

Magnetism and Electromagnetism

GCSE Physics

March 10, 2025

Permanent and Induced Magnetism

Key Concepts:

- ▶ **Permanent Magnet:** Produces its own magnetic field.
- ▶ **Induced Magnet:** Becomes a magnet when placed in a magnetic field; loses magnetism when removed.
- ▶ **Magnetic Poles:** The regions where magnetic forces are strongest.

Forces Between Poles:

- ▶ **Like Poles:** Repel.
- ▶ **Unlike Poles:** Attract.

Attraction and repulsion are examples of non-contact forces.

Magnetic Fields

Definition: The region around a magnet where a force acts on another magnet or magnetic material. **Key Points:**

- ▶ The magnetic field is strongest at the poles.
- ▶ Field strength decreases with distance from the magnet.
- ▶ Field lines show the direction of the force on a north pole.

Earth's Magnetic Field:

- ▶ A magnetic compass contains a small bar magnet.
- ▶ The compass needle aligns with the Earth's magnetic field.

Electromagnetism

Key Concepts:

- ▶ A current-carrying wire produces a magnetic field.
- ▶ The strength of the magnetic field depends on:
 - ▶ Current through the wire.
 - ▶ Distance from the wire.
- ▶ A solenoid (wire shaped into a coil):
 - ▶ Produces a strong and uniform magnetic field.
 - ▶ Has a field similar to a bar magnet.
 - ▶ Becomes stronger with an iron core (electromagnet).

Fleming's Left-Hand Rule (HT Only)

The Motor Effect: When a current-carrying conductor is placed in a magnetic field, a force acts on it.

Fleming's Left-Hand Rule:

- ▶ **Thumb:** Direction of force.
- ▶ **First Finger:** Magnetic field direction.
- ▶ **Second Finger:** Current direction.

Factors Affecting Force:

- ▶ Length of wire.
- ▶ Magnetic field strength.
- ▶ Size of current.

Electric Motors (HT Only)

How It Works:

- ▶ A coil of wire carrying a current in a magnetic field experiences a force.
- ▶ This force causes the coil to rotate.

Application: The rotation of the coil is the basis of an electric motor.

Loudspeakers and Headphones (HT Only)

How They Work:

- ▶ Use the motor effect to convert variations in current into pressure variations (sound waves).
- ▶ Current in a coil produces a magnetic field.
- ▶ Interactions with another magnetic field cause vibrations, creating sound waves.

Practice Problems

1. Describe the difference between a permanent and an induced magnet.
2. Sketch the magnetic field lines around a bar magnet.
3. Explain how the strength of a solenoid can be increased.
4. Use Fleming's Left-Hand Rule to determine the direction of the force on a conductor.

Answers to Practice Problems

1. Permanent magnets produce their own field; induced magnets only become magnetic in a field.
2. Field lines go from north to south outside the magnet, and loop inside.
3. Increase the current, add more turns to the coil, or use an iron core.
4. Apply the rule: Thumb = force, First Finger = field, Second Finger = current.