AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.7.1.2

Magnetic fields

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**8**
Available paper years	**2018–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

6.7.1.2 Magnetic fields

Answer 01 · Mark scheme

June 2018 | 8464/P/2H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	1st box ticked		1	AO1 6.7.1.2
02.2	(permanent magnet) has no effect on the aluminium iron is attracted (to the permanent magnet) (only) the (permanent) magnet can be repelled (by the permanent magnet)		1 1 1	AO2 6.7.1.1 6.7.1.2

6.7.1.2 Magnetic fields

Answer 01 · Mark scheme

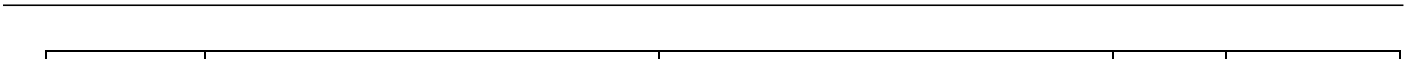
June 2018 | 8464/P/2H | Original Q2

Question	Answers	Mark	AO / Spec. Ref.
02.3	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to give a clear account.	5–6	AO2
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.	3–4	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content • completing the circuit • turns the electromagnet on • there is a current in the coil • a magnetic field is produced around the coil • the iron core becomes magnetised • move electromagnet towards the blocks • the block is attracted to the electromagnet • moving the crane moves the block • switching off the current switches off the electromagnet • releasing the block		6.7.2.1
Total			**10**

6.7.1.2 Magnetic fields

Answer 01 · Mark scheme

June 2018 | 8464/P/2H | Original Q2



6.7.1.2 Magnetic fields

Answer 02 · Mark scheme June 2019 | 8464/P/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1			1	AO1 6.7.2.2	A
04.2	reverse the direction of the current reverse the direction of the magnetic field		1 1	AO1 6.7.2.2	E
04.3	B = 0.360 (T) $0.072 = 0.360 \times I \times 0.050$ $I = \frac{0.072}{(0.360 \times 0.050)}$ I = 4.0 (A)	an answer of 4.0 (A) scores **4** marks allow a correct substitution using an incorrectly / not converted value of B allow a correct rearrangement using an incorrectly / not converted value of B allow a correct calculation using an incorrectly / not converted value of B	1 1 1 1	AO2 6.7.2.2	E

6.7.1.2 Magnetic fields

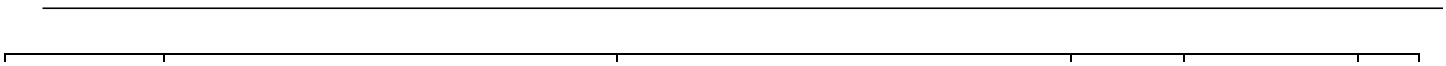
Answer 02 · Mark scheme

04.4	there is a magnetic field (due to the permanent magnet) **and** current in a wire causes a magnetic field current is in opposite directions in each side of the coil so forces act in opposite directions on either side of the coil (the split ring ensures that) the current in the left / right side of the coil is always in the same direction	 allow (the split ring ensures that) the force in the left / right side of the coil is always in the same direction allow the current reverses each half rotation	1 1 1 1	AO1 6.7.2.3	E
Total			**11**		

6.7.1.2 Magnetic fields

Answer 02 · Mark scheme

June 2019 | 8464/P/2H | Original Q4



6.7.1.2 Magnetic fields

Answer 03 · Mark scheme

November 2020 | 8464/P/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	iron and steel will be attracted (to the magnet) aluminium, copper and tin will not be attracted (to the magnet)	 allow **1** mark is one metal is in the incorrect list, but all the other four are correct if no other mark awarded allow **1** mark for iron and steel are magnetic	1 1	AO1 6.7.1.1
01.2	the paperclip would still be attracted to the magnet because of induced magnetism	 allow the paper clip becomes an induced magnet allow because the paper clip is a temporary magnet allow there is a magnetic field at the south pole	1 1	AO1 6.7.1.1
01.3	weight = mass × gravitational field strength or W = mg	do not accept gravity for gravitational field strength	1	AO1 6.5.1.3
01.4	1.0 g = 0.0010 kg weight of 1 paperclip = 0.0010 × 9.8 Force = 0.0098 x 20 = 0.196 (N)	allow 0.001 (kg) allow 0.0098 (N) allow correct substitution using incorrectly/not converted value of mass of paperclip allow correct calculation using incorrectly/not converted value of mass of paperclip	1 1 1	AO2 6.5.1.3

