

Magnetism 1

Name: _____

Class: _____

Date: _____

Time: **62 minutes**

Marks: **56 marks**

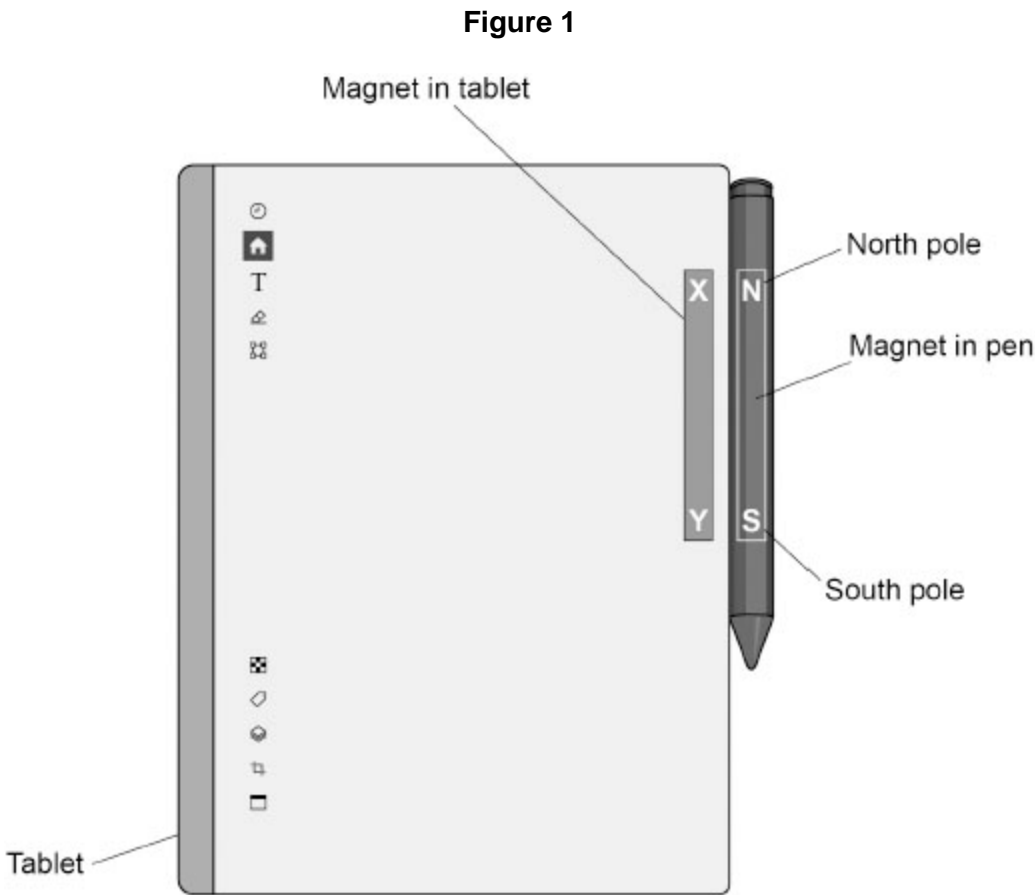
Comments:

1.

A student uses a special pen to write notes on an electronic tablet.

There is a bar magnet inside the pen and a bar magnet inside the tablet.

Figure 1 shows the pen and tablet being held together by the magnets.



(a) The bar magnets in the tablet and pen attract each other.

What name is given to pole X and to pole Y in Figure 1?

Give the reason for your answer.

