6.1 Magnetism and the motor effect

Name: _____ Class: _____ Date: _____ **Total: 21 marks**

Objective

Build the skills to answer exam questions on **magnetism and the motor effect** : magnetic poles and fields, magnetic and non-magnetic materials, field around a wire and a solenoid, electromagnets, the force on a current-carrying wire, and electric motors.

You must be able to:

- describe magnetic fields of magnets, wires and solenoids
- use the left-hand rule to find the direction of the force on a wire
- explain how a simple d.c. motor works
- describe how to change the strength of an electromagnet

1 Key knowledge and worked examples

Magnetism

idea	rule
poles	like poles repel; unlike poles attract
field lines	go from N to S; closer lines show a stronger field
magnetic materials	iron, steel, nickel and cobalt; soft iron magnetises and demagnetises easily
wire and solenoid	a current makes a magnetic field; a solenoid's field is like a bar magnet's
motor effect	a current-carrying wire across a magnetic field feels a force
left-hand rule	First finger: Field; seCond finger: Current; thuMb: Motion (force)

Worked example 1: left-hand rule. Field to the right, current into the page. Find the force.

1. Known: field right; current into the page.
2. Rule: left hand, First finger right, seCond finger into the page.

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3. Numbers: the thumb points down the page.
4. Result: **force downwards**.

Worked example 2: reversing. What happens to the force if both the current and the field are reversed?

1. Known: both reversed.
2. Rule: reversing one reverses the force.
3. Numbers: two reversals cancel.
4. Result: **the force stays in the same direction**.

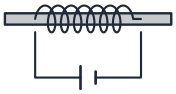
Answer shapes: a bigger current or a stronger magnet gives a bigger force.

2 Practice

2.1 Draw arrows to show the direction of the field lines between the two poles, and state whether the magnets attract or repel. [2]



2.2 Give **two** ways to make an electromagnet stronger. [2]



3 Exam-style questions

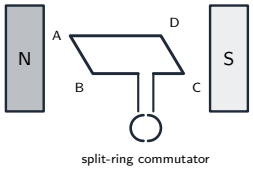
3.1 A wire carries a current between the poles of a magnet. Use the left-hand rule to find the direction of the force on the wire, and give **two** ways to reverse it. [3]



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3.2 The diagram shows a simple d.c. motor. The coil can turn between the poles of a magnet.

(a) Explain why side AB moves up while side CD moves down. [2]



(b) The split-ring commutator reverses the current in the coil every half turn. Explain why this is needed. [3]

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(c) Give **three** changes that would make the motor turn faster. [3]

(d) A scrapyard crane uses a large electromagnet to lift steel cars. Explain how the electromagnet works, why its core is soft iron, and how the driver drops a car. [6]

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Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

- field lines from N to S across the gap
- they attract

2.2

- increase the current
- more turns on the coil, or use a soft iron core

3.1

- field N to S, left to right; current into the page; force downwards
- reverse the current
- or swap the poles (reverse the field)

3.2

(a) the current in AB and CD flows in opposite directions; so the forces on them are in opposite directions, by the left-hand rule

(b) without it, after half a turn the forces would push the coil back the other way; so the coil would rock and stop; reversing the current keeps the forces turning the coil the same way

(c) any three: a larger current/higher voltage; a stronger magnet; more turns on the coil

(d) points to include:

- a current in the coil makes a magnetic field, like a bar magnet's (K)
- the soft iron core is magnetised and makes the field much stronger (K)
- steel is a magnetic material, so it is attracted and lifted (K)
- the field strength can be raised with more current or more turns (App)
- soft iron loses its magnetism when the current stops (An)
- so switching off the current releases the car; a steel core would stay magnetised (An)

Levels: **5–6** a full, logical answer with correct physics and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.

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