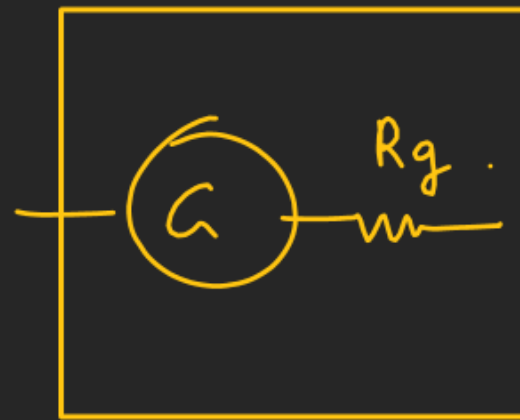
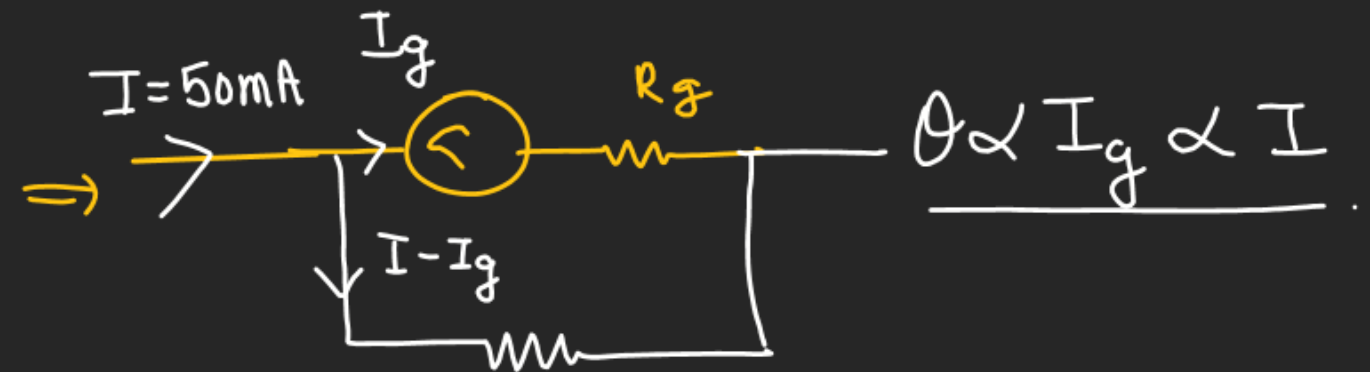


Q.1 What shunt resistance is required to make the 1.00 mA, 20 Ω galvanometer into an ammeter with a range of 0 to 50.0 mA?



Galvanometer

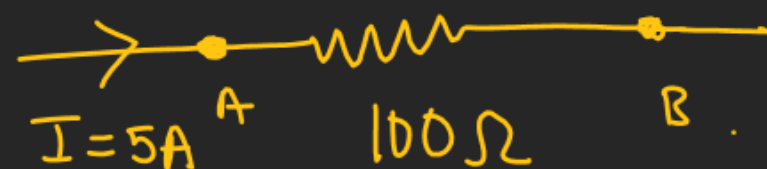


$$I_g R_g = (I - I_g) R_{sh}$$

$$R_{sh} = \frac{I_g R_g}{I - I_g} = \frac{10^{-3} \times 20}{(50 - 1) \times 10^{-3}} = \left(\frac{20}{49} \right) \Omega \quad \checkmark$$

