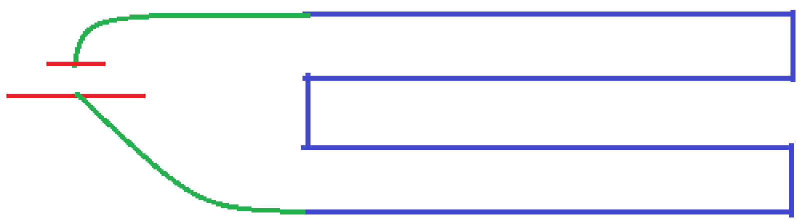
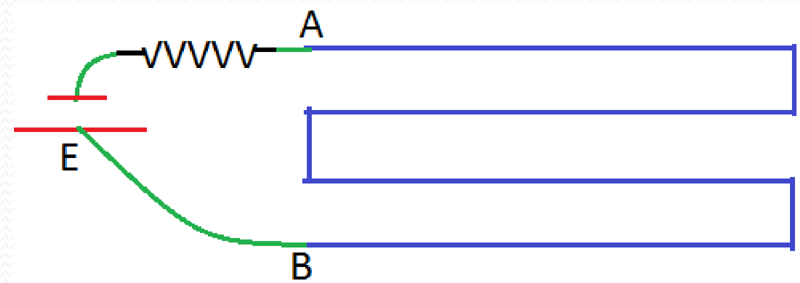
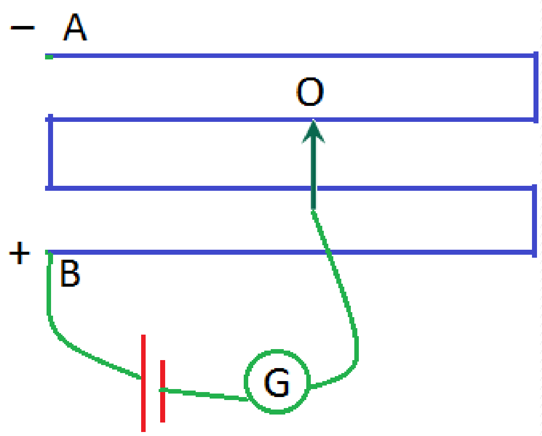
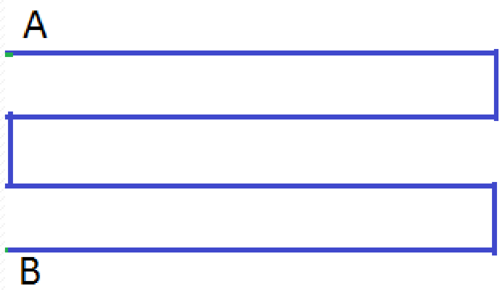


