Physics | JEE

Class 12 Physics - Current Electricity

JEE track | Short Notes + 5 CBSE-based questions + 5 JEE Main PYQ-based questions with solutions

Prepared by: Lakshya Institute Academic Desk	Focus: JEE + CBSE alignment
Format: Quick revision + solved practice	Chapter scope: Class 12 Physics

1. Quick Short Notes

- Current I = nqAv_d e, where n is free electron density, A is area, v_d is drift speed and e is electronic charge.
- Ohm's law: V = IR for ohmic conductors at constant temperature.
- Resistance of a wire: R = rho*l/A. Resistivity rho is a material property and its SI unit is ohm-m.
- Current density J = I/A and J = sigma E, where sigma = 1/rho.
- In series, resistances add: Rs = R1 + R2 + ... ; in parallel, 1/Rp = sum(1/Ri).
- Cell current: I = E/(R + r), where E is emf, R is external resistance and r is internal resistance.
- Terminal voltage of a discharging cell: V = E - Ir.
- Kirchhoff's junction law is based on conservation of charge; loop law is based on conservation of energy.
- Potentiometer is a null-deflection device used to compare emf and measure internal resistance accurately.
- Board tip: write the reason while applying Kirchhoff laws and always show unit of resistivity and emf.

2. CBSE-based Board Practice

Q1. A resistor of 5 ohm is connected across 10 V. Find the current through it.

Solution: Using Ohm's law, I = V/R = 10/5 = 2 A.

Q2. A wire has resistance 4 ohm, length 2 m and cross-sectional area 0.5 mm^2. Calculate its resistivity.

Solution: rho = RA/l = 4 x (0.5 x 10^-6)/2 = 1.0 x 10^-6 ohm-m.

Q3. Two resistors 2 ohm and 3 ohm are connected in series across 10 V. Find current in the circuit and voltage across each resistor.

Solution: Rtotal = 2 + 3 = 5 ohm. Current I = 10/5 = 2 A. Voltage drops: V1 = 2 x 2 = 4 V, V2 = 2 x 3 = 6 V.

Q4. A cell of emf 2 V and internal resistance 0.5 ohm is connected to an external resistance of 3.5 ohm. Find the current and terminal voltage.

Solution: I = E/(R + r) = 2/(3.5 + 0.5) = 0.5 A. Terminal voltage V = E - Ir = 2 - 0.5 x 0.5 = 1.75 V.

Q5. State the principle of a potentiometer. Why is it preferred over a voltmeter for measuring emf?

Solution: Principle: the potential drop across a uniform wire is proportional to its length when a steady current flows through it. It is preferred because it works on null method and draws no current from the cell under test.

3. JEE Main PYQ-based Practice

Q1. Two resistors 6 ohm and 3 ohm are connected in parallel across 12 V. Find the total current drawn from the battery.

Solution: Req = (6 x 3)/(6 + 3) = 2 ohm. Total current I = 12/2 = 6 A.

Q2. In a metre bridge, balance point is obtained at 40 cm from the left end. If the left gap contains 2 ohm resistance, find the unknown resistance in the right gap.

Solution: At balance, P/Q = l1/l2 = 40/60 = 2/3. With P = 2 ohm, 2/Q = 2/3, so Q = 3 ohm.

Q3. The balancing lengths for two cells in a potentiometer are 300 cm and 250 cm. Find the ratio of their emfs.

Solution: For a potentiometer, emf is proportional to balancing length. Therefore E1/E2 = 300/250 = 6/5.

Q4. A cell of emf 12 V and internal resistance 2 ohm is connected to an external resistance. For what external resistance is the power delivered maximum? Also find the maximum power.

Solution: Maximum power transfer occurs when external resistance R = internal resistance r = 2 ohm. Pmax = E^2/(4r) = 144/8 = 18 W.

Q5. Find the drift speed of electrons in a copper wire carrying 3.2 A current. Take n = 8 x 10^28 per m^3, area = 1 x 10^-6 m^2 and e = 1.6 x 10^-19 C.

Solution: v_d = I/(nAe) = 3.2 / (8 x 10^28 x 1 x 10^-6 x 1.6 x 10^-19) = 2.5 x 10^-4 m/s.

Practice tip: First revise the short notes, then attempt CBSE board questions in written format, and finally solve the exam-specific section in timed mode.