



Magnetism and Electromagnetism

FREE Online Physics GCSE Course

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Name _____ Date _____

TIME ALLOWED

35 minutes

TOTAL MARKS

23 COMBINED · 34 TRIPLE

YOU WILL NEED

a ruler, a pencil, a black or blue pen and a calculator

Instructions

- **Combined Science:** answer Questions 1–5 (about 25 minutes).
- **Physics (triple):** answer all seven questions.
- Write in black or blue ink.
- In calculations, show clearly how you work out your answer.

Information

- The marks for each question are shown in brackets.
- Combined Science is out of 23 marks. Physics (triple) is out of 34 marks.
- You are reminded of the need for good English and clear presentation in your answers.

Your score

Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Total	%
Out of	6	3	4	3	7	5	6	23 / 34	100
Your mark									

Marking your test

The full mark scheme is at the back of this booklet. Try every question first, then mark your answers in a different colour.

1 Question 1

6 marks

This question is about magnets.

- (a) Which statements apply to **permanent magnets**, which apply to **electromagnets** and which apply to **both**? Tick one box in each row.

	Permanent magnets	Electromagnets	Both
Need an electric current to work	☐	☐	☐
Have a constant magnetic field	☐	☐	☐
Can be turned off	☐	☐	☐
Have north and south poles	☐	☐	☐
Often contain a coil of wire	☐	☐	☐

(2)

- (b) What is an **induced** magnet?

Tick (✓) one box.

A A permanent magnet made by passing a current through a piece of steel

☐

B A temporary magnet made by repeatedly heating a piece of steel

☐

C A permanent magnet made by repeatedly stroking a piece of steel with a magnet

☐

D A temporary magnet made by placing a piece of steel in a magnetic field, or touching it with a magnet

☐

(1)

- (c) Describe how to find the direction of the magnetic field around a permanent magnet using a small compass. You may draw a diagram.

(3)

Total for this question: 6 marks

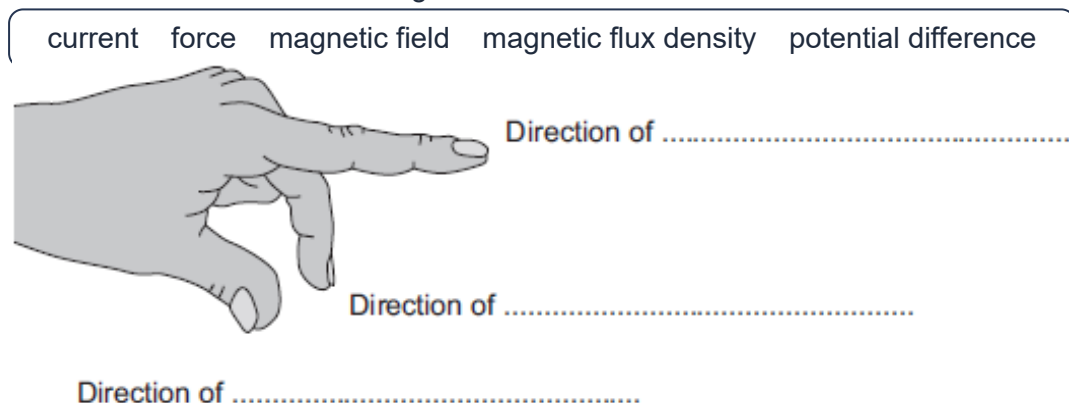
2

Question 2

3 marks

The left-hand rule is used to find the direction of the force on a current-carrying wire in a magnetic field.

Use words from the box to label the diagram of the left hand.



