AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.7.2 THE MOTOR EFFECT (PACK 2)

SCORE	PERCENTAGE
/72	%

STEMUP

These questions belong to AQA, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by AQA. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with AQA and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. AQA has not endorsed, approved or been involved in the production of it. AQA and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

AQA publishes its past papers, mark schemes and examiner reports. Always check the current specification at aqa.org.uk before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

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) place thumb and first two fingers (of left hand) at right angles to each other

1

first / index finger indicates (direction of) magnetic field

allow forefinger for first/index finger
*do **not** accept electric field*

1

STEMUP.CO.UK

second / middle finger indicates (direction of) current

1

thumb (then) shows (direction of) force

allow motion / thrust

1

*a clearly labelled diagram can score up to **4** marks*

(b) there is a downwards force on the magnets

1

(because when there is a current in the wire) there is a magnetic field around the wire

1

which interacts with the magnetic field of the (permanent) magnets

1

(c) $0.00214 = B \times 0.32 \times 0.048$

this mark may be awarded if F is incorrectly / not converted

1

$$B = \frac{0.00214}{0.32 \times 0.048}$$

this mark may be awarded if F is incorrectly / not converted

1

0.1393 (T)

*an answer that rounds to 0.14 (T) scores **3** marks*

1

0.14 (T)

allow answer consistent with their incorrectly / not converted F to 2 significant figures
allow an answer from an incorrect calculation to 2 significant figures

1

*an answer of 0.14 (T) scores **4** marks*

*an answer of 140 scores **3** marks*

[11]

Q3.

(a) the direction of the magnetic field

1

(b) decreases

1

(c) the distance between the field lines

*allow the closer the lines the stronger the field for **2** marks*

1

is smaller where the field is stronger

STEMUP.CO.UK

*allow where the lines are close the field is strong for **1** mark*

1

(d) straight line drawn within 1 mm of all points on the graph

1

(e) 1.3 – 0.9

1

0.4 arbitrary units

1

(f) increase the current through the solenoid

*if more than 2 boxes are ticked deduct **1** mark for each extra box ticked*

1

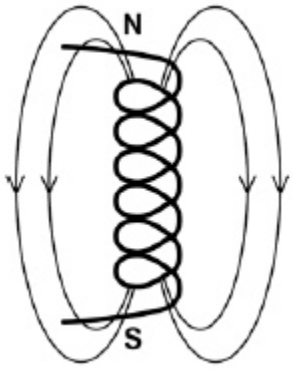
increase the potential difference across the solenoid

1

(g) at least one field line on each side of the solenoid

1

an arrow to indicate the field going from North to South pole



1

(h) add an <u>iron</u> core

allow a description of this, eg wrap the wire around an <u>iron</u> nail

adding a core is insufficient

1

[12]

Q4.

(a) the current creates a magnetic field in the wire

1

which interacts with the magnetic field from the permanent magnet

1

Flemming's left hand rule says the force on the wire is upwards

1

so the force on the permanent magnets is downwards

1

STEMUP.CO.UK

(b) x-axis labelled current **and**
y-axis labelled (magnetic) force
ignore units on labels

1

straight line through the origin

1

(c) $W = mg = 1.2 \times 10^{-3} \times 9.8$

1

$W = 0.01176$

1

$0.01176 = B \times 0.80 \times 4.8 \times 10^{-2}$

1

$$B = \frac{1.2 \times 10^{-3} \times 9.8}{0.8 \times 4.8 \times 10^{-2}}$$

1

$B = 0.31$
*an answer of 0.031 scores **3** marks*
*an answer of 0.31 scores **5** marks*

1

[11]

Q5.

(a) velocity is a vector (so has both magnitude and direction)

1

direction is changing (and so velocity is changing)

1

if velocity is changing, there is an acceleration

1

(b) as radius increases, force required decreases
allow converse statements for all marking points

1

as speed increases, force required increases

1

at greater speeds, change in force for same change in speed is greater
allow force proportional to square of speed

1

(c) a conductor carrying a current in magnetic field has a force exerted on it (by the motor effect)

1

(so) force on opposite sides in opposite directions (so the coil turns)
allow current in opposite directions

1

as coil turns, commutator reverses direction of current relative to coil (so rotation

STEMUP.CO.UK

can continue)

allow current / force directions in terms of arrows on the diagram (force directions do not have to be correct from Fleming's LHR to illustrate the point)

1

[9]

Q6.

(a) S – top, N – bottom

1

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

1

(c) the magnetic needles point to the north pole

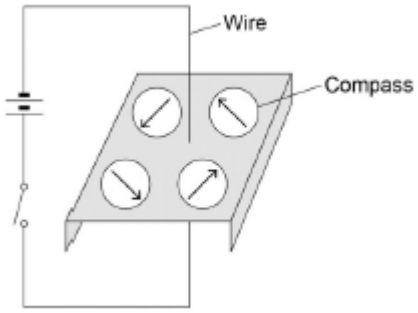
1

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

(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]

Q7.

(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

STEMUP.CO.UK

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]

STEMUP.CO.UK

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.

STEMUP.CO.UK

Q2.

(a) Many students did not seem to be familiar with Fleming's Left Hand Rule. Just under half of students scored no marks. Many students re-phrased the question or wrote something irrelevant.

Those students who showed some knowledge of the rule were often unable to link the correct digit with the correct quantity.

Many either omitted the fact that the thumb, first finger and second fingers needed to be at right angles to each other, or attempted to describe the orientation of the digits in terms of up / down, out / in or left / right.

Nevertheless, about 10% of students achieved three or four marks.

(b) Three quarters scored no marks. A very small percentage gained all three marks.

The majority did not think to link this question with the previous one relating to the motor effect and came up with some creative ideas as to why the balance reading should increase. Common answers were that the weight of the magnets would increase, or gravity would become stronger, or the current has mass.

(c) Students seem to be more willing to tackle calculations than written answers, with around 94% of students attempting this question. Although only around 4% gained the full four marks, a further one third scored three marks, being able to select the correct equation and to manipulate it successfully.

The main error was in not converting the force from mN to N, or incorrectly converting it − many seem to think that 1mN = 1000 N. A substantial number of students had taken note of the requirement to give their answer to two significant figures. Unfortunately, some did not do this correctly.

STEMUP.CO.UK