5.2 Magnetism and electromagnetism

Name: _____ Class: _____ Date: _____ **Total: 23 marks**

KEY WORDS induced magnet • solenoid

Objective

Build the skills to answer exam questions on **magnetism and electromagnetism** : poles and fields, permanent and induced magnets, the Earth's field, the field around a wire, solenoids and electromagnets.

You must be able to:

- describe the forces between poles and draw magnetic field lines
- tell permanent magnets from induced magnets
- describe the magnetic field around a wire and a solenoid
- explain how electromagnets are made stronger and how they are used

1 Key knowledge and worked examples

Magnetism and electromagnetism

idea	equation or rule
poles	like poles repel, unlike poles attract; field lines go from N to S
permanent and induced	a permanent magnet makes its own field; an induced magnet (iron, steel, nickel, cobalt) is magnetic only inside a field and is always attracted
Earth's field	the Earth has a magnetic field; a compass needle lines up with it and points north
wire with a current	circular field lines around the wire; reverse the current and the field reverses
solenoid	a coil of wire with a field like a bar magnet's; stronger with more turns, more current or an iron core (an electromagnet)
uses	an electromagnet can be switched off: scrap-metal cranes, relays, electric bells

Worked example 1: a compass. A compass is placed just next to the N pole of a bar magnet. Which way does it point?

1. Known: field lines leave the N pole.
2. Rule: a compass needle points along the field lines, from N to S.
3. Apply: next to the N pole the field lines point away from the magnet.
4. Result: **the compass points away from the N pole**.

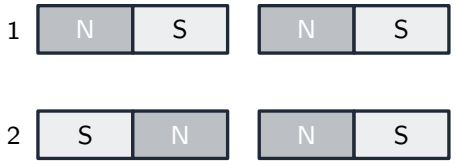
Worked example 2: a stronger electromagnet. An electromagnet lifts 4 nails with a current of 0.5 A. Give two ways to make it lift more nails.

1. Known: the strength depends on the current, the turns and the core.
2. Rule: more current or more turns give a stronger field.
3. Apply: increase the current to 1.0 A; wind more turns of wire on the core.
4. Result: **more current, more turns (or an iron core)**.

Answer shapes: draw field lines with arrows from N to S that never cross; an induced magnet is always attracted, never repelled.

2 Practice

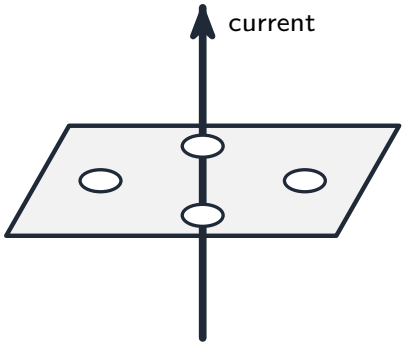
2.1 The diagram shows two pairs of magnets. Does each pair attract or repel? [2]



2.2 Which of these materials are attracted by a magnet? [2]

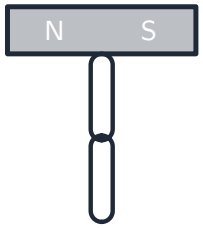
iron | copper | steel | aluminium | nickel

2.3 Plotting compasses are placed around a vertical wire with a current in it. Describe the shape of the magnetic field. What happens to the compasses when the current is reversed? [2]



3 Exam-style questions

3.1 A steel paper clip hangs from a magnet. A second clip hangs from the first. Explain why. What happens if the clips are made of soft iron and the magnet is taken away? [3]



3.2 A student makes an electromagnet by winding wire around an iron nail. She counts how many paper clips it lifts with different numbers of turns. The current is 1.0 A each time.



turns	10	20	30	40	50
clips lifted	3	6	9	11	12

(a) Describe the relationship between the number of turns and the number of clips. [3]

(b) Give two variables she must keep the same. [2]

(c) Explain why the core is made of iron. Explain why a scrap-metal crane would not use a steel core. [3]

(d) Describe how the student did this investigation. Include how she kept the test fair and safe. [6]