6.7.1.2 Magnetic fields

Answer 03 · Mark scheme

November 2020 | 8464/P/2H | Original Q1

Total			**8**	

6.7.1.2 Magnetic fields

Answer 04 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	the downward force on the balance increased	allow when there is a current in the wire there is a magnetic field around the wire (which causes a magnetic force)	1	AO3 6.7.2.2 6.5.4.2.3
	therefore the wire must experience an equal and opposite force (which is upwards)		1	
07.2	calculate the difference between the two mass readings	allow 254.8 – 252.3 = 2.5	1	AO1 6.7.2.2
	convert to kg **and** multiply by gravitational field strength	allow (2.5 / 1000) × 9.8 = 0.02375 (N)	1	
07.3	gradient $= \frac{(0.0210 - 0.0)}{(0.70 - 0.02)}$		1	AO3
	gradient = 0.031	allow answer correctly given to any number of significant figures	1	AO3
	0.031 = B × 0.125	allow correct substitution using correctly calculated value given to any number of significant figures	1	AO2
	B = 0.25 T	allow answer correctly given to any number of significant figures	1	AO2
		any rounding must be correct for subsequent marks to be awarded.		6.7.2.2
		max **2** marks if a pair of readings from the graph are used instead of gradient calculation		
Total			**8**	

6.7.1.2 Magnetic fields

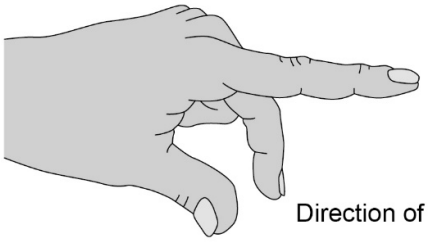
Answer 05 · Mark scheme

November 2021 | 8464/P/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	at the poles		1	AO1 6.7.1.2
04.2	the distance between the field lines varies		1	AO1 6.7.1.2
04.3	electromagnet is easy to demagnetise so easy to remove separated metal	allow electromagnet can be switched off allow electromagnet is (generally) stronger than a permanent magnet for **1** mark if no other marks are awarded	1 1	AO1 6.7.2.1
04.4	cobalt nickel		1 1	AO1 6.7.1.2
04.5	increases the current in the coil of the electromagnet bring the electromagnet closer to the pieces of iron and steel	allow increase potential difference across the coil	1 1	AO1 AO3 6.7.2.1

6.7.1.2 Magnetic fields

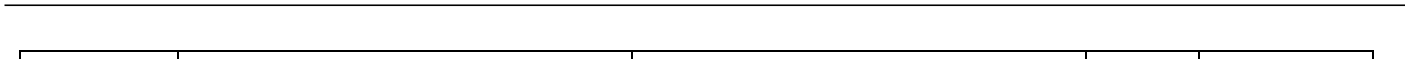
Answer 05 · Mark scheme

04.6	L = 0.120 m 0.36 = B × 4.0 × 0.120 $B = \frac{0.36}{(4.0 \times 0.120)}$ B = 0.75 T	 allow a correct substitution of an incorrectly / not converted value of L allow a correct rearrangement using an incorrectly / not converted value of L allow a correct calculation using an incorrectly / not converted value of L	1 1 1 1 1	AO2 6.7.2.2
04.7	 Direction of magnetic field Direction of current Direction of force allow **1** mark for 1 or 2 correct		2	AO1 6.7.2.2
Total			**15**	

6.7.1.2 Magnetic fields

Answer 05 · Mark scheme

November 2021 | 8464/P/2H | Original Q4



6.7.1.2 Magnetic fields

Answer 06 · Mark scheme

June 2023 | 8464/P/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	inertia		1	AO1 6.5.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2			1	AO2 6.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	increase the current so that the (resultant) force increases	allow use a stronger magnet	1 1	AO1 6.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	bring the (same end of the) iron bar close to each pole / end of the permanent magnet any repulsion shows the iron bar is a permanent magnet **or** if one end of the iron bar is attracted to both poles it is not a permanent magnet	allow bring each end of the iron bar to the same pole of the magnet	1 1	AO3 6.7.1.1

6.7.1.2 Magnetic fields

Answer 06 · Mark scheme

June 2023 | 8464/P/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	the compass (needle always) points in the same direction because it aligns itself with the Earth's magnetic field	allow the compass (needle always) points north dependent on MP1	1 1	AO1 6.7.1.2

