Magnetism 3

Name: _____

Class: _____

Date: _____

Time: **73 minutes**

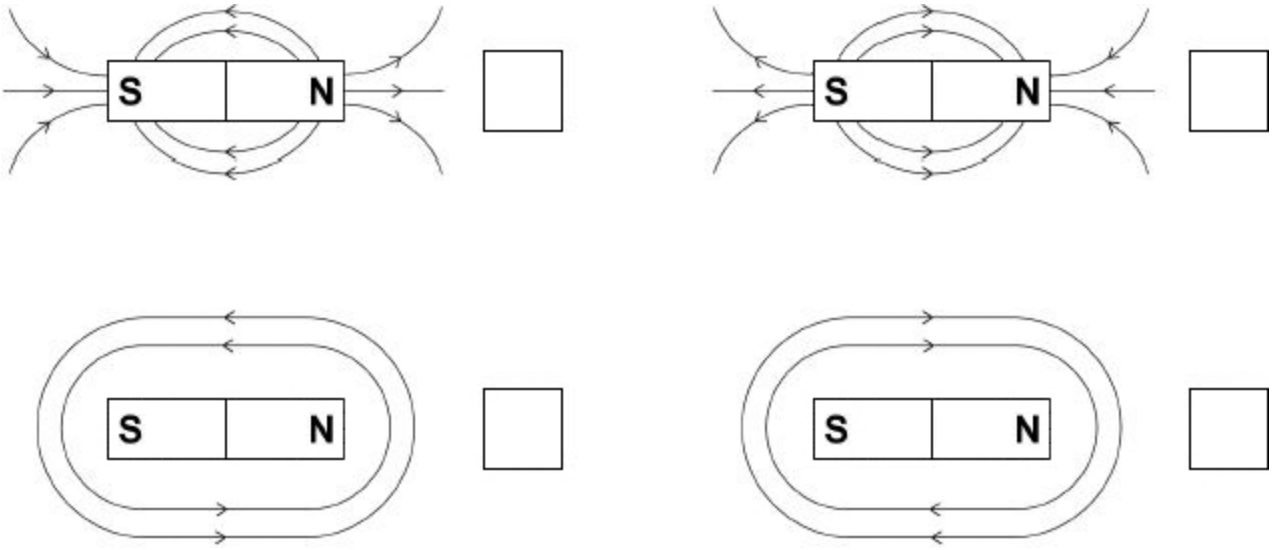
Marks: **69 marks**

Comments:

1. A magnet produces a magnetic field.

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

Tick **one** box.



(1)

(b) **Figure 1** shows three metal blocks.

The blocks are not labelled.

One block is a permanent magnet, one is iron and one is aluminium.

Figure 1

Describe how another permanent magnet can be used to identify the blocks.

_____

_____

_____

_____

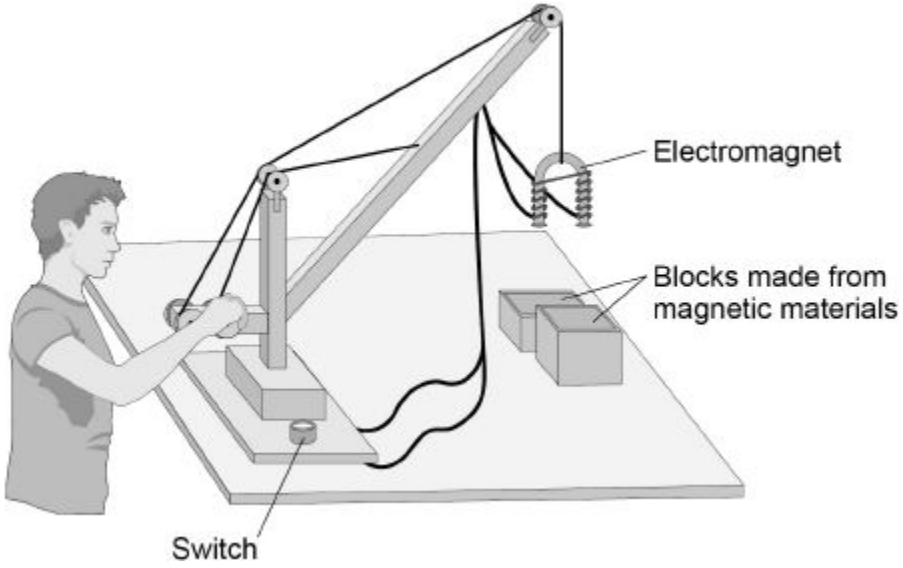
_____

_____

(3)

(c) **Figure 2** shows a toy crane.

