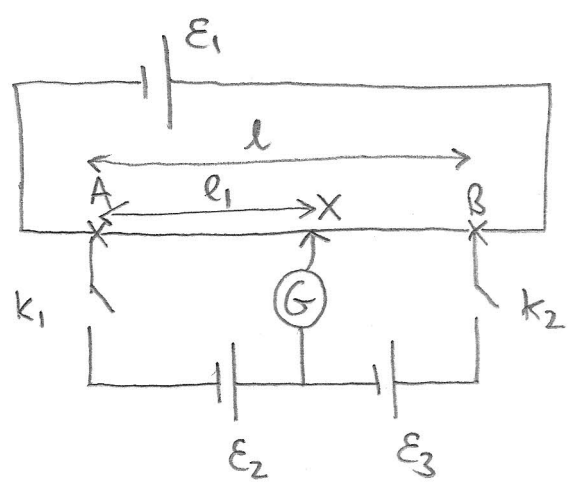


Q2/



a) k_1, k_2 open

(ii) So PD between X and A (i.e. 'potential at X')

$$\text{is } \boxed{\mathcal{E} = \frac{l_1}{l} \mathcal{E}_1}$$

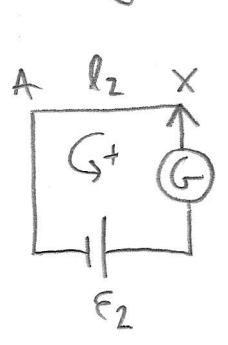
(Since resistance of a wire \propto length)

(iii) Now k_1, k_2 are closed. X is now moved to l_2 from A

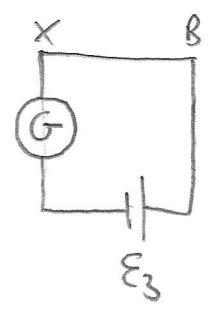
We are given $\boxed{\mathcal{E}_1 = \mathcal{E}_2 + \mathcal{E}_3}$

$$\rightarrow \text{So } \boxed{\mathcal{E} = \frac{l_2}{l} \mathcal{E}_1}$$

Applying Kirchhoff II to the loops left and right of the galvanometer:



$$\boxed{\mathcal{E}_2 = \frac{l_2}{l} \mathcal{E}_1}$$



$$\mathcal{E}_3 = \mathcal{E}_1 - \mathcal{E}$$

$$\boxed{\mathcal{E}_3 = \mathcal{E}_1 \left(1 - \frac{l_2}{l}\right)}$$

[Not this guarantees $\mathcal{E}_1 = \mathcal{E}_2 + \mathcal{E}_3 \rightarrow$ So what would happen if this was not true? Would internal resistance of the wires mean Kirchhoff II satisfied?]

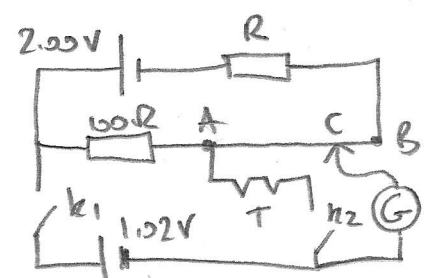
b) AB is a wire of length $\boxed{l = 1.00 \text{ m}}$

$$\boxed{R_{AB} = 2.00 \Omega}$$

We are given:

(I) * No current through \textcircled{G} k_1 closed k_2 open $AC = 0.90 \text{ m}$

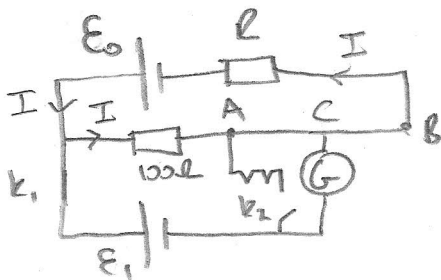
(II) * " " " \textcircled{G} k_1 open k_2 closed $AC = 0.45 \text{ m}$



This is a stembridge

(1)

(I)



$$E_0 = 2.00V$$

$$E_1 = 1.02V$$

(EMFs)

If current through \odot is zero then all current is in the upper loop.

Kirchoff II: (upper loop)

$$E_0 = I(100 + R_{AB} + R)$$

$$R_{AB} = 200 \Omega \quad \text{so}$$

$$E_0 = I(102 + R) \quad (1)$$

Kirchoff II (lower loop)

$$E_1 = I(100 + R_{AC})$$

$$R_{AC} = \frac{0.90}{1.00} \times 200 \Omega = 1.8 \Omega$$

$$[AC = 0.90m]$$

$$\therefore E_1 = I(101.8) \quad (2)$$

(1)/(2)

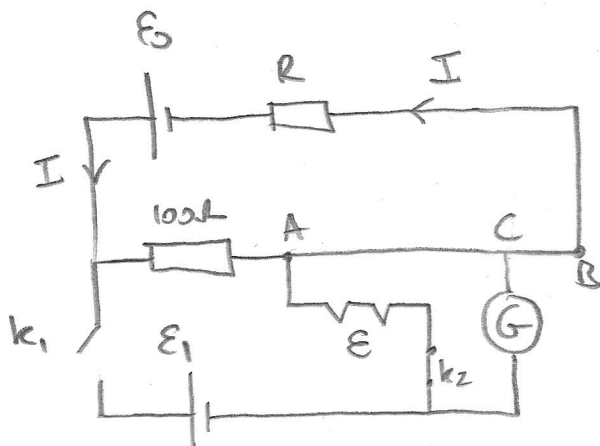
$$\frac{E_0}{E_1} = \frac{102 + R}{101.8}$$

$$\therefore R = 101.8 \frac{E_0}{E_1} - 102$$

$$R = 101.8 \times \frac{2.00}{1.02} - 102$$

$$R = 97.6 \Omega$$

(II)



$$[AC = 0.45m]$$

Kirchoff II: (upper loop)

$$E_0 = I(102 + R)$$

[is same as before]

Kirchoff II (diamond loop)

$$E = I R_{AC}$$

$$R_{AC} = \frac{0.45}{1.00} \times 200$$

$$\therefore \frac{E_0}{E_1} = \frac{102 + R}{0.9}$$

$$\therefore E = \frac{E_0 \times 0.9}{102 + 97.6} = 9.02 \times 10^{-3} \text{ V}$$

$$= 9.02 \times 10^{-3} \text{ V}$$

$$= 9.02 \text{ mV}$$

(2)

