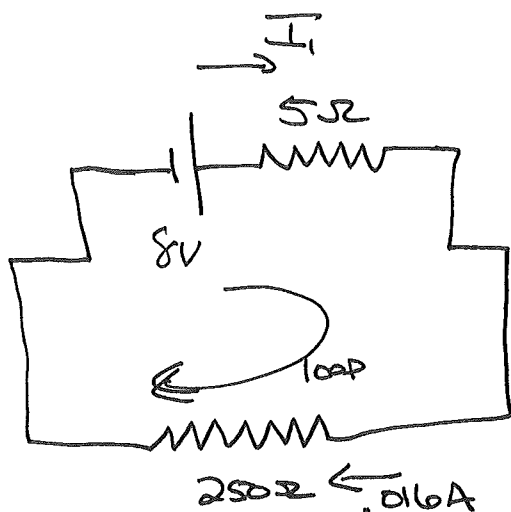
$250\Omega \leftarrow .016A$

$$8V - I_1(5\Omega) - .016A(250\Omega) = 0$$

$$\Rightarrow 8V - I_1(5\Omega) - 4V = 0$$

$$\Rightarrow I_1(5\Omega) = 4V \Rightarrow I_1 = 0.8A$$

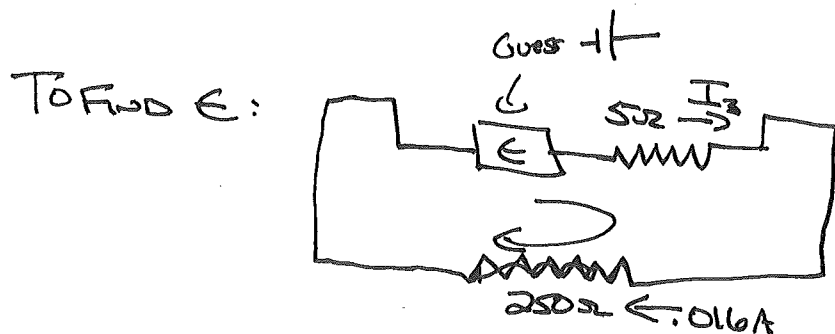$5V \quad I_2$

5Ω

$250\Omega \leftarrow .016A$

$$-5V + I_2(5\Omega) - .016A(250\Omega) = 0$$

$$\Rightarrow -5V + I_2(5\Omega) - 4V = 0$$

$$\Rightarrow I_2(5\Omega) = 9V \Rightarrow I_2 = 1.8A$$

$$I_3 = I + I_2 - I_1 = .016A + 1.8A - .8A \Rightarrow I_3 = 1.016A \Leftarrow \text{guessed right}$$

TO FIND $\mathcal{E}$:

Guess

$\mathcal{E}$

$5\Omega \quad I_3$

$250\Omega \leftarrow .016A$

$$\mathcal{E} - I_3(5\Omega) - 250\Omega(.016A) = 0$$

$$\Rightarrow \mathcal{E} - 1.016A(5\Omega) - 4V = 0$$

$$\Rightarrow \mathcal{E} = 5.08V + 4V$$

$$\Rightarrow \boxed{\mathcal{E} = 9.08V}$$

GUESSED CORRECTLY, LEFT SIDE IS AT lower POTENTIAL

(b) The $0.6\,m$-long straight wire shown below has $3\,A$ of current flowing through it. If there is an upward-pointing, uniform magnetic field of magnitude $0.6\,T$. What is the magnitude and direction of the force acting on the wire? *(4pts)*

$\vec{B}$ $\vec{B}$ $\vec{B}$

I

$\overline{ 0.6\,m }$
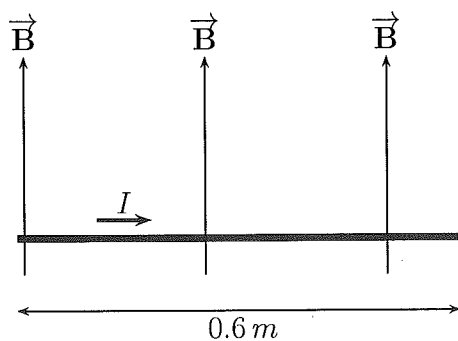
STRAIGHT WIRE

$\Rightarrow \vec{F} = I\vec{L} \times \vec{B}$

$\vec{L} = .6M, \; \rightarrow$

$\vec{B} = 0.6T, \; \uparrow$

$RHR \Rightarrow \vec{L} \times \vec{B} = LB \sin 90°, \; \odot$

$\Rightarrow \vec{F} = ILB, \; \odot = (3A)(.6M)(.6T), \; \odot$

$\Rightarrow \boxed{\vec{F} = 1.08\,N, \; \odot}$