Figure 2



The toy crane uses an electromagnet to pick up and move the blocks.

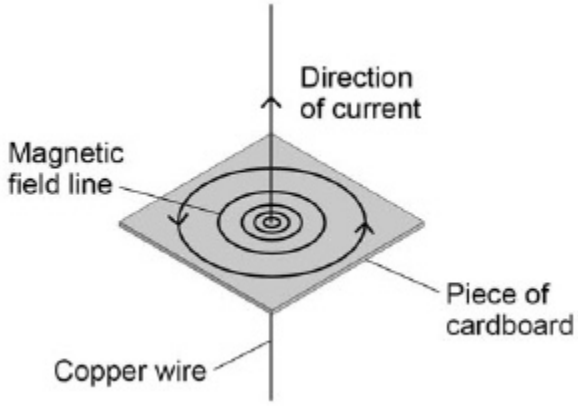
Explain how this electromagnet is able to pick up and move the blocks.

(6)

(Total 10 marks)

2. **Figure 1** shows the magnetic field around a copper wire carrying a current.

Figure 1



(a) What do the arrows on the magnetic field line represent?

_____

_____

(1)

(b) Complete the sentence.

Choose the answer from the box.

decreases	**increases**	**stays the same**

As the distance from the copper wire increases, the

magnetic field strength _____ .

(1)

(c) Suggest how the field lines on **Figure 1** show the variation in field strength.

_____

_____

_____

_____

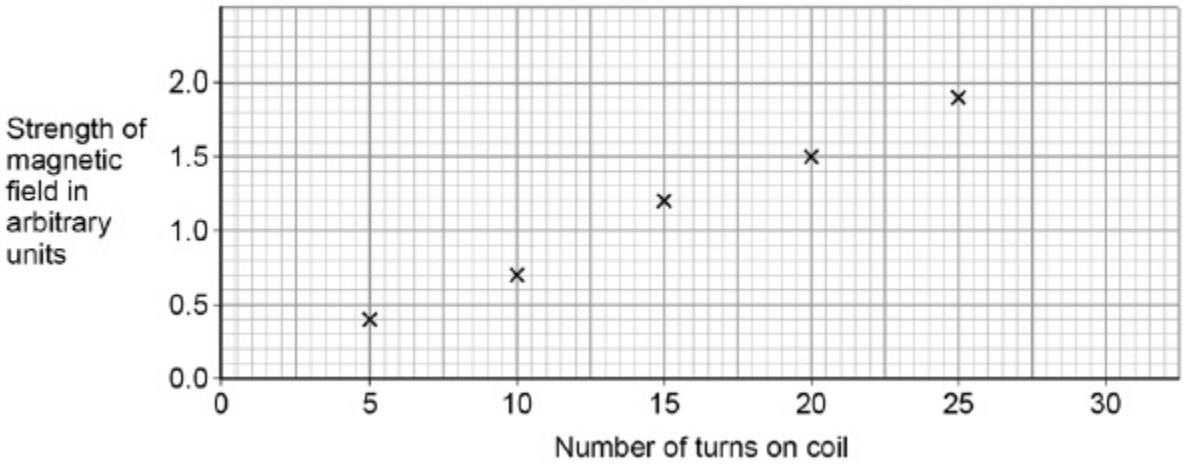
(2)

A student coiled the copper wire a different number of times to form a solenoid.

Each time the student measured the strength of the magnetic field inside the solenoid.

Figure 2 shows the results.

Figure 2



(d) Draw a line of best fit on **Figure 2**.

(1)

(e) Determine the increase in strength of magnetic field when the number of turns on the coil is changed from 12 to 18

_____

_____

_____

Increase in strength of magnetic field = _____ arbitrary units

(2)

(f) How could the strength of the magnetic field be increased?

