Magnetism

Questions

Name: _____

Class: _____

Date: _____

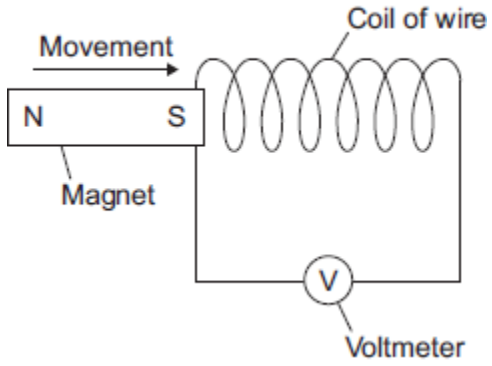
Time: **103 minutes**

Marks: **99 marks**

Comments:

1 **Figure 1** shows a magnet moving into a coil of wire. This movement causes a reading on the voltmeter.

Figure 1



(a) Use the correct word from the box to complete the sentence.

generated	**induced**	**produced**

Moving the magnet into the coil of wire causes a reading on the voltmeter because a potential difference is _____ across the ends of the wire.

(1)

(b) A student investigated how the number of turns on the coil of wire affects the maximum voltmeter reading. The student changed the number of turns on the coil of wire, then moved the magnet into the coil. The student recorded the maximum voltmeter reading.

To obtain valid data, suggest **two** variables that the student should control in this investigation.

1. _____

_____

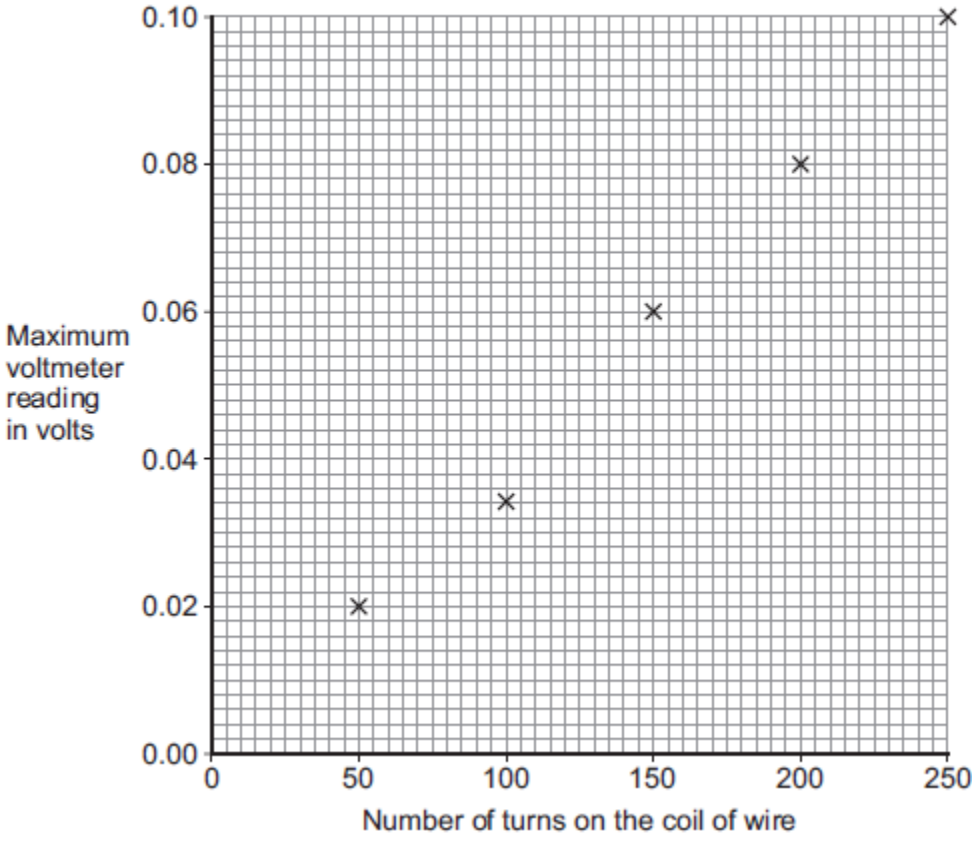
2. _____

_____

(2)

(c) The student's results are shown in **Figure 2**.