Pole X _____

Pole Y _____

Reason _____

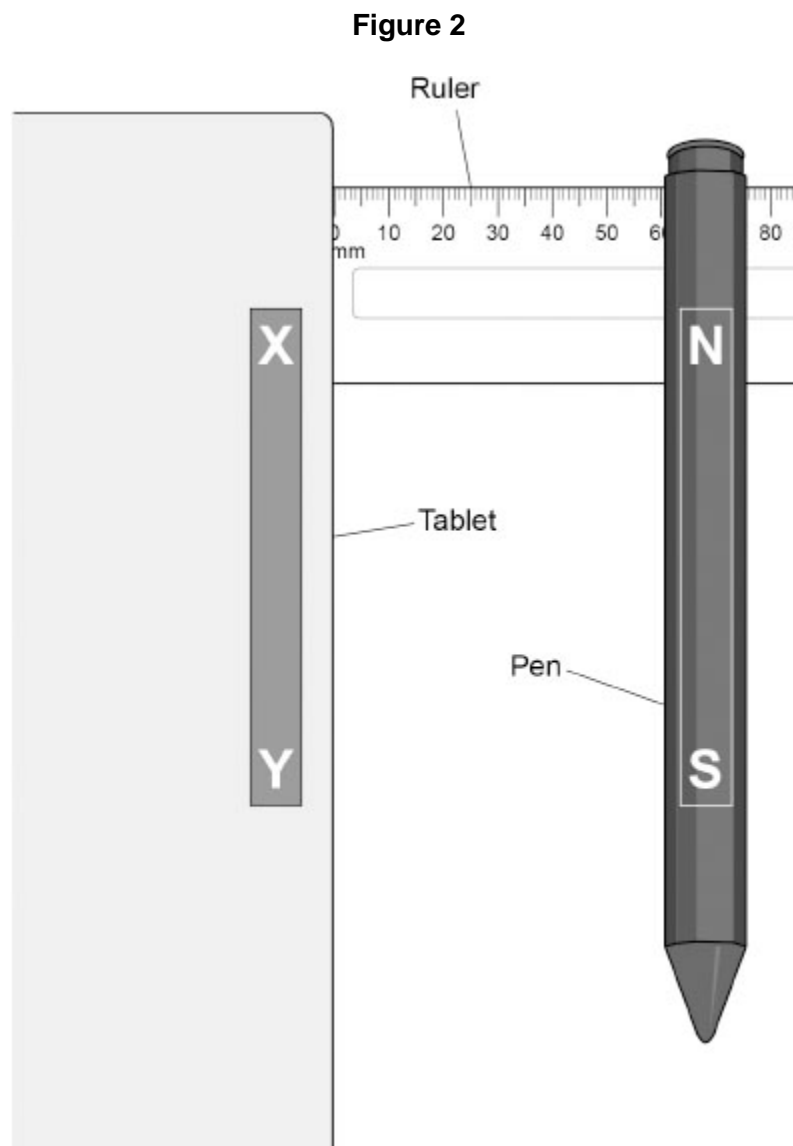
(2)

A student investigated the maximum distance from where the pen moves back to the tablet.

This is the method used.

1. Place the edge of the tablet at 0 cm on a ruler.
2. Place the pen 0.5 cm away from the tablet.
3. Release the pen.
4. If the pen moves to the tablet, repeat steps 2, 3 and 4 using a greater distance.
5. Record the greatest distance from where the pen moves back to the tablet.

Figure 2 shows the apparatus.



The student repeated the investigation.

The distances recorded by the student were:

4.0 cm 3.5 cm 4.0 cm 3.5 cm 4.5 cm

(b) What was the range of distances recorded by the student?

Range = from _____ to _____ cm

(1)

(c) Calculate the mean of the distances recorded by the student.

Mean distance = _____ cm

(2)

(d) Complete the sentence.

Choose the answer from the box.

| | | |
|----------------------|--------------------------|--------------------|
| random errors | systematic errors | zero errors |
|----------------------|--------------------------|--------------------|

Repeating and calculating a mean reduces the effect

of _____.

(1)

(e) Describe how the size of the magnetic force on the pen changed as the pen was moved away from the tablet.

(1)

(f) What material could the magnet in the pen be made of?

Tick (✓) **one** box.

Aluminium

Copper

Steel

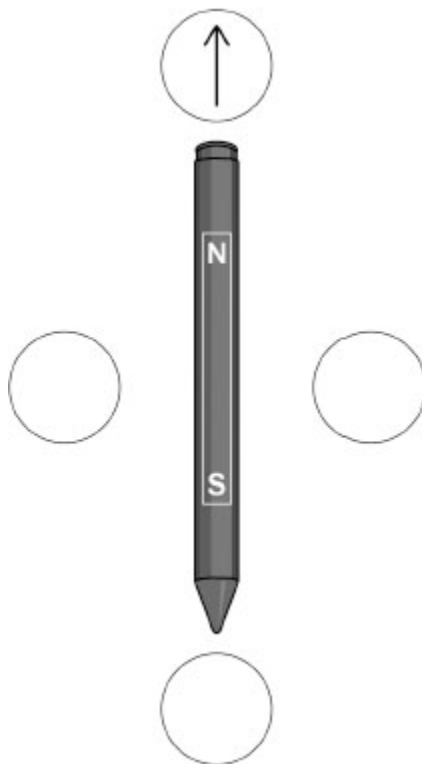
Zinc

(1)

- (g) The student used four plotting compasses to show the magnetic field pattern around the pen.