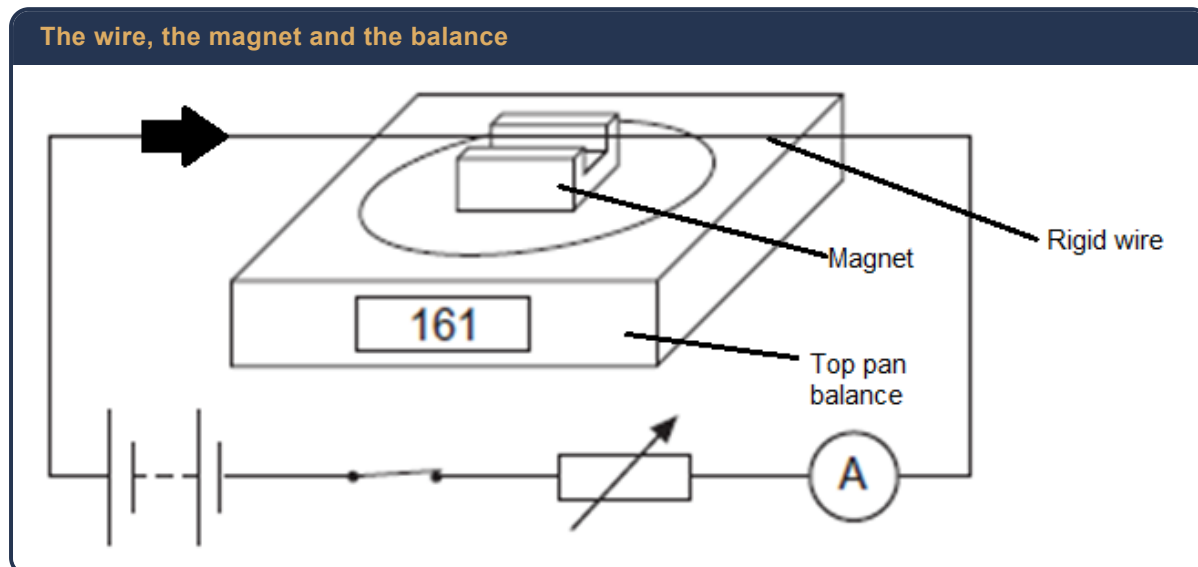
(3)

Total for this question: 3 marks

3 Question 3

4 marks

The diagram shows a rigid wire held between the poles of a U-shaped magnet. The magnet sits on a top pan balance.



The magnet was placed on the balance before the current was switched on, and the balance was then zeroed. After the current was switched on, the balance read 161 g. The arrow shows the direction of the current in the circuit.

(a) Which direction was the force on the **balance**?

Tick (✓) **one** box.

A In the same direction as the arrow ☐

B Down onto the balance ☐

C Up from the balance ☐

D From the front of the balance to the back ☐

(1)

(b) By Newton's third law, the force on the **wire** is in the opposite direction to the force on the balance. Which direction was the magnetic field?

Tick (✓) **one** box.

A In the same direction as the arrow ☐

B Down onto the balance ☐

C Up from the balance ☐

D From the front of the balance to the back ☐

(1)

- (c) Explain what would happen to the reading on the balance if the current in the wire was increased.

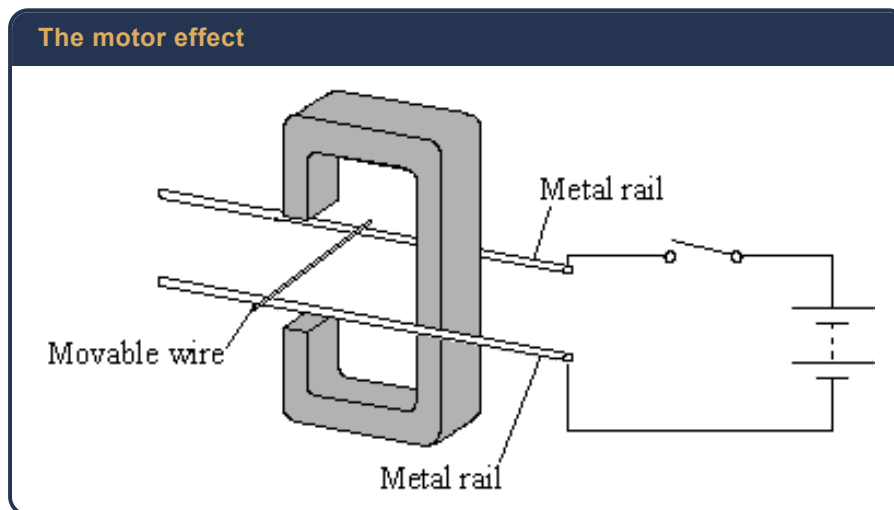
(2)

Total for this question: 4 marks

4 Question 4

3 marks

The diagram shows apparatus used to demonstrate the motor effect. When the switch is closed, the movable wire rolls along the metal rails.