Figure 2



(i) One of the results is anomalous.
Suggest a reason for the anomalous result.

_____

(1)

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

(1)

(d) A data-logger can automatically record and store data.

It may have been better for the student to have used a data-logger in his investigation rather than a voltmeter.

Suggest **one** reason why.

_____

_____

(1)

(Total 6 marks)

2 The area around a magnet is called the magnetic field.

(a) The Earth has a magnetic field.

What causes the Earth's magnetic field?

Tick **one** box.

The movement of liquid iron in the Earth's outer core ☐

The gravitational field of the Earth ☐

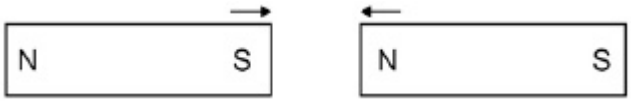
The permanent magnet in the Earth's core ☐

(1)

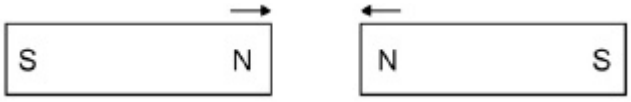
(b) Look at **Figure 1**.

Figure 1

Opposite poles brought together



Same poles brought together



What will happen in each case when the poles of two magnets are brought close together?

Opposite poles brought together _____

_____

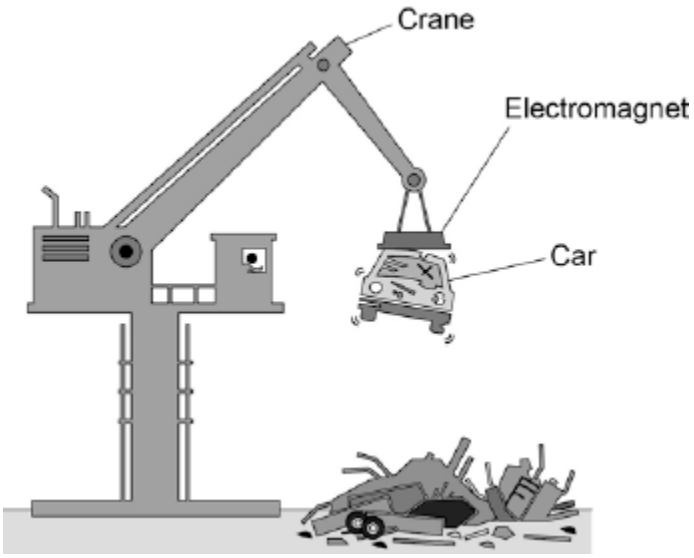
Same poles brought together _____

_____

(2)

(c) **Figure 2** shows an electromagnet being used to lift a car in a scrapyard.

Figure 2



An electromagnet is a solenoid.

Explain why it is better to use an electromagnet rather than a permanent magnet in a scrapyard.

You should include a comparison of the properties of electromagnets and permanent magnets in your answer.

(4)

