Magnetism 2

Name: _____

Class: _____

Date: _____

Time: **63 minutes**

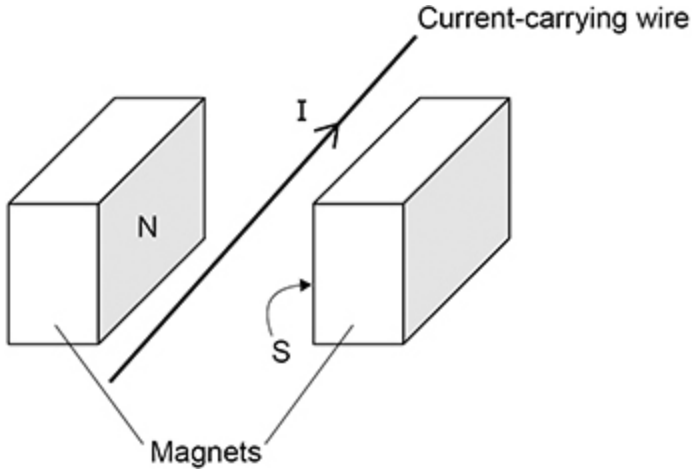
Marks: **57 marks**

Comments:

1. A teacher demonstrated the motor effect.

Figure 1 shows the equipment used.

Figure 1



(a) Explain why there is a force on the wire when there is a current in the wire.

_____

_____

_____

_____

(2)

(b) Explain how the direction of the force on the wire can be predicted.

_____

_____

_____

_____

_____

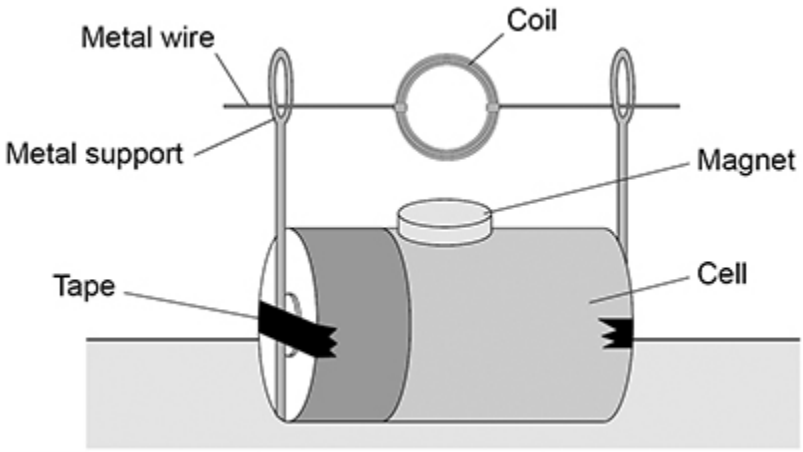
_____

_____

(3)

(c) **Figure 2** shows a simple electric motor.

Figure 2



Explain **one** way that the motor could be changed to increase the rate at which the coil rotates.

_____

_____

_____

_____

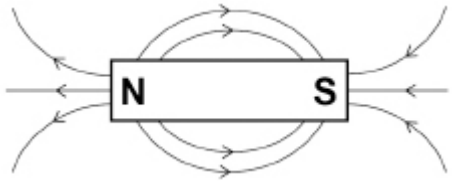
(2)

(Total 7 marks)

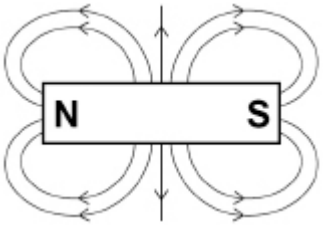
2. Magnets attract some metals.

(a) Which diagram shows the correct magnetic field pattern for a bar magnet?

Tick (✓) **one** box.



