Ohm's Law, Cells and Batteries

30 Important Questions and Answers

1. Ohm's Law

Q1. State Ohm's law.

Ans: At constant temperature, the current flowing through a conductor is directly proportional to the potential difference across its ends: V = I x R, or I = V / R.

Q2. A 230 V supply is connected across a 46 ohm resistor. Find the current.

Ans: I = V / R = 230 / 46 = 5 A.

Q3. What are the limitations of Ohm's law?

Ans: It does not apply when temperature changes, and it fails for non-ohmic devices such as diodes, transistors, electric arcs, thermistors and electrolytes.

2. Kirchhoff's Laws

Q4. State Kirchhoff's Current Law (KCL).

Ans: The algebraic sum of currents at a junction is zero. In other words, total current entering a junction equals total current leaving it.

Q5. State Kirchhoff's Voltage Law (KVL).

Ans: In any closed loop, the algebraic sum of all EMFs and voltage drops (I x R) is zero.

Q6. On which basic principles are Kirchhoff's laws based?

Ans: KCL is based on conservation of charge. KVL is based on conservation of energy.

3. Effects of Variation of Temperature on Resistance

Q7. How does temperature affect the resistance of pure metals?

Ans: Resistance of pure metals increases with rise in temperature. They have a positive temperature coefficient.

Q8. How does temperature affect the resistance of semiconductors, carbon, insulators and electrolytes?

Ans: Their resistance decreases with rise in temperature. They have a negative temperature coefficient.

Q9. Which alloys have a very small temperature coefficient? Where are they used?

Ans: Eureka, manganin and constantan. They are used for standard resistors, resistance boxes and measuring instruments, where resistance must stay steady. Formula: Rt = R0 (1 + alpha x t).

4. Chemical Effect of Electric Current

Q10. What is electrolysis?

Ans: The decomposition of a chemical compound (electrolyte) into its elements or ions when an electric current is passed through it.

Q11. What are the anode and cathode?

Ans: The anode is the electrode connected to the positive terminal of the supply, and the cathode is the electrode connected to the negative terminal.

Q12. Name some applications of the chemical effect of current.

Ans: Electroplating, electro-refining of metals, anodising, extraction of metals, and charging of batteries. Faraday's first law: mass deposited m = Z x I x t.

5. Laws of Resistance

Q13. State the laws of resistance.

Ans: Resistance is (1) directly proportional to length, (2) inversely proportional to cross-sectional area, (3) dependent on the nature of the material, and (4) dependent on temperature.

Q14. If a wire is stretched to double its length, how does its resistance change?

Ans: Volume stays constant, so length doubles and area halves. Resistance becomes four times the original.

Q15. Find the resistance of a copper wire 100 m long with cross-section 2 sq mm. (Resistivity of copper = 1.7 x 10^{-8} ohm-m)

Ans: R = rho x L / A = (1.7 x 10^{-8} x 100) / (2 x 10^{-6}) = 0.85 ohm.

6. Different Types of Cells

Q16. What is the difference between primary and secondary cells?

Ans: A primary cell cannot be recharged once its chemicals are used up (dry cell). A secondary cell can be recharged by passing current in the reverse direction (lead-acid cell).

Q17. Give examples of primary and secondary cells.

Ans: Primary: Leclanche cell, zinc-carbon dry cell, alkaline cell, mercury cell. Secondary: lead-acid, nickel-cadmium (Ni-Cd), nickel-iron (Edison) and lithium-ion cells.

Q18. What is the function of a depolariser in a cell?

Ans: It removes the hydrogen bubbles collected at the positive electrode, which would otherwise increase internal resistance and reduce cell output. Manganese dioxide is used in a dry cell.

7. Grouping of Cells

Q19. What is series grouping of cells? State its use.

Ans: The positive terminal of one cell is joined to the negative terminal of the next. Total EMF = n x E and internal resistance = n x r. It is used to get higher voltage.

Q20. What is parallel grouping of cells? State its use.

Ans: All positive terminals are joined together and all negative terminals are joined together. EMF stays the same (E) and internal resistance = r / n. It is used to get higher current capacity.

Q21. Six cells of 1.5 V, each with 0.5 ohm internal resistance, are connected in series. Find the total EMF and internal resistance.

Ans: Total EMF = 6 x 1.5 = 9 V. Total internal resistance = 6 x 0.5 = 3 ohm.

8. Care and Maintenance of Cells

Q22. What is the specific gravity of electrolyte in a lead-acid cell when fully charged and when discharged?

Ans: About 1.250 to 1.280 when fully charged (varies with battery type) and about 1.150 or less when discharged. It is measured with a hydrometer.

Q23. What should be used to top up the electrolyte level in a lead-acid battery?

Ans: Only distilled (battery) water, never acid or tap water. The level should be kept just above the plates as per the maker's mark.

Q24. List the main care points for a lead-acid battery.

Ans: Keep terminals clean and coat with petroleum jelly, keep vent plugs tight and the top dry, avoid overcharging and deep discharge, never leave it in a discharged state, and keep it away from flame or sparks because hydrogen gas is released.

9. Buckling

Q25. What is buckling in a lead-acid cell?

Ans: Buckling is the bending or warping of the plates of a cell.

Q26. What are the causes of buckling?

Ans: Excessive charging or discharging current, overheating, short circuit, and uneven current distribution over the plates.

Q27. What are the effects of buckling, and how can it be prevented?

Ans: Buckled plates may touch each other and cause an internal short circuit, and the active material may fall off. It is prevented by avoiding high charge/discharge rates and short circuits. Badly buckled plates must be replaced.

10. Sedimentation

Q28. What is sedimentation in a lead-acid cell?

Ans: It is the collection of active material shed from the plates as a deposit (sediment or mud) at the bottom of the cell container.

Q29. What are the causes of sedimentation?

Ans: Overcharging, high charging or discharging rates, gassing, vibration and shocks, and normal ageing of the plates.

Q30. What are the effects of sedimentation and its remedy?

Ans: If the sediment builds up to touch the plates, it causes a short circuit and loss of capacity. Space is provided under the plates to hold sediment. Avoid overcharging, and clean out the sediment or replace the cell when needed.