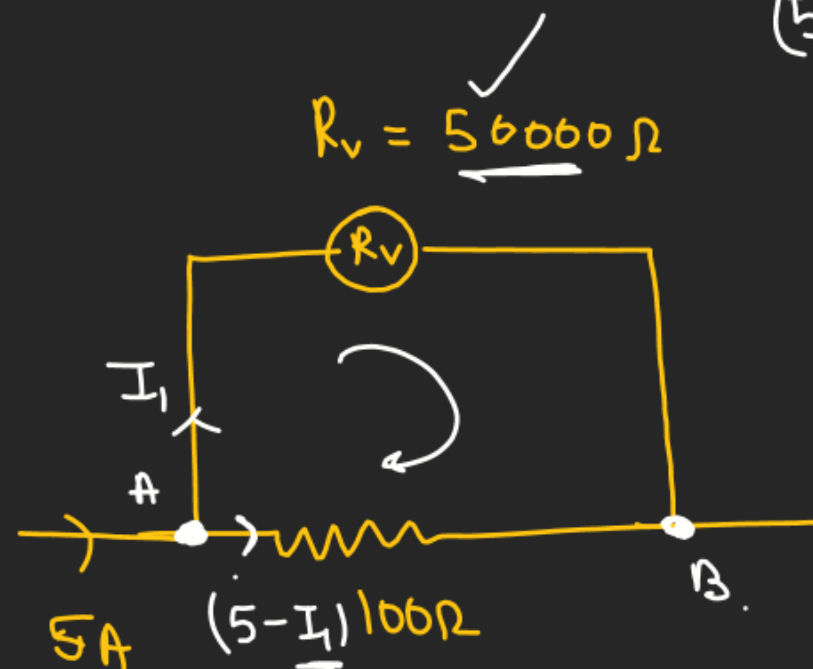
$$I_g = 1 \times 10^{-3} \text{ A}$$

$$R_g = 20 \Omega$$

Error of VoltmeterEx:-

$$V_A - V_B = 100 \times 5$$

$$= \boxed{500 \text{ Volt}}$$



$$V_A - V_B = (5 - I_1) \times 100$$

$$= \left(5 - \frac{5}{501}\right) \times 100$$

$$= 5 \times \frac{500}{501} \times 100$$

$$(5 - I_1) \times 100 = I_1 \times 50000$$

$$5 - I_1 = 500 I_1$$

$$5 = 501 I_1$$

$$I_1 = \left(\frac{5}{501}\right) \checkmark$$

$$\Rightarrow \% \text{ error} = \left(\frac{500 - 499}{500} \times 100\right)$$

$$= \frac{1}{500} \times 100$$

$$\frac{25 \times 10^4}{501}$$

$$0.0499 \times 10^4$$

$$\underline{499 \text{ volt}}$$

Q.4

Meter bridge →

↳ Based on the principle of balance wheat-stone bridge

↳ To find Unknown resistance

⇒ AB → [Uniform Cross section]
100cm = L

Null point = [potential difference across the galvanometer is zero, $V_p = V_q$]