Total Question 4	8

6.7.1.2 Magnetic fields

Answer 07 · Mark scheme

June 2024 | 8464/P/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	into the page		1	AO2 6.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	$0.092 = B \times 4.6 \times 0.080$ $B = \frac{0.092}{4.6 \times 0.080}$ $B = 0.25$ tesla or T	 allow a correct rearrangement using an incorrectly / not converted value of l allow a correct calculation using an incorrectly / not converted value of l	1 1 1 1	AO2 6.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	Newton's third law		1	AO1 6.5.4.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	any **two** from: • move the electromagnet closer to the permanent magnet • add more turns to the coil / electromagnet • increase the current (in the coil / electromagnet)	 allow increase the potential difference (across the coil / electromagnet)	2	AO1 6.7.2.1

6.7.1.2 Magnetic fields

Answer 07 · Mark scheme

June 2024 | 8464/P/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	any **two** from • reverse the current in the coil / electromagnet • turn the electromagnet around (to reverse the poles) • wrap the coil (around the iron core) in the opposite direction		2	AO1 AO3 6.7.2.1

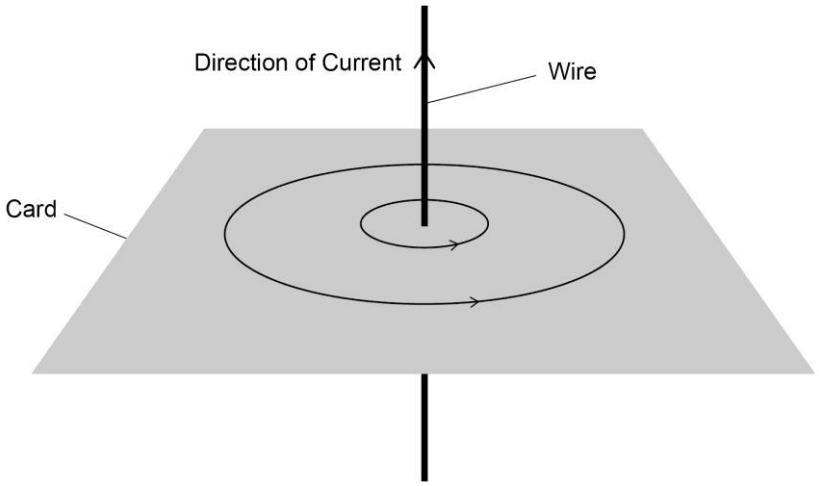
Total Question 4	**10**

6.7.1.2 Magnetic fields

Answer 08 · Mark scheme

June 2025 | 8464/P/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(at least) 2 concentric rings around the point where the wire passes through the card with arrow(s) drawn in anticlockwise direction around the wire		1 1	AO1 6.7.2.1
				

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	2.1 mN = 0.0021 N	subsequent marks may be awarded if *F* is incorrectly / not converted	1	AO2
	$0.0021 = B \times 0.56 \times 0.050$		1	AO2
	$B = \frac{0.0021}{0.56 \times 0.050}$		1	AO2
	$B = 0.075$		1	AO2
	tesla **or** T		1	AO1 6.7.2.2

6.7.1.2 Magnetic fields

Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	there is a magnetic field between the poles of the magnets		1	AO1 6.7.2.2 6.7.2.3
	a current in a loop of wire causes a magnetic field		1	
	the current is in opposite directions in side A and side B		1	
	(so) the (vertical) forces on side A and side B are in opposite directions		1	
	the force on side A is downwards **or** the force on side B is upwards	allow the forces on side A and side B cause the loop to rotate anticlockwise	1	

Total Question 4	12

Answer 01 · Examiner comments

Question 2 (standard demand)

02.1 60% scored this mark. The most common incorrect response was where the direction of the magnetic field lines ran from south to north.

02.2 Many students did not appreciate that they needed to identify all three blocks. Many identified iron and aluminium and not the second permanent magnet.

There appeared to be widespread confusion as to which of iron and aluminium were magnetic and a significant minority simply said that a material was magnetic without indicating how they would identify it.

As a result, 40% scored zero for this question, and 17% scored scored all three marks.

02.3 There were many very vague responses to this question, with few inclusions of the level of detail expected. Many made reference to the ability to turn the electromagnet on and off but there were few descriptions of how the electromagnet worked with many incorrect references to 'electricity' passing through the core.