- (a) State **one** way to make the wire move in the opposite direction.

(1)

- (b) Explain why the wire moves.

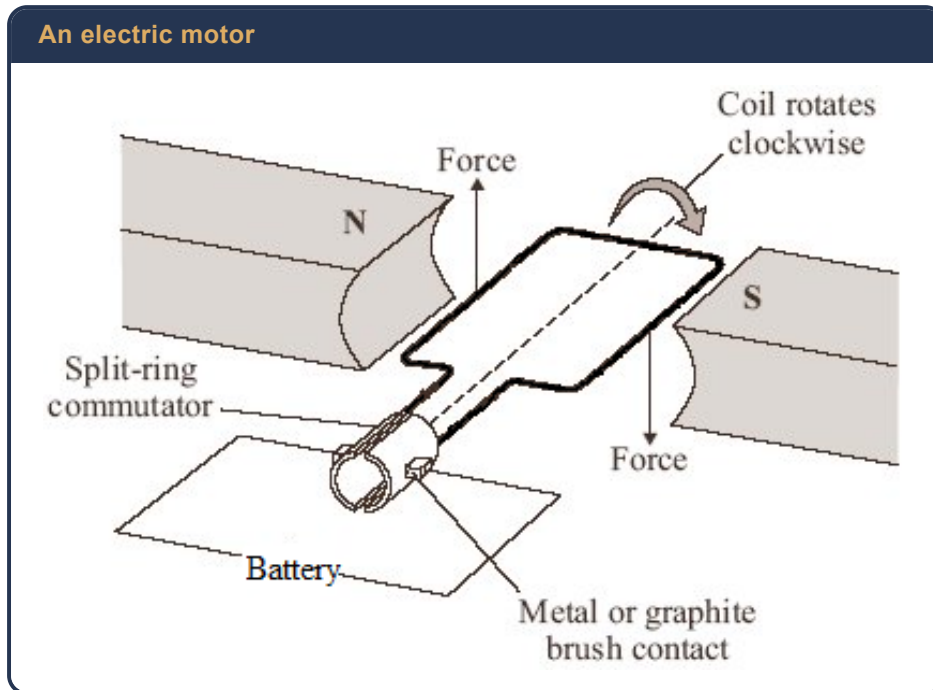
(2)

Total for this question: 3 marks

5 Question 5

7 marks

The diagram shows a simple electric motor. A coil spins between the poles of two magnets.



- (a) Add an arrow to the diagram to show the direction of the current in the coil.

(1)

- (b) The motor is part of an electric drill. It needs to be able to change direction and speed.

Describe how the **direction** and the **speed** of the drill could be changed **without** changing the way the motor is built.

(2)

- (c) State **two** ways the **construction** of the motor could be changed to increase its speed.

(2)

- (d) A student builds a model motor. The magnetic flux density between the poles is 3×10^{-2} T. The length of one side of the coil between the poles is 2 cm. The current is 0.5 A.

Calculate the force on one side of the coil. Give your answer in standard form.

Force = _____ N
(2)