$$R = \left(\frac{\rho l}{A} \right)$$

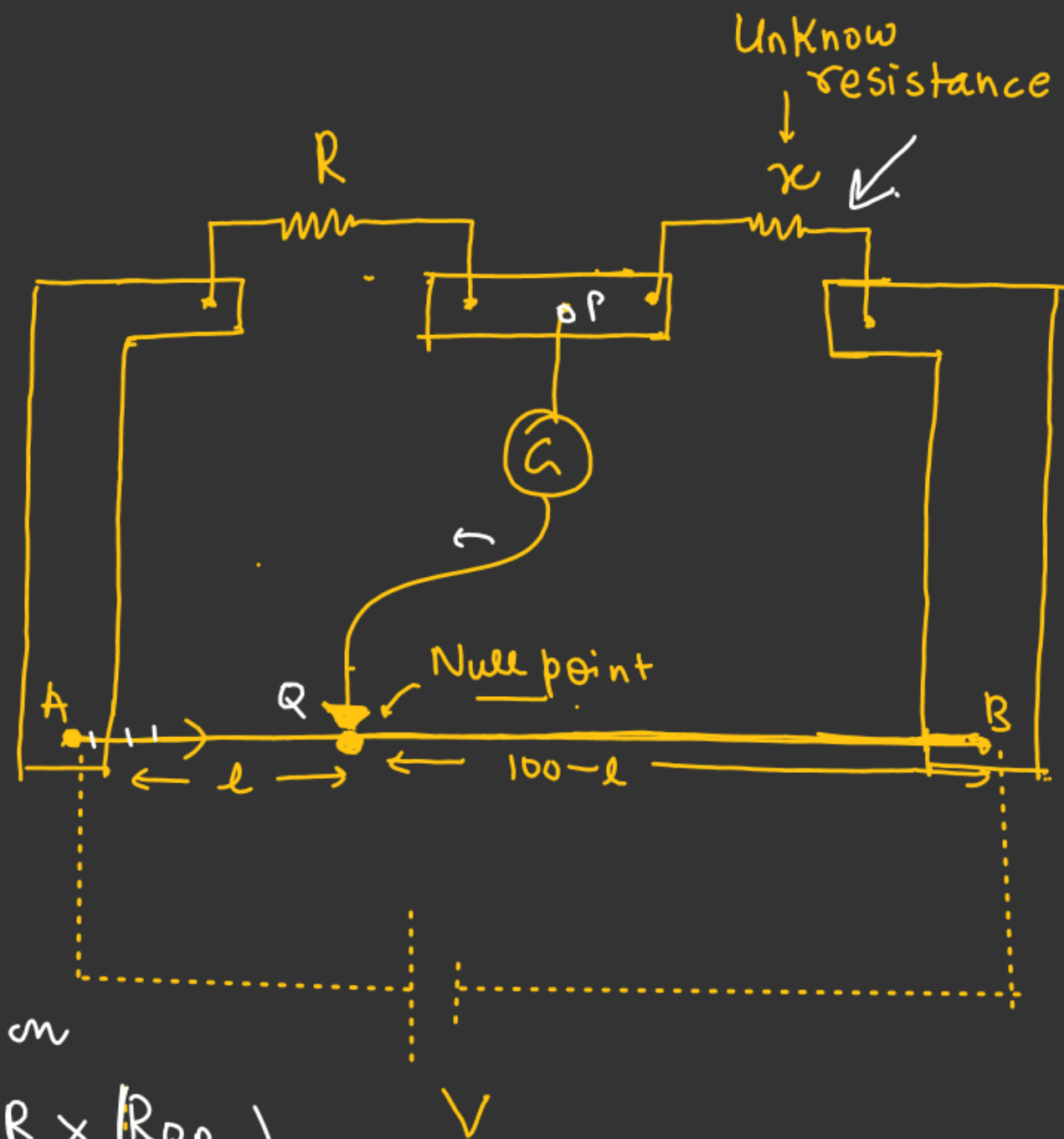
$$R_{QB} = \frac{\rho (100-l)}{A}$$

$$R_{AQ} = \left(\frac{\rho l}{A} \right)$$

At the time of Null deflection

$$\frac{R}{R_{AQ}} = \frac{x}{R_{QB}} \Rightarrow x = R \times \left(\frac{R_{QB}}{R_{AQ}} \right)$$

$$x = R \times \left(\frac{100-l}{l} \right)$$



(A) Potentiometer

principle:- Potential difference across any length of the wire is directly proportional to its length.