Many believed that the magnetic blocks were, in fact, magnets themselves and talked about the attraction and repulsion between the blocks and the electromagnet. As a result, only about 8% gave answers worthy of level three and a further 32% gave answers worthy of level two.

6.7.1.2 Magnetic fields

Answer 05 · Examiner comments November 2021 | 8464/P/2H | Original Q4

Question 4 (standard demand and standard/high demand)

04.1 33% of students knew that the field was strongest at the poles.

04.2 12% of students were able to correctly describe how the diagram showed that the field was not the same at all places. Many incorrect answers did not refer to ay feature of Figure 4.

04.3 40% of students gained 1 mark on this question. Most of them identified that the electromagnet could be easily demagnetised. A further 8% went on to say that this meant that the pieces of metal could be easily removed.

Some of the 40% that scored 1 mark scored the mark because they said that electromagnets are (generally) stronger.

04.4 20% of students could name one of the magnetic metals, and 20% of those students could name both the metals. Of those that could only name 1 magnetic metal, there was an approximately even number for each correct answer.

04.5 Approximately 35% of students scored one mark, nearly all of these suggested increasing the current. Only a handful of students also suggested moving the electromagnet closer and scored 2 marks.

04.6 This standard/high demand calculation was reasonably well answered. Nearly 40% scored 3 or 4 marks for a correct calculation, but either did not recall the unit, did not convert the length or did neither. 5% of students scored full marks.

04.7 30% of students scored at least 1 mark for getting at least 1 word correct and in the correct place. 10% were able to write the correct word in the correct place for each finger.

The majority of students that scored 0 marks wrote words that were not related to electromagnetism.

Answer 06 · Examiner comments June 2023 | 8464/P/2H | Original Q4

Question 4 (standard demand and standard/high demand)

04.1 Fewer than 20% of students correctly answered inertia.

04.2 Just over 50% of students gave the correct direction for the acceleration.

Answer 06 · Examiner comments June 2023 | 8464/P/2H | Original Q4

04.3 Approximately 50% of students gained one mark on this question. Most of those that did suggested increasing the current or the strength of the magnet. Very few went on to explain that this would increase the force on the copper rod.

04.4 Approximately 20% scored two marks on this question. Of the 20% that scored 1 mark, most suggested bringing both sides of the magnet close to the iron bar (or vice versa) but then incorrectly stated that any attraction proves it is a magnet.

04.5 Approximately 40% of students gained at least one mark on this question. Even the credit worthy responses mostly contained simple statements like 'it always points north'. Only a small percentage explained that this was because the magnet aligns itself with the Earth's magnetic field.

Answer 07 · Examiner comments June 2024 | 8464/P/2H | Original Q4

Question 4 (standard & standard/high demand)

04.1 A third of students were able to use Fleming's left-hand rule and give the correct direction.

04.2 The majority of students were able to access this calculation, with 80% gaining at least 2 marks and 13% full marks. 25% of students either did not know the unit or missed the conversion, so were limited to gaining 2 of the 3 marks available.

04.3 About two-thirds of students knew that the forces were an example of Newton's Third Law. The most common incorrect answer was Newton's First Law.

04.4 About a third of students gave two correct changes and a third of students one correct change. The most popular correct answer was to increase the current. Students should be encouraged to state that the number of turns *on the coil* should be increased, as 'increasing the number of coils' is ambiguous and would not gain the mark.

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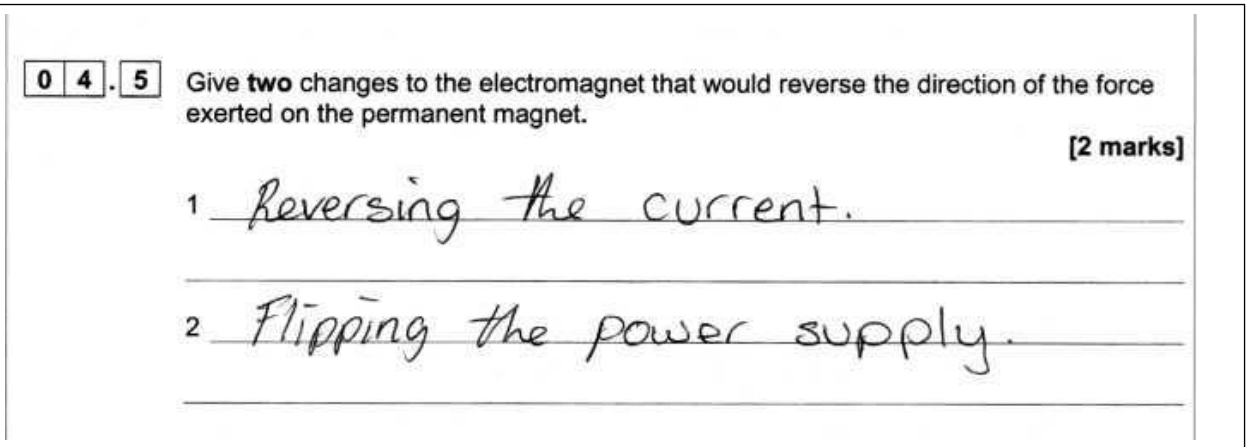
6.7.1.2 Magnetic fields

