

LABORATORY MANUAL FOR POTENTIOMETER: TO FIND INTERNAL RESISTANCE OF A CELL



Experiment No-03

AIM

To Measure the Internal Resistance of a Cell by Stretched Wire Potentiometer.

APPARATUS

Stretched Wire Potentiometer, Battery – 2V, Primary Cell - 1, One way Key -02, Resistance Box (low, value)—1, Galvanometer-1.

Outcome: *Learning the basis and origin of internal resistance of a cell and estimating its value*

THEORY

The Circuit is as shown in a diagram and A and B are the two end points of the stretched wire. If L_1 is the balancing length of potentiometer wire when Leclanche cell is open circuited with resistance box (i.e. when K key is pressed and K_1 key is open) e.m.f. of Leclanche cell is equal to potential difference across L_1 length of wire. Hence,

$$E = kL_1 \text{ ----- (1)}$$

If r is resistance in resistance box and L_2 is balancing length of potentiometer wire when both keys K and K_1 are pressed (i.e. Leclanche cell is closed circuited with resistance box) then potential difference (V) across R is equal to potential difference across L_2 length of the wire.

$$\text{So, } V = kL_2 \text{ ----- (2)}$$

From equations (1) and (2) we have,

$$\frac{E}{V} = \frac{L_1}{L_2}$$

Let ' r ' is the internal resistance Leclanche cell. If ' I ' is the current in closed circuited Leclanche cell and resistance box then from Ohm's law

$$E = i(R + r) = iR + ir = V + ir$$
$$\therefore E - V = ir$$

$$r = \frac{E - V}{i} = \frac{V}{i} \left(\frac{E}{V} - 1 \right) = R \left(\frac{E}{V} - 1 \right)$$

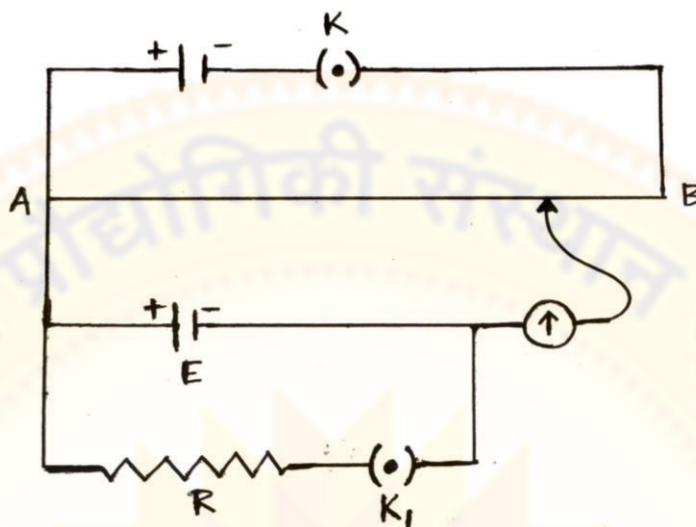
if e.m.f. (E_1) of the cell 'E' is balanced by a length ' L_1 ' of the wire (Keeping key ' K_1 ' open) and if the potential difference of the cell 'E' is balanced by a length ' L_2 ' when resistance ' R ' is inserted through the resistance box and keeping key ' K_1 ' closed. Then Internal resistance ' r ' of the given by

$$r = R \left(\frac{L_1 - L_2}{L_2} \right)$$

PROCEDURE

- I. Circuit is completed as shown in the diagram.
- II. K is closed (Keeping K_1 open), the jockey is connected (by pressing the knob) at one end then at the other end of the stretched wire one by one and if deflection in Galvanometer is observed in two different directions in the two cases, then circuit is O.K.

Figure.



- III. Keeping K_1 open, balanced length L_1 is obtained by moving the jockey along the length of stretched wire.
- IV. Then K_1 is closed and resistance R is inserted through the Resistance Box ($1\ \Omega$, $2\ \Omega$, $3\ \Omega$ ----- $10\ \Omega$) again balanced length L_2 is obtained.
- V. L_2 is obtained for different values of variable resistances R .

OBSERVATION

Table for determination of Internal resistance

No. of Obs.	L_1 (cm) (K_1 open)	Mean L_1 (cm)	R (Ω)	L_2 (cm) (K_1 closed)	Internal Resistance r (Ω)	Mean Internal Resistance (Ω)
	1					
	2					
	3				

Note: Kindly analyze the data and calculate the applicable error analysis as well.

CALCULATION

Show all calculations for internal resistance (r) and calculate the mean value.

PRECAUTION

1. Connections should not be loose.
2. In resistance box the keys should be very tight.
3. The positive terminal of both battery and cell should be connected at same point.
4. Avoid pressing keys for large time otherwise cell will be discharged.