☐



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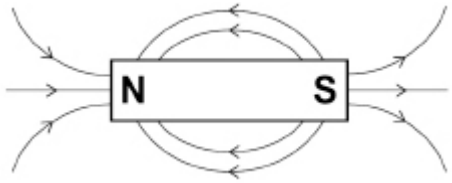

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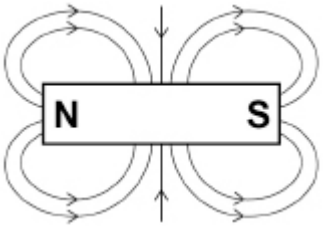


☐

(1)

Figure 1 shows an iron bar near a permanent magnet.

Figure 1

The iron bar becomes an induced magnet.

(b) Label the poles on the iron bar.

(1)

(c) The magnet is turned around so that the north pole is closest to the iron bar.

Which statement about the iron bar is true?

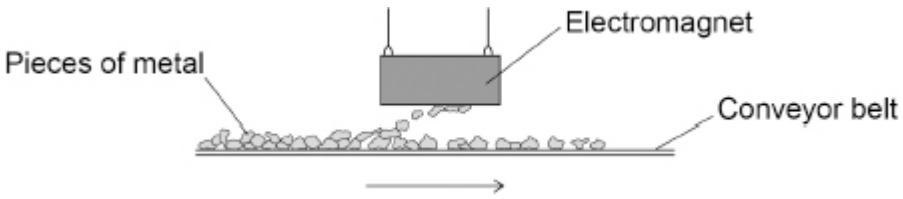
Tick (✓) **one** box.

The iron bar does not experience a magnetic force.	☐
The iron bar experiences a magnetic force of attraction.	☐
The iron bar experiences a magnetic force of repulsion.	☐

(1)

Figure 2 shows an electromagnet being used to separate pieces of different types of metal on a conveyor belt.

Figure 2



(d) Which **two** of the following types of metal would be attracted to the electromagnet?

Tick (✓) **two** boxes.

Aluminium	☐
Copper	☐
Magnesium	☐
Nickel	☐
Steel	☐

(2)

(e) What is an advantage of using an electromagnet instead of a permanent magnet to separate the types of metal?

Tick (✓) **one** box.

An electromagnet attracts more types of metal than a permanent magnet. ☐

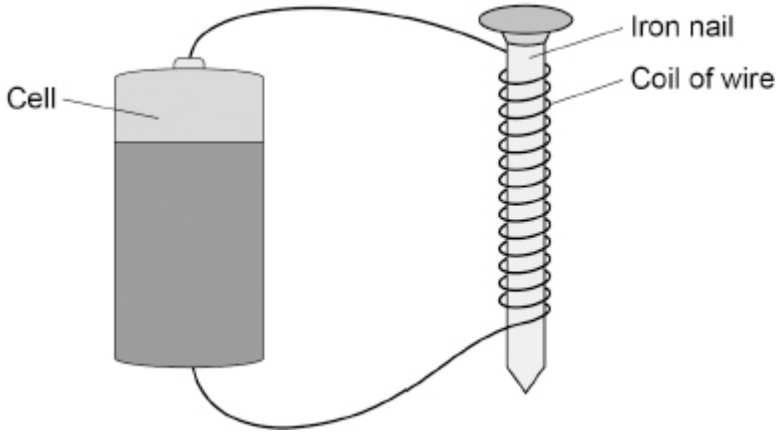
An electromagnet can be switched on and off. ☐

An electromagnet transfers less energy than a permanent magnet. ☐

(1)

Figure 3 shows a simple electromagnet.

Figure 3



(f) What is the purpose of the iron nail inside the coil of wire?

Tick (✓) **one** box.

The iron nail makes the magnetic field stronger. ☐

The iron nail reduces the magnetic field to zero. ☐

The iron nail reverses the magnetic field. ☐

(1)

(g) Which of the following would increase the strength of the electromagnet?

Tick (✓) **one** box.

Use a greater current. ☐

Use a shorter nail. ☐

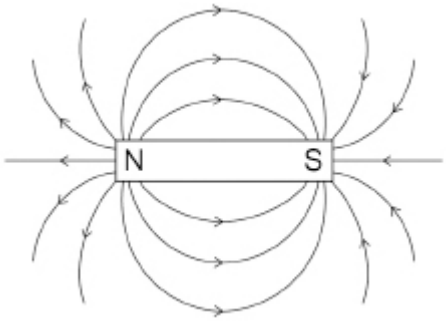
Use a thinner wire. ☐

(1)

(Total 8 marks)

3. **Figure 1** shows the magnetic field pattern around a permanent magnet.