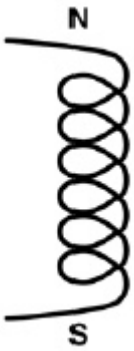
Tick **two** boxes.

Increase the current through the solenoid.	☐
Increase the potential difference across the solenoid.	☐
Increase the temperature of the solenoid.	☐
Spread the turns of wire on the solenoid further apart.	☐
Use wire with a higher resistance to make the solenoid.	☐

(2)

(g) **Figure 3** shows the north and south poles of a solenoid.

Figure 3



Draw field lines to show the magnetic field around the solenoid.

(2)

(h) How can the solenoid be made into an electromagnet?

_____

_____

(1)

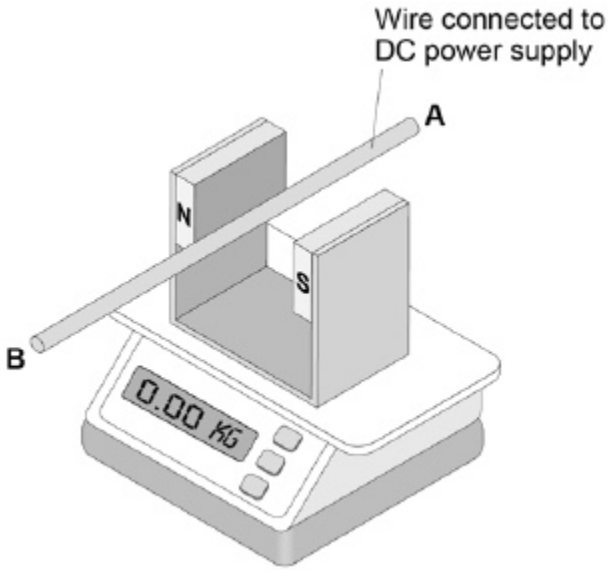
(Total 12 marks)

3. A student placed a permanent magnet on a top-pan balance.

He clamped a straight piece of wire so that it was suspended in the magnetic field.

Figure 1 shows the apparatus.

Figure 1



(a) When a current passed through the wire from **A** to **B**, the reading on the balance increased.

Explain why.

(4)

(b) The student increased the current in the wire.

Sketch a graph on **Figure 2** to show the relationship between the current and magnetic force on the wire.

Label the axes, with the independent variable on the x-axis.

Figure 2

(2)

(c) The length of the wire in the magnetic field in **Figure 1** is 4.8×10^{-2} m

The current in the wire is 0.80 A

The reading on the balance is 1.2×10^{-3} kg

Gravitational field strength = 9.8 N/kg

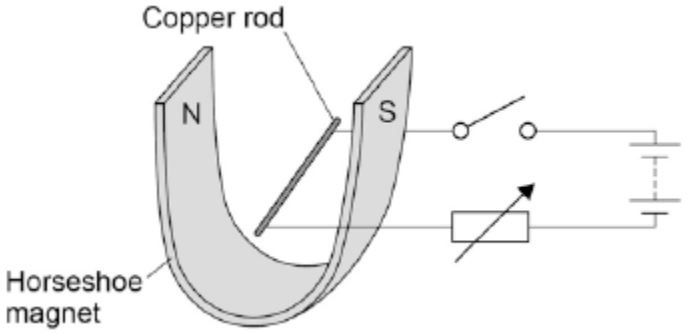
Calculate the magnetic flux density of the permanent magnet.

Magnetic flux density = _____ tesla

(5)

(Total 11 marks)

4. A teacher used the equipment shown in the figure below to demonstrate the motor effect.



(a) Describe how Fleming's left-hand rule can be used to determine the direction in which the rod will move when the switch is closed, and state the direction.

(4)

(b) Increasing the current can increase the force acting on the copper rod.

Give **one** other way in which the size of the force acting on the copper rod could be increased.

(1)

(c) The copper rod in the figure above has a length of 7 cm and a mass of 4×10^{-4} kg.

When there is a current of 1.12 A the resultant force on the copper rod is 0 N.

Calculate the magnetic flux density.

Gravitational field strength = 9.8 N / kg

Magnetic flux density = _____ T

(5)

(Total 10 marks)

5. (a) Electromagnets are often used at recycling centres to separate some types of metals from other materials.

