AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.7.1 PERMANENT AND INDUCED MAGNETISM, MAGNETIC FORCES AND FIELDS (PACK 1)

SCORE	PERCENTAGE
/113	%

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Q1.

(a) 1st box ticked

1

(b) (permanent magnet) has no effect on the aluminium

1

iron is attracted (to the permanent magnet)

1

(only) the (permanent) magnet can be repelled (by the permanent magnet)

1

(c) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to give a clear account.

5–6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

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

[10]

Q2.

(a) iron = 60 (g)
and
nickel = 6 (g)

both required for a mark

1

(b) 14 (g)

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*allow ecf from part **(a)***

1

bar drawn at 14 g

allow an incorrectly calculated value for mass of chromium correctly drawn

allow a tolerance of ± half a small square

1

(c) 600 (g)

*allow ecf from part **(a)***

1

(d) mixture of metals

allow a mixture of elements with at least one being a metal

1

(e) alloys are harder

allow alloys are stronger
allow alloys can be designed for specific purposes
allow alloys are corrosion resistant

ignore references to cost, reactivity

1

(f) cobalt

1

(g) permanent

1

(h) the magnetic field is strongest at the poles of the magnet

1

(i) **Level 2:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- make a dot at the tip of the compass needle
- move the compass tail to the new dot
- make a dot at the tip
- repeat until the compass reaches the other pole of the magnet
- draw a line through the dots
- add arrow to show direction of field line (from north to south)
- repeat for different starting positions at the poles

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[13]

Q3.

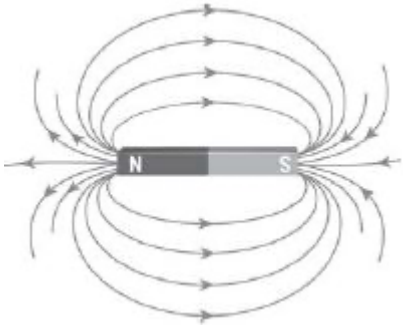
(a) continuous field lines that start and finish on the poles

1

direction of arrow from North to South

1

the diagram:



*scores **2** marks*

(b) **Level 2:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- place the magnet on a piece of paper
- draw around the magnet
- mark north and south poles
- place the compass by a pole of the magnet
- make a dot at the tip of the compass needle
- move the compass tail to the new dot
- make a dot at the tip
- repeat until the compass reaches the other pole of the magnet
- draw a line through the dots
- add arrow to show direction of field line (from north to south)
- repeat for different starting positions at the poles

(c) compass needle is a (small bar) magnet

1

(so) the compass / needle and bar magnet exert a force on each other

1

or

(so) the compass / needle is attracted / repelled by the bar magnet

(d) cobalt

1

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(e) (magnetic north / south) poles are changing position

allow reference to compass needle changing direction (over time)

1

direction of magnetic field has reversed

allow magnetic patterns in rocks (at constructive plate boundaries)

allow changing migration patterns of birds / animals

1

(f) (molten) iron moving

1

in (Earth's outer) core

1

[13]

Q4.

(a) correct plotting of all points

*allow **1** mark for three or four correctly plotted points*

allow ± ½ a square

2

line of best fit

1

(b) as (number of) turns increases, number of paperclips increases

allow positive correlation

1

(c) no paperclips would be picked up

1

(electro)magnet would not have been strong enough

or

magnetic field would not have been strong enough

1

(d) take repeat readings (1)

to allow a mean to be calculated (1)

allow to identify / exclude anomalies

allow to reduce the effect of random errors

allow to assess the repeatability of the data

or

extend range of data (1)

to see if pattern continues (1)

allow to identify / exclude anomalies

or

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use smaller intervals for number of turns (1)

to be able to see the pattern in the data more clearly (1)

allow to identify / exclude anomalies

or

use smaller paperclips (1)

to be able to detect smaller changes in strength of magnetic field **or** so fewer turns required to pick up one paperclip (1)

or

increase strength of electromagnet (1)

allow increase current

so fewer turns required to pick up one paperclip (1)

Max 2 marks

(e) the distance from the electromagnet

1

the size of the current through the wire

1

[10]

Q5.