Figure 3 shows the pen and the outline of the plotting compasses.

Figure 3



Draw one arrow inside **each** compass on **Figure 3** to show which direction the compass needle points.

One arrow has been drawn for you.

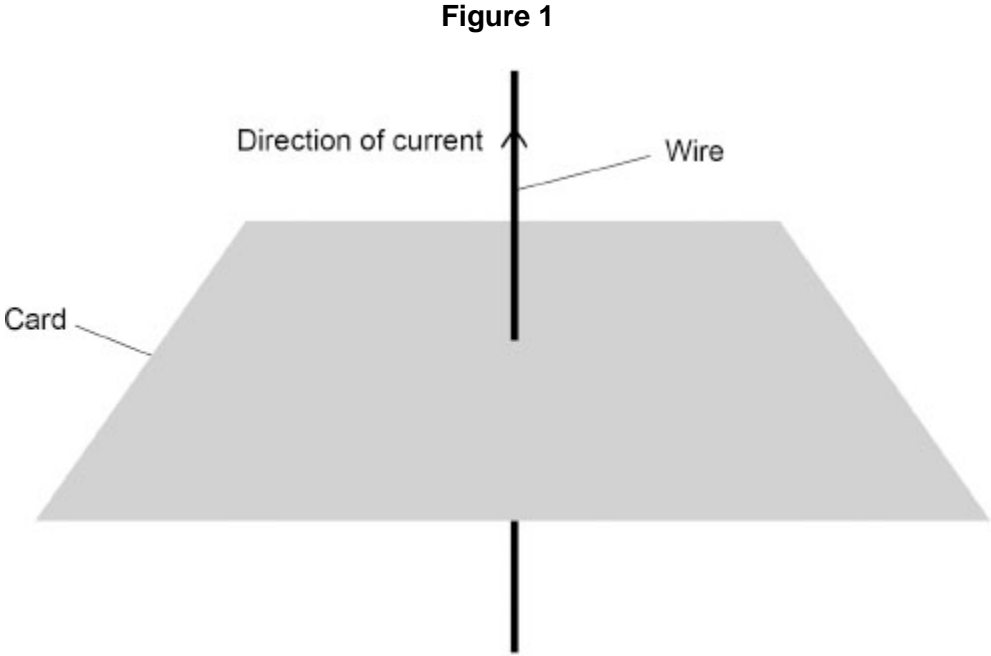
(2)
(Total 10 marks)

2.

When there is a current in a wire, there is a magnetic field around the wire.

(a) **Figure 1** shows a wire passing through a piece of card.

There is a current in the wire.



Draw **two** magnetic field lines on the card in **Figure 1** to show the magnetic field pattern around the wire.

(2)

(b) A student positioned a straight wire in the magnetic field between two magnets.

The wire was perpendicular to the magnetic field.

There was a current of 0.56 A in the wire.

The magnetic force on the wire was 2.1 mN.

The length of wire in the magnetic field was 0.050 m.

Calculate the magnetic flux density of the magnetic field between the magnets.

Use the Physics Equations Sheet.

Give the unit.

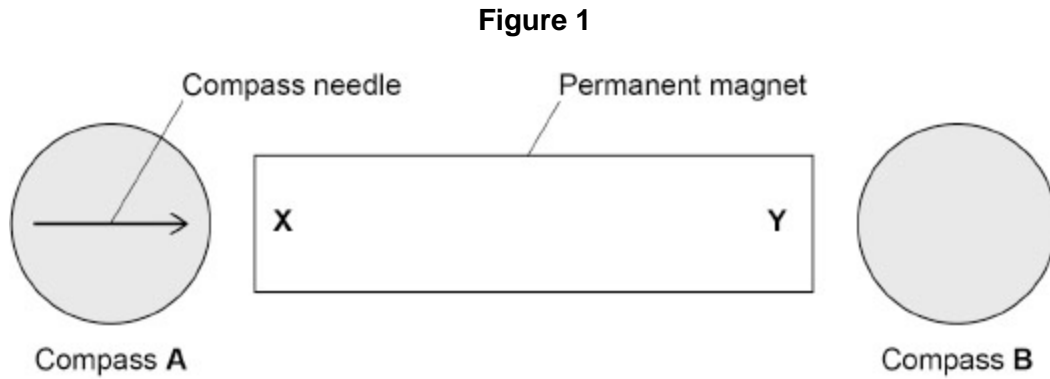
Magnetic flux density = _____ Unit _____

(5)

3.

