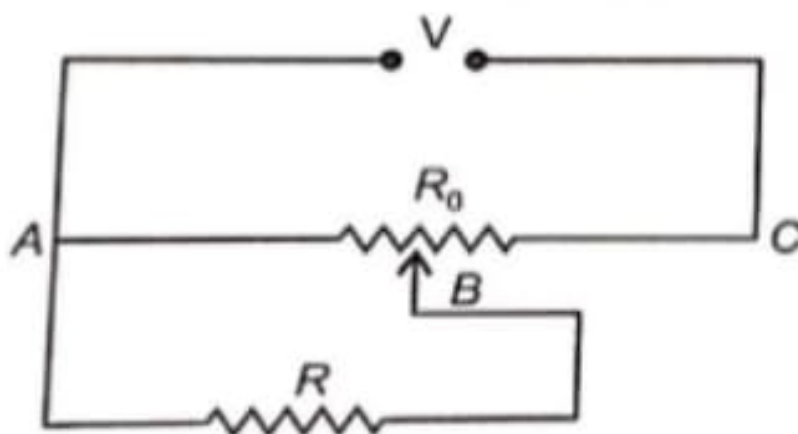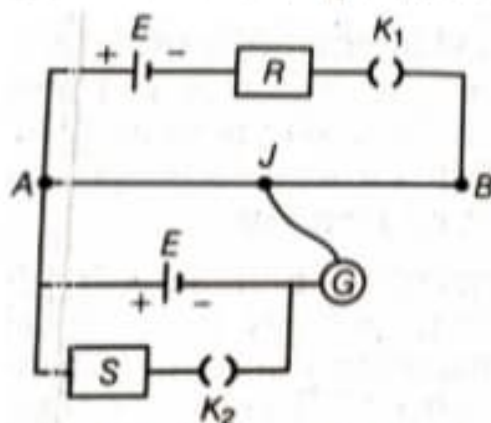# Home Assignment

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)

Question: 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 affected, if

a) X increases the value of resistance R in the setup by keeping the key K_1 closed and the key K_2 open?

b) Y decreases the value of resistance S in the setup, while the key K_2 remains open and then K_1 closed?
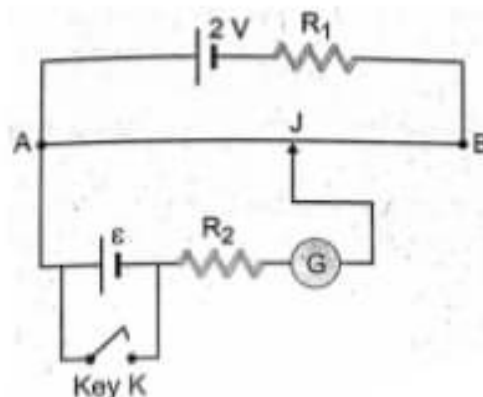
Justify your answer.

Home Assignment

Question: Answer the following.
a) State the underlying principle of a potentiometer. Why is it necessary to
   i. use a long wire,
   ii. have uniform area of cross-section of the wire and
   iii. use a driving cell whose emf is taken to be greater than the emfs of the primary cells?
b) In a potentiometer experiment, if the area of the cross-section of the wire increases uniformly from one end to the other, draw a graph showing how potential gradient would vary as the length of the wire increases from one end.

Question: Below figure shows the circuit diagram of a potentiometer for determining the emf ε of a cell of negligible internal resistance.

a) What is the purpose of using high resistance R_2?
b) How does the position of balance point (J) change when the resistance R_1, is increased?
c) Why cannot the point be obtained,
   1) When the emf ε is greater than 2V, and
   2) When the key K is closed.

Question: For the circuit shown in the below figure would the balancing length increase, decrease or remain the same if
a) R_1, is decreased
b) R_2 is increased,
without any change (in each case) in the rest of the circuit ? Justify your answer in each case.
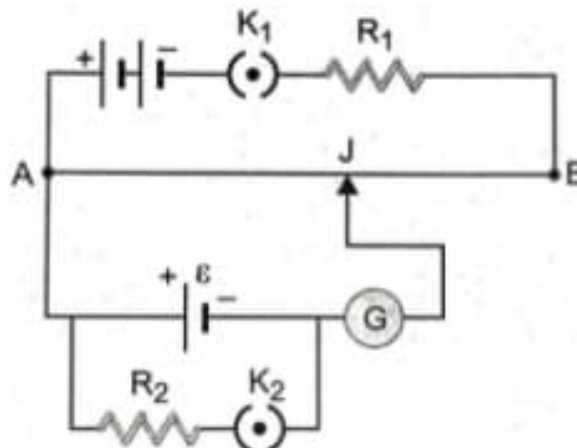
1

When the slide is in middle, a resistance of $R_0/2$ is between the point A and B. Let the resistance between A & B be R_1.

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

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

The total resistance between A & c is the sum of resistance between A & B & B & c

$$\Rightarrow R_1 + R_0/2$$

The current flow 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.

$$V_1 = IR_1 = \frac{2V}{2R_1 + R_0} \times R_1$$

Substituting for R_1, we have a

$$V_1 = \frac{2V}{2\left[\frac{R_0 \times R}{R_0 + 2R}\right] + R_0} \times \frac{R_0 \times R}{R_0 \times 2R} = \frac{2VR}{2R + R_0 + 2R}$$

2 a) By increasing 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.

b) By decreasing resistance S, the current through AB remains the same, potential gradients does not change. As k_2 is open so there is no effect of s on null point.

3 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) We use a long wire to have a lower values of potential gradient.

ii) The area of cross-section has to be uniform to

i. get a uniform wire as per the principle of the potentiometer.

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

b) Potential gradient $k = V/l$
The required graph is as shown →

Now, as the length inc. potential gradient will start decreasing.
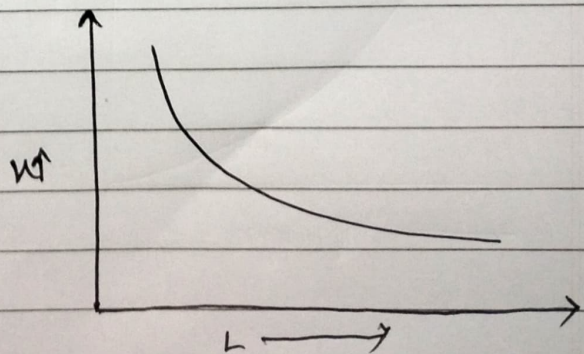
4 a) The purpose of high resistance R_2 is to reduce the current through the galvanometer, when jockey is far from balance point, this saves the galvanometer and the cell (of emf ε) from being damaged.

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

c)i) The balance point is not obtained because maximum emf accross potentiometer wire is 2v.

ii) when key (K) is closed, the terminal potential difference of cell is zero; so balance point cannot be between A and B, (since, $v = kl \Rightarrow l = 0$ for $v = 0$)

5 a) Decreases (The potential gradient would increase)

b) Increase (The terminal potential diff. accross the cell would increase.