Wire AB

L = Total length

$$V_A - V_B = V$$



$$\text{Potential gradient} = \left(\frac{V}{L} \right)$$

$$V_{AC} = \left(\frac{V}{L} \right) \times (l)$$

① To Compare the e.m.f of two ideal Cells: →

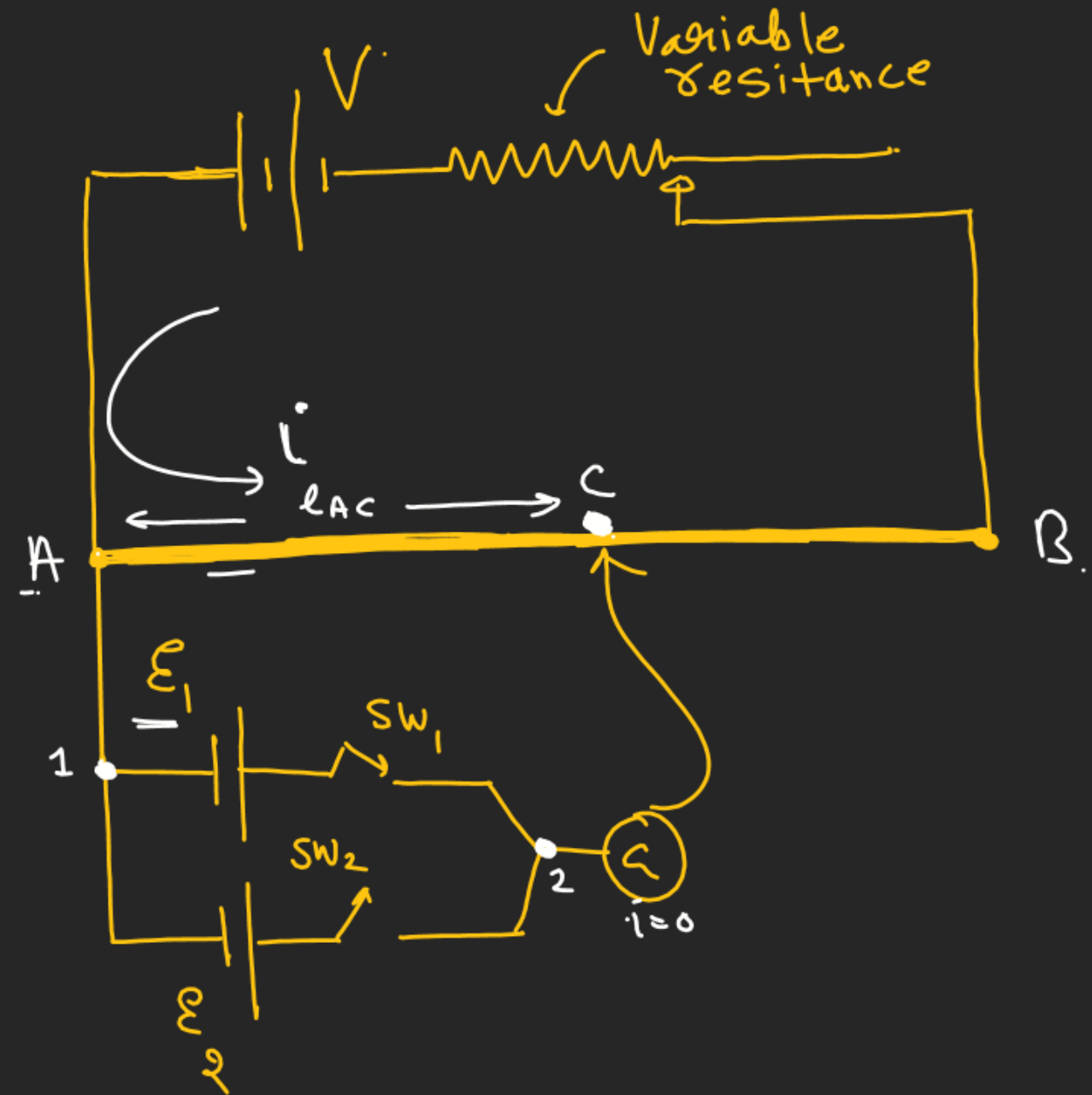
SW₁ is closed, SW₂ open.

let, l_{AC} be the length at the time of null deflection.