Figure 1 shows a permanent magnet and two magnetic compasses.

The poles of the magnet are labelled **X** and **Y**.



(a) The direction of the compass needle in compass **A** is shown.

Give the names of the poles labelled **X** and **Y** in **Figure 1**.

X _____

Y _____

(2)

(b) Draw an arrow on compass **B** in **Figure 1** to show the direction of the magnetic field at that position.

(1)

Figure 2 shows security tags on some clothes in a shop.

Security tags can be detected if clothes are taken out of the shop with tags still attached.

Figure 2



The tags are attached to the clothes by pins made from a magnetic material.

A shop assistant can use a magnet to remove the pins.

(c) Which of the following are magnetic materials?

Tick (✓) **two** boxes.

Aluminium

Copper

Iron

Lead

Nickel

Tin

(2)

(d) Which of the following describes the force between a magnetic material and a magnet?

Tick (✓) **one** box.

The force is always attractive.

The force is always repulsive.

The force can be either attractive or repulsive.

(1)

(e) The shop assistant removes a security tag and drops the tag into a collecting bin.

As it falls, the tag accelerates at 9.8 m/s^2 .

The mass of the tag is 0.030 kg .

Calculate the resultant force acting on the tag.

Use the equation:

$$\text{resultant force} = \text{mass} \times \text{acceleration}$$

Resultant force = _____ N

(2)

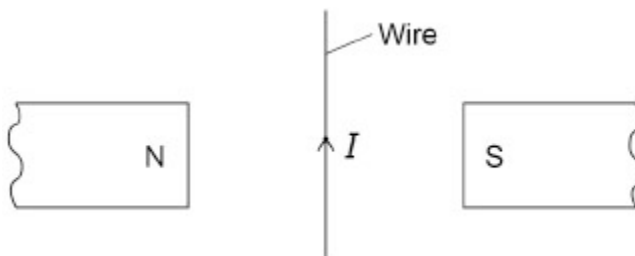
(Total 8 marks)

4.

Figure 1 shows two magnets and a wire.

There is a current in the wire.

Figure 1



(a) A force acts on the wire in **Figure 1**.

What is the direction of the force on the wire?

Tick (✓) **one** box.

- Into the page
- Out of the page
- To the left
- To the right

(1)

(b) The length of the wire in the magnetic field between the magnets is 80 mm.

The current in the wire is 4.6 A.

The force on the wire is 0.092 N.

Calculate the magnetic flux density between the magnets.

Use the Physics Equations Sheet.

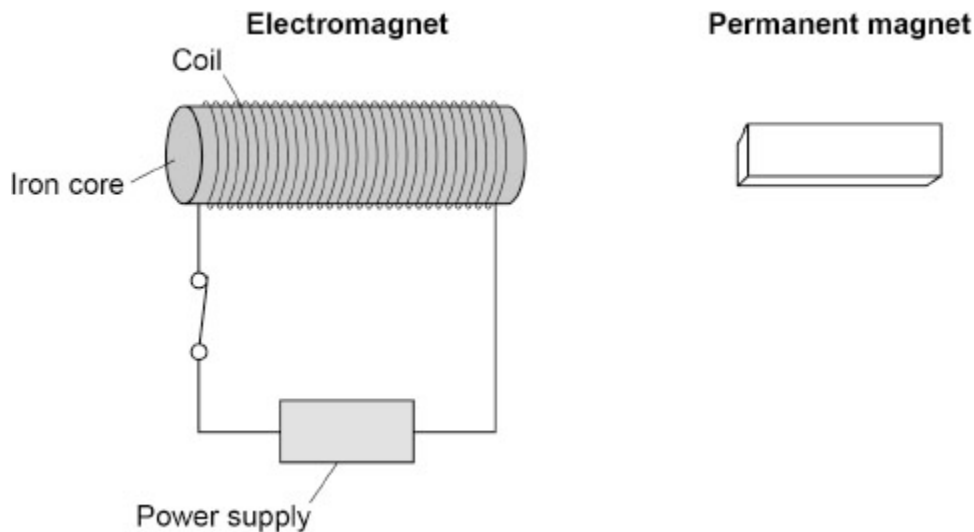
Give the unit.

Magnetic flux density = _____ Unit _____

(4)

Figure 2 shows an electromagnet close to a permanent magnet.

Figure 2



- (c) The electromagnet exerts a force on the permanent magnet.
The permanent magnet exerts an equal and opposite force on the electromagnet.

