To Compare The EMF Of Two Given Primary Cells Using A Potentiometer

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Aim

To compare the EMF of two given primary cells (Daniel and Leclanche cells) with the help of a potentiometer.

Apparatus/Material Required

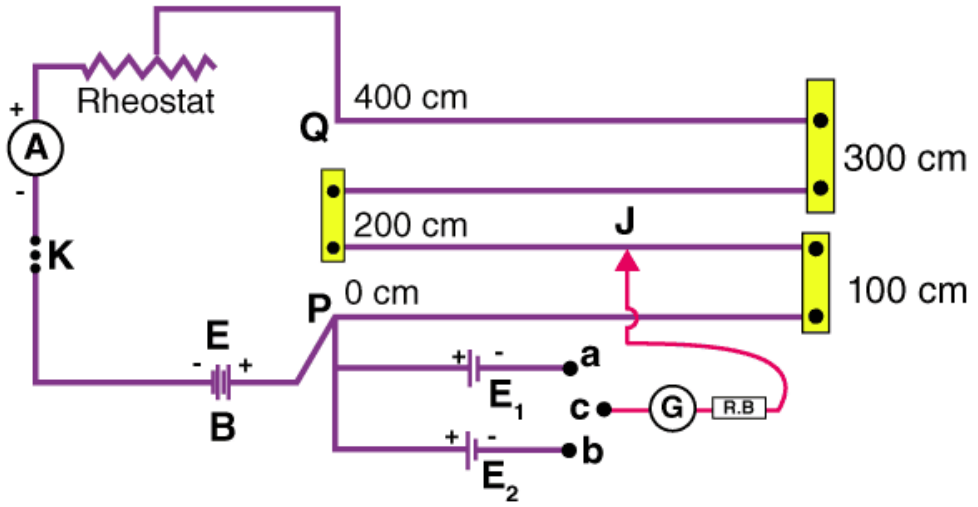
- Potentiometer
- Daniel Cell
- Leclanche Cell
- low resistance Rheostat
- Ammeter
- Voltmeter
- Galvanometer
- A one-way key
- A two-way key
- Set Square
- Jockey
- Resistance Box
- Connecting wires
- Piece of sandpaper

Theory:

Using a voltmeter it is possible to measure only the potential difference between the two terminals of a cell, but using a potentiometer we can determine the value of emf of a given cell. Where E1 and E2 are EMFs of two cells, l1 and l2 are the balancing lengths when E1 and E2 are connected to the circuit respectively and φ is the potential gradient along the potentiometer wire.

$E1 / E2 = \varphi l1 / \varphi l 2 = l1 / l 2$

Circuit Diagram



Procedure

1. Connect the circuit as shown in the figure.
2. With the help of sandpaper, remove the insulation from the ends of connecting copper wire.
3. Measure the EMF (*E*) of the battery and the EMFs (E_1 and E_2) of the cell and see if $E_1 > E$ and $E_2 > E$.
4. Connect the positive pole of the battery to the zero ends (P) of the potentiometer and the negative pole through the one-way key, low resistance rheostat, and the ammeter to the other end of the potentiometer (Q).
5. Connect the positive poles of the cells to the terminal at the zero ends (P) and the negative poles to the terminals *a* and *b* of the two-way key.
6. Connect the common terminal *c* of the two-way key through a galvanometer (*G*) and a resistance box to the jockey *J*.
7. Take maximum current from the battery by making the rheostat resistance zero.
8. Insert the plugin the one-way key through the resistance box and the galvanometer to the jockey *J*.
9. Take out the 2000 Ω plug form the resistance box.
10. Note down the direction of the deflection in the galvanometer by pressing the jockey at zero ends.
11. Now, press the jockey at the other end of the potentiometer wire. If the deflection is in the opposite direction to that in the first case, the connections are correct.
12. Push the jockey smoothly over the potentiometer up to a point where the galvanometer shows no deflection.
13. Put the 2000 Ω plug back to the resistance box and obtain the null point position accurately with the help of the set square.
14. Note the length l_1 of the wire for the cell E1.
15. Note the current as indicated by the ammeter.

16. Disconnect the cell E1 from the plug
17. Connect E2 by inserting the plug into the gap be of the two-way key.
18. Take out a 2000 ohms plug from the resistance box and slide the jockey along the potentiometer wire and obtain no deflection position.
19. Put 2000 ohms plug back in the RB and obtain null for E2.
20. Note the length L2 of wire in this position for the cell E2.
21. By increasing the current and adjusting the rheostat get three sets of observation.

Observation

E.M.F of battery, E =

E.M.F of Leclanche cell, E_1 =

E.M.F of Daniel cell, E_2 =

Range of voltmeter =

Least count of voltmeter =

Least count of ammeter =

Zero error of ammeter =

S. No	**Corrected Ammeter Reading**	**Balance point when E_1 (Leclanche cell) in the circuit l_1 cm**			**Balance point when E_2 (Daniel cell) in the circuit l_2 cm**			$E_1E_2=l_1l_2$
(1)	**(2)**	***1*** **(*3a*)**	***2*** **(*3b*)**	**Mean l_1 (*3c*)**	***1*** **(*4a*)**	***2*** **(*4b*)**	**Mean l_2 (*4c*)**	**(5)**
1								
2								
3								

Calculations

1. For each observation, find mean l_1 and mean l_2 and record it *3c* and *4c* respectively.
2. Find E_1/E_2, by dividing l_1/l_2
3. Find the mean of E_1/E_2

Result

The ratio of EMFs, $E_1/E_2 \cong$ _____.

Viva Voice

1. What is an EMF of a cell?

Ans: Electromotive force is the measurement of the energy that causes the current to flow through a circuit. It is also known as voltage and is measured in volts.

2. What is potentiometer?

Ans: A potentiometer is a three-terminal device that is used to measure the potential difference by manually varying the resistance.

3. On what principle does the potentiometer work?

Ans: For a constant current, the fall of potentiometer along a uniform wire is directly proportional to its length.

4. How is the emf of the cell determined for given cells?

Ans: E1/E2 = l1/l2

5. Is the cross-section of the potentiometer wire uniform?

Ans: No