Total for this question: 7 marks

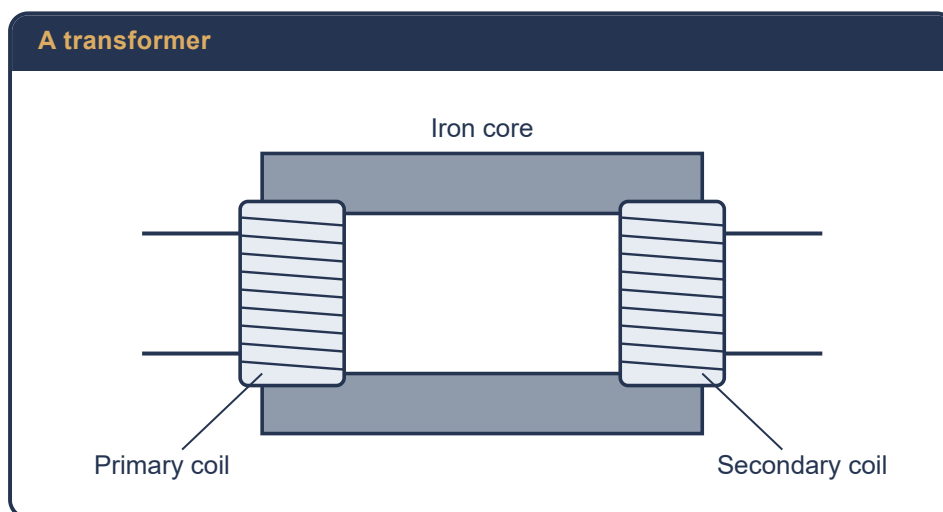
6 Question 6

Physics (triple) only

5 marks

Physics (triple) only. Combined Science students: skip this question.

The diagram shows a transformer.



- (a) Explain why a transformer will **not** work with a battery.

(1)

- (b) Describe the construction of a **step-up** transformer.

(2)

- (c) A transformer has 2800 turns on its primary coil and 700 turns on its secondary coil. The potential difference across the secondary coil is 12 V.

Calculate the potential difference across the primary coil.

Potential difference across the primary coil = _____ V

(2)

Total for this question: 5 marks

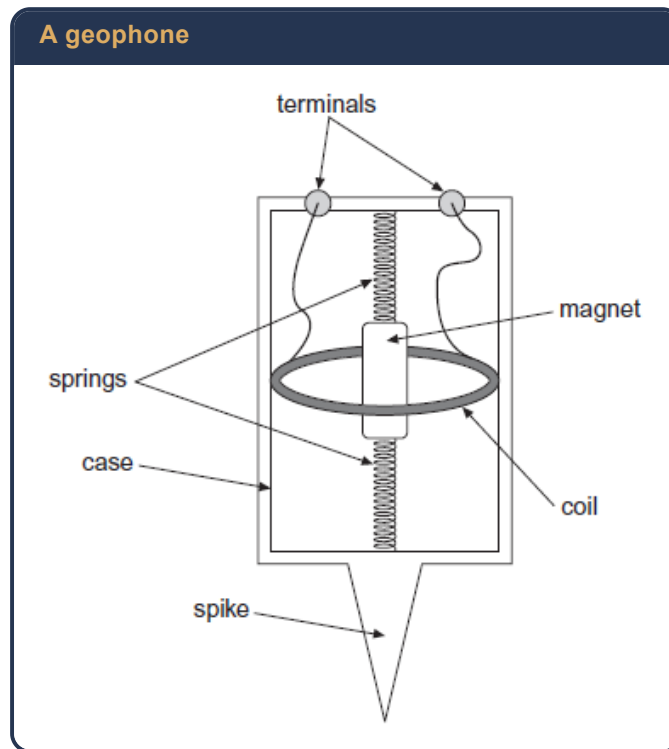
7 Question 7

Physics (triple) only

6 marks

Physics (triple) only. Combined Science students: skip this question.

The diagram shows a geophone: a device used to detect earthquakes. The spike fixes the geophone firmly into the ground. An ammeter is connected to the terminals.



When an earthquake happens, the case and the coil move up and down with the ground. The magnet is heavy, so it does not move.

Explain how the reading on the ammeter would change when there is:

- no earthquake
- a small earthquake
- a large earthquake.

(6)

Total for this question: 6 marks

END OF TEST

Now mark your answers using the mark scheme that follows.

MARK SCHEME

Magnetism and Electromagnetism · Topic Test

[1] in the Mark column means one mark for that line.

accept / allow notes (gold) are other answers that also score.

reject / do not accept notes (red) are answers that do not.

1 Question 1 — mark scheme

6 marks

PART	ANSWER	MARK
(a)	Need an electric current to work: electromagnets Have a constant magnetic field: permanent magnets Can be turned off: electromagnets Have north and south poles: both Often contain a coil of wire: electromagnets <i>all five rows correct: 2 marks</i> <i>three or four rows correct: 1 mark</i>	2
(b)	a temporary magnet made by placing a piece of steel in a magnetic field, or touching it with a magnet (D)	1
(c)	place the compass at different points around the magnet <i>accept a clearly labelled diagram for any or all points</i>	1
	mark the direction the compass needle points at each position (the needle lines up with the field lines)	1
	join the marks up to make field lines, with arrows from north to south	1

