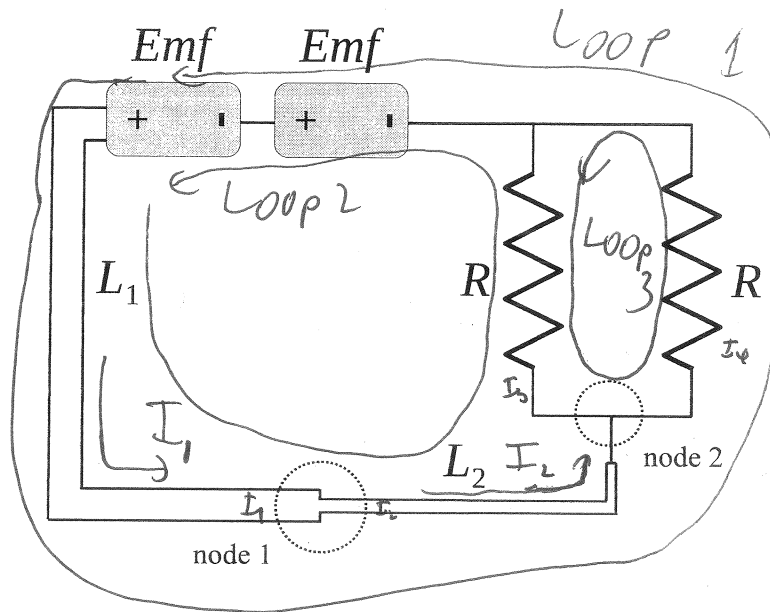


Name: KEY Section _____

Please show all of your work and box your final answers for full credit.

 Two identical resistors with resistance R , are connected in parallel. The resistors are connected with two batteries and two pieces of nichrome wire, each with the same electron density and mobility n, u . The first wire, with length L_1 , has twice the radius of the second wire of length L_2 . These wires and circuit elements are all connected as shown in the diagram.


- (10 points) Label the direction of the conventional current in wires L_1 and L_2 .
- (50 points) Write down all possible loop (conservation of energy) rules for this circuit. Write down a node (conservation of charge) rule for node 1 and node 2 (dashed circle), as indicated on the diagram.

Loop 1

$$Emf + Emf - I_1 \frac{L_1}{|q|nuA_1} - I_2 \frac{L_2}{|q|nuA_2} - I_4 R = 0$$

$$A_1 = 4A_2$$

$$|q| = 1.6 \times 10^{-19}$$

$$I_1 = I_2$$

Loop 2

$$Emf + Emf - I_1 \frac{L_1}{|q|nuA_1} - I_2 \frac{L_2}{|q|nuA_2} - I_3 R = 0$$

Loop 3

$$-I_4 R + I_3 R = 0$$

Node 1 $I_1 = I_2$

Node 2 $I_2 = I_3 + I_4$

3. (40 points) Determine the current flowing through each resistor R . The final algebraic expressions should be in terms of the variables given in the problem statement.

Loop 3
~~Since~~ $-I_3 R + I_4 R = 0 \Rightarrow I_3 = I_4$

Node 2

$$I_2 = I_3 + I_4$$

$$I_3 = \frac{1}{2} I_2$$

Node 1

$$I = I_1 = I_2$$

Find I

Loop 1

$$Emf + Emf - I \frac{L_1}{\ln u A_1} - I \frac{4L_2}{\ln u A_1} - \frac{I}{2} R = 0$$

$$2Emf = I \left(\frac{L_1 + 4L_2}{\ln u A_1} + \frac{1}{2} R \right)$$

$$I = \frac{2Emf}{\left(\frac{L_1 + 4L_2}{\ln u A_1} + \frac{R}{2} \right)}$$

So current through each resistor $\Rightarrow \frac{I}{2} = \frac{Emf}{\left(\frac{L_1 + 4L_2}{\ln u A_1} + \frac{R}{2} \right)}$