$$V_{AC} = \mathcal{E}_1$$

$$V_{AC} = \left(\frac{V_{AB}}{L} \right) \times l_{AC}$$

$$\mathcal{E}_1 = \left(\frac{V_{AB}}{L} \right) l_{AC} \quad \text{--- (1)}$$



SW₁ open and SW₂ Closed

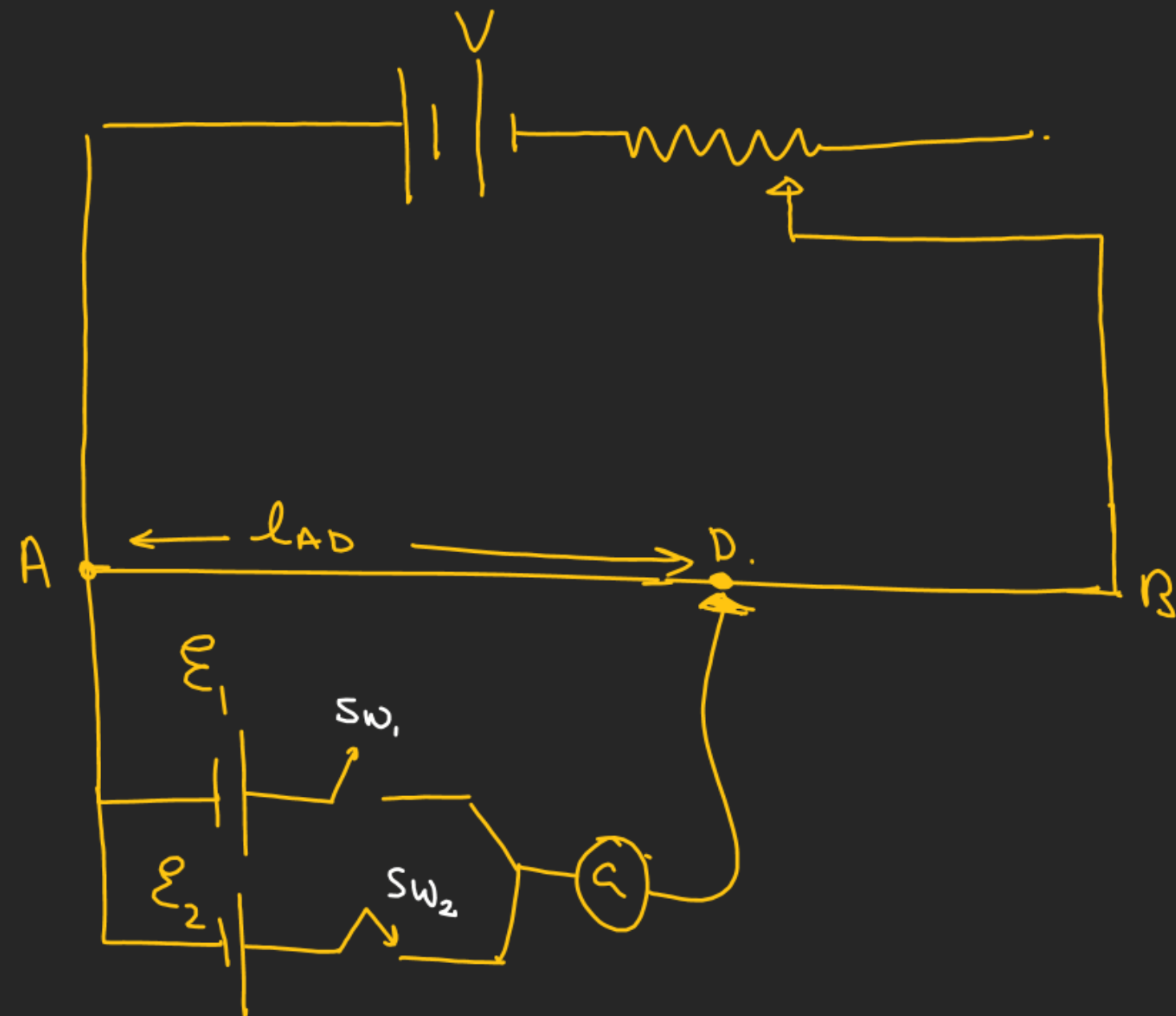
At the time of Null deflection.

$$V_{AD} = \mathcal{E}_2$$

$$\mathcal{E}_2 = \left(\frac{V_{AB}}{L} \right) \times l_{AD} \quad \text{--- (2)}$$

$$\textcircled{1} \div \textcircled{2}$$

$$\frac{\mathcal{E}_1}{\mathcal{E}_2} = \left(\frac{l_{AC}}{l_{AD}} \right) \quad **$$