Total: 6 marks

2 Question 2 — mark scheme

3 marks

PART	ANSWER	MARK
	first finger (pointing straight out): magnetic field <i>these words, in this order only</i>	1
	second finger: current	1
	thumb: force	1

Total: 3 marks

3 Question 3 — mark scheme

4 marks

PART	ANSWER	MARK
(a)	down onto the balance	1
(b)	from the front of the balance to the back	1
(c)	the reading would increase	1
	because the force on the wire increases with the current ($F = BIL$), so the force down on the balance increases	1
	do not accept "the magnetic flux density increases": the magnet is the same	
	KEY EQUATION $F = BIL$	

Total: 4 marks

4 Question 4 — mark scheme

3 marks

PART	ANSWER	MARK
(a)	reverse the current (turn the battery round) or reverse the magnetic field (turn the magnet over / swap the poles)	1
	doing both does not score: the wire would move the same way	
(b)	the current in the wire makes a magnetic field around the wire	1
	the two fields interact (combine), giving a resultant force on the wire	1
	accept: the motor effect gives a force on a current-carrying wire in a magnetic field	

Total: 3 marks

5 Question 5 — mark scheme

7 marks

PART	ANSWER	MARK
(a)	arrow showing the current going anticlockwise round the coil (seen from above)	1
	current towards the commutator in the side next to the N pole, away from it in the side next to the S pole	
(b)	direction: reverse the current / turn the battery round	1
	speed: change the size of the current (or the potential difference)	1
(c)	increase the number of turns on the coil	1
	use stronger magnets	1
	accept: put an iron core in the coil	

(d) $F = BIL = 3 \times 10^{-2} \times 0.5 \times 0.02$
 the length must be in metres: $2 \text{ cm} = 0.02 \text{ m}$

1

$= 3 \times 10^{-4} \text{ (N)}$
 $0.03 \text{ N (cm not changed to m) gains 1 mark}$

1

Total: 7 marks

6 Question 6 — mark scheme

Physics (triple) only

5 marks

PART	ANSWER	MARK
(a)	a transformer needs alternating current, but a battery gives direct current accept: the magnetic field in the core must keep changing to induce a p.d.	1
(b)	the secondary coil has more turns than the primary coil	1
	both coils are wound on an iron core	1
(c)	$V_p \div V_s = n_p \div n_s$: $V_p \div 12 = 2800 \div 700$	1
	$V_p = 48 \text{ (V)}$ $3 \text{ V (ratio upside down) gains 1 mark}$	1

Total: 5 marks

7 Question 7 — mark scheme

Physics (triple) only

6 marks

PART	ANSWER	MARK
	Use a 'best-fit' approach to the levels.	
0	No relevant content.	0
L1	Isolated points, with errors in the physics and / or incorrect or inconsistent use of scientific words.	1–2
L2	A clear answer giving the main points, but maybe out of order. Some correct scientific words, maybe with a few minor errors.	3–4
L3	A clear, coherent answer that links the movement of the coil relative to the magnet to the changing current in the ammeter, and links the movement of the ground to the alternating current.	5–6

Indicative content

- no earthquake: no movement, so no current in the coil (the ammeter reads zero)
- in an earthquake, the coil moves relative to the magnet
- the coil cuts the magnetic field lines
- so a potential difference is induced across the coil and a current flows
- the current changes direction each time the ground changes direction: alternating current
- a larger earthquake has a larger amplitude (the coil moves further / faster)
- so the (maximum) current is larger

Model answer

- **No earthquake:** the coil and the magnet do not move relative to each other, so no potential difference is induced and the ammeter reads zero.
- **Small earthquake:** the case and coil move up and down but the heavy magnet stays still, so the coil moves relative to the magnet. The coil cuts the magnetic field lines, which induces a potential difference across the coil, and a current flows through the ammeter.
- The current changes direction each time the coil changes direction, so it is an alternating current, at the same frequency as the ground shakes.
- **Large earthquake:** the coil moves further and faster, so it cuts the field lines faster. The induced p.d. is bigger, so the ammeter shows a bigger (alternating) current.

Total: 6 marks

END OF MARK SCHEME
