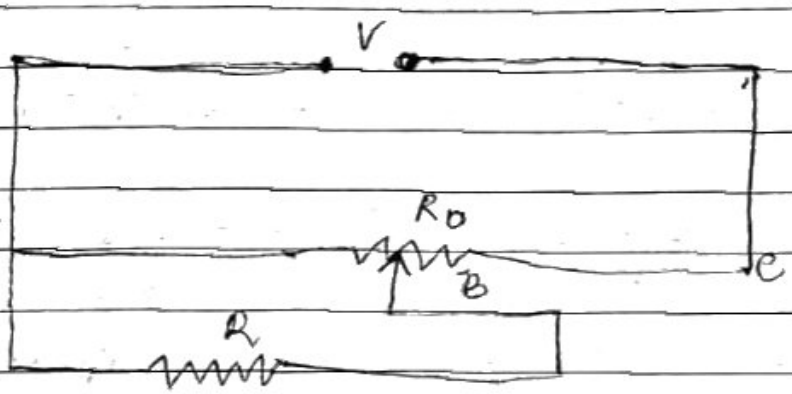
Ch - Current Electricity

Question:
A resistance R draws current from a potentiometer of resistance R_0 as shown. Derive an expression for the voltage across R when the sliding contact is in the middle of the potentiometer wire.
(NCERT)



Ans
When the sliding contact is in middle, a resistance of $R_0/2$ is connected in series with a parallel combination of R and $R_0/2$.
Hence, net resistance is ~~given~~ given by:

$$R_{eq} = \frac{R_0}{2} + \frac{R_0}{2} \| R$$

Current flowing through the circuit is given by

$$I = \frac{V}{R_{eq}}$$

Potential across R is given by:

$$V_R = I\left(\frac{R_0}{2} \| R\right) \qquad V_R = \frac{V}{R_{eq}}\left(\frac{R_0}{2} \| R\right)$$

Solving $V_R = \frac{R}{4R + R_0} V$

Q Two students x and y perform an experiment on potentiometer separately using the circuit given below. Keeping other parameters unchanged, how will the position of the null point be affect; if

ans

(a) 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.

ans

(b) 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.

Q3

a)(i) long wire is used so that potential gradient can be observed easily and can be measured.

(ii) wire having uniform area is taken so that potential gradient value may not change drastically while doing the experiment.

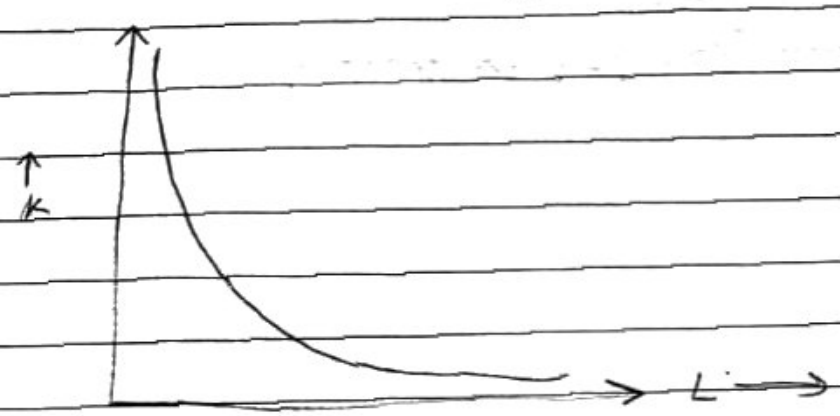
(iii) Emf of driver cell should be greater because as the circuit starts the potential is dropped across the resistor and more emf is needed to drive current in the circuit.

b)

kms

as we know that Potential gradient, $k = \frac{V}{L}$

Now as the length increases, potential gradient will start decreasing.



Q

a) The purpose of high resistance R_2 is to reduce the current through the galvanometer. When jockey is far from balance point, this saves the galvanometer and the cell 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) (i) The balance point is not obtained because maximum emf across potentiometer wire is 2 V.

(ii) When key (K) is closed the terminal difference of cell is zero, so balance point cannot be between A and B. (∵ $l \propto V, K$ ∴ $l = 0$ for $V = 0$)

Q

(i) R_1 is decreased

ans : Decreases

(The potential gradient would increase)

(ii) R_2 is increased

ans Increases

(The terminal p.d across the cell would increase)