Perm + Include Magnetism, Magnetic Forces & Fields

Question Paper

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Physics
Exam Board	AQA
Topic	6.7 Magnetism and Electromagnetism
Sub-Topic	Perm + Include Magnetism, Magnetic Forces & Fields
Difficulty Level	Bronze Level
Booklet	Question Paper

Time Allowed: **51 minutes**

Score: **/49**

Percentage: **/100**

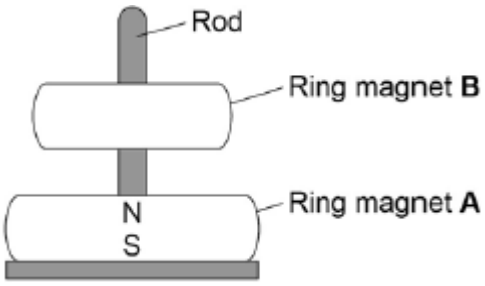
Grade Boundaries:

Q1.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?

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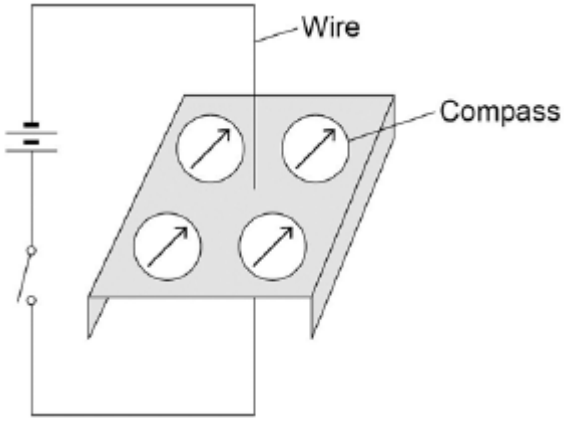
(1)

(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.

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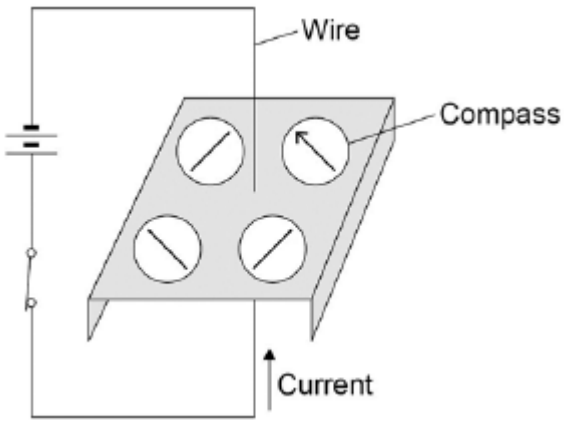
(2)

(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?

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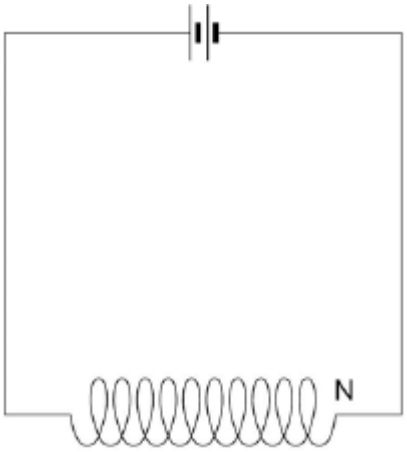
(1)

(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)

Q2. 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 ☐

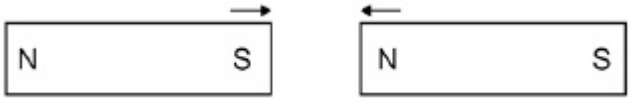
The permanent magnet in the Earth's core ☐

(1)

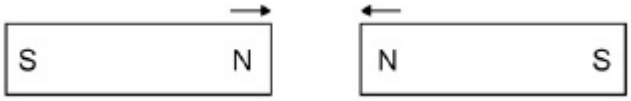
(b) Look at **Figure 1**.