Figure 1



(a) Where is the magnetic field of the magnet the strongest?

_____

_____

(1)

(b) How does **Figure 1** show that the strength of the magnetic field is not the same at all places?

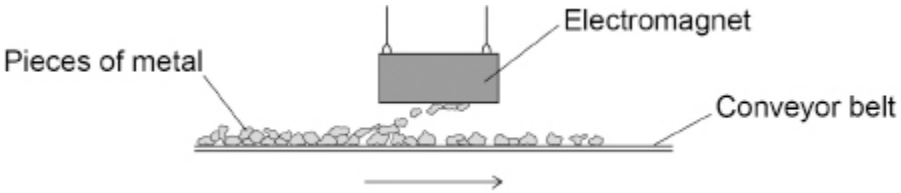
_____

_____

(1)

Figure 2 shows an electromagnet being used to separate iron and steel from non-magnetic metals.

Figure 2



(c) Explain **one** reason why an electromagnet is used instead of a permanent magnet.

_____

_____

_____

_____

(2)

(d) Pieces of iron and steel are attracted to the electromagnet.

Name **two** other metals that would be attracted to the electromagnet.

1 _____

2 _____

(2)

(e) The design of the electromagnet **cannot** be changed.

Give **two** ways the force exerted by the electromagnet on a piece of iron or steel could be increased.

1 _____

_____

2 _____

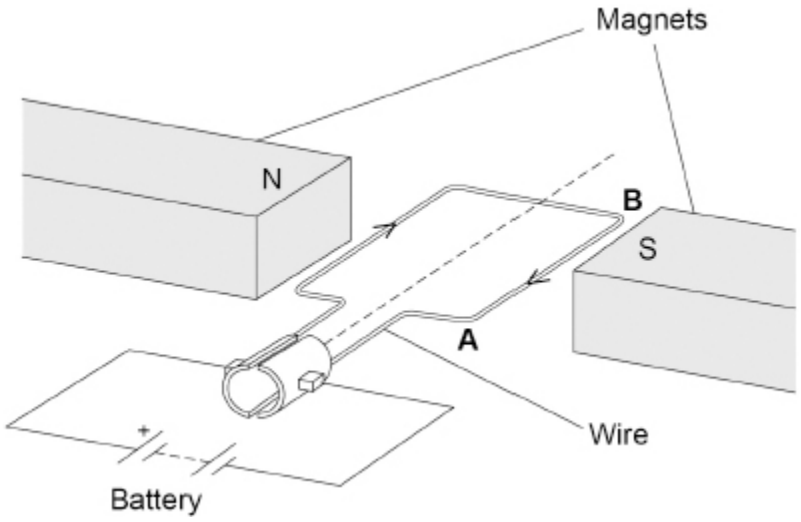
_____

(2)

The conveyor belt that moves the pieces of metal is driven by an electric motor.

Figure 3 shows a simple electric motor.

Figure 3



(f) The length of the wire **AB** in the magnetic field is 120 mm.

There is a current of 4.0 A in the wire. The length of wire **AB** experiences a force of 0.36 N.

Calculate the magnetic flux density between the magnets.

Give the unit.