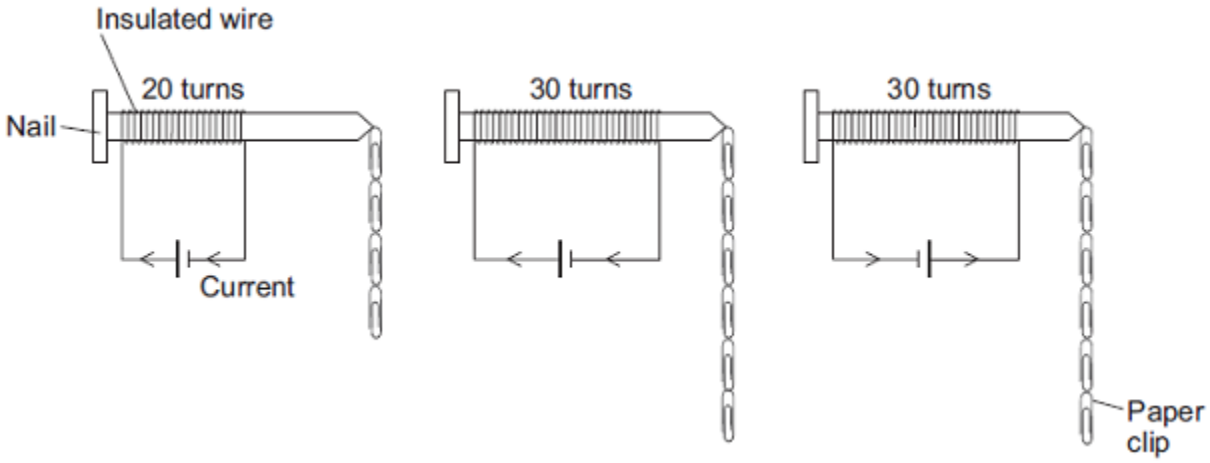
(Total 7 marks)

3 A student is investigating the strength of electromagnets.

Figure 1 shows three electromagnets.

The student hung a line of paper clips from each electromagnet.

Figure 1



Electromagnet **A** Electromagnet **B** Electromagnet **C**

No more paper clips can be hung from the bottom of each line of paper clips.

(a) (i) Complete the conclusion that the student should make from this investigation.

Increasing the number of turns of wire wrapped around the nail will

_____ the strength of the electromagnet.

(1)

(ii) Which **two** pairs of electromagnets should be compared to make this conclusion?

Pair 1: Electromagnets _____ and _____

Pair 2: Electromagnets _____ and _____

(1)

(iii) Suggest **two** variables that the student should control in this investigation.

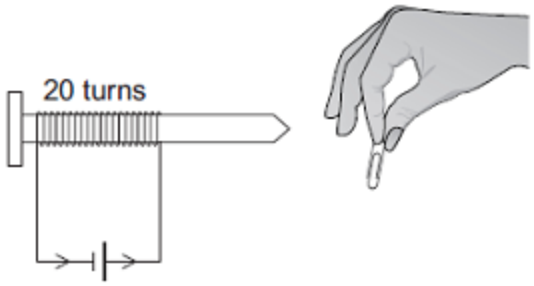
1. _____

2. _____

(2)

(b) The cell in electromagnet **A** is swapped around to make the current flow in the opposite direction. This is shown in **Figure 2**.

Figure 2



What is the maximum number of paper clips that can now be hung in a line from this electromagnet?

Draw a ring around the correct answer.

fewer than 4 **4** **more than 4**

Give **one** reason for your answer.

_____

_____

_____

(2)

(c) Electromagnet **A** is changed to have only 10 turns of wire wrapped around the nail.

Suggest the maximum number of paper clips that could be hung in a line from the end of this electromagnet.

Maximum number of paper clips = _____

(1)

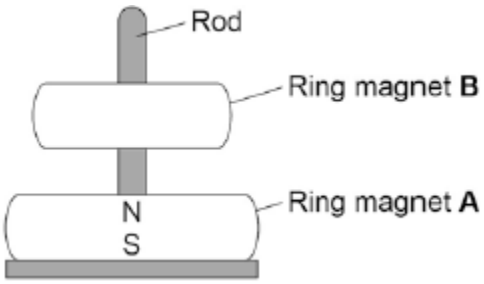
(Total 7 marks)

4 A magnetic toy uses ring-shaped magnets.

Look at **Figure 1**.

The magnets can move up and down the rod. Ring magnet **B** appears to float.

Figure 1



(a) The magnetic poles are labelled on ring magnet **A**.

Label the magnetic poles on ring magnet **B**.

(1)

(b) What would happen if ring magnet **B** was turned upside down?

