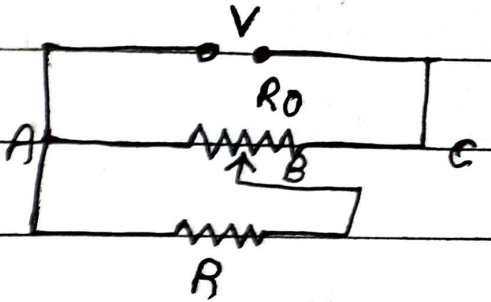
Home Assignment

Derive an expression for the voltage across R when the sliding contact is in the middle of the potentiometer



$$R_{total} = \frac{R_0}{2} + \frac{\frac{R_0}{2} \times R}{\frac{R_0}{2} + R} = \frac{R_0 (R_0 + 4R)}{2 (R_0 + 2R)}$$

$$I_{total} = \frac{V}{R_{total}}$$

Current through R $= I_2 = I_{total} \times \frac{\frac{R_0 \times R}{2}}{\frac{R_0}{2} + R}$

$= I_{total} \times \frac{R_0}{R_0 + 2R} = \frac{V\,2(R_0+2R)}{R_0(R_0+4R)} \times \frac{R_0 \times R}{R_0+2R}$

$= \frac{2VR_0R}{R_0(R_0+4R)}$

Voltage across $R = I_2R = \left(\frac{2VR}{R_0+4R}\right)$

(2) i) By increasing resistance R the current through AB decreases so, potential gradient decreases. Hence a greater length of wire is required to balance the same potential difference So nullpoint shifts towards B.

ii) By ↓↓ Resistance of S, the I through AB remains same K does not change. As K_2 is open so there is no effect of S on null point.

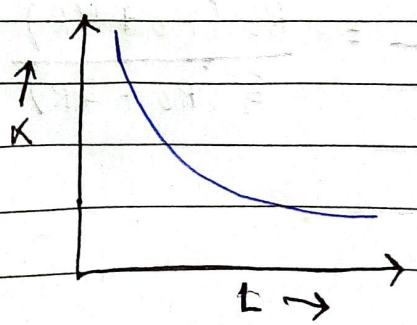
(3) a) a) Principle of Potentiometer: The potential drop across the length of a steady current carrying wire of uniform cross section is proportional to the length of the wire.

i) Why long wire: to have a lower value of potential gradient i.e a lower 'least count' or greater sensitivity of the potentiometer.

ii) Why uniform cross section of wire: as per the principle

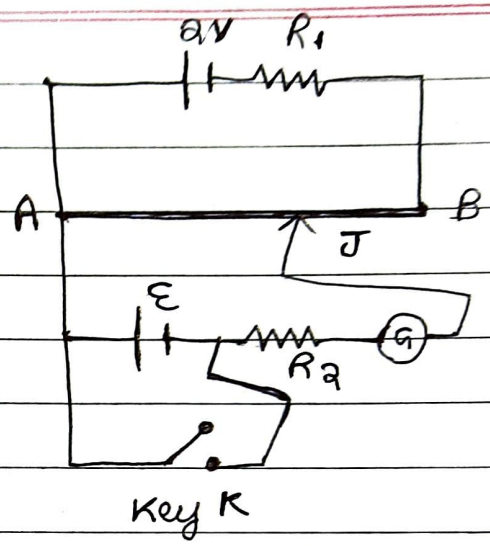
iii) Why EMF of driver cell > primary cell: or else no balance point would be obtained.

b) Potential gradient $K = \frac{V}{L}$



(4) a) Why high resistance R_2?

Is to reduce the current through the galvanometer. When jockey is kept ~~away~~ far from balance point this saves the glvanometer and the cell from being damaged.



b) When R_1 is ↓↓ the potential gradient of potentiometer wire increases, so balance point (J) shifts to longer length of wire.

(iii) i) becoz maximum emf across potentiometer wire is 2V.

b) When Key (K) is closed, the terminal potential difference of cell is zero, so balance point cannot be between A and B.

($V = Kl \Rightarrow l = 0$ for $V = 0$)

(5) i) Decreases (K increases)

ii) Increases (The terminal PD across the cell would increase)