Home Assignment :

1 While the slide is in the middle of the potentiometer only half of its resistance ($R_0/2$) will be between the points A and B. Hence, the total resistance between A and B, say R_1, will be given by the following expression :

$$\frac{1}{R_1} = \frac{1}{R} + \frac{1}{(R_0/2)}$$

$$\therefore R_1 = \frac{R_0 R}{R_0 + 2R}$$

The total resistance between A and C will be sum of resistance between A and B and B and C, i.e., $R_1 + R_0/2$

∴ The current flowing through the potentiometer will be,

$$I = \frac{V}{R_1 + R_0/2} = \frac{2V}{2R_1 + R_0}$$

The voltage V_1 taken from the potentiometer will be the product of current I and resistance R_1,

$$V_1 = IR_1 = \left(\frac{2V}{2R_1 + R_0}\right) \times R_1$$

Substituting for R_1, we have a

$$V_1 = \frac{2V}{2\left(\frac{R_0 \times R}{R_0 + 2R}\right) + R_0} \times \frac{R_0 \times R}{R_0 + 2R}$$

$$V_1 = \frac{2VR}{2R + R_0 + 2R} \quad \text{or} \quad V_1 = \frac{2VR}{4R + R_0}$$

2i) By increasing resistance R, the current through AB decreases, so potential gradient decreases. Hence, a greater length of wire would be needed for balancing the same potential difference. So, the null point would shift towards B.

ii) By decreasing resistance S, the current through AB remains the same, potential gradient does not change. As K_2 is open so there is no effect of S on null point.

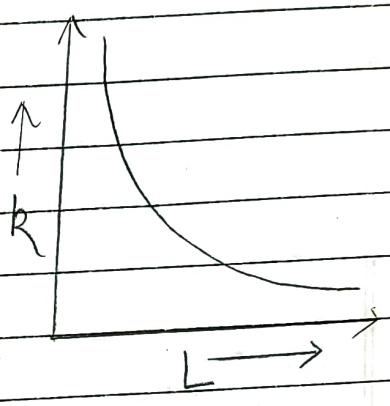
3a) Principle of potentiometer: The potential drop across the length of a steady current carrying wire of uniform cross-section is proportional to the length of the wire.

i) We use a long wire to have a lower value of potential gradient (i.e, a lower 'least count') or greater sesitivity of the potentiometer.

ii) The area of cross-section has to be uniform to get a 'uniform wire' as per the principle of the potentiometer.

iii) The emf of the driving cell has to be greater than the emf of the primary cells as otherwise no balance point would be obtained.

b) Potential gradient $k = V/L$



4 a) The purpose of high resistance R_2 is to reduce the current through the galvanometer. When jockey is far from the balance point, this saves the galvanometer and the cell (of emf ε) from being damaged.

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

c) (1) The balance point is not obtained because maximum emf across potentiometer wire is 2V

(2) When key (K) is closed, the terminal potential difference of cell is zero, so balance point cannot be between A and B. (Since $V = Rl \Rightarrow l = 0$ for $V = 0$)

5 i Decreases as the potential gradient would increa

ii Increases as the terminal p.d. across the ci
would increase.