_____

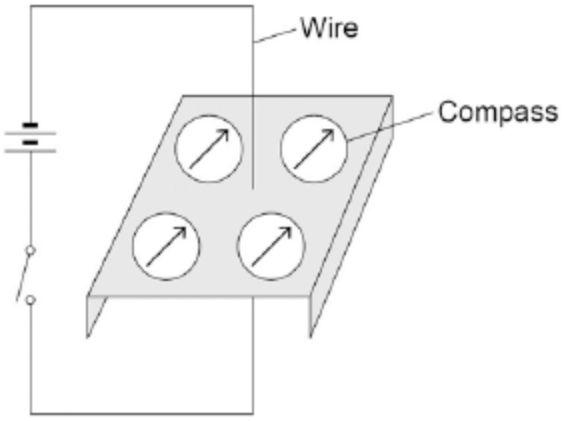
_____

(1)

(c) **Figure 2** shows four plotting compasses arranged around a wire.

The needle of a compass is a magnet.

Figure 2



In **Figure 2** the switch is open and there is no current in the wire.

Explain why the compass needles all point in the same direction.

_____

_____

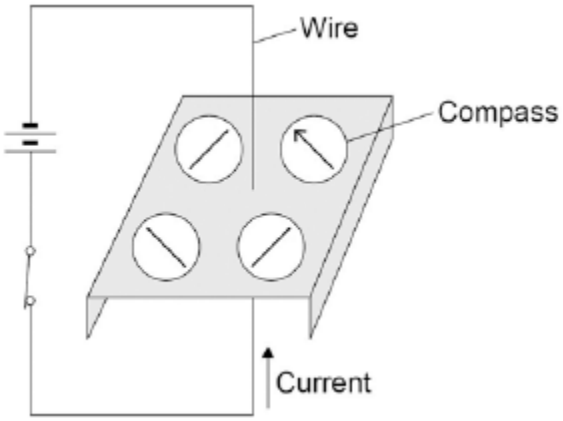
_____

_____

(2)

(d) **Figure 3** shows the switch closed.

Figure 3



There is now a current in the wire.

The compass needles change direction.

On **Figure 3** draw arrowheads on the three incomplete compass needles to show their direction.

(1)

(e) What would happen to the direction of the compass needles if the current was reversed?

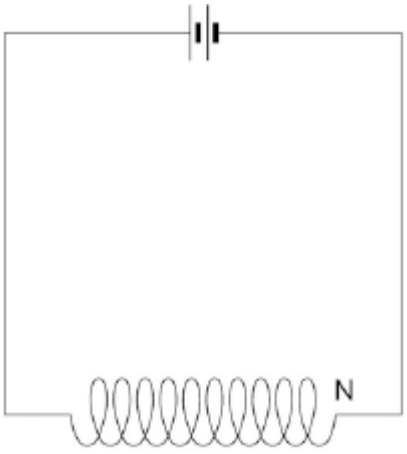
_____

_____

(1)

(f) **Figure 4** shows a coil of wire in a circuit.

Figure 4



On **Figure 4** draw the magnetic field due to the current in the coil.

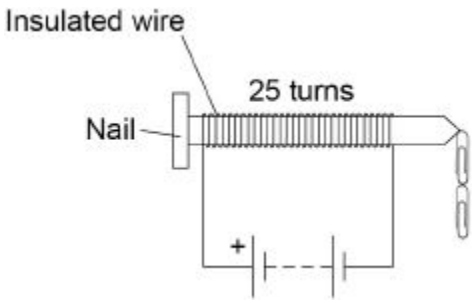
(3)

(Total 9 marks)

5 A student investigated how the number of turns of wire on an electromagnet affects how many paper clips the electromagnet can pick up.

Figure 1 shows the apparatus used.

Figure 1



This is the method used.

1. Wrap wire around an iron nail.
2. Count the number of turns of wire.
3. Connect the wire to a battery to make the electromagnet.
4. Switch on the electromagnet and place it near the paper clips.
5. Count the number of paper clips picked up.
6. Repeat steps 1−5 for different numbers of turns of wire.

