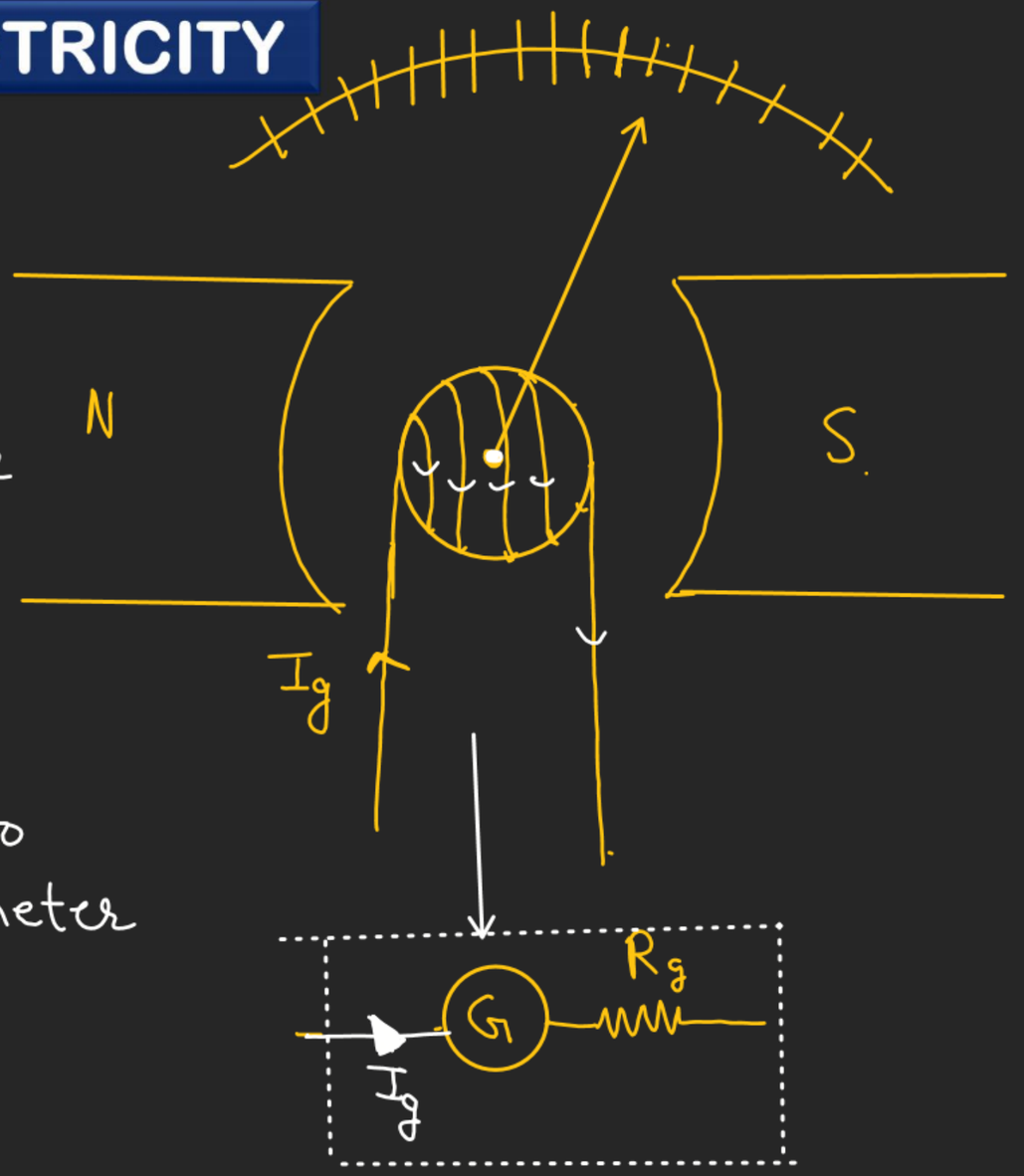
CURRENT ELECTRICITY

(★) Galvanometer :→

Magnets produces magnetic field.
When Current is passed through the windings due to magnetic torque needle deflection take's place.



- I_g = Full Scale deflection Current.
- Deflection is directly proportional to Current through the galvanometer ie I_g.