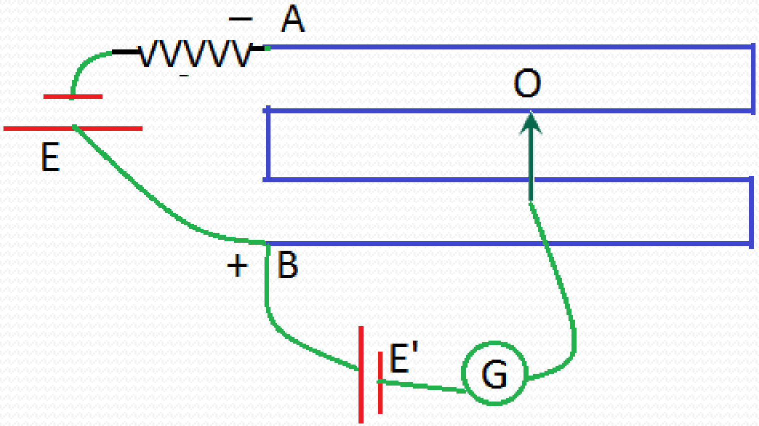

A
E
B


− A
O
+ B
G


A
B

$$AB = L, R_L = R$$

$$I = \frac{E}{R} = \frac{E}{\rho\frac{L}{A}} = \frac{EA}{\rho L}$$

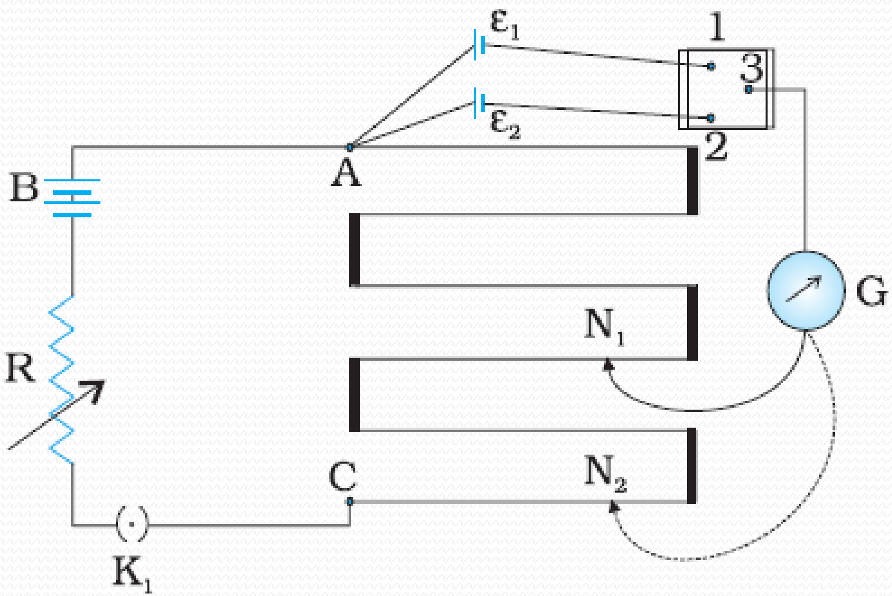


$$V_l = IR_l = I\rho\frac{l}{A}$$

$$V_l \propto l \Rightarrow V_l = kl$$

$E' = V_{BO}$ Galvanometer $I' = 0$

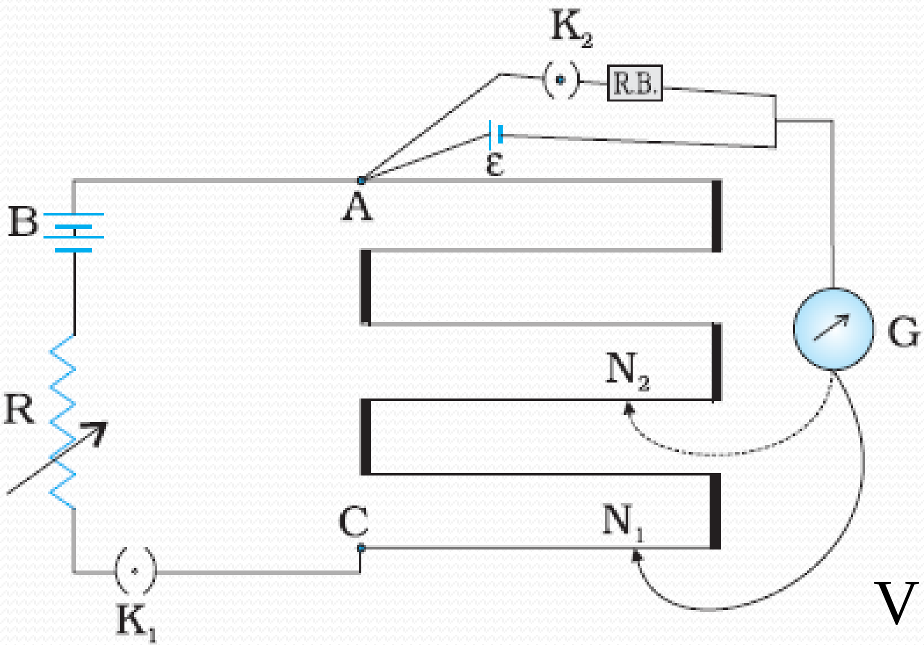
$$V_{BO} = IR_{BO} = I\rho\frac{l_{BO}}{A}$$