Which law is this an example of?

Tick (✓) **one** box.

Newton's first law

Newton's second law

Newton's third law

(1)

- (d) Give **two** changes to the electromagnet that would increase the force exerted on the permanent magnet.

1 _____

2 _____

(2)

- (e) Give **two** changes to the electromagnet that would reverse the direction of the force exerted on the permanent magnet.

1 _____

2 _____

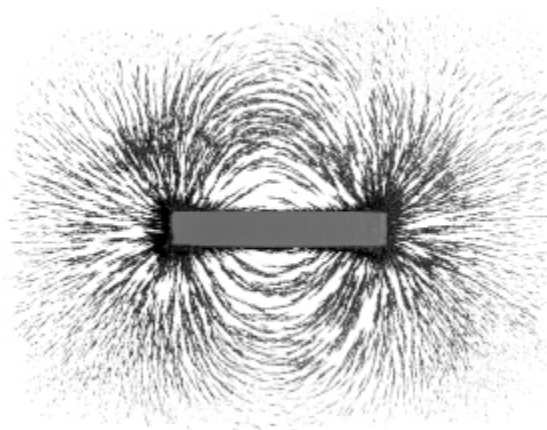
(2)

(Total 10 marks)

5.

Figure 1 shows iron filings sprinkled around a bar magnet.

Figure 1



- (a) Why are the iron filings attracted to the bar magnet?

Tick (✓) **one** box.

Iron is a metal.

Iron is charged.

Iron is heavy.

Iron is magnetic.

(1)

(b) **Figure 2** shows a bar magnet.

Draw magnetic field lines to show the magnetic field pattern around the bar magnet.

You should add arrows to the field lines to show the direction of the magnetic field.

Figure 2



(2)

(c) **Figure 3** shows two bar magnets.

Figure 3



The magnets attract each other.

What conclusion can be made about the two poles marked **X** and **Y**?

Tick (✓) **one** box.

They are both north poles.

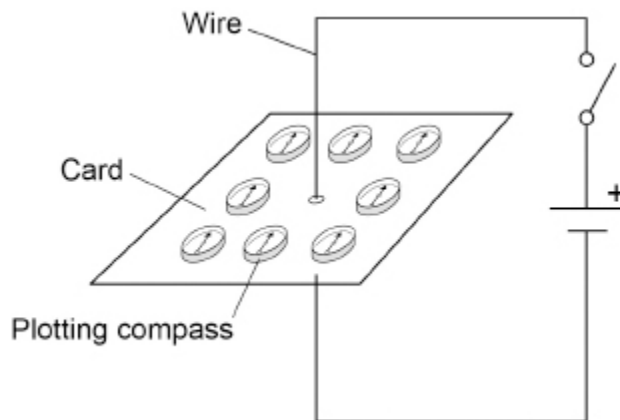
They are both south poles.

They are opposite poles.

(1)

Figure 4 shows some plotting compasses around a wire. There is no current in the wire.

Figure 4



(d) Why do the plotting compasses all point in the same direction?

(1)

(e) When the switch is closed there is a current in the wire.

The current creates a magnetic field.

What shape are the magnetic field lines around the wire?

Tick (✓) **one** box.

