CURRENT ELECTRICITY

1 ELECTRIC CURRENT (I)

- Rate of flow of electric charge.

$$I = \frac{dQ}{dt}$$

- SI unit : Ampere (A)
- $1\,A = 1\,C\,s^{-1}$

2 OHM'S LAW

- At constant temperature for a conductor.

$$V = IR$$

- SI unit of R : ohm (Ω)

3 RESISTANCE (R)

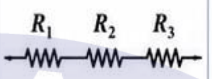
$$R = \rho \frac{l}{A}$$

- Depends on length (l), area (A) and nature of material (ρ).
- SI unit : ohm (Ω)

4 RESISTANCE IN SERIES

- Same current flows through each resistor.

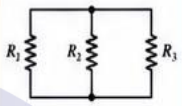
$$R_s = R_1 + R_2 + R_3 + \cdots$$



5 RESISTANCE IN PARALLEL

- Same potential difference across each resistor.

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$$

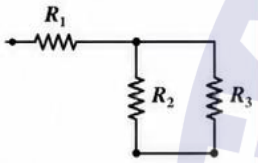


POWER TIPS

- Remember : $I = \frac{Q}{t}$
- Ohm's Law is the base for solving circuits.
- Series → Same current
  Parallel → Same voltage
- Use equivalent resistance (Req) to simplify.
- Units : I (A), V (volt), R (ohm), P (watt)
- Draw circuit diagram clearly in exam.

6 RESISTANCE IN SERIES–PARALLEL COMBINATION

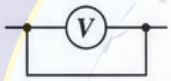
- Combine step by step using series and parallel rules.



7 MEASURING INSTRUMENTS

- Ammeter : Low resistance

- Voltmeter : High resistance



- Galvanometer : Sensitive

8 POTENTIOMETER

- Measures potential difference without drawing current.

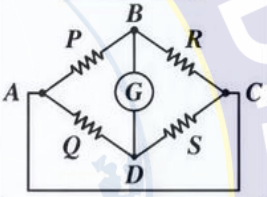
$$\frac{V}{V'} = \frac{l}{l'}$$

(At balance length)

9 WHEATSTONE BRIDGE

- Bridge is balanced when

$$\frac{P}{Q} = \frac{R}{S}$$



10 EMF AND INTERNAL RESISTANCE

- Terminal potential difference.

$$V = E - Ir$$

E : emf of cell
r : internal resistance
V : terminal voltage

11 COMBINATION OF CELLS

- Series adding :

$$E_{eq} = E_1 + E_2 + \cdots$$
$$r_{eq} = r_1 + r_2 + \cdots$$

- Series opposing :

$$E_{eq} = E_1 - E_2$$
$$r_{eq} = r_1 + r_2$$

- Parallel (identical cells) :

$$E_{eq} = E \qquad r_{eq} = \frac{r}{n}$$

12 POWER IN CIRCUIT

- Electrical power,

$$P = VI = I^2R = \frac{V^2}{R}$$

- Unit : Watt (W)
- Energy consumed,

$$W = Pt = VIt = I^2Rt$$

13 JOULE'S LAW OF HEATING

- Heat produced in a conductor,

$$H = I^2Rt$$

H : Heat (joule)
R : Resistance (ohm)
t : Time (second)

14 DRIFT VELOCITY

- Average velocity acquired by free electrons.

$$v_d = \frac{I}{neA}$$

n : number density
e : charge of electron
A : area of cross-section

15 RELAXATION TIME (τ)

- Average time between two successive collisions.

$$v_d = \frac{eE\tau}{m}$$

E : electric field
m : mass of electron

16 RESISTIVITY (ρ)

- Resistivity is property of material.

$$\rho = \frac{m}{ne^2\tau}$$

m : mass of electron
n : number density
e : charge of electron
τ : relaxation time

17 TEMPERATURE COEFFICIENT OF RESISTANCE

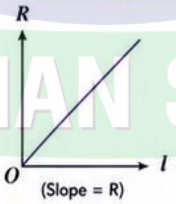
- Resistance varies with temperature.

$$R_T = R_0[1 + \alpha(T - T_0)]$$

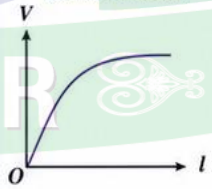
α : temperature coefficient
T : temperature
T_0 : reference temperature
R_0 : resistance at T_0

IMPORTANT GRAPHS

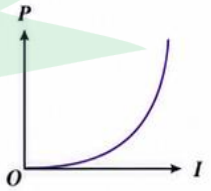
(i) R vs l (Ohmic conductor)



(ii) V vs l (Ohmic conductor)



(iii) P vs I



IMPORTANT FORMULAS SUMMARY

- $I = \frac{dQ}{dt}$
- $V = IR$
- $R = \rho \frac{l}{A}$
- $R_s = R_1 + R_2 + R_3 + \cdots$
- $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$
- $V = E - Ir$
- $P = VI = I^2R = \frac{V^2}{R}$
- $H = I^2Rt$
- $v_d = \frac{I}{neA}$
- $v_d = \frac{eE\tau}{m}$
- $\rho = \frac{m}{ne^2\tau}$
- $R_T = R_0[1 + \alpha(T - T_0)]$

EXAM FOCUS

- ★ Ohm's Law : Most Important
- ★ Series–Parallel Combination : High Weightage
- ★ Bridge & Potentiometer : Frequently Asked
- ★ Power & Heating : Direct Numericals
- ★ Graphs & Concepts : Scoring
- ★ Practice PYQs regularly for high score!

IMPORTANT SYMBOLS & UNITS | I : Ampere (A) | V : Volt (V) | R : Ohm (Ω) | P : Watt (W) | Q : Coulomb (C) | E : Volt | ρ : Ohm-metre (Ω.m)