Give **one** reason why an electromagnet would be used rather than a permanent magnet.

(1)

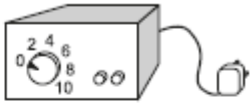
(b) **In this question you will gain marks for using good English, organising information clearly and using scientific words correctly.**

Some students want to build an electromagnet.

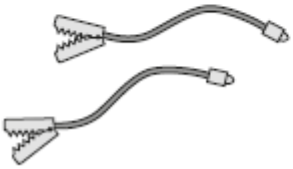
The students have the equipment shown below.

Insulated wire

Iron nail

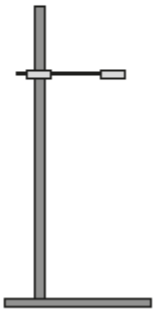


Power supply



Connecting leads

Steel paperclips



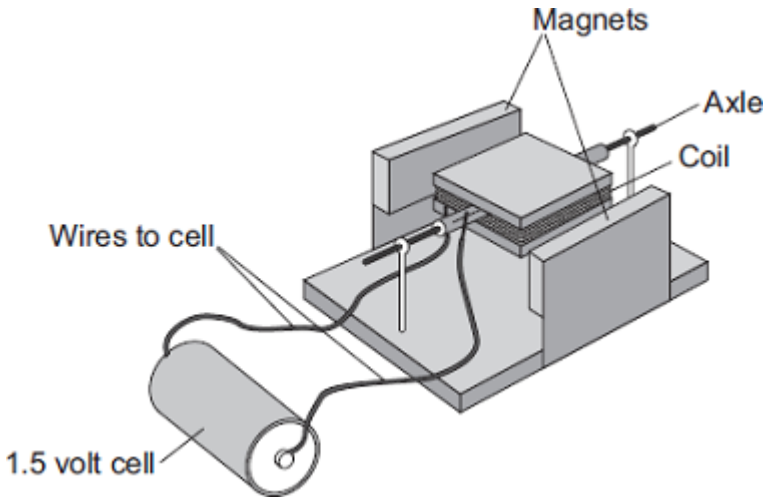
Wooden clamp and stand

Describe how the students could build an electromagnet. Include in your answer how the students should vary and test the strength of their electromagnet.

(6)

(Total 7 marks)

6. A student has made a simple electric motor. The diagram shows the electric motor.



(a) Complete the following sentence by drawing a ring around the correct line in the box.

Once the coil is spinning, one side of the coil is pushed by

the cell
the coil
a force

and

the other side is pulled, so the coil continues to spin.

(1)

(b) Suggest **two** changes to the electric motor, each one of which would make the coil spin faster.

1. _____

_____

2. _____

_____

(2)

(c) Suggest **two** changes to the electric motor, each one of which would make the coil spin in the opposite direction.

1. _____

_____

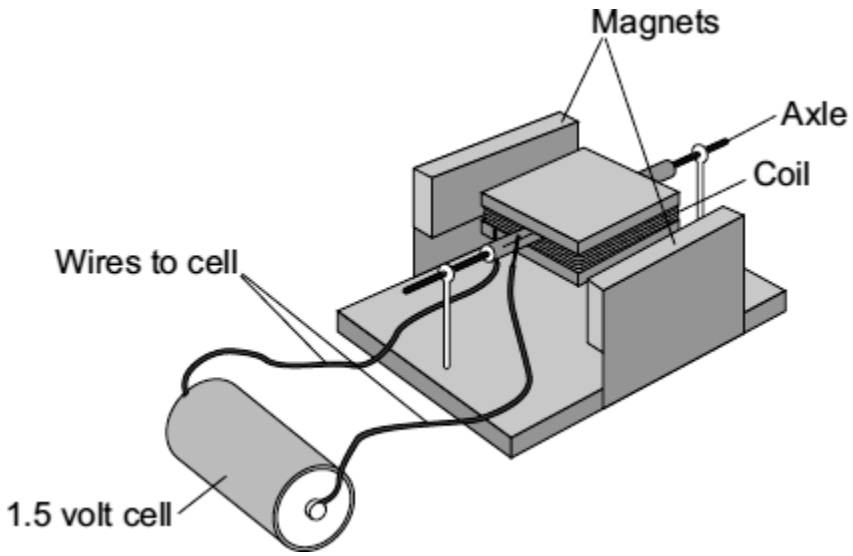
2. _____

_____

(2)

(Total 5 marks)

7. (a) Complete the description of the device shown below by drawing a ring around the correct line in each box.