Circular

Rectangular

Square

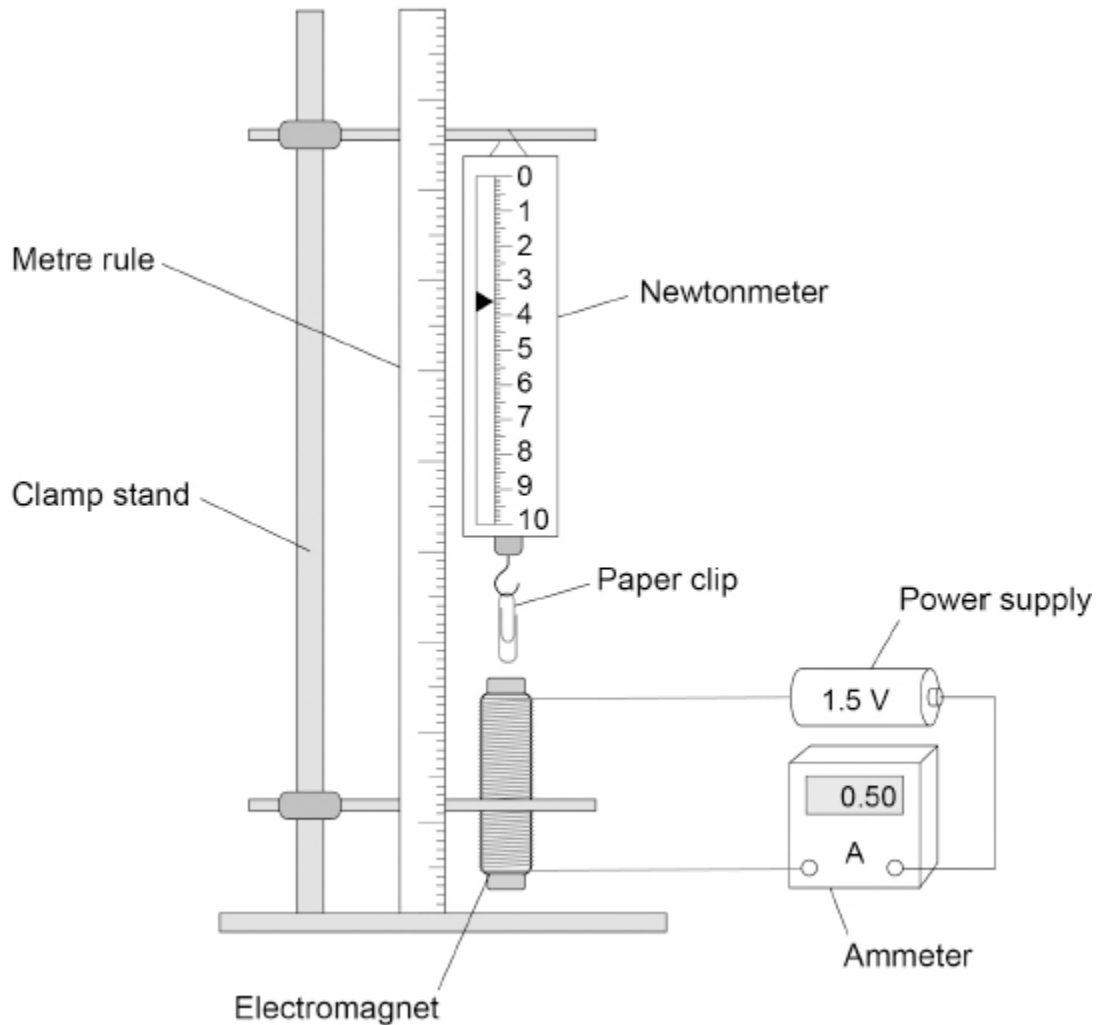
Triangular

(1)

A student investigated the force exerted by an electromagnet on a paper clip.
The student varied the distance between the paper clip and the electromagnet.

Figure 5 shows the equipment used.

Figure 5



The student recorded the reading on the newtonmeter for several different distances.

(f) The current in the electromagnet was the same for each distance.

Complete the sentence.

Choose the answer from the box.

| | | |
|------------------|----------------------|------------------------|
| a control | the dependent | the independent |
|------------------|----------------------|------------------------|

In the investigation, the current was _____ variable.

(1)

(g) What is the size of the downward force on the paper clip in **Figure 5**?

Force = _____ N

(1)

(h) The distance between the paper clip and the electromagnet is **increased**.

What happens to the size of the downward force?

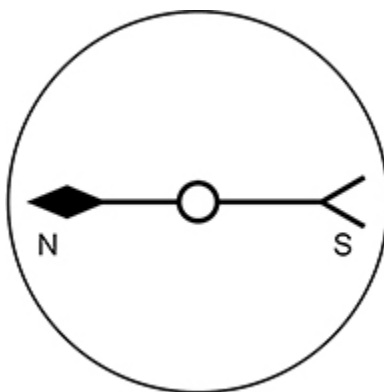
(1)

(Total 9 marks)

6.

Figure 1 shows a compass.

Figure 1



(a) Why does the compass always point in the same direction when it is **not** near a magnet?

Tick (✓) **one** box.

The compass is not magnetic.

The Earth has a magnetic field.

There is no force acting on the compass.

(1)

(b) What material could the needle of the compass be made from?

Tick (✓) **one** box.