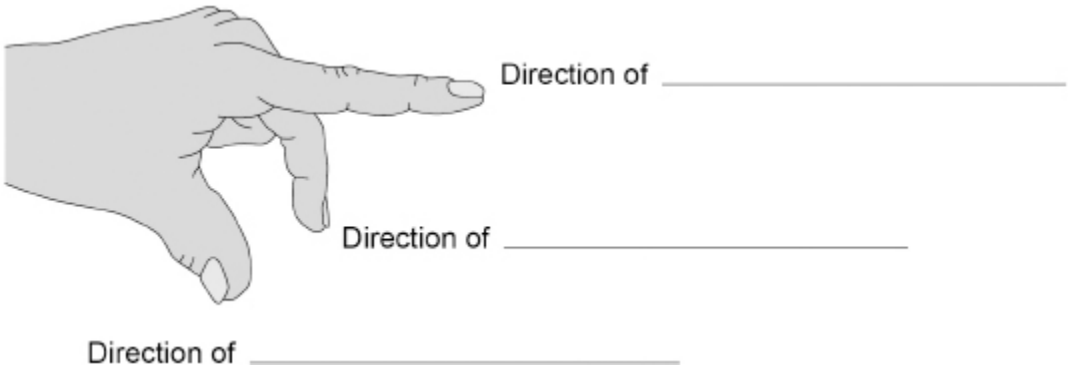
Magnetic flux density = _____ Unit _____

(5)

(g) Fleming's left-hand rule can be used to determine the direction of the force on wire **AB**.

Complete the labels on **Figure 4** to show Fleming's left-hand rule.

Figure 4



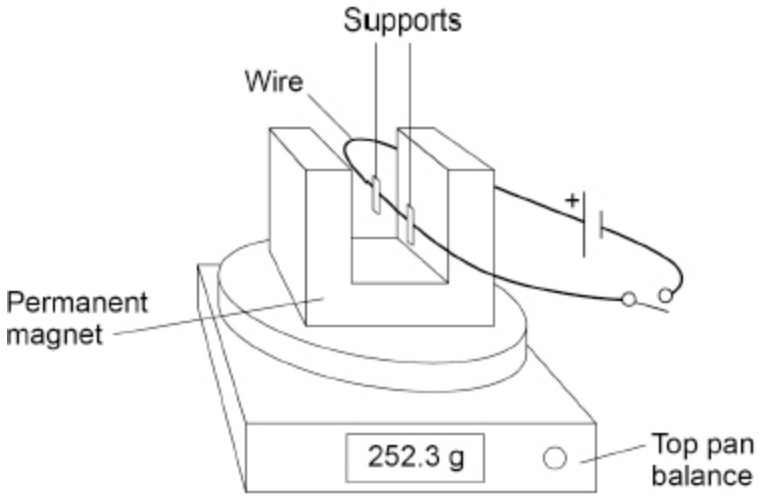
(2)

(Total 15 marks)

4. A student clamped a wire between the poles of a permanent magnet.

The student investigated how the force on the wire varied with the current in the wire.

The diagram below shows the equipment used.



The top pan balance was used to determine the force on the wire.

(a) When the switch was closed the reading on the top pan balance increased.

Explain why the increased reading showed that there was an upward force on the wire.

_____

_____

_____

_____

(2)

(b) The table below shows the readings on the top pan balance with the switch open and with the switch closed.

Switch	**Mass in grams**
Open	252.3
Closed	254.8

Explain how the values in the table above can be used to determine the size of the force on the wire.

