GCSE
PHYSICS
AQA - COMBINED SCIENCE

Materials
For this paper you must have:

- Ruler
- Pencil, Rubber, Protractor and Compass
- Scientific calculator, which you are expected to use when appropriate

Instructions

- Answer all questions
- Answer questions in the space provided
- All working must be shown
- Do all rough work in this book. Cross out any rough work you don't want to be marked

Information

- The marks for the questions are shown in brackets

www.examqa.com
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

(b) Look at Figure 1.

**Figure 1**

Opposite poles brought together

![Diagram of opposite poles]

Same poles brought together

![Diagram of same poles]

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

Opposite poles brought together ____________________________________________

_______________________________________________________________________

Same poles brought together _____________________________________________

_______________________________________________________________________
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)
The diagram shows a demonstration carried out by a teacher.

When the switch is closed, there is a current of 2 A through the wire. The wire experiences a force and moves.

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

<table>
<thead>
<tr>
<th>generator</th>
<th>motor</th>
<th>transformer</th>
</tr>
</thead>
</table>

The demonstration shows the __________________________effect.

(b) State two changes that the teacher could make to the demonstration, each of which would increase the force on the wire. The teacher does not touch the wire.

1. _________________________________________________________________
   ___________________________________________________________________

2. _________________________________________________________________
   ___________________________________________________________________

(c) State one change that the teacher could make to the demonstration to change the direction of the force on the wire.

   ___________________________________________________________________
(d) With the switch closed, the teacher changes the position of the wire so that the force on the wire is zero.

What is the position of the wire?

Tick (✓) one box.

- The wire is at 90° to the direction of the magnetic field.
- The wire is at 45° to the direction of the magnetic field.
- The wire is parallel to the direction of the magnetic field.

(Total 5 marks)

(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.

(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.

<table>
<thead>
<tr>
<th>Number of sheets of paper between the magnets</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newtonmeter reading as the magnets separate</td>
<td>3.1</td>
<td>2.6</td>
<td>2.1</td>
<td>1.5</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

(i) Describe the pattern of her results.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(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)

(2)
(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)
(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.

(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.

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

1. _________________________________________________________________
   ___________________________________________________________________

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

1. _________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

2. _________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

(Total 6 marks)

(a) A science technician sets up the apparatus shown below to demonstrate the motor effect. He uses a powerful permanent magnet.

The copper roller is placed across the metal rails. When the switch is closed, the copper roller moves to the right.

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

   This happens because copper is
   an electrical conductor.
   an electrical insulator.
   a magnetic material.

(ii) Suggest one change that the technician can make which will cause the copper roller to move faster.

   ________________________________________________________________
   ________________________________________________________________

(1)

(1)
(iii) Suggest two changes which the technician can make, each of which will separately cause the copper roller to move to the left.

1. ____________________________________________________________
   ______________________________________________________________

2. ____________________________________________________________
   ______________________________________________________________

(b) Many electrical appliances, such as vacuum cleaners, drills and CD players, contain electric motors. As more electrical appliances are developed, more electricity needs to be generated. Generating electricity often produces pollutant gases.

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

Generating more electricity to power the increasing number of electrical appliances used raises an ethical  
an environmental  
a political  
issue.

(ii) The number of electrical appliances used in the world’s richest countries is increasing yet many people in the world’s poorest countries have no access to electricity.

What type of issue does this inequality between people in different countries raise?

________________________________________________________________________

(Total 6 marks)
Many electrical appliances use the circular motion produced by their electric motor.

(a) Put ticks (✓) in the boxes next to all the appliances in the list which have an electric motor.

- electric drill
- electric fan
- electric food mixer
- electric iron
- electric kettle
- electric screwdriver

(b) One simple design of an electric motor is shown in the diagram. It has a coil which spins between the ends of a magnet.

(i) Give two ways of reversing the direction of the forces on the coil in the electric motor.

1. __________________________________________________________
   __________________________________________________________

2. __________________________________________________________
   __________________________________________________________

(2)
(ii) Give **two** ways of increasing the forces on the coil in the electric motor.

1. _________________________________________________________________

2. _________________________________________________________________

(Total 6 marks)

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. _________________________________________________________________

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

1. _________________________________________________________________

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

___________________________________________________________________
___________________________________________________________________

(Total 5 marks)

(a) A laboratory technician sets up a demonstration.

A flexible wire is suspended between the ends of a horseshoe magnet. The flexible wire hangs from a cotton thread. When the switch is closed, the wire kicks forward.

Identify the effect which is being demonstrated.

___________________________________________________________________

(b) A teacher makes some changes to the set-up of the demonstration.

What effect, if any, will each of the following changes have?

(i) more powerful horseshoe magnet is used.

___________________________________________________________________
___________________________________________________________________

(1)
(ii) The connections to the power supply are reversed.

______________________________________________________________

______________________________________________________________

(1)
(Total 3 marks)
The diagram shows a ‘G-machine’. The G-machine is used in astronaut training.

The G-machine moves the astronaut in a horizontal circle.

(a) The force causing the astronaut to move in a circle is measured.

The graph shows how the speed of the astronaut affects the force causing the astronaut to move in a circle for two different G-machines.

The radius of rotation of the astronaut is different for each G-machine.

(i) State three conclusions that can be made from the graph.

1. ____________________________________________________________
   ____________________________________________________________
2. ____________________________________________________________
   ____________________________________________________________
3. ____________________________________________________________
   ____________________________________________________________
(ii) The speed of rotation of G-machine 1 is increased from 20 m/s to 40 m/s. Determine the change in force on the astronaut.

Change in force = ____________________________ N

(b) Each G-machine is rotated by an electric motor. The diagram shows a simple electric motor.

(i) A current flows through the coil of the motor. Explain why side A of the coil experiences a force.

(ii) Draw arrows on the diagram to show the direction of the forces acting on side A of the coil and side C of the coil.
(iii) When horizontal, side B experiences no force.

Give the reason why.

___________________________________________________________________

___________________________________________________________________

(1)

(c) While a G-machine is rotating, the operators want to increase its speed.

What can the operators do to make the G-machine rotate faster?

___________________________________________________________________

___________________________________________________________________

(1)

(d) The exploration of space has cost a lot of money.

Do you think spending lots of money on space exploration has been a good thing?

Draw a ring around your answer.

Yes           No

Give a reason for your answer.

___________________________________________________________________

___________________________________________________________________

(1)

(Total 10 marks)
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.

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___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(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.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(4)

(1)
(c) The copper rod in the figure above has a length of 7 cm and a mass of $4 \times 10^{-4}$ 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)