Class 10th Electricity Notes

1 Electric Current and Circuit

- **Electric Current (I):** The flow of electric charge through a conductor. Measured in amperes (A).
  - Formula: $I = \frac{Q}{t}$, where Q is charge (in coulombs, C) and t is time (in seconds, s).
- **Electric Circuit:** A closed, continuous path for current flow, including components like a cell, battery, wires, resistors, and switches.
- **Direction of Current:** Conventionally flows from positive to negative terminal (opposite to electron flow).

2 Electric Potential and Potential Difference

- **Electric Potential:** Work done per unit charge to bring a charge from infinity to a point.
- **Potential Difference (V):** Work done per unit charge to move a charge between two points.
  - Formula: $V = \frac{W}{Q}$, where W is work done (in joules, J) and Q is charge (in coulombs, C).
  - Measured in volts (V) using a voltmeter (connected in parallel).
- **Cell/Battery:** Provides potential difference to drive current.

3 Ohm's Law

- **Statement:** Potential difference (V) across a conductor is directly proportional to current (I), provided temperature is constant.
  - Formula: $V = I \cdot R$, where R is resistance (in ohms, Ω).
- **Resistance (R):** Property of a conductor to oppose current flow.
  - Measured in ohms (Ω).
  - Factors affecting resistance:
    - **Length (L):** $R \propto L$ (longer wire, more resistance).
    - **Area of cross-section (A):** $R \propto \frac{1}{A}$ (thicker wire, less resistance).
    - **Material:** Depends on resistivity (ρ).
    - **Temperature:** Resistance increases with temperature.

- Formula: $R = \rho \cdot \frac{L}{A}$, where ρ is resistivity.

4 Resistivity

- **Definition:** Resistance of a conductor with unit length and unit cross-sectional area.
  - Unit: $\Omega \cdot$ m (ohm-meter).
  - Depends on material and temperature, not dimensions.
- **Good Conductors:** Low resistivity (e.g., copper, silver).
- **Insulators:** High resistivity (e.g., rubber, glass).
- **Alloys:** Higher resistivity than pure metals (e.g., nichrome).

5 Combination of Resistors

- **Series Combination:**
  - Resistors connected end-to-end; same current flows through each.
  - Total resistance: $R_{\text{total}} = R_1 + R_2 + R_3 + \ldots$.
  - Current is the same; potential difference is divided.
- **Parallel Combination:**
  - Resistors connected across the same two points; same potential difference.
  - Total resistance: $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$.
  - Potential difference is the same; current is divided.

6 Electric Power

- **Definition:** Rate of electrical energy consumption or dissipation.
  - Formula: $P = V \cdot I$.
  - Other forms: $P = I^2 \cdot R$, $P = \frac{V^2}{R}$.
  - Unit: Watt (W) (1 watt = 1 joule/second).
- **Commercial Unit:** Kilowatt-hour (kWh).
  - 1 kWh = 3.6×10^6 joules.
  - Energy consumed by a 1 kW device used for 1 hour.

7 Heating Effect of Electric Current

- Electrical energy converts to heat in a resistor.
- **Joule's Law of Heating:** Heat produced is proportional to:

  - Square of current (I^2).
  - Resistance (R).
  - Time (t).
  - Formula: $H = I^2 \cdot R \cdot t$.
- **Applications:**
  - Electric heaters, geysers, toasters (use nichrome).
  - Electric fuses (melt during overloading/short-circuiting).

8 Electric Circuit Components and Symbols

- **Components:**
  - **Cell:** Provides potential difference.
  - **Battery:** Combination of cells.
  - **Resistor:** Opposes current.
  - **Variable Resistor (Rheostat):** Adjusts current/resistance.
  - **Ammeter:** Measures current (in series).
  - **Voltmeter:** Measures potential difference (in parallel).
  - **Switch:** Controls current flow.
- **Circuit Diagram:** Schematic representation using standard symbols.

9 Practical Applications

- **Domestic Wiring:**
  - Appliances in parallel for same voltage (220 V in India) and independent operation.
  - **Earthing:** Prevents electric shocks.
  - **Fuse:** Prevents overloading/short-circuiting.
- **Overloading:** Excessive current due to too many appliances or faulty wiring.
- **Short-Circuiting:** Live and neutral wires in direct contact, causing large current.

10 Key Formulas

- Electric Current: $I = \frac{Q}{t}$.
- Potential Difference: $V = \frac{W}{Q}$.
- Ohm's Law: $V = I \cdot R$.
- Resistance: $R = \rho \cdot \frac{L}{A}$.

- Series Resistance: $R_{\text{total}} = R_1 + R_2 + \ldots$.
- Parallel Resistance: $\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$.
- Electric Power: $P = V \cdot I$, $P = I^2 \cdot R$, $P = \frac{V^2}{R}$.
- Heat Energy: $H = I^2 \cdot R \cdot t$.

11 Important Points

- **SI Units:**
  - Current: Ampere (A).
  - Potential Difference: Volt (V).
  - Resistance: Ohm (Ω).
  - Power: Watt (W).
  - Energy: Joule (J) or kWh (commercial).
- **Safety Tips:**
  - Avoid touching live wires.
  - Use insulated tools and rubber gloves.
  - Ensure proper earthing and use fuses/circuit breakers.
- **Ohmic vs. Non-Ohmic Conductors:**
  - Ohmic: Follow Ohm's Law (e.g., copper).
  - Non-Ohmic: Do not follow Ohm's Law (e.g., diodes, filament lamps).

12 Exam Preparation Tips

- **Understand Concepts:** Focus on Ohm's Law, series/parallel combinations, and heating effect.
- **Practice Numerical Problems:** Solve problems on resistance, power, and energy.
- **Draw Circuit Diagrams:** Practice with correct symbols.
- **Memorize Formulas:** Keep a formula sheet.
- **Learn Applications:** Relate to domestic wiring and safety devices.