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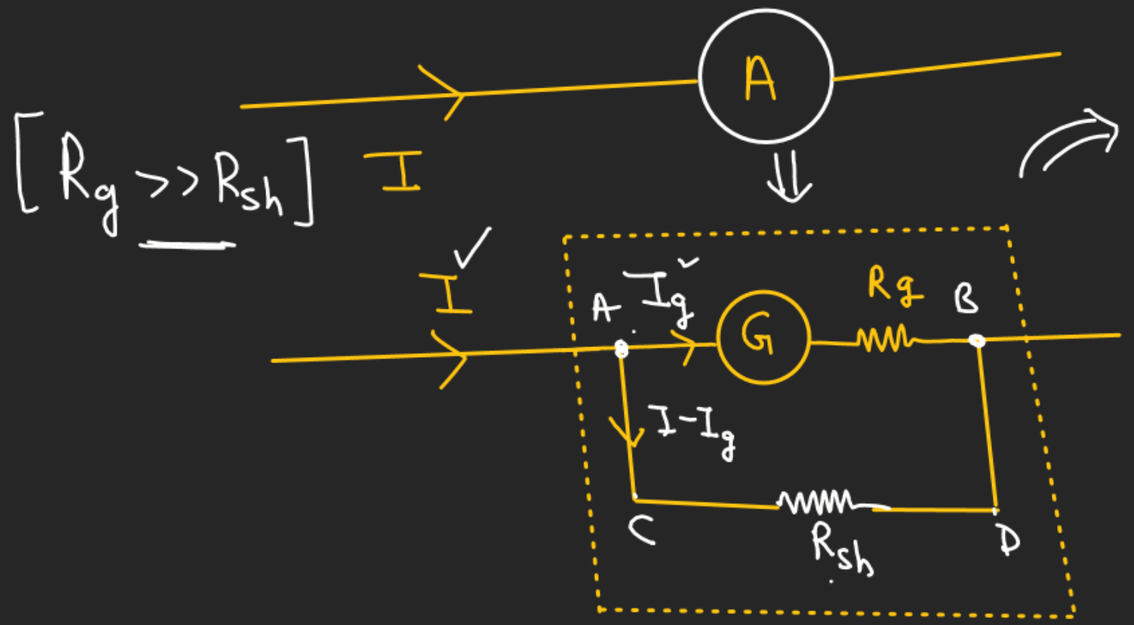
Electrical Instruments

CURRENT ELECTRICITY

Galvanometer as an Ammeter :→

Ammeter :–

- Current measuring device.
- Always Connected in Series w.r.t the Current which is measured.



Galvanometer → Ammeter

↳ To Convert galvanometer into ammeter we connect a very small resistance parallel to the galvanometer Called Shunt.

R_{sh} = Shunt

$V_{AB} = V_{CD}$.

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

$I_g (R_g + R_{sh}) = I R_{sh} \Rightarrow I = \left(\frac{R_g + R_{sh}}{R_{sh}}\right) I_g$

$$R_{sh} = \frac{I_g}{I}\left(1 + \frac{R_g}{R_{sh}}\right)$$

$I_g \propto \theta$

$I \propto \theta$

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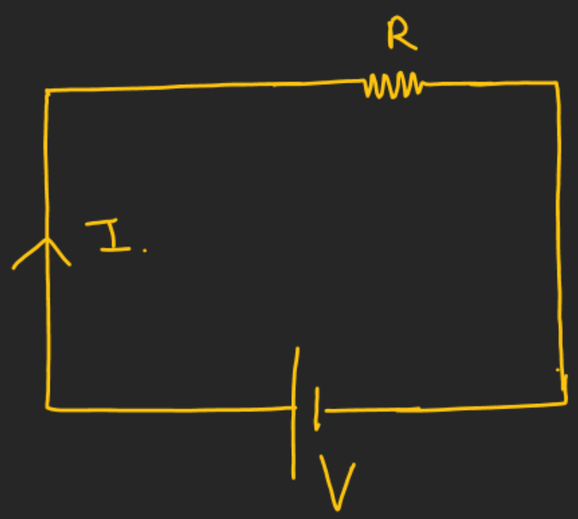
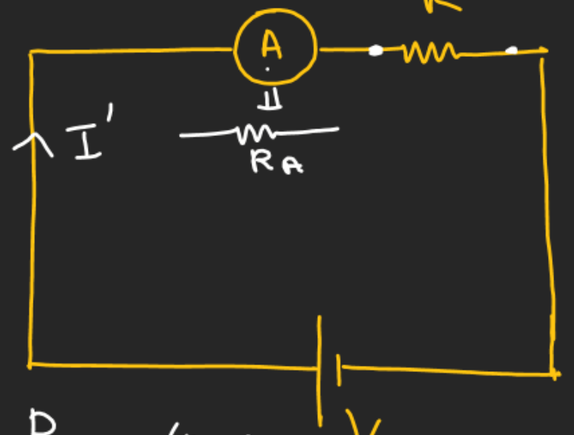
CURRENT ELECTRICITY

(A) Error in Ammeter :-

$$R_A = \left[\frac{R_g \cdot R_{sh}}{R_g + R_{sh}}\right] \checkmark$$



$$I = \left(\frac{V}{R}\right)$$



$$R_{eq} = (R + R_A)$$

$$I' = \left(\frac{V}{R+R_A}\right)$$

I' ⇓ Current measured by Ammeter

$$\% \text{ Error in Current measurment} = \left[\frac{I - I'}{I} \times 100\right]$$

$$= \frac{\frac{V}{R} - \frac{V}{R+R_A}}{V/R} \times 100$$

$$= \left(1 - \frac{R}{R+R_A}\right] \times 100$$

$$\simeq \left(\frac{R_A}{R+R_A} \times 100\right)$$

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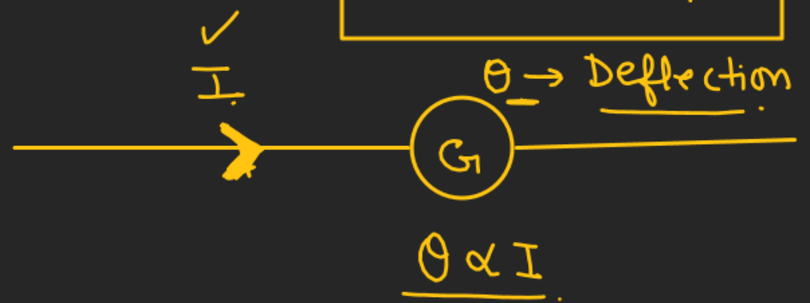
CURRENT ELECTRICITY

