The Motor Effect

Question Paper

Level	IGCSE
Subject	Physics (4403)
Exam Board	AQA
Unit	P3
Topic	Keeping Things Moving
Sub-Topic	The Motor Effect
Booklet	Question Paper

Time Allowed: **38 minutes**

Score: **/38**

Percentage: **/100**

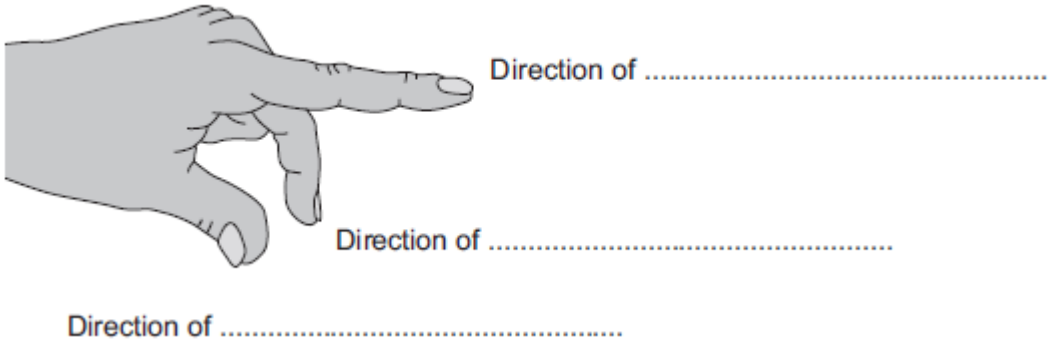
Grade Boundaries:

Q1. The left-hand rule can be used to identify the direction of the force acting on a current-carrying conductor in a magnetic field.

(a) Use words from the box to label **Figure 1**.

current	**field**	**force**	**potential difference**

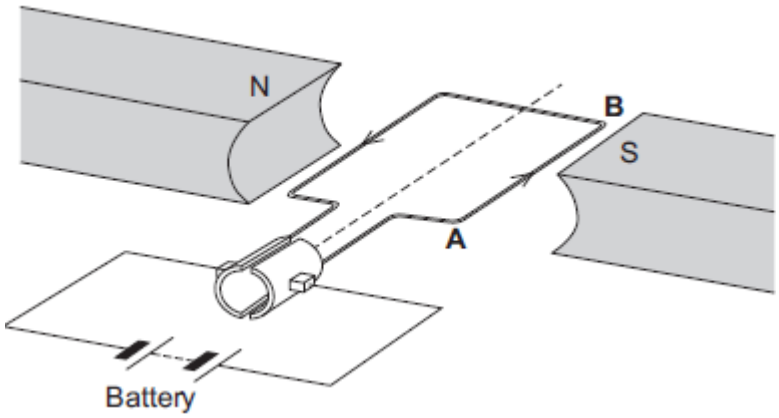
Figure 1



(3)

(b) **Figure 2** shows an electric motor.

Figure 2



(i) Draw an arrow on **Figure 2** to show the direction of the force acting on the wire **AB**.

(1)

(ii) Suggest **two** changes that would increase the force acting on the wire **AB**.

1.....

2.....

(2)

(iii) Suggest **two** changes that would reverse the direction of the force acting on the wire **AB**.

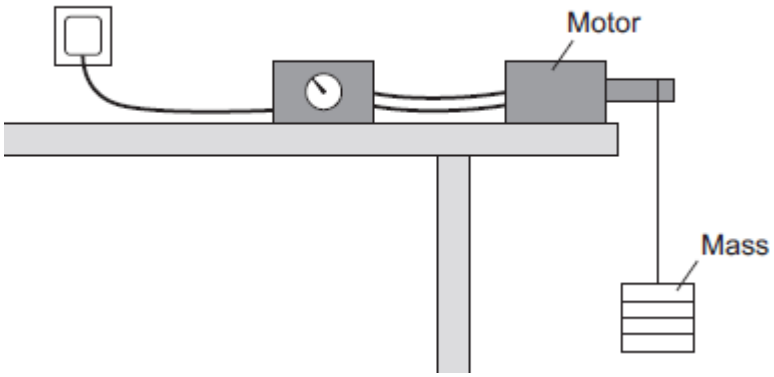
1.....

2.....

(2)

(c) A student used an electric motor to lift a mass. This is shown in **Figure 3**.

Figure 3



The student varied the electrical input power to the motor. For each different electrical input power, he recorded the time taken to lift the mass and calculated the output power of the motor.

The results are shown in the table.