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 .....

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Same poles brought together .....

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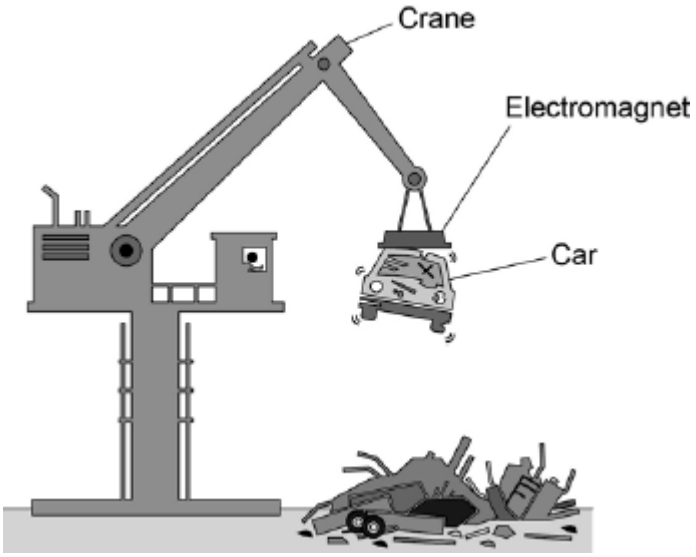
(2)

(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.

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(4)
(Total 7 marks)

Q3. This question is about magnetism.

(a) Which two materials are magnetic?

Tick **two** boxes.

Carbon ☐

Cobalt ☐

Copper ☐

Nickel ☐

Sodium ☐

(2)

(b) Describe how you could find the magnetic field pattern of a permanent bar magnet.

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(3)

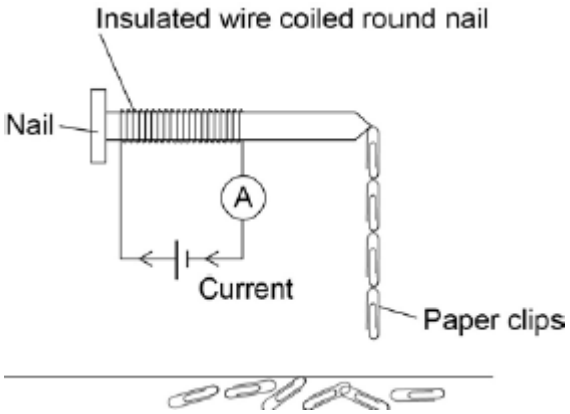
(c) A student investigates how the number of turns of wire on a solenoid affects the strength of the solenoid.

To test the strength of the solenoid she looks at how many paper clips the solenoid could lift.

Figure 1 shows how she sets up the equipment.

She keeps the current through the coil constant throughout the experiment.