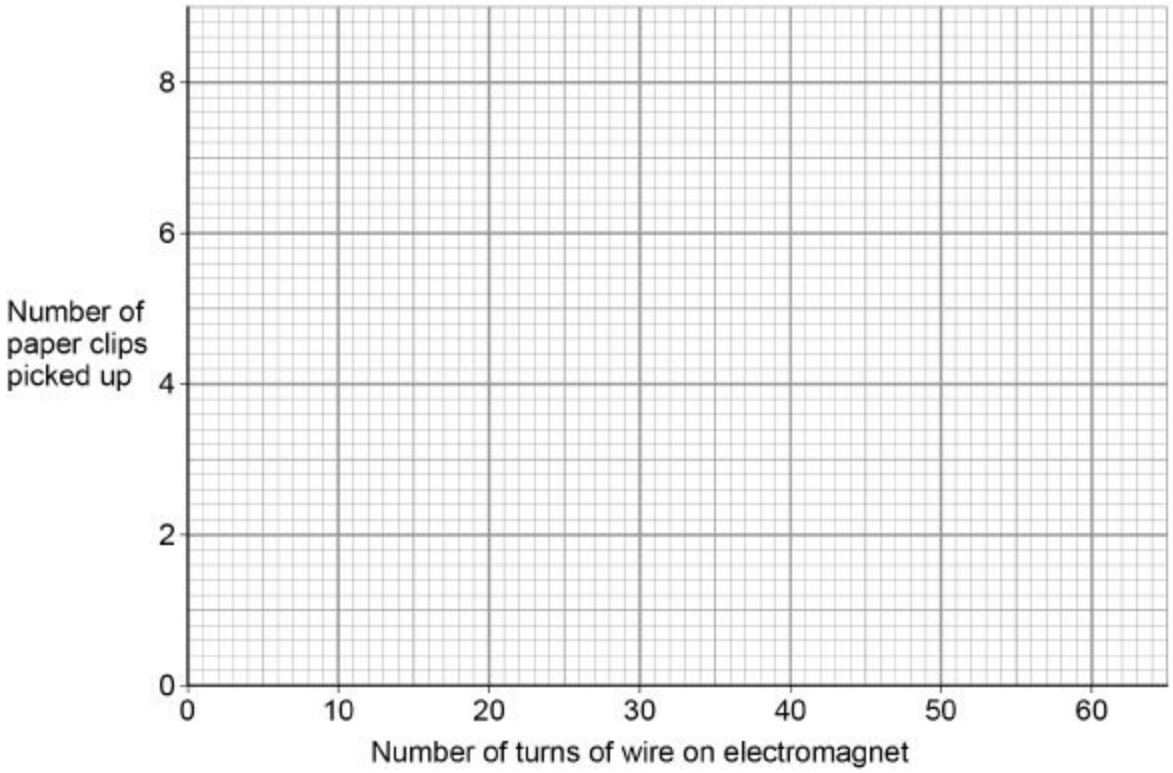
The table below shows the results.

Number of turns of wire on electromagnet	**Number of paper clips picked up**
10	1
25	2
40	4
55	5
60	6

(a) Plot the data from the table above on **Figure 2**.

Draw a line of best fit.

Figure 2



(3)

(b) Describe the relationship between the number of paper clips picked up and the number of turns on the electromagnet.

_____

_____

(1)

(c) Suggest what would happen if the student used 5 turns of wire in the investigation.

Give a reason for your answer.

_____

_____

_____

_____

(2)

(d) Describe **one** way the student's investigation could have been improved.

Give a reason for the improvement.

Improvement _____

_____

Reason _____

_____

(2)

(e) Which **two** factors would affect the strength of the magnetic field around the electromagnet?

Tick **two** boxes.

- The colour of the insulation around the wire ☐
- The direction of the current through the wire ☐
- The distance from the electromagnet ☐
- The size of the paper clips ☐
- The size of the current through the wire ☐

(2)

(Total 10 marks)

6 (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)

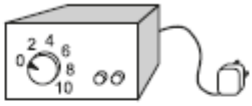
(b) **In this question you will gain marks for using good English, organising information clearly and using scientific words correctly.**

Some students want to build an electromagnet.