(i) The device is being used as

an electric motor.
a generator.
a transformer.

(1)

(ii) The coil needs a flick to get started. Then one side of the coil is pushed by the

cell
coil
force

and the other side is pulled, so that the coil spins.

(1)

(b) Suggest **two** changes to the device, each one of which would make the coil spin faster.

1. _____

_____

2. _____

_____

(2)

(c) Suggest **two** changes to the device, each one of which would make the coil spin in the opposite direction.

1. _____

_____

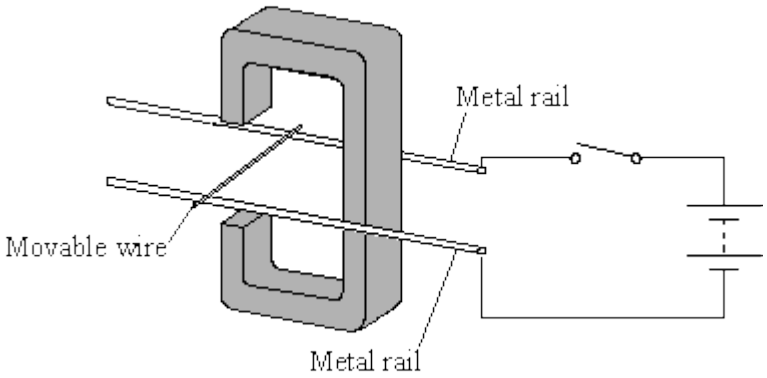
2. _____

_____

(2)

(Total 6 marks)

8. The diagram shows apparatus used to demonstrate the electric motor effect. When he switch is closed the wire moves.



(i) Draw an arrow on the diagram to show the direction the wire moves.

(1)

(ii) Explain why the wire moves.

_____

_____

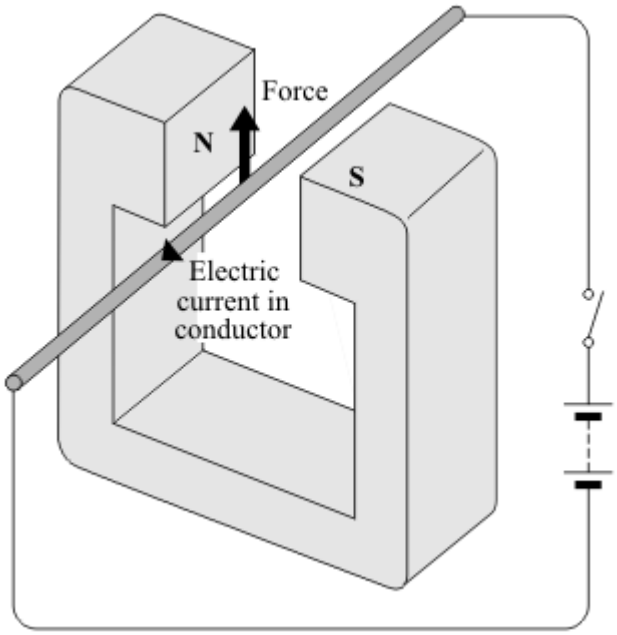
_____

_____

(2)

(Total 3 marks)

9. When a conductor carrying an electric current is placed in a magnetic field a force may act on it.



(a) State **two** ways in which this force can be increased.

1. _____

2. _____

(2)

(b) State **two** ways in which this force can be made to act in the opposite direction.

1. _____

2. _____

(2)

(c) In what circumstance will **no** force act on a conductor carrying an electric current and in a magnetic field?

_____

_____

(1)

(Total 5 marks)

1.

(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]

2.