_____

_____

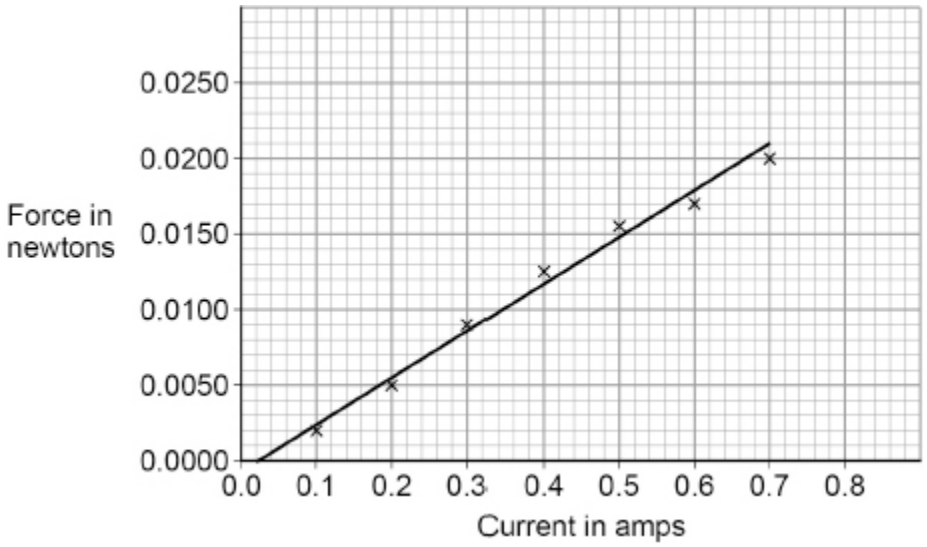
_____

_____

(2)

(c) The student varied the current in the wire and calculated the force acting on the wire.

The graph below shows the results.



The length of the wire in the magnetic field was 0.125 m

Determine the magnetic flux density.

Magnetic flux density = _____ T

(4)

(Total 8 marks)

5. Magnetic force is a non-contact force.

(a) Which **two** of these are also non-contact forces?

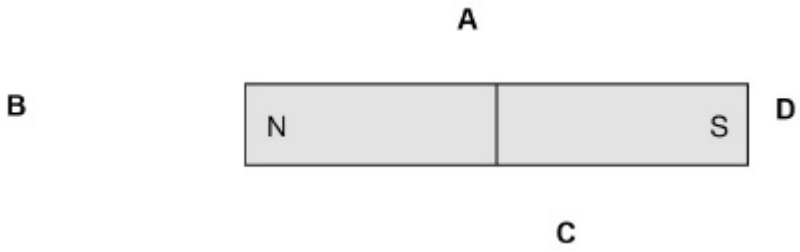
Tick (✓) **two** boxes.

- Air resistance ☐
- Electrostatic ☐
- Friction ☐
- Gravitational ☐
- Tension ☐

(2)

(b) **Figure 1** shows a bar magnet.

Figure 1



Which letter shows the position where the magnetic field around the bar magnet is strongest?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) When two magnets are brought close to each other they exert a force on each other.

Describe how two bar magnets can be used to demonstrate a force of attraction and a force of repulsion.

Force of attraction _____

_____

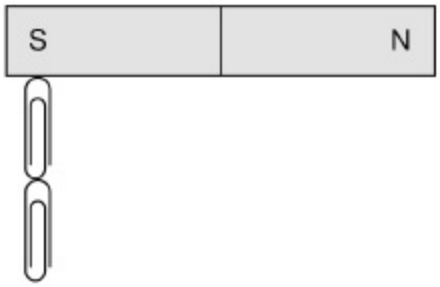
Force of repulsion _____

_____

(2)

Figure 2 shows some paper clips that are attracted to a permanent magnet.

Figure 2



(d) The paperclips become magnetised when they are close to the permanent magnet.

What is the name of this type of magnetism?

Tick (✓) **one** box.

Forced magnetism ☐

Induced magnetism ☐

Strong magnetism ☐

(1)

(e) Label the north and south poles of the two magnetised paper clips in **Figure 2**.

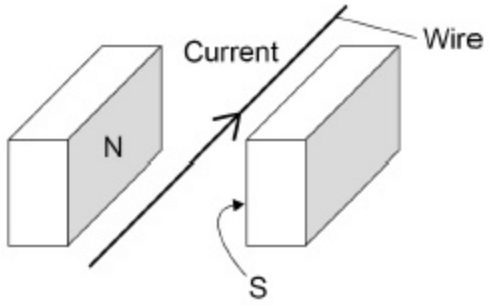
(2)

(Total 8 marks)

6. **Figure 1** shows a wire in a magnetic field.

The direction of the current in the wire is shown.