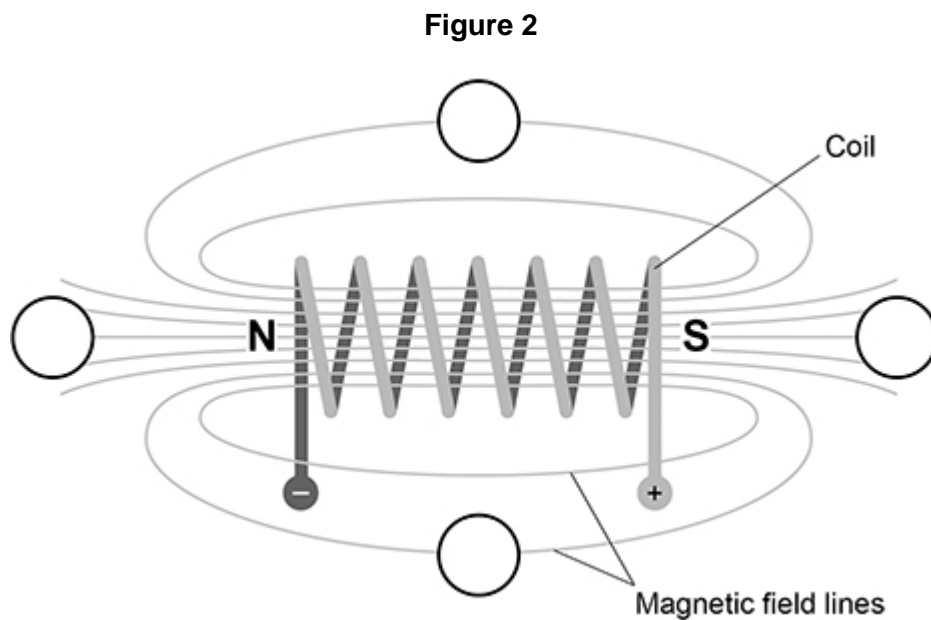
- Aluminium
- Copper
- Plastic
- Steel

(1)

Figure 2 shows a coil of wire.

There is a current in the coil.

The circles show the position of four compasses.



(c) Which statement describes the magnetic field around the coil?

Tick (✓) **one** box.

The field has the same strength at all points.

The field is stronger further away from the coil.

The field is strongest at the ends of the coil.

(1)

(d) Draw **one** arrow in **each** circle on **Figure 2** to show the direction of the magnetic field at that point.

(2)

(e) Give **two** ways the magnetic field around the coil could be made stronger.

1 _____

2 _____

(2)

(Total 7 marks)

Mark schemes

1.

- (a) pole X south
and
pole Y north

allow X is S

allow Y is N

1

opposite poles attract

or

a north pole and a south pole attract

MP2 dependent on MP1

1

- (b) from 3.5 to 4.5 cm

either order

1

- (c)

$$\frac{4.0 + 3.5 + 4.0 + 3.5 + 4.5}{5}$$

allow $\frac{19.5}{5}$

1

3.9 (cm)