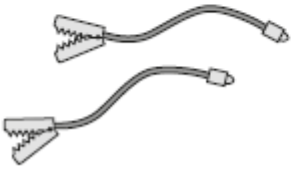
The students have the equipment shown below.

Insulated wire

Iron nail

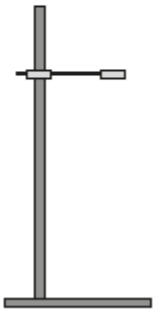


Power supply



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.

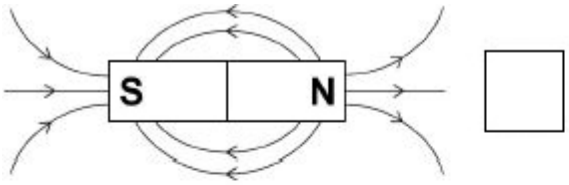
(6)

(Total 7 marks)

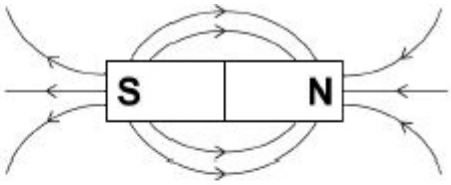
7 A magnet produces a magnetic field.

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

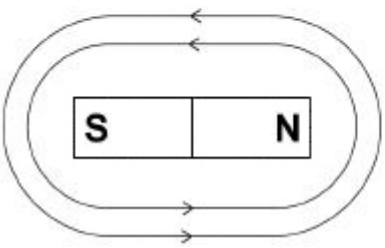
Tick **one** box.



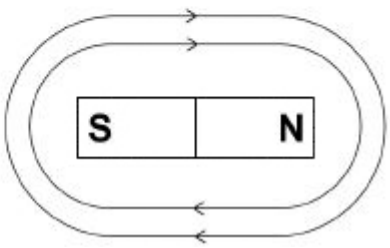
☐



☐



☐



☐

(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.

_____

_____

_____

_____

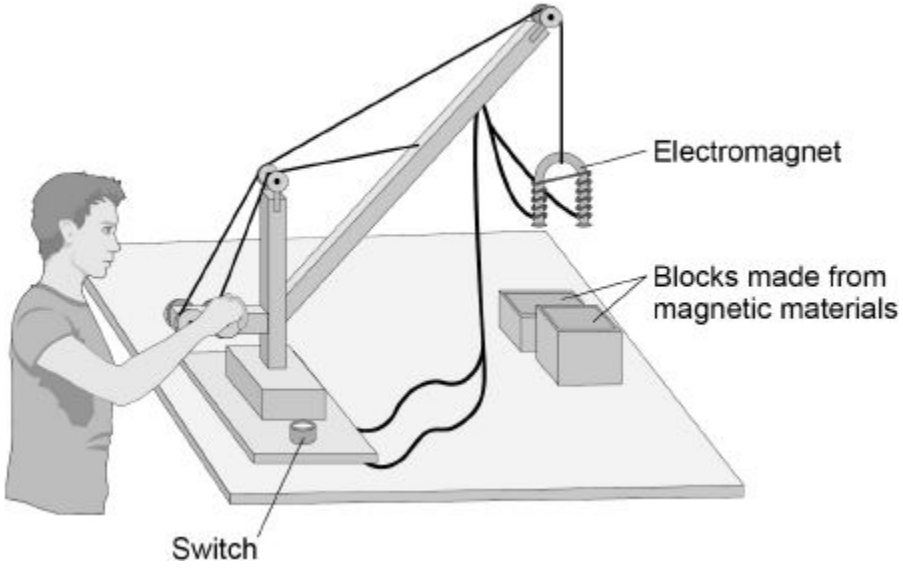
_____

_____

(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)

8 The diagram below shows a bar magnet.

(a) Complete the diagram to show the magnetic field lines around a bar magnet.