$$E_1 = kl_1 = kl_{AN_1}$$

$$E_2 = kl_2 = kl_{AN_2}$$

$$\frac{E_1}{E_2} = \frac{kl_1}{kl_2} = \frac{l_1}{l_2}$$



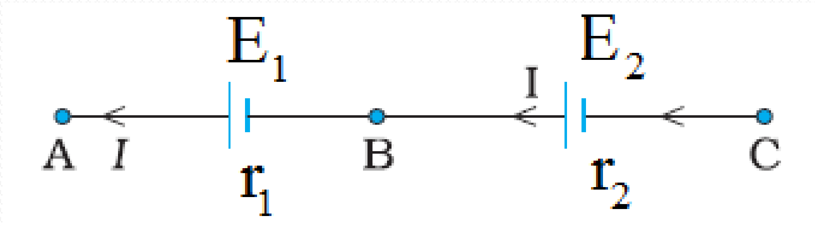
$$E = kl_1 = kl_{AN_1} = kl_1$$

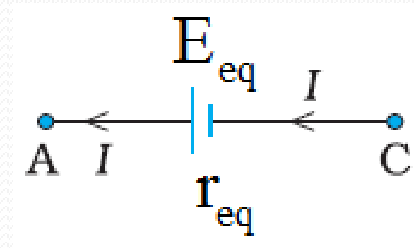
$$V = E - Ir = kl_{AN_2} = kl_2$$

$$I = \frac{E}{R + r}$$

$$V = E - \frac{E}{R + r} r = \frac{ER}{R + r} = kl_2$$

$$\frac{R + r}{R} = \frac{l_1}{l_2} \Rightarrow r = R\left(\frac{l_1}{l_2} - 1\right)$$



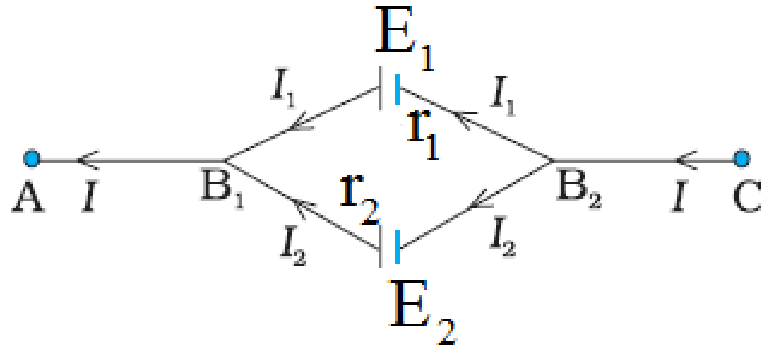


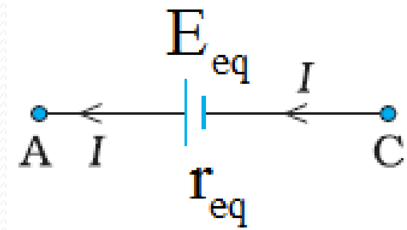
$$V_{AB} = E_1 - Ir_1; \qquad V_{BC} = E_2 - Ir_2$$

$$V_{AC} = V_{AB} + V_{AC} = E_1 - Ir_1 + E_2 - Ir_2$$

$$V_{AC} = (E_1 + E_2) - I(r_2 - r_1) \qquad\qquad V_{AC} = E_{eq} - Ir_{eq}$$

$$E_{eq} = E_1 + E_2 \quad \text{and} \; r_{eq} = r_1 + r_2$$





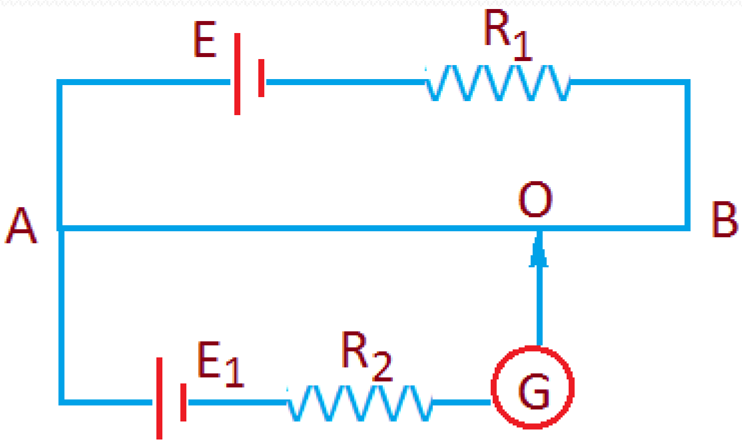
$$V_{AC} = E_1 - I_1 r_1 = E_2 - I_2 r_2$$

$$I_1 = \frac{E_1 - V_{AC}}{r_1} \qquad I_2 = \frac{E_2 - V_{AC}}{r_2}$$

$$I = I_1 + I_2 = \frac{E_1 - V_{AC}}{r_1} + \frac{E_2 - V_{AC}}{r_2}$$

$$= \frac{E_1}{r_1} + \frac{E_2}{r_2} - V_{AC}\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$$

$$\frac{E_{eq}}{r_{eq}} = \frac{E_1}{r_1} + \frac{E_2}{r_2} \qquad \frac{1}{r_{eq}} = \frac{1}{r_1} + \frac{1}{r_2}$$