(a) S – top, N – bottom

1

(b) touch / attracted to magnet **A**

1

(c) the magnetic needles point to the north pole

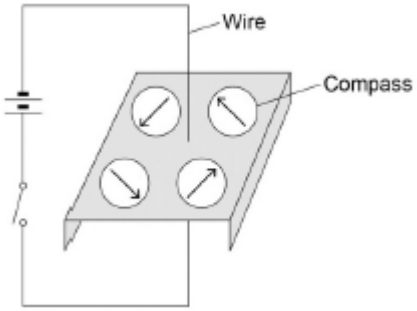
1

because The Earth has a magnetic field

1

*accept the needles align to the Earth's magnetic field for **2** marks*

(d)



1

(e) point in the opposite direction

change direction is insufficient

1

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(f) uniform field lines through the wire coil.

1

field lines curving round the top and bottom of the wire coil.

1

arrows indicating direction from N to S

*do **not** accept conflicting arrows*

1

[9]

Q6.

(a) thumb, index finger and third finger are held mutually at right angles

1

index finger shows the direction of the magnetic field from North to South, third finger
shows the direction of the current from positive to negative terminal

1

the thumb then shows the direction of the force acting on the copper rod

1

so the copper rod will move upwards

1

(b) any **one** from:

use a stronger magnet

increase the magnetic flux density

increase the length of the copper rod in the magnetic field

coil the copper rod

1

(c) $W = 9.8 \times 4 \times 10^{-4} = 3.92 \times 10^{-3}$

1

conversion of the length 7cm to 0.07m

1

$3.92 \times 10^{-3} = B \times 1.12 \times 0.07$

1

$B = 3.92 \times 10^{-3} / 0.0784$

1

B = 0.05 (T)

1

*allow 0.05 (T) without working shown for the **5** calculation marks*

[10]

Q7.

(a) The movement of liquid iron in the Earth's outer core

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1

(b) will attract

1

will repel

1

(c) **Level 2 (3–4 marks):**
A detailed explanation is provided that includes a coherent comparison of the properties
of the types of magnet and presents a clear argument to support the use of electromagnets. Logical links are made between relevant points and use in a scrapyard

Level 1 (1–2 marks):
Relevant points made about the properties of the magnets. An attempt at comparison
may be made, but logic is unclear and unstructured and links to use in scrapyard may
not be present

0 marks:
No relevant content.

Allow steel or iron for car body throughout

Indicative content

- an electromagnet can be switched on and off
- so it can be used to lift a car body
- and release a car body
- so it can easily be used to move car bodies from one place to another in the scrapyard
- a permanent magnet cannot be switched off to release a car body
- so would not be as useful in the scrapyard
- the strength of the magnetic field of an electromagnet can be varied
- so an electromagnet can lift different masses
- so can deal with different vehicles
- but the strength of the magnetic field of a permanent magnet cannot be varied or is fixed
- so a permanent magnet can only lift up to a certain mass

4

[7]

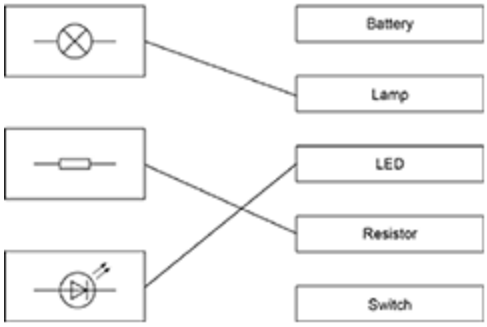
Q8.

(a) electrons

1

(b)

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extra lines from a symbol negate the mark

3

(c) the total power = 7360 watts

1

current = 7360 ÷ 230

1

= 32 A

*allow 32 with no working shown for **3** marks*

1

so the current is greater than 30 A

1

(d) to increase the voltage (across the cables) or to decrease the current (through the cables)

1

reducing energy losses (in the cables)

*do **not** allow electricity for energy*

*do **not** allow no energy loss*

1

increasing the efficiency of transmission

1

(e) to decrease the potential difference for domestic use

1

(f) $efficiency = \frac{useful\ output\ energy\ transfer}{total\ input\ energy\ transfer}$

1

(g) 405 / 900

1

=0.45

accept 45%

1

*allow 0.45 **or** 45% with no working shown for **2** marks*

[15]

Q9.

