AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.7.2 THE MOTOR EFFECT (PACK 1)

SCORE	PERCENTAGE
/168	%

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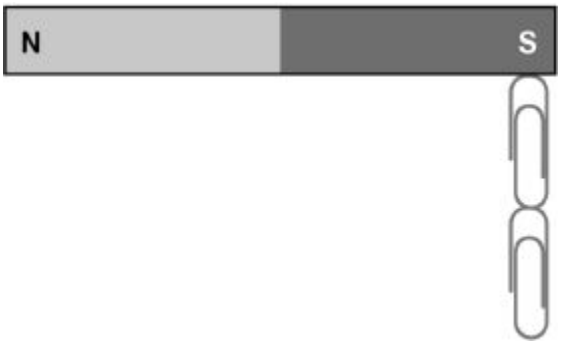
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Q1.

Figure 1 shows two paper clips hanging from a bar magnet.

Figure 1



The paper clips have become magnetised.

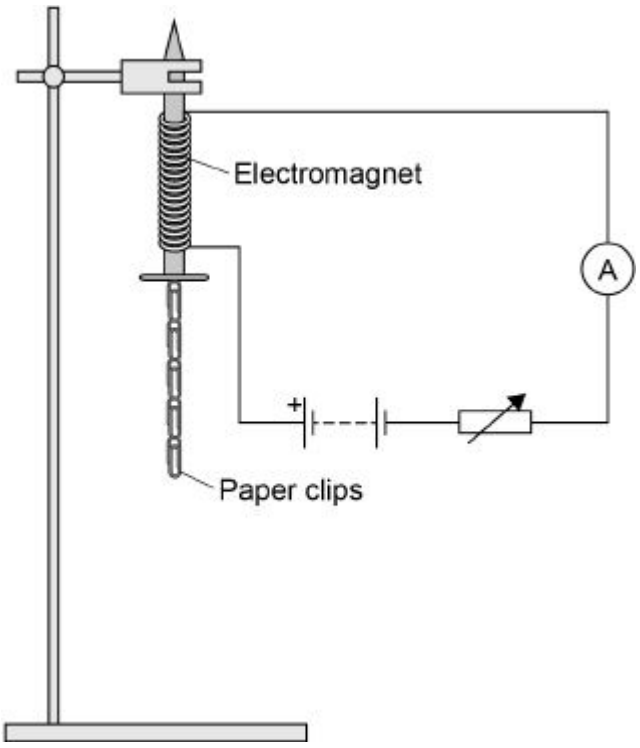
(a) Label the north and south poles of both paper clips.

(1)

A student investigated how the number of turns of wire on an electromagnet affects the strength of the electromagnet.

Figure 2 shows the equipment used by the student. Throughout the investigation the student kept the current through the wire constant.

Figure 2



(b) The student measured the strength of the electromagnet by counting the number of paper clips the electromagnet could hold.

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Explain why it was important that the paper clips were all the same size.

_____

_____

_____

_____

(2)

The table below shows the student's results.

Number of turns of wire on the electromagnet	Number of paper clips held
10	3
20	6
30	9
40	12

(c) Describe the pattern shown in the table.

_____

_____

_____

_____

(2)

(d) The student then used 50 turns of wire on the electromagnet.

The electromagnet picked up 18 paper clips. This was more paper clips than the student had expected.

Which **one** is the most likely cause of this result?

Tick **one** box.

The paper clips used with 50 turns were larger than the others. ☐

There were less than 50 turns of wire on the electromagnet. ☐

Some of the paper clips were already magnetised. ☐

(1)

(e) The student repeated the measurement for 50 turns of wire three more times.

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This gave her the following set of results.

18 16 14 15

Explain what the student should now do with the **four** results for 50 turns of wire.

_____

_____

_____

_____

_____

_____

(3)

(f) The student wrote the hypothesis:

'Increasing the current through the wire will make the electromagnet stronger.'

Describe how the student should change the investigation to test this hypothesis.

_____

_____

_____

_____

_____

_____

(3)

(Total 12 marks)

Q2.

The circle in **Figure 1** represents a straight wire carrying a current. The cross shows that the current is into the plane of the paper.

Figure 1



(a) Complete **Figure 1** to show the magnetic field pattern around the wire.

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(2)

(b) The magnetic flux density 10 cm from the wire is 4 microtesla.

Which of the following is the same as 4 microtesla?

Tick **one** box.

4×10^{-2} T ☐

4×10^{-3} T ☐

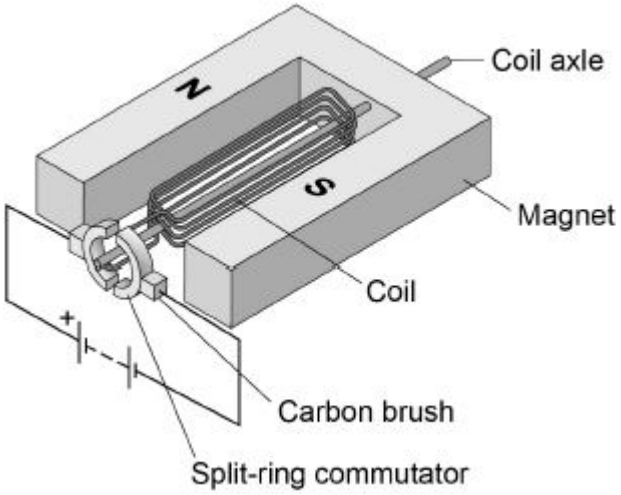
4×10^{-6} T ☐

4×10^{-9} T ☐

(1)

(c) **Figure 2** shows a simple electric motor.

Figure 2



When there is a current in the coil, the coil rotates continuously.

