⚡ ELECTRICITY – COMPLETE NOTES

🔷 Basic Terms & Definitions

- **Electric Charge (Q)**
  A fundamental property of matter due to which it experiences electrical forces.
  Q = charge (Coulomb, C).
- **Electric Current (I)**
  Rate of flow of electric charge across a cross-section of a conductor.

$$I = \frac{Q}{t}$$

  - **I = current (Ampere, A)**
  - **Q = charge (Coulomb, C)**
  - **t = time (seconds, s)**

- **Potential Difference (V)**
  Work done to move a unit charge between two points in a circuit.

$$V = \frac{W}{Q}$$

  - **V = potential difference (Volt, V)**
  - **W = work done (Joule, J)**
  - **Q = charge (Coulomb, C)**

- **Resistance (R)**
  Opposition offered by a conductor to the flow of current.

$$R = \frac{V}{I}$$

  - **R = resistance (Ohm, Ω)**
  - **V = potential difference (Volt, V)**
  - **I = current (Ampere, A)**

- **Resistivity (ρ, rho)**
  Resistance of a conductor of unit length and unit area.

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

  - **ρ = resistivity (Ohm–metre, Ω·m)**
  - **l = length of conductor (metre, m)**
  - **A = cross-sectional area (m^2)**

🔷 Important Laws & Theories

1. **Ohm's Law**
   At constant temperature, current through a conductor is directly proportional to potential difference across it.

$$V = IR$$

   - **V = potential difference (Volt, V)**
   - **I = current (Ampere, A)**
   - **R = resistance (Ohm, Ω)**

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2. **Joule's Law of Heating**
   Heat produced is proportional to square of current, resistance, and time.

$$H = I^2Rt$$

   - **H = heat produced (Joule, J)**
   - **I = current (Ampere, A)**
   - **R = resistance (Ohm, Ω)**
   - **t = time (seconds, s)**

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3. **Combination of Resistances**
   - **Series Combination**

$$R_{eq} = R_1 + R_2 + R_3$$

     - **R_eq = equivalent resistance (Ω)**
     - **R_1, R_2, R_3 = individual resistances (Ω)**

- **Parallel Combination**

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Same meanings as above.

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4. **Electric Power (P)**
   Rate at which work is done or energy consumed.

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

   - **P = power (Watt, W)**
   - **V = potential difference (Volt, V)**
   - **I = current (Ampere, A)**
   - **R = resistance (Ohm, Ω)**

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5. **Electrical Energy (E)**
   Total energy consumed by an appliance.

$$E = P \times t$$

   - **E = energy (Joule, J) or Kilowatt-hour (kWh)**
   - **P = power (Watt, W)**
   - **t = time (seconds, s or hours, h)**

1 kWh = $1000\ W \times 3600\ s = 3.6 \times 10^6\ J$

🔷 **Key Concepts**

- **Electric Fuse**: A safety device that melts and breaks the circuit if excessive current flows.
- **Heating Effect of Current**: Current produces heat when it flows through a resistor → used in heaters, bulbs, irons.
- **Short Circuit**: When live and neutral wires touch, causing a sudden flow of large current.
- **Overloading**: When too many appliances draw current from the same supply line.

- **Commercial Unit of Electricity**: Kilowatt-hour (kWh), also called a "unit" of electricity.

🔷 Quick Formula Sheet (with Abbreviations)

1. $I = \frac{Q}{t}$
   - I: current (A), Q: charge (C), t: time (s)
2. $V = \frac{W}{Q}$
   - V: potential difference (V), W: work (J), Q: charge (C)
3. $R = \frac{V}{I}$
   - R: resistance (Ω), V: potential difference (V), I: current (A)
4. $R = \rho \frac{l}{A}$
   - ρ: resistivity (Ω·m), l: length (m), A: area (m^2)
5. $V = IR$(Ohm's Law)
6. $H = I^2Rt$(Joule's Heating Law)
7. $R_{eq} = R_1 + R_2 + R_3$(Series)
8. $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$(Parallel)
9. $P = VI = I^2R = \frac{V^2}{R}$(Power)
10. $E = P \times t$(Energy)
    - in Joule or kWh