(a) Fe_2O_3 + 3 CO → 2Fe + 3 CO_2

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correct formulae of reactants

1

correct formulae of products

1

correct balancing

1

(b) iron loses oxygen – reduction

1

carbon gains oxygen – oxidation

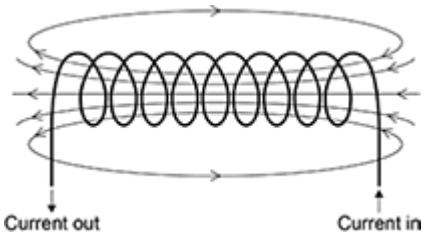
1

(c) any **four** from:

- resources for manufacture are limited
- recycling reduces the use of resources
- reduces energy consumption in extraction / manufacture
- reduces waste from processing and extraction
- reduces environmental impact of extraction

4

(d)



field lines going through and around coil

1

correct directional arrows

1

(e) any **two** from:

***1** mark for suggestion, **1** mark for correctly linked explanation*

- use many coils **or** tight coils **or** long wire (1)
- to give a strong magnetic field for lifting heavy objects (1)

explanation must be correctly linked to the suggestion to gain the mark

or

- add an iron core
- to increase field circuit for lifting

or

- include a switch in circuit
- so can drop / pick up cars

max. 4

[15]

Q10.

(a) Cobalt

1

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Nickel

1

(b) **Either**

- put iron filings

1

- on a piece of paper

1

- over the magnet

1

or

- use (plotting) compass(es) (1)
- around the magnet (1)
- with the needle showing the direction (1)

(c) all points plotted correctly

*2 points plotted correctly for **1** mark*

2

correctly drawn line of best fit

allow ecf from incorrectly drawn points

1

(d) as the number of turns increases so does the amount of paper clips picked up

1

linear / directly proportional

allow doubling the number of turns doubles the number of paper clips picked up

1

(e) 32

allow number correctly extrapolated from student's graph

1

[11]

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Q1.

Foundation

(a) Only 38% scored this mark. The most common incorrect response was where the direction of the magnetic field lines ran from south to north, although a number of students selected the third and fourth options.

(b) This question was not well understood, because 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 was 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.

A significant number of students believed the attractive force varied in strength between the two blocks. Others referred to the colour / shade or weight of the block.

As a result, 60% scored zero for this question, and only 4% scored full marks. 16% did not attempt this question.

(c) There were many very vague responses to this question, with few inclusions of the level of detail expected. Many students simply stated that the electromagnet could be switched on, moved to a different position and then switched off. There were few descriptions of how the electromagnet worked.

Many believed that the magnetic blocks were themselves magnets and talked about attraction and repulsion between the blocks and the electromagnet. As a result, only 2% gave answers worthy of level three and only a further 10% gave answers worthy of level two. 13% did not attempt this question with 28% scoring no marks.

Higher

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

(b) 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 all three marks.

(c) 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.

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Q2.

(a) 75% of students were able to determine the correct values for the mass of iron and the mass of nickel from the bar chart.

(b) A significant number of students were unable to use the values calculated in part **(a)** to determine the mass of chromium. 16% of students did not attempt this question. Often the values obtained were above the total mass of the alloy which was 80 g. Students who determined a value that was suitable in size for the bar chart were then usually able to correctly plot the value (40% of students).

(c) The higher-attaining students were able to calculate correctly the mass of iron present in 0.80 g of the alloy. The conversion factor was not well known and students often attempted to calculate the mass of the alloy rather than iron.

(d) 21% of students could correctly give the definition of an alloy. Students often referred to a combination or joining together of metals or just mentioned metals but made no mention of mixing. To make a new metal was also a phrase seen quite frequently.

A significant number of students thought that an alloy was something that was fixed to the wheel of a car.

(e) 18% of students could provide an acceptable reason why alloys are used. A variety of alternative responses were given, most commonly in terms of cost.

(f) Almost as many students thought copper was a magnetic metal as knew that cobalt was.

(g) 50% of students knew that bar magnets are permanent magnets, though induced was a very common distractor.

(h) This was well answered with 69% of students knowing that the magnetic field is strongest at the poles of a magnet.