$E = 20\text{ V},\quad R_{AB} = 20\ \Omega,\ R_1 = 5\ \Omega,\ R_2 = 5\ \Omega$

$L_{AB} = 200\text{ cm},$ Find AO

(i) $E_1 = 12\text{ V}$ (ii) $E_1 = 18\text{ V}$

$$V_{AB} = ? \qquad V_{AB} = IR_{AB} \qquad I = \frac{20}{20+5} = \frac{4}{5}\text{A}$$

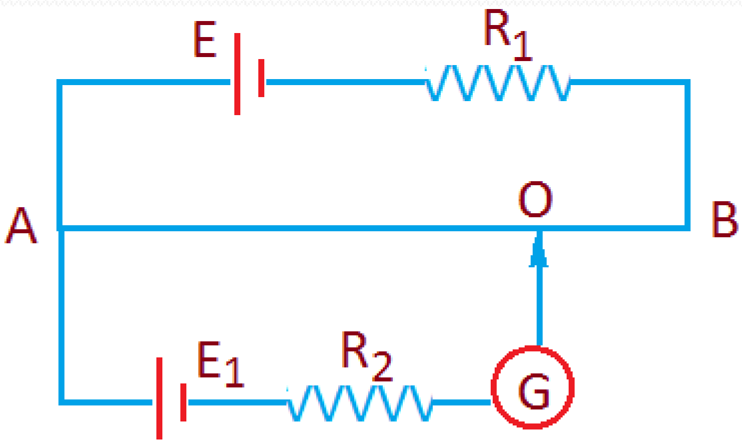
$$V_{AB} = \frac{4}{5} \times 20 = 16\text{V}$$

$$16\text{V} \equiv 200\text{ cm} \Rightarrow 12\text{ V} \equiv \frac{200}{16} \times 12 = 150\text{cm}$$

$$\text{Pot Gradient} = k = \frac{16}{200\text{ cm}}\frac{\text{V}}{}$$

$$12\text{V} = \frac{16}{200\text{ cm}}\frac{\text{V}}{}.\text{L} \Rightarrow \text{L} = 150\text{cm}$$

$$18\text{V} = \frac{16}{200\text{ cm}}\frac{\text{V}}{}.\text{L} \Rightarrow \text{L} = 225\text{ cm}$$



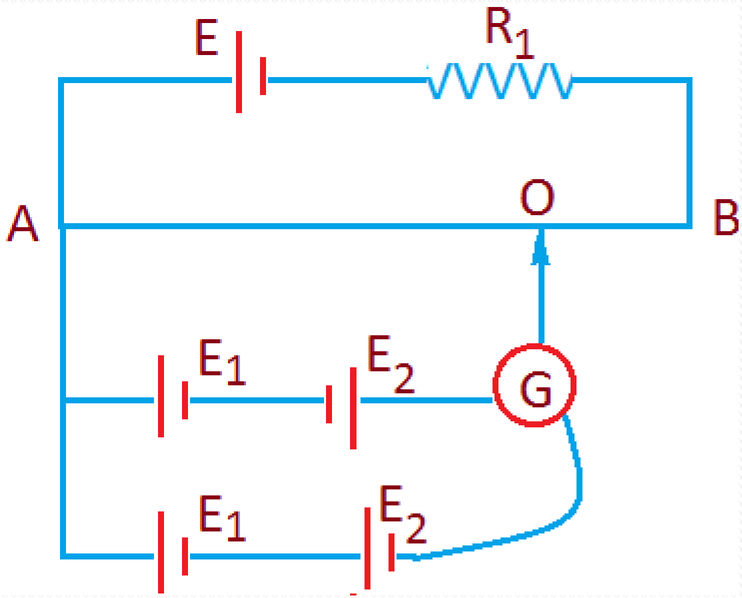
$E = 20$ V, $R_{AB} = 10\ \Omega$, $R_1 = 6\ \Omega$, $R_2 = 5\ \Omega$
$L_{AB} = 200$ cm, AO = 40 cm Find E_1 ?