Q. To find the internal resistance of a cell. →

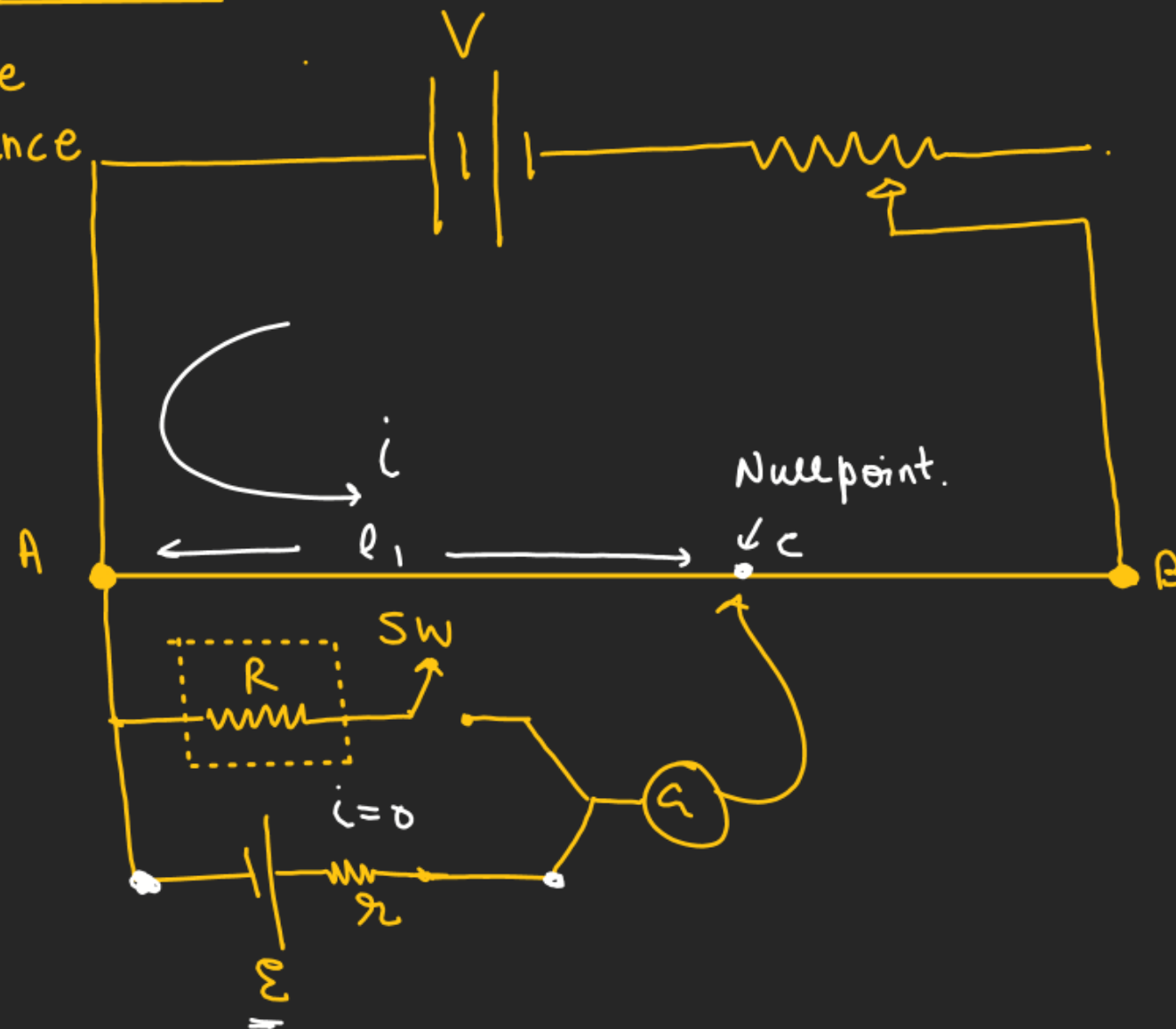
Step 1:- SW open and find null deflection.

let, l_1 be the length of wire from A at the time of null deflection.

$R \rightarrow$ Resistance of Resistance box.

[Known]

$$\mathcal{E} = \frac{V_{AC}}{L} \times l_1 \quad \text{--- (1)}$$



Step-2, SW is closed.

$$V_{12} = \mathcal{E} - i_1 r$$

$$i_1 = \left(\frac{\mathcal{E}}{R+r} \right)$$

$$V_{AD} = \mathcal{E} - i_1 r$$

$$= \mathcal{E} - \frac{\mathcal{E} r}{R+r} = \left(\frac{\mathcal{E} R}{R+r} \right)$$