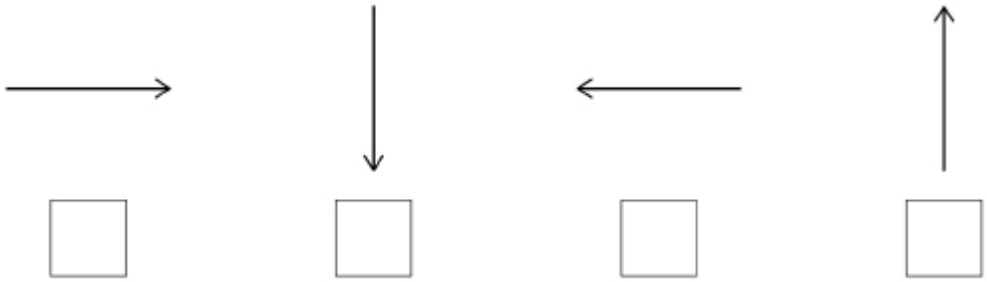
Figure 1



(a) There is a force on the wire due to the current in the magnetic field.

In which direction is the force on the wire?

Tick (✓) **one** box.



(1)

(b) Give **two** ways that the direction of the force on the wire could be reversed.

1 _____

2 _____

(2)

(c) The length of the wire in the magnetic field is 0.050 m

The force on the wire is 0.072 N

magnetic flux density = 360 mT

Calculate the current in the wire.

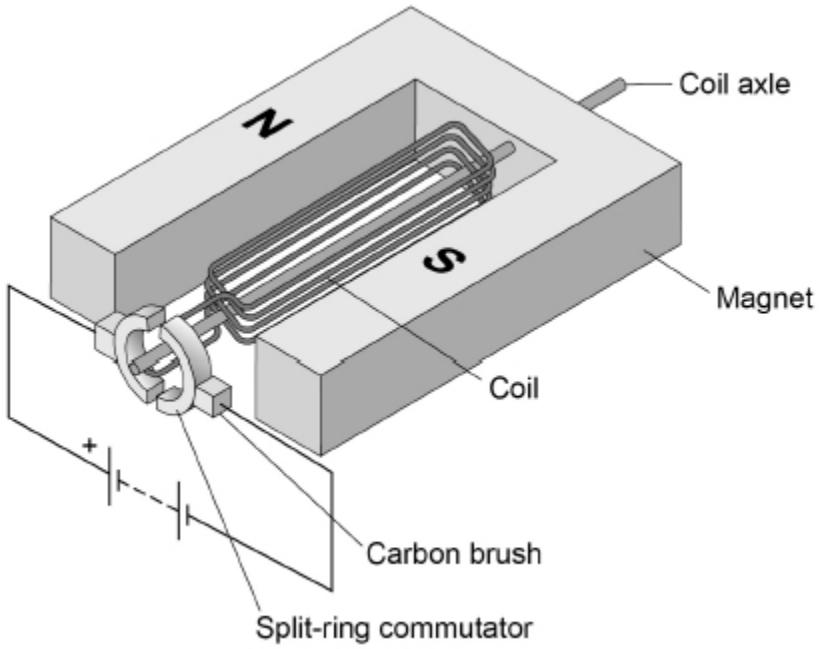
Use the Physics Equations Sheet.

Current = _____ A

(4)

(d) **Figure 2** shows a simple motor.

Figure 2



Explain why the coil rotates when there is a current in the coil.

(4)

(Total 11 marks)

1. (a) there is a magnetic field due to the (permanent) magnets

1

and the current in the wire produces a magnetic field

1

(b) use (Fleming's) left hand rule

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

1

place first finger in direction of the field lines **and** place second finger in direction of current

1

then thumb will show direction of the force

allow thumb points downwards

allow force is downwards

1

(c) any **one** from:

- more turns of the wire on the coil
- increase the current in the coil

allow use a cell with a greater potential difference

- stronger magnet

allow move the coil closer to the magnet

ignore bigger magnet

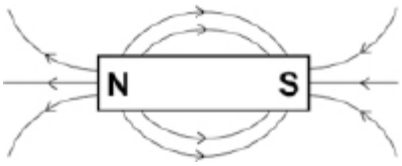
1

this will increase the force on the coil (due to the motor effect)

1

[7]

2. (a) first box ticked



1

(b)