(i) This is a practical method that appears in the specification but many students demonstrated little knowledge of the process, despite being given a prompt as to how the method started. In this 'extended response' question marks obtained were generally for a description of how to mark the direction of the compass needle. 2% of students were able to go further than this and give a method with a valid outcome and hence accessing level 2 of the mark scheme.

32% of students made no attempt to answer the question. And of those who did make an attempt, it was often describing a method using iron filings to see a pattern or describing the pattern that was drawn for part **(h)**.

A significant number of students referred to the compass when they meant the bar magnet, and vice versa. Others thought that a compass meant a pair of mathematical compasses and consequently were using the compasses to draw curved lines and semicircles around the bar magnet.

Q3.

(a) Those students who could recall the shape did so well, if somewhat untidily, and some of these were also able to add the correct field direction. Many students were unable to recall the shape and drew 'butterfly like' diagrams. Although some were able to show the direction of the field lines, others had North to South at the top, then South to North at the bottom.

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(b) This is a practical method that appears in the specification but many students demonstrated little knowledge of the process and 15% of students didn't attempt it. A significant number referred to the use of iron filings or mathematical compasses in their answer. The idea of marking the position of the needle tip and the moving the compass to that point was rarely referred to.

This was an 'extended response' question which used a 'level of response' mark scheme. To get into level 2 it was expected that a method for sensibly moving around the magnet and for seeing the pattern was given. 10% of students managed to do this. However those who knew what to do often did not fully express their ideas.

(c) Few students realised that compasses were magnets themselves, with many responses stating that there would be an interaction with the bar magnet because the needle is metal, rather than a magnet or magnetic. However more students were able to explain the attraction between magnet and compass. 14% of students achieved full marks.

(d) The correct answer was the most popular response (35%). But almost as many gave their response as steel, not appreciating that steel although magnetic is not an element.

(e) This question was not answered well with 3% of students achieving two marks. Students appeared to have little knowledge of this area of the specification and instead used knowledge from other areas, notably global warming and climate change, or ideas such as the Earth tilting to attempt to explain the changing poles. The most commonly seen correct responses were: the idea that the compass needle changes direction over time, or the change in migratory patterns of birds.

(f) 7% of students received any credit for this question that was also not answered well. Again, students appeared to have little knowledge of this area of the specification and instead used knowledge from other areas, notably global warming and climate change, or ideas such as the Earth tilting or solar flares.

Q4.

(a) Most students were able to plot the points correctly, gaining two marks. Although a few drew a dot-to-dot line, the majority attempted a line of best fit. Unfortunately, not all were in the correct place − the most common error was to draw a straight line through the first, third and fifth points, leaving the second and fourth points below the line. Around 86% of students gained two or three marks. A small minority drew a bar chart rather than a line graph, which scored no marks.

(b) Approximately 8% of students did not attempt this question. Two thirds of students were able to state a correct relationship. Students who did not gain the mark tended to use imprecise phrases such as 'the higher the electromagnet' or 'the bigger the size of the paper clips'.

(c) Approximately 10% of students did not attempt this question. Many students realised that with five turns of wire, no paper clips would be picked up, but fewer were able to give a reason. The most common reason given was along the lines of 'it took 10 turns to pick up one', rather than a reference to the strength of the electromagnet.

(d) Around 85% of students attempted this question. In general, students found suggesting improvements challenging, with fewer than 4% gaining both marks.

Those who described a correct improvement were able to gain one mark but were

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frequently unable to give a valid reason for the improvement − ‘make it more accurate’ or ‘make it a fair test’ were common reasons which were not credited. The most popular correct responses were to repeat the experiment and to go up in increments of 5 turns of wire.

A common error was to think that increasing the number of turns in regular increments such as ten turns at a time would be an improvement as it would make it a fair test.

Some students described how they could extend the investigation, rather than improve it, for example trying different metals instead of the iron nail or repeating with the nail at different distances from the paper clips.

(e) More than half of students gained at least one mark, with around one quarter scoring both marks. All the options were chosen, with a fair number of students thinking that the colour of the insulation around the wire would affect the strength of the magnetic field around the electromagnet. Despite the instruction being to tick two boxes, around 10% of students ticked only one box.

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