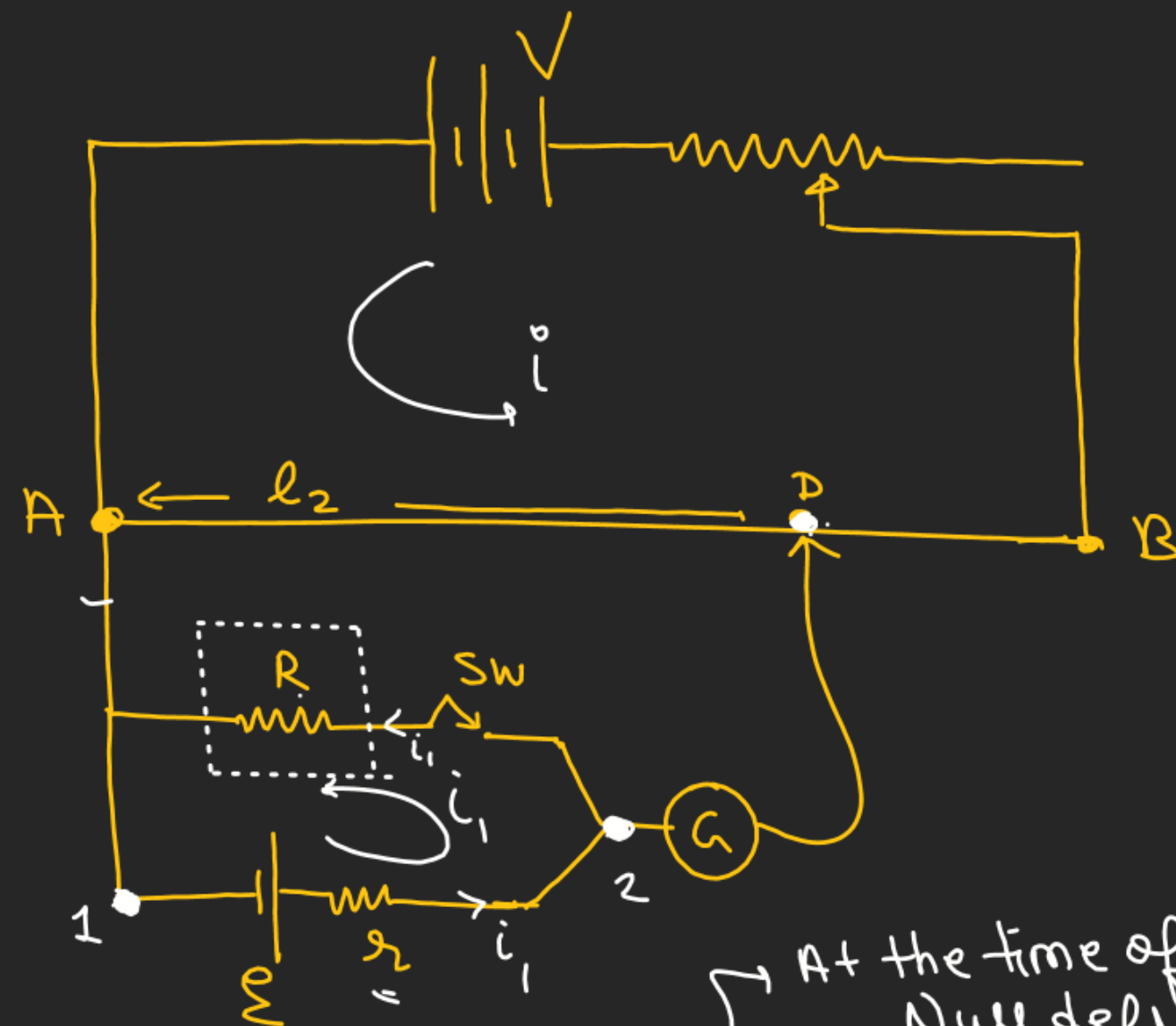
$$V_{AB} = \left(\frac{V_{AB}}{L} \times l_2 \right)$$

$$\frac{V_{AB}}{L} \times l_2 = \frac{\mathcal{E} R}{R+r} \quad \text{--- (2)}$$

(1) ÷ (2)

$$\frac{l_1}{l_2} = \frac{R+r}{R} = 1 + \frac{r}{R} \Rightarrow \frac{r}{R} = \left(\frac{l_1}{l_2} - 1 \right)$$