Test	Electrical input power in watts	Work done lifting the mass in joules	Time taken to lift the mass in seconds	Output power in watts
A	20	24	2.4	10
B	40	24	1.2	20
C	60	24	0.8	30
D	80	24	0.2	120

The result for **Test D** is anomalous.

(i) Calculate the efficiency of the motor in **Test D**.

Use the correct equation from **Section C** of the Physics Equations Sheet.

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.....

Efficiency = ...

(2)

(ii) Comment on your answer to part (c)(i).

.....

.....

(1)

(iii) Suggest a reason for this anomalous result.

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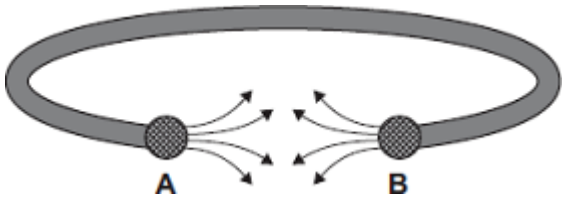
(1)
(Total 12 marks)

Q2.(a) Some people wear magnetic bracelets to relieve pain.

Figure 1 shows a magnetic bracelet.

There are magnetic poles at both **A** and **B**.
Part of the magnetic field pattern between **A** and **B** is shown.

Figure 1



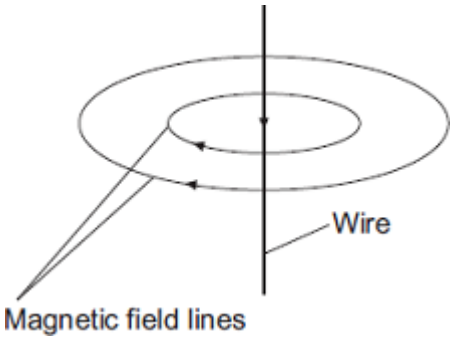
What is the pole at **A**? .....

What is the pole at **B**? .....

(1)

(b) **Figure 2** shows two of the lines of the magnetic field pattern of a current-carrying wire.

Figure 2



The direction of the current is reversed.

What happens to the direction of the lines in the magnetic field pattern?

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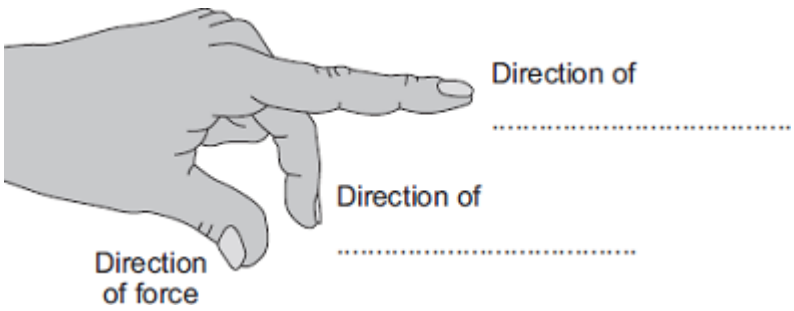
(1)

(c) Fleming's left-hand rule can be used to identify the direction of a force acting on a current-carrying wire in a magnetic field.

(i) Complete the labels in **Figure 3**.

Figure 3

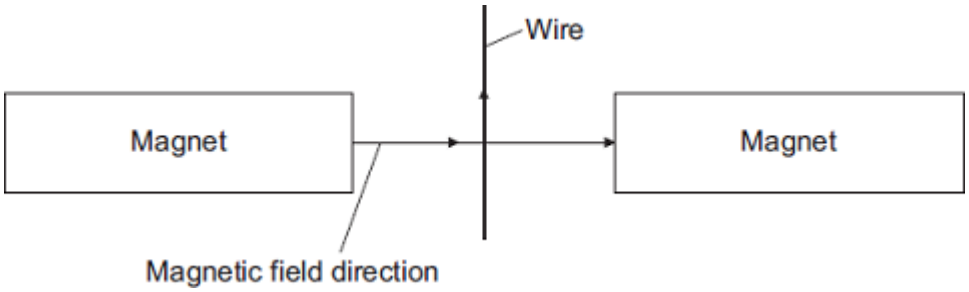


(2)

(ii) **Figure 4** shows:

- the direction of the magnetic field between a pair of magnets
- the direction of the current in a wire in the magnetic field.

Figure 4



In which direction does the force on the wire act?

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(1)

(iii) Suggest **three** changes that would **decrease** the force acting on the wire.

1 .....

2 .....