(2)

(b) Describe a method using a compass to plot the magnetic field lines around a bar magnet.

(4)

(c) Explain why a compass needle moves when placed near the bar magnet.

_____

_____

_____

_____

_____

(2)

(d) Iron is a magnetic element.

Which of the following is also a magnetic **element**?

Tick **one** box.

Cobalt ☐

Copper ☐

Steel ☐

Zinc ☐

(1)

(e) Give **two** pieces of evidence that show the Earth's magnetic field is changing.

1. _____

_____

2. _____

_____

(2)

(f) Describe the most likely cause of the changes in the Earth's magnetic field.

(2)

(Total 13 marks)

9 Iron is a metal that has many uses.

(a) Iron is extracted from iron ore. Part of the process involves reduction of the ore with carbon monoxide.

Iron ore contains iron oxide (Fe_2O_3).

Write a balanced equation for the reaction of iron oxide with carbon monoxide.

(3)

(b) Explain why this reaction is a redox reaction.

(2)

Steel is an alloy of iron. Steel is used to make cars.

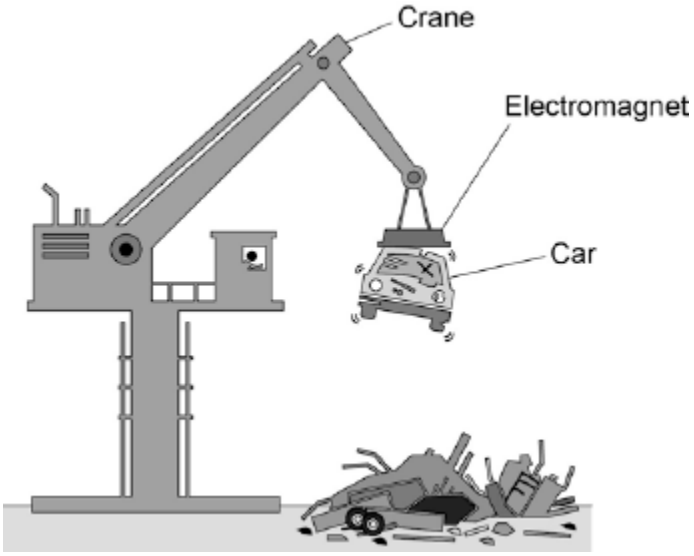
After its useful life a car is taken to a scrapyard for recycling.

(c) Suggest **four** benefits of recycling a car body.

(4)

(d) **Figure 1** shows an electromagnet being used to lift a car in a scrapyard.

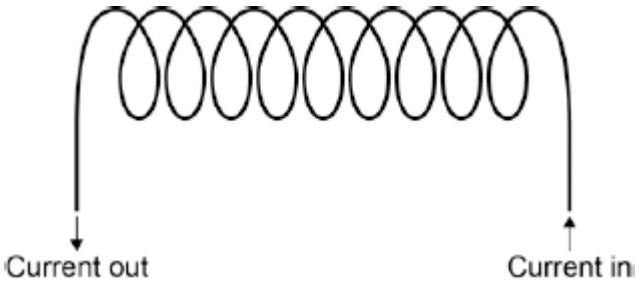
Figure 1



An electromagnet is made up of a solenoid.

Figure 2 shows a solenoid.

Figure 2



Draw the magnetic field of the solenoid on **Figure 2**.

(2)

(e) In a scrapyard, an electromagnet is used to lift and release cars so they can be moved around.

Suggest **two** ways a solenoid could be made to lift and release cars in a scrapyard.

Explain why each suggestion would be useful in the scrapyard.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 15 marks)

10 (a) **Diagram 1** shows a magnetic closure box when open and shut. It is a box that stays shut, when it is closed, due to the force between two small magnets.

These boxes are often used for jewellery.

