3055 BA SANGAM COLLEGE

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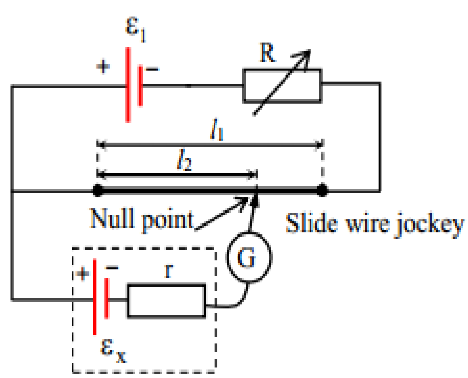
WORKSHEET 18

SCHOOL: BA SANGAM COLLEGE **YEAR: 13**
SUBJECT: PHYSICS **NAMEOF STUDENT: ____________________**

STRAND	**5 - DIRECT CURRENT**
SUB-STRAND	**5.2 – The Wheat stone Bridge**
LEARNING OUTCOME	To understand how a wheat stone bridge works

The Slide Wire Potentiometer

The slide wire potentiometer circuit measures the emf of a cell by a null point that is, galvanometer reading is zero. Which means the circuit draws no current from the cell or other source of emf. Basically this device balances an unknown potential difference against an adjustable, measurable potential difference.



- When the galvanometer reads zero, the balance point is obtained. At this point there is no current flowing in the unknown emf source

Making ε_x the subject leaves

$$\varepsilon_x = \left(\frac{l_1}{l_2}\right)\varepsilon_1$$

Where: l_1 and l_2 = balancing lengths
ε_x and ε_1 = emf of cell

We can then write two equations involving the individual emf.

$$\varepsilon_1 = IR(l_1)$$

$$\varepsilon_x = IR(l_2)$$

Dividing equation (5.21) by equation (5.22) we get:

$$\frac{\varepsilon_1}{\varepsilon_x} = \frac{IRl_1}{IRl_2} \qquad R = \rho\frac{l}{A}$$

So the ratio

$$\frac{Rl_1}{Rl_2} = \frac{l_1}{l_2}$$

$$\frac{\varepsilon_1}{\varepsilon_x} = \frac{l_1}{l_2}$$

Making ε_x the subject leaves

$$\varepsilon_x = \left(\frac{l_1}{l_2}\right)\varepsilon_1$$

Where: l_1 and l_2 = balancing lengths
ε_x and ε_1 = emf of cell

EXAMPLE

In the circuit shown in Figure 5.29, source battery has emf of 2 V. XY is a uniform wire of length 100 cm with a resistance of 5 Ω. Cell ε_x has an emf of 1.5 V. Calculate the length AB required to produce zero deflection in the galvanometer.

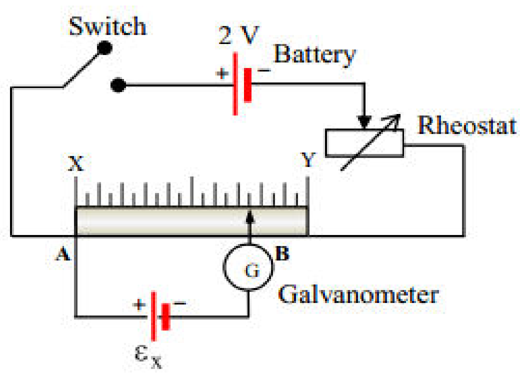


Figure 5.29

$\varepsilon_x = 1.5V \qquad \varepsilon_1 = 2V \qquad l_1 = 100cm \qquad l_2 = ??$

$$\frac{\varepsilon_1}{\varepsilon_x} = \frac{l_1}{l_2}$$

$$\frac{2}{1.5} = \frac{100}{l_2}$$

$$l_2 = 75cm$$

Alternatively

$R = 5\Omega$

$\varepsilon = V = IR$

$2 = I(1.5)$

$I = 0.4\,A$

$\varepsilon = V = Ir$

$1.5 = (0.4)r$

$r = 3.75\Omega$

$$\frac{R}{r} = \frac{l_1}{l_2}$$

$$\frac{5}{3.75} = \frac{100}{l_2}$$

$$l_2 = \frac{100(3.75)}{5}$$

$$l_2 = 75\text{cm}$$

EXERCISE

1) What is a potentiometer?

It is an instrument used for accurate measurement of small potential differences and to compare the emf of given primary cells.

2) State the working principle of a potentiometer.

For a conducting wire of uniform cross-section area carrying a steady current; potential difference across a given length of the wire is directly proportional to the length.

3) The simple potentiometer circuit shown in Figure 5.30 is used to compare the emf of cells.

a) At a balance point, two quantities measured become zero. What are these two quantities?

b) A standard cell of 1.2 V gives a balance point at 60.2 cm and a dry cell gives a balance point at 83.2 cm. Calculate the emf, ε_x of the dry cell.

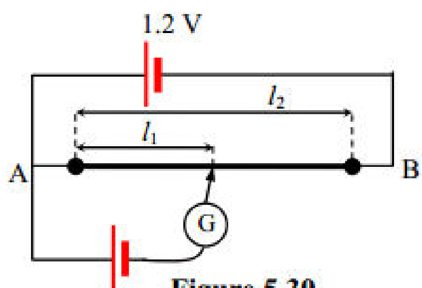


Figure 5.30

A potentiometer wire XY of length 1.00 m is connected to a car battery and ammeter as shown in Figure 5.31. A cell C of unknown emf, a galvanometer G is connected as shown, and the sliding contact S is moved along XY until there is zero current in the galvanometer. The length XS is found to be 0.133 m. At the same time voltmeter (not shown in diagram) connected across XY reads 11.5 V calculate the emf of cell C.

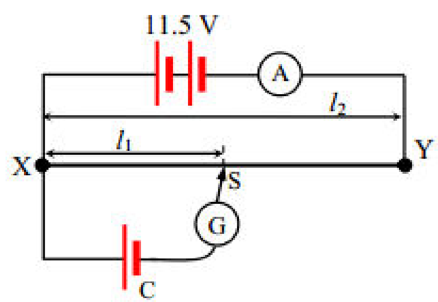


Figure 5.31

4. A potentiometer wire of length 1 m has a resistance of 10 Ω. Determine the emf of the primary cell which gives a balance point at 40 cm.