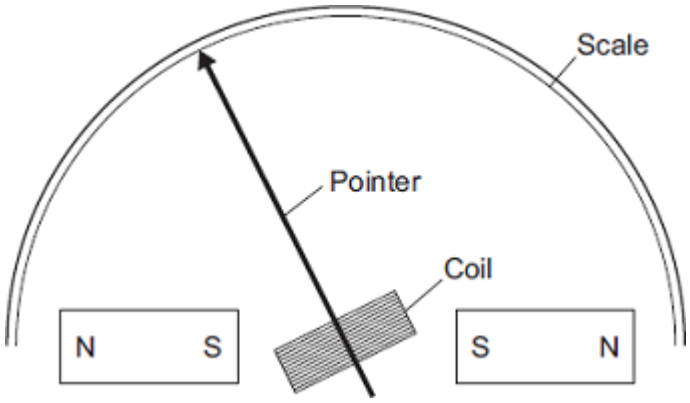
3 .....

(3)

(d) **Figure 5** shows part of a moving-coil ammeter as drawn by a student.

The ammeter consists of a coil placed in a uniform magnetic field.
When there is a current in the coil, the force acting on the coil causes the coil to rotate and the pointer moves across the scale.

Figure 5



(i) The equipment has **not** been set up correctly.

What change would make it work?

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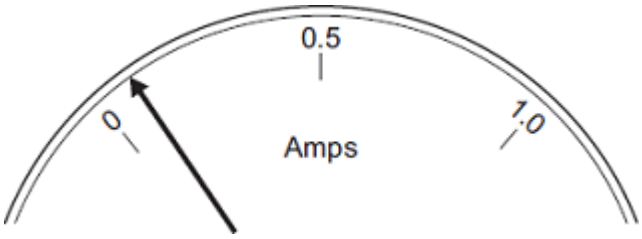
(1)

(ii) **Figure 6** shows the pointer in an ammeter when there is no current.

Figure 6



What type of error does the ammeter have?

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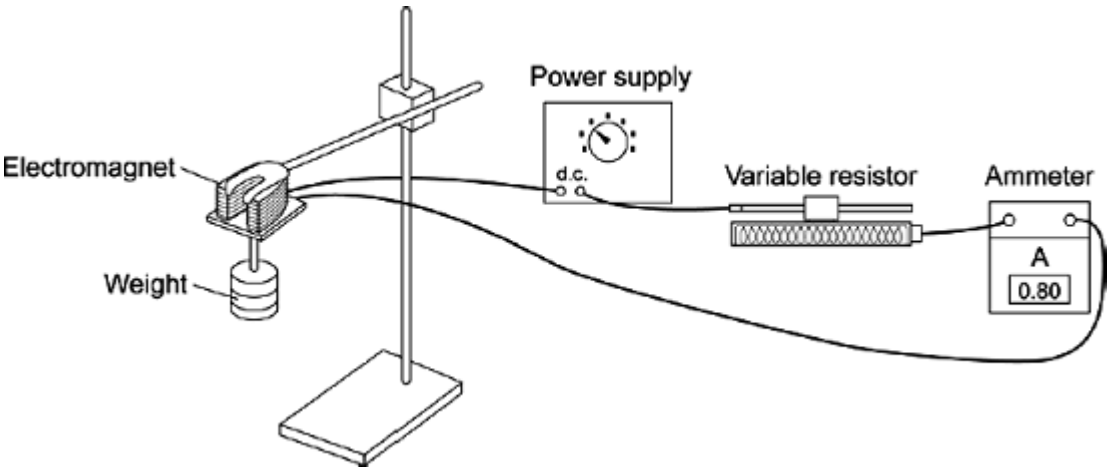
(1)
(Total 10 marks)

Q3. A student used the apparatus shown in the diagram to investigate how the weight supported by an electromagnet depends on:

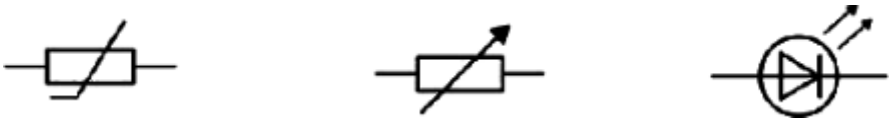
- the current, *I*, flowing through the wire
- the number of turns of wire, *n*, wrapped around the iron core.



For different values of *I* and *n* the student measured the maximum weight supported by the electromagnet.

(a) Which **one** of the following is the circuit symbol for a variable resistor?

Draw a ring around **one** answer.



(1)

(b) The student obtained the three sets of results given below.