$$V_{AB} = IR_{AB} = \frac{20}{16} \times 10 = 12.5\,\text{V} \qquad k = \frac{12.5}{200}$$

$$V_{AO} = kL_{AO} = \frac{12.5}{200} \times 80 = 5\,\text{V}$$

Find E , if $R_{AB} = 10\ \Omega$, $R_1 = 6\ \Omega$, $R_2 = 5\ \Omega$ $L_{AB} = 300$ cm, AO = 60 cm and $E_1 = 8$ V.

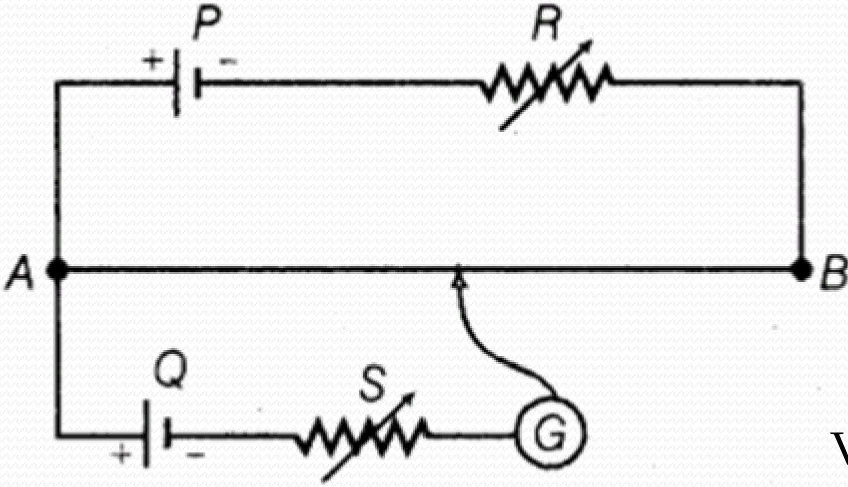
$$k = \frac{8}{120} \qquad V_{AB} = \frac{8}{120} \times 300 = 20\text{ V} \qquad I_{AB} = I = \frac{20}{10} = 2\,\text{A} \qquad E = 2 \times 16 = 32\text{ V}$$



In the figure, a long uniform potentiometer wire AB is having a constant potential gradient along its length. The null points for the two primary cells of emf's E_1 and E_2 connected in the manner shown, are obtained at a distance of 120 cm and 300 cm from the end A. Find (i) E_1 / E_2 and (ii) position of null point for the cell E_1

$$E_1 - E_2 = kl_1 = 120k \qquad E_1 + E_2 = kl_1 = 300k \qquad \frac{E_1 + E_2}{E_1 - E_2} = \frac{300}{120} = \frac{5}{2}$$

$$2E_1 + 2E_2 = 5E_1 - 5E_2 \Rightarrow 7E_2 = 3E_1 \Rightarrow \frac{E_1}{E_2} = \frac{7}{3} \qquad E_1 + \frac{3}{7}E_1 = \frac{10}{7}E_1 = 300k \Rightarrow E_1 = 210k$$



Effect on balancing Length :

(i) Resistance R is increased
(ii) Resistance S is increased
(iii) Length AB is increased
(iv) Voltage of P is increased
(v) Voltage of Q in increased
(vi) Another R attached in parallel to R

$V = kL$; k = Potential Gradient

$$k = \frac{V_{AB}}{L_{AB}} \qquad V_{BALANCE} = \left(\frac{V_{AB}}{L_{AB}}\right) L_{BALANCE}$$

(i) V_{AB} decrease $L_{BALANCE}$ increase

(ii) V_{AB} NO EFFECT $L_{BALANCE}$ NO EFFECT

(iii) L_{AB} increase , $L_{BALANCE}$ increase

(iv) V_{AB} increase , $L_{BALANCE}$ decrease

(v) $V_{BALANCE}$ increase , $L_{BALANCE}$ increase

(vi) V_{AB} Increase , $L_{BALANCE}$ Decrease