(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

*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

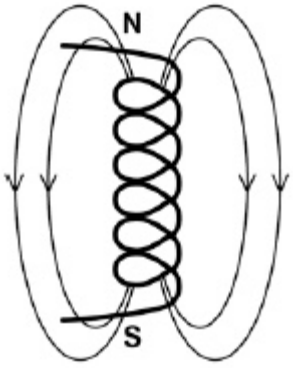
increase the potential difference across the solenoid

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 iron core

allow a description of this, eg wrap the wire around an iron nail

adding a core is insufficient

1

[12]

3. (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

(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]

4. (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]

5. (a) an electromagnet can be switched off

accept a permanent magnet cannot be switched off

or

an electromagnet is stronger

accept control the strength

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a 'best-fit' approach to the marking.

Level 3 (5 – 6 marks):
there is a description of how the electromagnet is made
and
there is a description of how the strength of the electromagnet can be varied
and
there is a description of how the strength of the electromagnet can be tested

Level 2 (3 – 4 marks):
there is a description of how the electromagnet is made
and either
there is a description of how the strength of the electromagnet can be varied
or
there is a description of how the electromagnet can be tested

Level 1 (1 – 2 marks):
there is a basic description of how to make an electromagnet
or
there is a basic description of how the strength of the electromagnet can be varied
or
there is a basic description of how the electromagnet can be tested

Level 0 (0 marks):
No relevant / correct content

examples of the points made in the response

Details of how to make an electromagnet
- wrap the wire around the nail
- connect the wire to the power supply (with connecting leads and croc clips)
- switch on the power supply

accept a current should be sent along the wire

Details of how to vary the strength of the electromagnet
- change the number of turns (on the coil)
- change the current (through the coil)
- change the separation of the turns

allow change the potential difference (across the coil)

accept wrap the coil more tightly

Details of how to test the electromagnet
- suspend paperclips from the electromagnet
- the more paperclips suspended, the stronger the electromagnet is
- clamp the electromagnet at different distances from the paperclip(s)
- the further the distance from which paperclips can be attracted the stronger the electromagnet is
- test before and after making alterations to change the strength
- compare the results from before and after making alterations
- use de-magnetised paper clips

accept count the number of paperclips

*with different current **or** p.d. **or** no. of turns*

***or** core and see if the number changes/increases*

6

[7]

6. (a) a force

1

(b) any **two** from:

- more powerful magnet
  *do **not** allow 'bigger magnet'*
- reduce the gap (between magnet and coil)
- increase the area of the coil
- more powerful cell
  *do **not** allow 'bigger cell'*
  accept battery for cell
  accept add a cell
  accept increase current / potential difference
- more turns (on the coil)
  allow 'more coils on the coil'
  *do **not** allow 'bigger coil'*

2

(c) reverse the (polarity) of the cell
allow 'turn the cell the other way round'
accept battery for cell

1

reverse the (polarity) of the magnet
allow 'turn the magnet the other way up'

1

[5]

7. (a) (i) an electric motor

1

(ii) force

1

(b) any **two** from:

- more powerful magnet
  *do **not** allow 'bigger magnet'*
- reduce the gap (between magnet and coil)
- increase the area of the coil
- more powerful cell
  *do **not** allow 'bigger cell'*
  accept battery for cell
  accept add a cell
  accept increase current / potential difference
- more turns (on the coil)
  allow 'more coils on the coil'
  *do **not** allow 'bigger coil'*

2

(c) reverse the (polarity) of the cell
allow 'turn the cell the other way round'
accept battery for cell

1

reverse the (polarity) of the magnet
allow 'turn the magnet the other way up'

1

[6]

8. (i) away from magnet
arrow should be perpendicular to field lines and current as judged by eye

1

(ii) current in wire creates magnetic field around wire

1

two fields interact **or** combine giving a resultant force (on the wire)

1

[3]

9. (a) increase the current (1)

credit increase the p.d./voltage
credit reduce the resistance
credit have thicker wiring
credit add extra / more cells

1

increase the magnetic field (strength) (1)

credit 'have stronger magnet(s)
*do **not** credit 'bigger magnets' either order*

1

(b) **either** reverse polarity

or connect the battery the other way round

1

either reverse direction of the magnetic field

or put the magnet the other way round / reverse the magnet

*do **not** give any credit to a response in which both are done at the same time*

either order

1

(c) **either**

conductor parallel to the magnetic field

or lines of magnetic force and path of electricity do not cross

1

[5]