$$\boxed{r = R \left(\frac{l_1}{l_2} - 1 \right)} \quad **$$

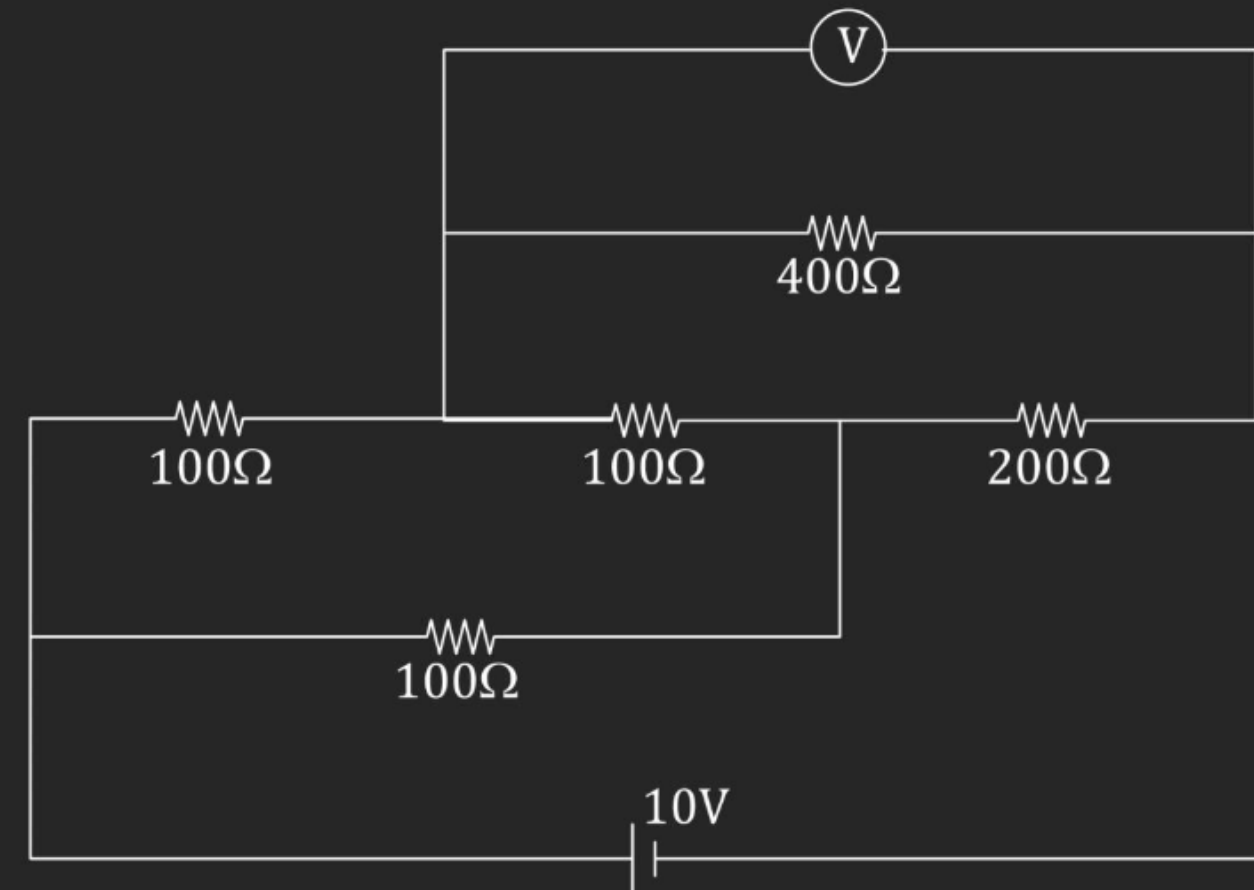


At the time of Null deflection

$$\underline{V_1 - V_0 = V_{AD}}$$

H.W.

Q.2 An electric circuit is shown in figure. Calculate the potential difference across the resistor of 400Ω , as will be measured by the voltmeter V of resistance 400Ω .



H.W.

Q.3 A battery of emf 1.4 V and internal resistance 2Ω is connected to a resistance of 100Ω resistance through an ammeter. The resistance of ammeter is $4/3\Omega$. A voltmeter has also been connected to find the potential difference across the resistor.

(a) Draw the circuit diagram.

(b) The ammeter reads 0.02 A . What is the resistance of voltmeter.

(c) the voltmeter reads 1.10 V . What is the error in the reading?

Q.7 *H.W* A galvanometer (coil resistance 99Ω) is converted into an ammeter using a shunt of 1Ω and connected as shown in Fig. (a). The ammeter reads 3 A. The same galvanometer is converted into a voltmeter by connecting a resistance of 101Ω in series. This voltmeter is connected as shown in Fig. (b). Its reading is found to be $4/5$ of the full scale reading. Find:

- (i) internal resistance of the cell (r).
- (ii) range of the ammeter and voltmeter.
- (iii) full scale deflection current of the galvanometer.