Diagram 1

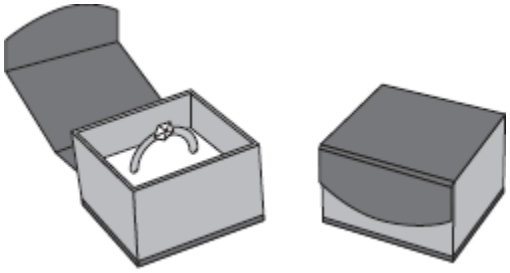
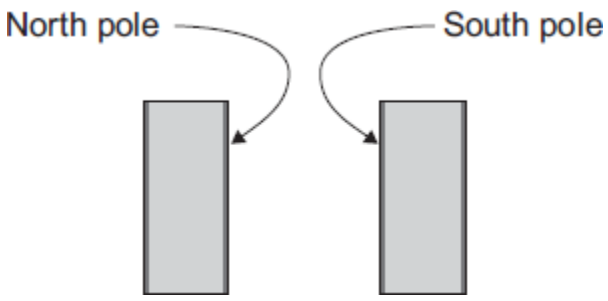


Diagram 2 shows the two magnets. The poles of the magnets are on the longer faces.

Diagram 2



(i) Draw, on **Diagram 2**, the magnetic field pattern between the two facing poles.

(2)

(ii) The magnets in the magnetic closure box must **not** have two North poles facing each other.

Explain why.

_____

_____

_____

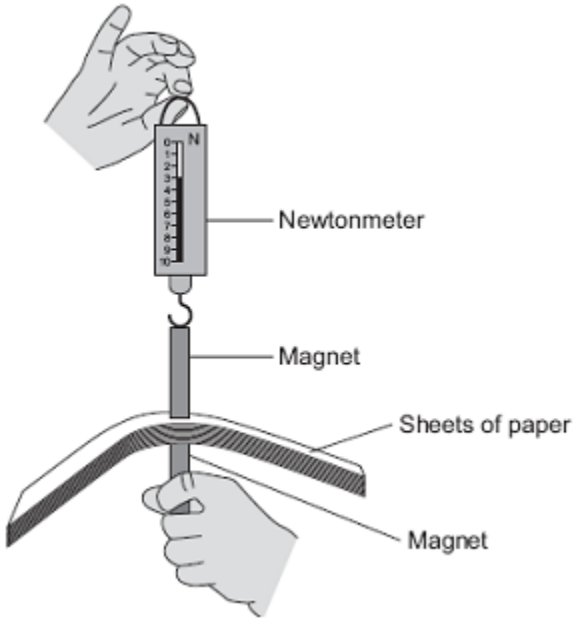
_____

(2)

(b) A student is investigating how the force of attraction between two bar magnets depends on their separation.

She uses the apparatus shown in **Diagram 3**.

Diagram 3



She uses the following procedure:

- ensures that the newtonmeter does not have a zero error
- holds one of the magnets
- puts sheets of paper on top of the magnet
- places the other magnet, with the newtonmeter magnetically attached, close to the first magnet
- pulls the magnets apart
- notes the reading on the newtonmeter as the magnets separate
- repeats with different numbers of sheets of paper between the magnets.

The results are shown in the table.

Number of sheets of paper between the magnets	10	20	30	40	50	60	70	80	120
Newtonmeter reading as the magnets separate	3.1	2.6	2.1	1.5	1.1	1.1	1.1	1.1	1.1

(i) Describe the pattern of her results.

_____

_____

_____

_____

(2)

(ii) No matter how many sheets of paper the student puts between the magnets, the force shown on the newtonmeter never reaches zero.

Why?

_____

_____

(1)

(iii) The student is unable to experiment with fewer than 10 sheets of paper without glueing the magnet to the newtonmeter.

Suggest why.

_____

_____

_____

_____

(2)

(iv) Suggest **three** improvements to the procedure that would allow the student to gain more accurate results.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(v) The thickness of one sheet of paper is 0.1 mm.

What is the separation of the magnets when the force required to separate them is 2.1 N?

_____

_____

_____

Separation of magnets = _____ mm

(3)

(Total 15 marks)