1

(c) the iron bar experiences a magnetic force of attraction

1

(d) nickel

1

steel

1

(e) an electromagnet can be switched on and off

1

(f) the iron nail makes the magnetic field stronger

1

(g) use a greater current

1

[8]

3. (a) at the poles

1

(b) the distance between the field lines varies

1

(c) electromagnet is easy to demagnetise

allow electromagnet can be switched off

1

so easy to remove separated metal

*allow electromagnet is (generally) stronger than a permanent magnet for **1** mark if no other marks are awarded*

1

(d) cobalt

1

nickel

1

(e) increases the current in the coil of the electromagnet

allow increase potential difference across the coil

1

bring the electromagnet closer to the pieces of iron and steel

1

(f) L = 0.120 m

1

$0.36 = B \times 4.0 \times 0.120$

allow a correct substitution of an incorrectly / not converted value of L

1

$B = \frac{0.36}{(4.0 \times 0.120)}$

allow a correct rearrangement using an incorrectly / not converted value of L

1

B = 0.75

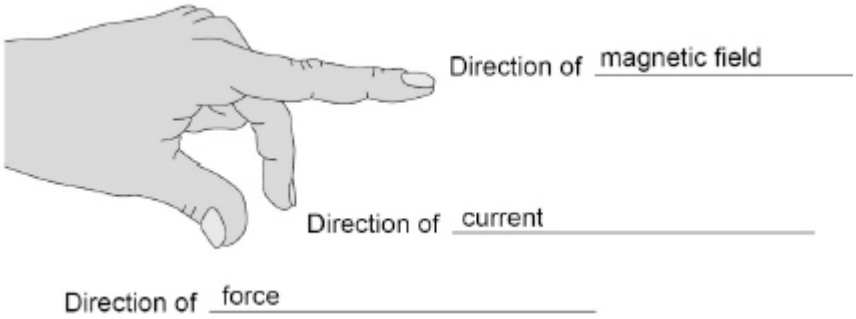
allow a correct calculation using an incorrectly / not converted value of L

1

T

1

(g)



allow **1** mark for 1 or 2 correct

2

[15]

4. (a) 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

therefore the wire must experience an equal and opposite force (which is upwards)

1

(b) calculate the difference between the two mass readings

allow 254.8 – 252.3 = 2.5

1

convert to kg **and** multiply by gravitational field strength

allow (2.5 / 1000) × 9.8 = 0.02375 (N)

1

(c) gradient = $\frac{(0.0210 - 0.0)}{(0.70 - 0.02)}$

1

gradient = 0.031

allow answer correctly given to any number of significant figures

1

0.031 = B × 0.125

allow correct substitution using correctly calculated value given to any number of significant figures

1

B = 0.25 T

allow answer correctly given to any number of significant figures

any rounding must be correct for subsequent marks to be awarded.

*max **2** marks if a pair of readings from the graph are used instead of gradient calculation*

1

[8]

5. (a) electrostatic

1

gravitational

1

(b) D

1

(c) bring two unlike poles close together

allow north and south poles

allow opposite poles

1

bring two like poles close together

allow two north / south poles

allow N for north and S for south

1

(d) induced magnetism

1

(e) all 4 poles correctly labelled north and south

allow N for north and S for south

allow 1 mark for 2 or 3 correctly labelled poles

2

[8]

6. (a)

1

(b) reverse the direction of the current

1

reverse the direction of the magnetic field

1

(c) *an answer of 4.0 (A) scores **4** marks*

B = 0.360 (T)

1

0.072 = 0.360 × I × 0.050

allow a correct substitution using an incorrectly / not converted value of B

1

$$I = \frac{0.072}{(0.360 \times 0.050)}$$

allow a correct rearrangement using an incorrectly / not converted value of B

1

I = 4.0 (A)

allow a correct calculation using an incorrectly / not converted value of B

1

(d) there is a magnetic field (due to the permanent magnet) **and** current in a wire causes a magnetic field

1

current is in opposite directions in each side of the coil

1

so forces act in opposite directions on either side of the coil

1

(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

[11]