Answer 07 · Examiner comments June 2024 | 8464/P/2H | Original Q4

04.5 This question was more demanding than question 04.4 with less than 50% of students gaining a mark. 10% of students were able to give two changes that would reverse the direction of the force.



0 4 . 5 Give **two** changes to the electromagnet that would reverse the direction of the force exerted on the permanent magnet.

[2 marks]

1 Reversing the current.

2 Flipping the power supply.

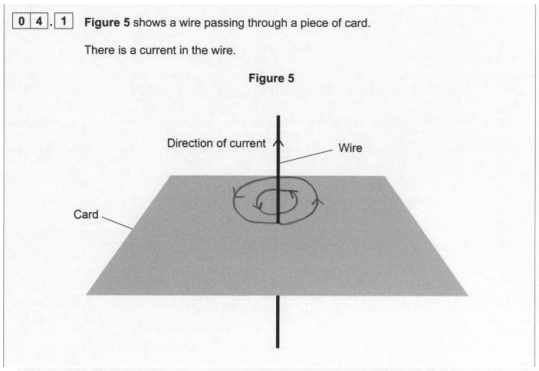
This example shows the most popular correct response, which was to reverse the direction of the current. The second answer would have gained the mark on its own because it will result in the current's direction reversing. However, both answers are the same marking point so only 1 mark is awarded.

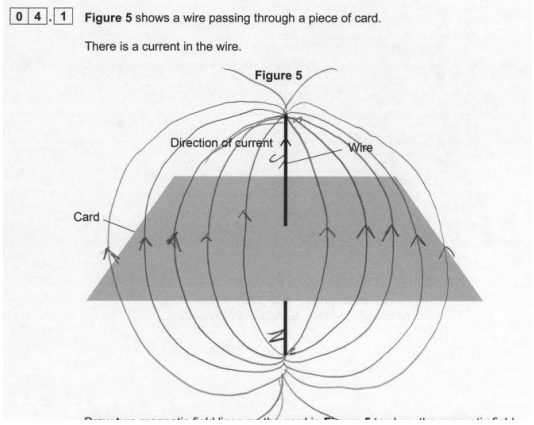
6.7.1.2 Magnetic fields

Answer 08 · Examiner comments June 2025 | 8464/P/2H | Original Q4

Question 4 (Standard, standard/high and high demand)

04.1 Surprisingly few students were able to draw the magnetic field pattern around a current-carrying wire, with only about 40% of students scoring any marks, and only about half of these gaining both marks. The marks were independent, and some students gained credit for giving the correct direction of the magnetic field without drawing 2 concentric rings. Students needed to draw both rings on the card, so that the bottom of each ring was between the lower edge of the drawing of the card and the point in the centre of the card where the wire emerged. Some students drew rings around the very top of the wire and the very bottom of the wire, which did not gain any credit. Common incorrect answers included drawing field lines connecting the wire below the card to the wire above the card, and drawing the field pattern for a bar magnet, with the top of the wire representing a north pole and the bottom of the wire representing a south pole.





Neither of these responses gained any credit. The top response shows a circular field pattern on the card behind the wire, with the field pointing to the right immediately behind the wire, which is incorrect.
The second response suggests that this student knows the field pattern for a bar magnet but is unfamiliar with the field pattern around a current-carrying wire.