Figure 1



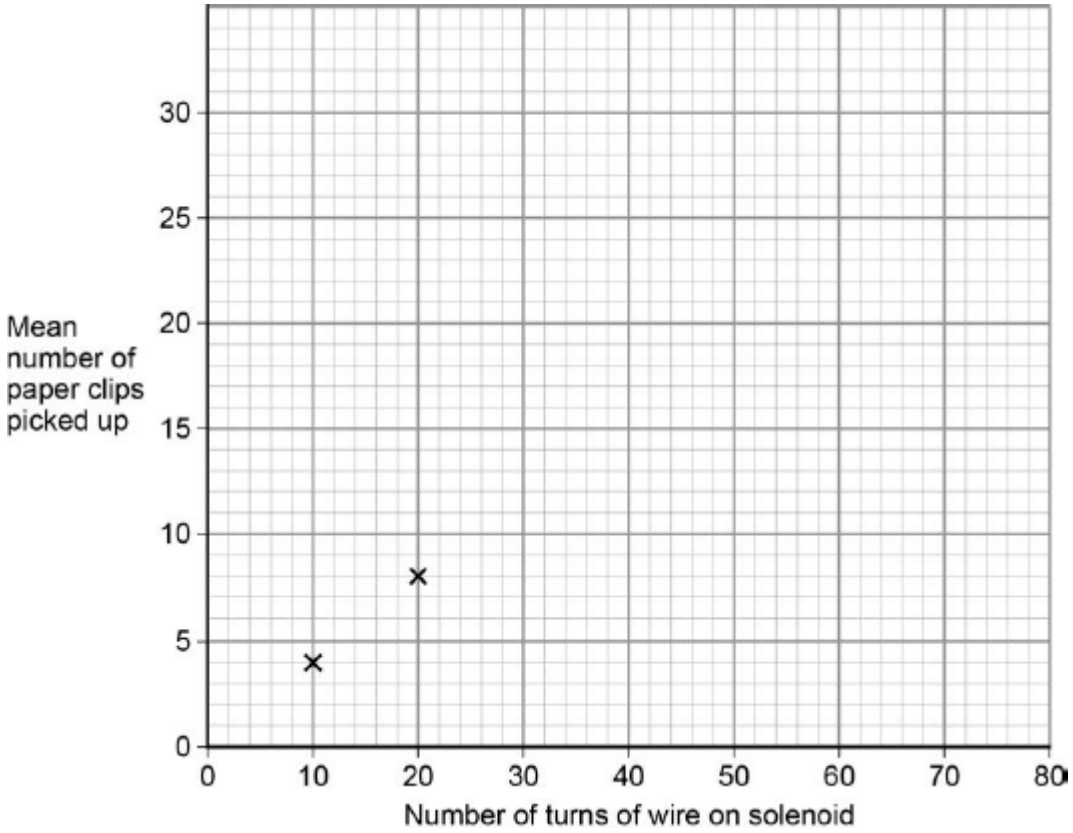
The table below shows the student's results.

Number of turns of wire on solenoid	Number of paper clips picked up by solenoid			
	Test 1	Test 2	Test 3	Mean
0	0	0	0	0
10	4	3	4	4
20	8	8	9	8
30	11	11	13	12
40	15	13	16	15
50	21	24	19	21
60	25	24	26	25

Use the data from the table above to complete the graph in **Figure 2**.

- The first two points have been plotted for you.
- Draw a line of best fit.

Figure 2



(3)

(d) Describe the pattern shown in the graph.

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(2)

(e) Use your graph to predict how many paper clips the solenoid will pick up when 80 turns of wire are used.

Number of paper clips picked up = ...

(1)

(Total 11 marks)

Q4.(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

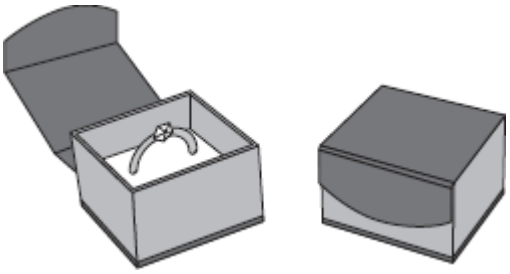
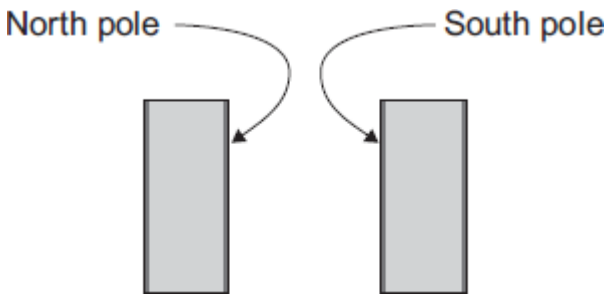


Diagram 2 shows the two magnets. The poles of the magnets are on the longer faces.

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.

