

# Electricity and Magnetism - Summary with Formulas and Examples

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## Laws of Magnetism

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- Like poles repel each other, and unlike poles attract.
- **Example:** Two bar magnets – bringing North-North poles close repels them, while North-South attracts.

## Magnetic Field

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- **Magnetic Field (B)** is the region around a magnet where its influence can be felt.
- **Magnetic field due to a straight current-carrying wire:**
  - **Formula:**  $B = \frac{\mu_0 I}{2\pi r}$
  - **Example:** A long wire carrying current produces concentric circular magnetic fields around it.
- **Magnetic field due to a circular loop:**
  - **Formula at the center:**  $B = \frac{\mu_0 I}{2R}$
  - **Example:** A loop of wire carrying current produces a magnetic field at its center.

## Electromagnetism

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- Electric current produces a magnetic field around a conductor.
- **Example:** Hans Oersted's experiment – a compass needle deflects when placed near a current-carrying wire.

## Electromagnetic Induction

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- **Faraday's Law:** A changing magnetic field induces an electromotive force (emf) in a circuit.
  - **Formula:**  $\mathcal{E} = -N \frac{d\Phi}{dt}$
  - **Example:** Moving a bar magnet in and out of a coil generates current.

# Electromagnets

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- A **temporary magnet** created by passing current through a coil wrapped around an iron core.
- **Example:** An iron nail wrapped with copper wire connected to a battery acts as a magnet.

# Solenoid

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- A tightly wound coil that behaves like a bar magnet when current flows through it.
- **Example:** MRI machines use solenoids to generate strong magnetic fields.

# Electricity and Circuits

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- **Electric Current (I):** Flow of electric charge.
  - **Formula:**  $I = \frac{Q}{t}$  (Charge per unit time)
  - **Example:** In a wire, electrons flow to create current.
- **Potential Difference (V):** Work done to move charge between two points.
  - **Formula:**  $V = IR$  (Ohm's Law)
  - **Example:** A 12V battery supplies voltage to a circuit.

# Electric Circuits

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- **Series Circuit:**
  - Same current flows through all components.
  - **Total resistance:**  $R_{total} = R_1 + R_2 + R_3$
  - **Example:** Bulbs in a series – if one fails, all stop working.
- **Parallel Circuit:**
  - Voltage is the same across components.
  - **Total resistance:**  $\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$
  - **Example:** House wiring – appliances work independently.

# Electric Bell

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- Uses an electromagnet to repeatedly strike a gong when current flows.
- **Example:** Doorbells in homes.

## Types of Current

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1. **Direct Current (DC):** Flows in one direction.
  - **Example:** Batteries and cells.
2. **Alternating Current (AC):** Changes direction periodically.
  - **Example:** Home electricity supply (220V, 50Hz in India).

## Sources of Electricity

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1. **Primary Cells (Non-rechargeable):** Dry cells, button cells.
2. **Secondary Cells (Rechargeable):** Car batteries, mobile phone batteries.

This structured summary includes all major concepts and formulas. Let me know if you need any modifications! 🚀