NCERT – GRADE 10 CHEAT SHEET

OHM'S LAW & SYSTEM OF RESISTORS

Key Concepts, Formulas & Diagrams at a Glance

1. OHM'S LAW

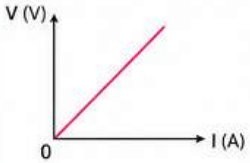
- At a constant temperature, the current (I) flowing through a conductor is directly proportional to the potential difference (V) across its ends.
- Mathematically,

$$V \propto I \quad \text{or} \quad V = IR$$

Where, R = constant of proportionality called resistance of the conductor.

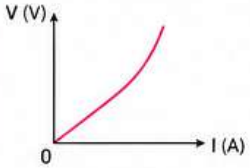
OHMIC CONDUCTOR

Obeys Ohm's law. V–I graph is a straight line passing through the origin.



NON-OHMIC CONDUCTOR

Does not obey Ohm's law. V–I graph is not a straight line.



KEY POINTS

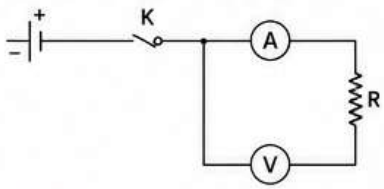
- Resistance (R) depends on the nature of material, length (l), area of cross-section (A) and temperature.
- Unit of Resistance: ohm (Ω)
- 1 Ω = 1 V is required to produce a current of 1 A.
- Higher resistance → Lower current (for same V)
- Ohm's law is valid only when physical conditions (especially temperature) remain constant.

RESISTANCE OF A UNIFORM CONDUCTOR

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

ρ = Resistivity of material (Ω m)
l = Length of conductor (m)
A = Area of cross-section (m^2)
R = Resistance (Ω)

OHM'S LAW EXPERIMENT (V–I CHARACTERISTIC)

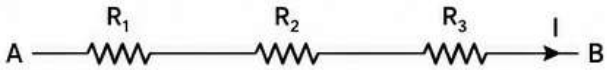


Conclusion:
For a given conductor at constant temperature, V/I is constant.

Hence, V = IR

2. SYSTEM OF RESISTORS

A. RESISTORS IN SERIES



RULES

- Same current flows through all resistors.
- Total potential difference is the sum of potential differences across each resistor.
- Effective resistance:

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

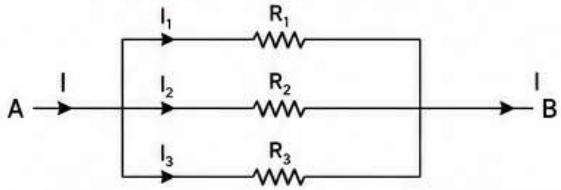
OTHER RELATIONS

$V = V_1 + V_2 + V_3 + \dots$

$V_1 = IR_1, \quad V_2 = IR_2, \dots$

$V_1 : V_2 : V_3 = R_1 : R_2 : R_3$

B. RESISTORS IN PARALLEL



RULES

- Same potential difference (V) across each resistor.
- Total current is the sum of currents through each resistor.
- Effective resistance:

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

OTHER RELATIONS

$I = I_1 + I_2 + I_3 + \dots$

$I_1 = \frac{V}{R_1}, \quad I_2 = \frac{V}{R_2}, \dots$

$I_1 : I_2 : I_3 = \frac{1}{R_1} : \frac{1}{R_2} : \frac{1}{R_3}$

3. SERIES vs PARALLEL – AT A GLANCE

Feature	Series Connection	Parallel Connection
No. of paths	One	More than one
Current	Same through all	Divides at junctions
Potential Difference	Divides	Same across each
Equivalent Resistance	$R_s = R_1 + R_2 + \dots$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$
Effect of adding a resistor	R_{eq} increases	R_{eq} decreases
If one resistor breaks	Circuit breaks	Other paths continue

4. QUICK FORMULAS

- ☑ Ohm's Law: $V = IR$
- ☑ Series: $R_s = R_1 + R_2 + R_3 + \dots$
- ☑ Parallel: $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$
- ☑ Current in series: $I = \frac{V}{R_s}$
- ☑ Current in parallel: $I_1 = \frac{V}{R_1}, \quad I_2 = \frac{V}{R_2}, \dots$
- ☑ Unknown Resistor: $R = \frac{V}{I}$

5. TIPS TO REMEMBER

- Ohm's law works only when temperature remains constant.
- Series → Current same, Resistance adds.
- Parallel → Voltage same, Conductance (1/R) adds.
- Always convert units correctly (m, Ω, A, V).
- Draw the circuit neatly before solving.

6. COMMON MISTAKES

- ⚠ Applying Ohm's law when temperature changes.
- ⚠ Forgetting that in parallel, voltage is same across all branches.
- ⚠ Adding resistances in parallel instead of reciprocals.
- ⚠ Not checking units in the final answer.

KEY TAKEAWAY: Ohm's law connects V, I and R. Understanding how resistors combine in series and parallel helps us analyze any electrical circuit with confidence!