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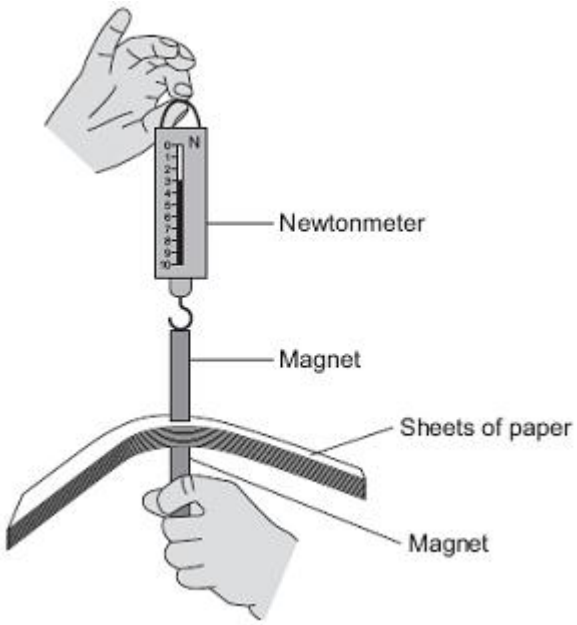
(2)

(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.

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(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?

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(1)

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

Suggest why.

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(2)

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

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(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?

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Separation of magnets = ... mm

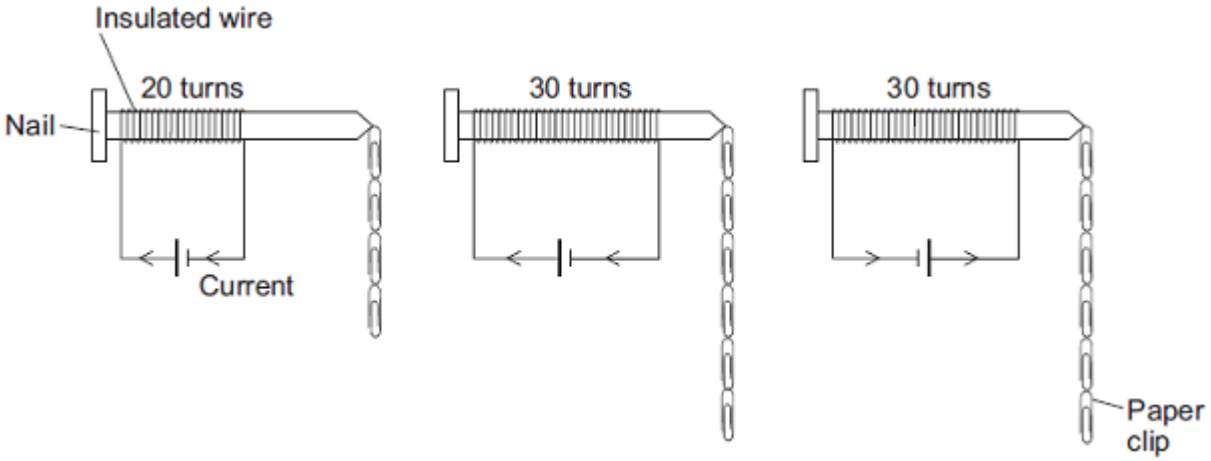
(3)
(Total 15 marks)

Q5.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.

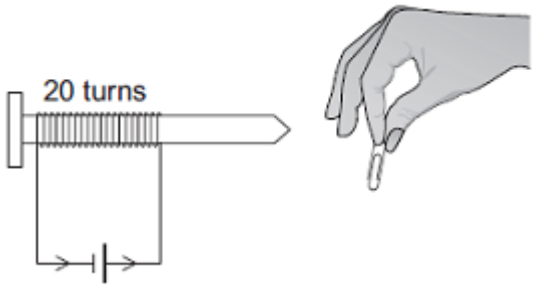
1 .....

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.

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(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)