Current Sensitivity of galvanometer

$$\text{Current Sensitivity} = \left[\frac{\text{Deflection in galvanometer}}{\text{Total Current}}\right]$$

$$C.S = \frac{\theta}{I} \quad -①$$

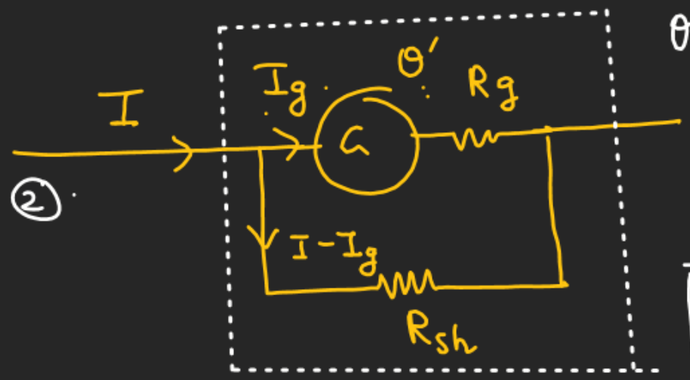


$\theta \propto I$

Dividing ① & ②

$$\frac{C.S'}{C.S} = \left[\frac{\theta'}{\theta}\right]$$

When galvanometer Converted into ammeter then Current Sensitivity :-



θ' = Deflection Corresponding to I_g.

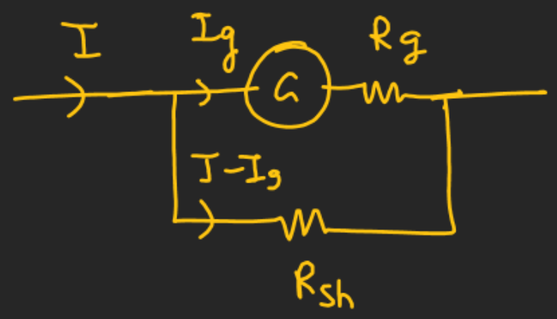
$$C.S' = \left[\frac{\theta'}{I}\right] - ②$$

$\theta' \propto I_g$

CURRENT ELECTRICITY

If $R_{sh} = \left(\frac{R_g}{n}\right)$ ✓

$$\left[\frac{C.S'}{C.S} = \frac{\theta'}{\theta} = \left(\frac{I_g}{I}\right)\right]$$



[Note:- Sensitivity decreases when galvanometer converted into ammeter]

$$\frac{C.S'}{C.S} = \left(\frac{1}{n+1}\right)$$ ✓

$$C.S' = \left(\frac{1}{n+1}\right) C.S$$

- [Ammeter Current Sensitivity]
- [Galvanometer Current Sensitivity]

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

$$I_g R_g = (I-I_g) \frac{R_g}{n}$$

$$I_g + \frac{I_g}{n} = \frac{I}{n}$$

$$(n+1) I_g = I$$

$$I_g/I = \left(\frac{1}{n+1}\right)$$

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Electrical Instruments

CURRENT ELECTRICITY

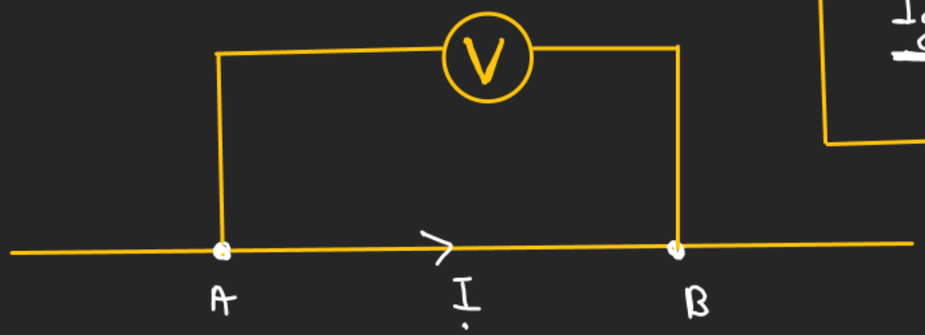
Voltmeter :-

↳ Measuring potential difference between two points.

↳ Always Connected in parallel between two points.

$I_g \propto \theta$.

$I_g(R+R_g) = V_{AB}$



V_{AB} = Reading of Voltmeter

(A) Galvanometer as a Voltmeter :→

⇒ Galvanometer Can be Converted into Voltmeter by Connecting a Very large resistance in Series with galvanometer.

[R↑ I_g↓ I−I_g→I]