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6.7.1.2 Magnetic fields

Answer 08 · Examiner comments June 2025 | 8464/P/2H | Original Q4

04.2 Very few students were able to recall the unit of magnetic flux density. Many used the equation $F = BIl$ to derive an equivalent unit in terms of newtons, metres and amps, but this was insufficient for the mark. It was relatively common for students to either make no attempt to convert mN to N, or to convert incorrectly. Almost 90% gained some credit on this question, with over 80% gaining at least 3 marks.

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6.7.1.2 Magnetic fields

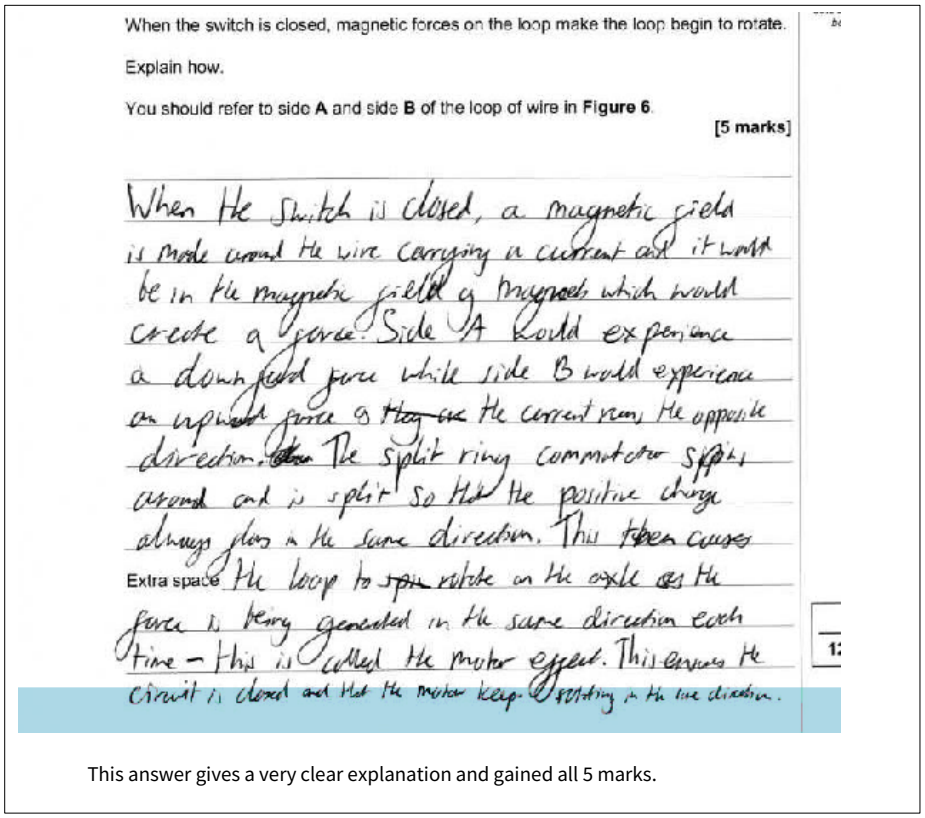
Answer 08 · Examiner comments June 2025 | 8464/P/2H | Original Q4

04.3 Students found it very difficult to explain how the loop begins to rotate. There were many misconceptions communicated, as well as many students who included in their answers explanations of why the loop continued to rotate once the plane of the coil became vertical. References to the commutator were ignored, as the question only asked for an explanation of why the rotation begins.

Misconceptions included ideas that:

- current is attracted or repelled by the north or south pole
- the current is in the axle
- the axle becomes a magnet
- side A has more current than side B, because the current comes from the positive side of the battery and reaches side A first
- side A is positively charged, and positive charge is attracted to the north pole of the magnet, and negative is repelled by the south pole
- the wires become induced magnets.

About a third of students managed to gain some credit on this question, but it was rare to see a full explanation given.


When the switch is closed, magnetic forces on the loop make the loop begin to rotate.

Explain how.

You should refer to side **A** and side **B** of the loop of wire in **Figure 6**.

[5 marks]

When the switch is closed, a magnetic field is made around the wire carrying a current and it would be in the magnetic field of magnets which would create a force. Side A would experience a downward force while side B would experience an upward force as the current runs the opposite direction. The split ring commutator splits around and is split so that the positive charge always flows in the same direction. This then causes the loop to spin/rotate on the axle as the force is being generated in the same direction each time - this is called the motor effect. This ensures the circuit is closed and that the motor keeps spinning in the same direction.

Extra space

This answer gives a very clear explanation and gained all 5 marks.

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