1

- (d) random errors

1

- (e) (the magnetic force) decreased

1

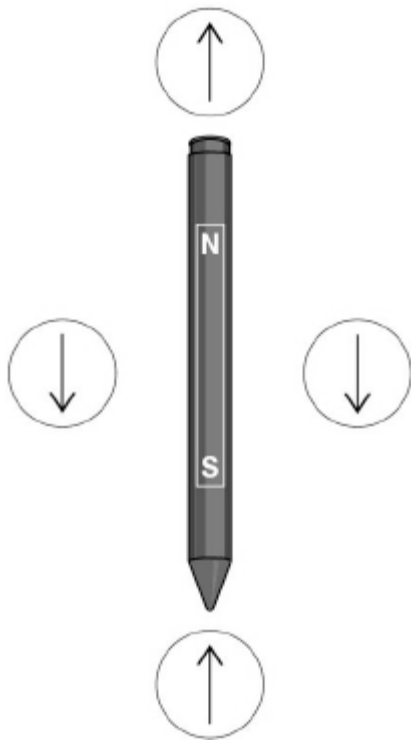
- (f) steel

1

(g) arrow in circle next to south pole pointing upwards

1

arrows in circles next to the middle of pen pointing downwards



1

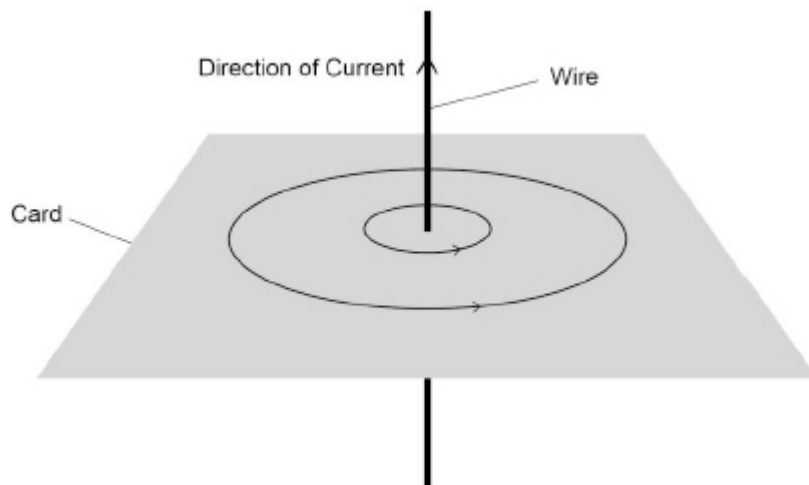
[10]

2.

(a) (at least) 2 concentric rings around the point where the wire passes through the card

1

with arrow(s) drawn in anticlockwise direction around the wire



1

(b) 2.1 mN = 0.0021 N

subsequent marks may be awarded if F is incorrectly / not converted

1

$$0.0021 = B \times 0.56 \times 0.050$$

1

$$B = \frac{0.0021}{0.56 \times 0.050}$$

1

$$B = 0.075$$

1

tesla **or** T

1

(c) there is a magnetic field between the poles of the magnets

1

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

[12]

3.

(a) X = south

allow S for south

1

Y = north

allow N for north

allow 1 mark if they are the wrong way round

1

(b)



1

- (c) iron 1
nickel 1
(d) the force is always attractive 1
(e) $F = 0.030 \times 9.8$ 1
0.294 (N)
allow 0.29 (N) 1

[8]

4.

- (a) into the page 1
(b) $0.092 = B \times 4.6 \times 0.080$ 1

$$B = \frac{0.092}{4.6 \times 0.080}$$

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

1

$$B = 0.25$$

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

1

tesla or T

1

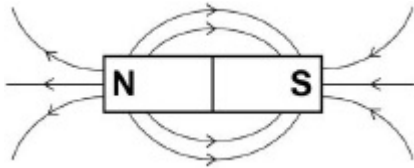
- (c) Newton's third law 1
(d) any **two** from:
 - move the electromagnet closer to the permanent magnet
 - add more turns to the coil / electromagnet
 - increase the current (in the coil / electromagnet)*allow increase the potential difference (across the coil / electromagnet)* 2

- (e) 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

[10]

5. (a) iron is magnetic 1
- (b) correct pattern of field lines 1

arrows on field lines away from N and towards S

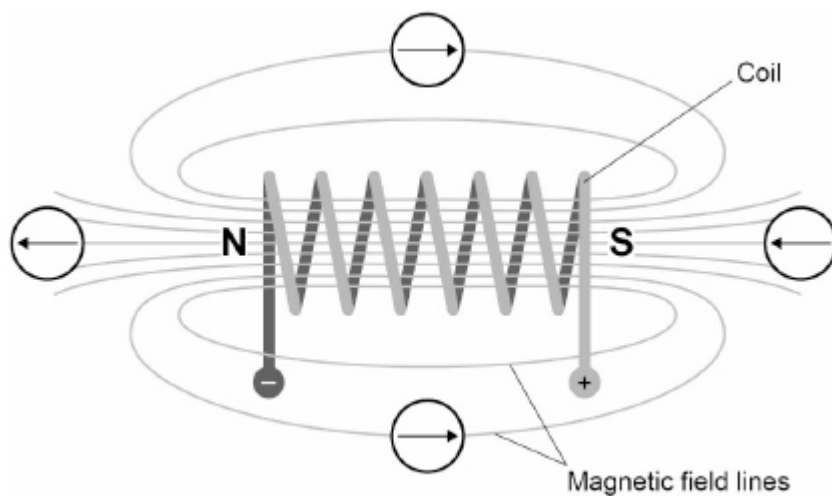


- (c) they are opposite poles 1
- (d) they line up with the Earth's magnetic field
allow them all point north 1
- (e) circular 1
- (f) a control 1
- (g) 3.6 (N) 1
- (h) (the force) decreases 1

[9]

6. (a) the Earth has a magnetic field 1
- (b) steel 1
- (c) the field is strongest at the ends of the coil 1

(d) all arrows in the correct direction



allow 1 mark for 2 or 3 arrows in the correct direction

2

(e) any **two** from:

- increase the current
allow increase potential difference
- insert an iron core
- increase the number of turns
allow turns closer together

2

[7]