Your notes

GCSE Physics: revision notes

Electromagnets and the motor effect

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Magnetic fields around wires

- When a current flows through a conducting wire, a magnetic field is produced around the wire.
- The field is made of circles around the wire. Its strength increases with the current and decreases with distance from the wire.
- The **right-hand grip rule** gives the direction: point your thumb along the current, and your fingers curl in the direction of the field.

Solenoids and electromagnets

- Shaping a wire into a coil (a **solenoid**) increases the strength of the magnetic field.
- Inside a **solenoid** the field is strong and uniform. Outside, the field has a similar shape to that of a bar magnet.
- Adding an iron core increases the strength of the field. A **solenoid** with an iron core is an **electromagnet**.
- **Electromagnets** can be switched on and off, and their strength can be changed. They are used in cranes for scrap iron, relays and electric bells.

The motor effect (Higher)

- When a conductor carrying a current is placed in a magnetic field, the magnet and the conductor exert a force on each other. This is the **motor effect**.
- **Fleming's left-hand rule**: first finger = field, second finger = current, thumb = motion (force). The fingers are held at right angles.
- F = B I l: force (N) = **magnetic flux density** (tesla, T) × current (A) × length of conductor in the field (m).

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- The force is biggest when the wire is at right angles to the field, and zero when it is parallel.

Motors and loudspeakers (Higher)

- A coil of wire carrying a current in a magnetic field tends to rotate. This is the basis of an electric motor. A **split-ring commutator** reverses the current every half turn to keep the coil turning.
- (Separate sciences) Loudspeakers and headphones use the **motor effect**: a changing current in a coil in a magnetic field makes a cone vibrate, turning variations in current into pressure variations in the air (sound waves).

Key terms

Electromagnet	A solenoid with an iron core, which is magnetic only when current flows.
Solenoid	A coil of wire that produces a magnetic field when current flows through it.
Right-hand grip rule	A rule for the direction of the magnetic field around a current-carrying wire.
Motor effect	The force on a current-carrying conductor in a magnetic field.
Fleming's left-hand rule	A rule for the direction of the force in the motor effect.
Magnetic flux density	The strength of a magnetic field, measured in tesla (T).
Split-ring commutator	A device in a motor that reverses the current every half turn.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What is produced around a wire carrying a current?
2. How can the magnetic field of a solenoid be made stronger?
3. What is an electromagnet?
4. What is the shape of the field outside a solenoid?
5. Why are electromagnets used in scrapyard cranes?
6. In Fleming's left-hand rule, what does the thumb show? (Higher)
7. What is the force on a 0.5 m wire carrying 2 A in a field of 0.1 T at right angles? (Higher)
8. When is the force on a wire in a magnetic field zero? (Higher)

Answers

1. A magnetic field
2. Add an iron core
3. A solenoid with an iron core

Your notes

4. Like a bar magnet
5. They can be switched on and off
6. The direction of the force (motion)
7. 0.1 N
8. When the wire is parallel to the field

What to do next

Practise 10 questions on this topic

Try 7 exam questions, with mark schemes

Read the lesson, one step at a time

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