I = 2.5 A *n* = 20 *W* = 6.4 N	*I* = 1.0 A *n* = 30 *W* = 6.5 N	*I* = 2.0 A *n* = 10 *W* = 3.7 N

Considering **only** these results, explain why it is not possible to come to any conclusion about how *I* and *n* separately affect the strength of the electromagnet.

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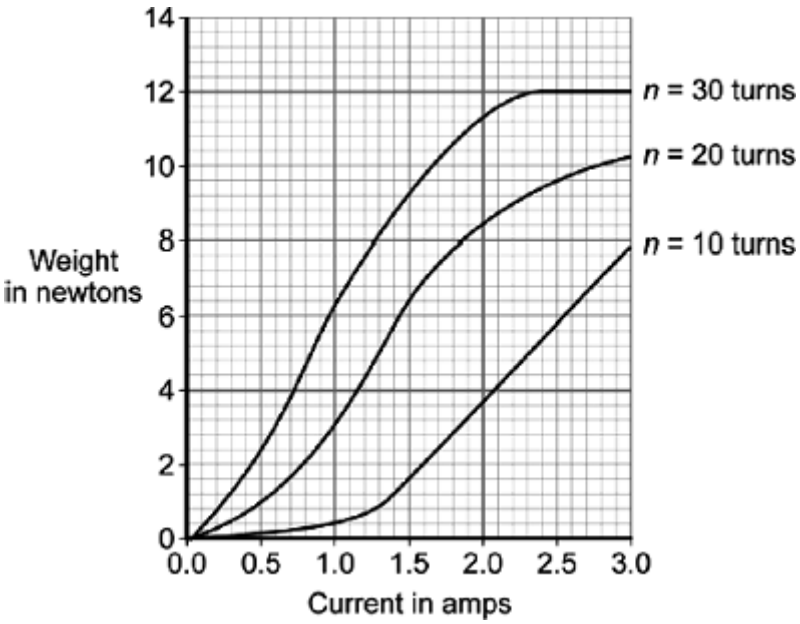
(2)

(c) The student obtained more results, and plotted the graph shown below.



Analyse **all** the results on the graph to draw conclusions for this investigation.

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(5)

(d) The greater the weight supported, the stronger the electromagnet.

The smallest current that gives an electromagnet maximum strength is called the *saturation current*.

What is the saturation current for the electromagnet with 30 turns of wire?

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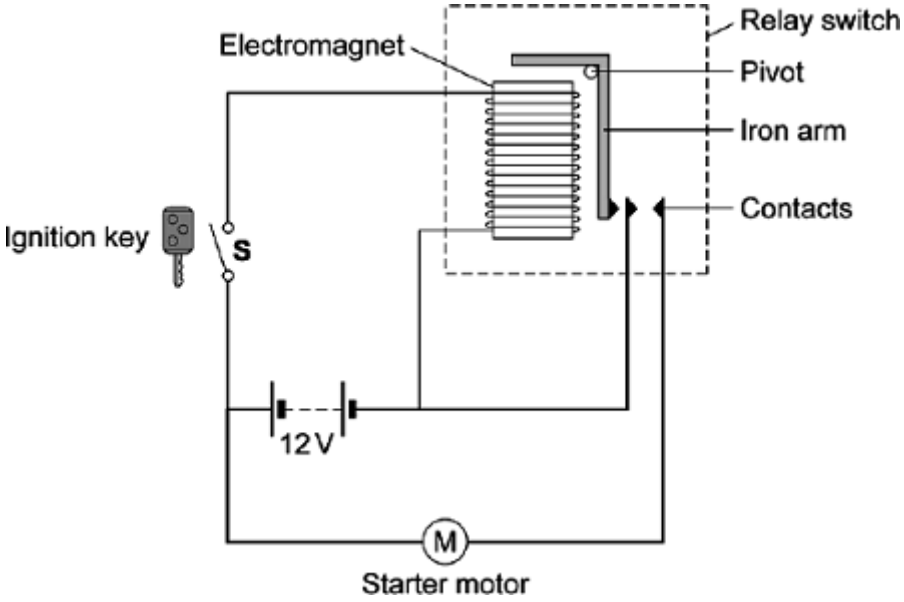
(1)

(e) The diagram shows the circuit for the electric starter motor of a car. The circuit includes a relay switch, which is a switch closed by an electromagnet.



(i) Explain how turning the ignition key causes the starter motor to work.

The explanation has been started for you.

When the ignition key is turned the switch S closes and ...

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(4)

(ii) Electric starter motors are always less than 100% efficient.

Explain why.

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(3)
(Total 16 marks)