Explain why.

_____

_____

_____

_____

_____

_____

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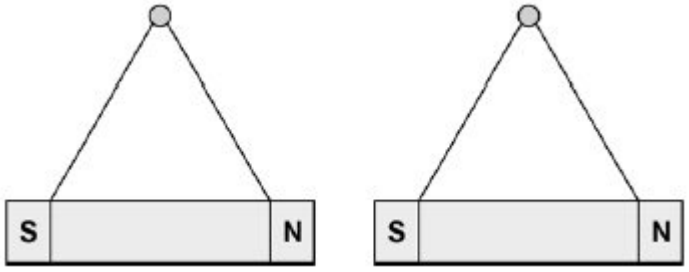
(4)

(Total 7 marks)

Q3.

Figure 1 shows two bar magnets suspended close to each other.

Figure 1



(a) Explain what is meant by the following statement.

'A non-contact force acts on each magnet'.

_____

_____

_____

_____

(2)

(b) Describe how to plot the magnetic field pattern of a bar magnet.

_____

_____

_____

_____

_____

_____

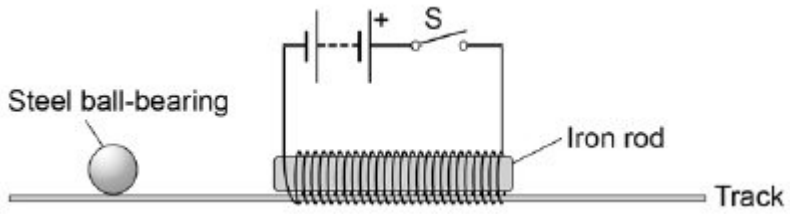
(3)

A student has set up the apparatus shown in **Figure 2**.

The iron rod is fixed to the track and cannot move.

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Figure 2



(c) The student gives the steel ball bearing a gentle push in the direction of the iron rod.

At the same time the student closes the switch **S**.

Explain the effect on the motion of the ball bearing when the switch **S** is closed.

_____

_____

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_____

_____

(4)

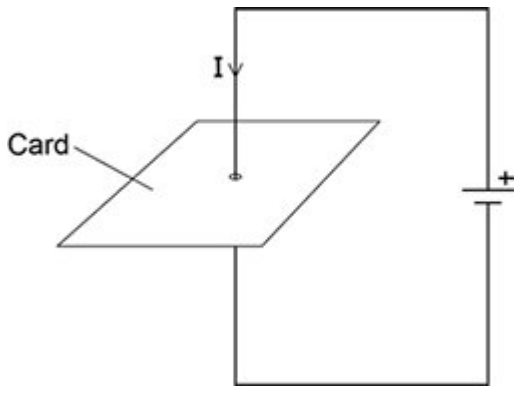
(Total 9 marks)

Q4.

Figure 1 shows a straight wire passing through a piece of card.

A current (I) is passing down through the wire.

Figure 1



(a) Describe how you could show that a magnetic field has been produced around the wire.

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_____

_____

_____

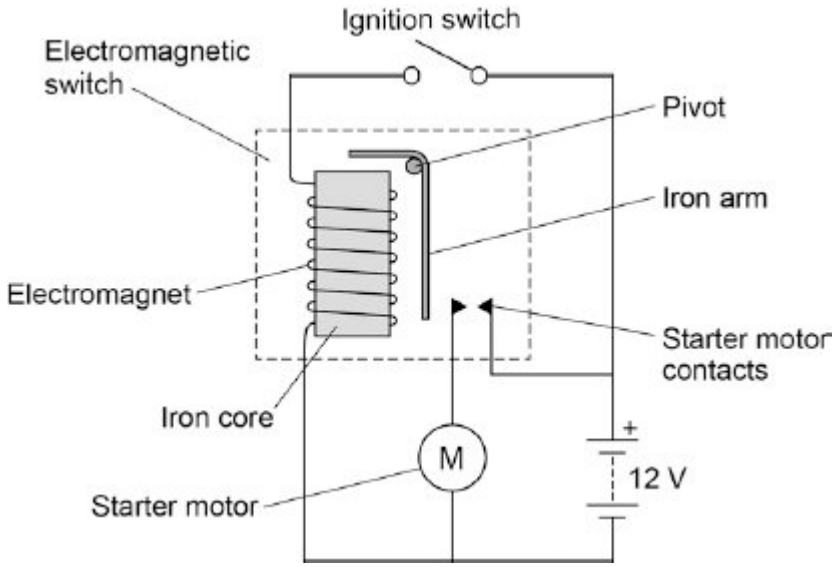
_____

(2)

(b) **Figure 2** shows the ignition circuit used to switch the starter motor in a car on.

The circuit includes an electromagnetic switch.

Figure 2



Explain how the ignition circuit works.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 6 marks)

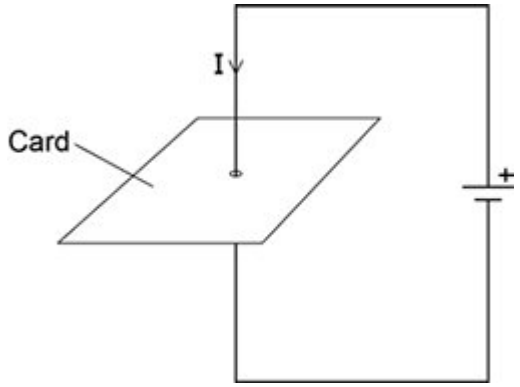
Q5.

Figure 1 shows a straight wire passing through a piece of card.

A current (I) is passing down through the wire.

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Figure 1



(a) Describe how you could show that a magnetic field has been produced around the wire.

_____

_____

_____

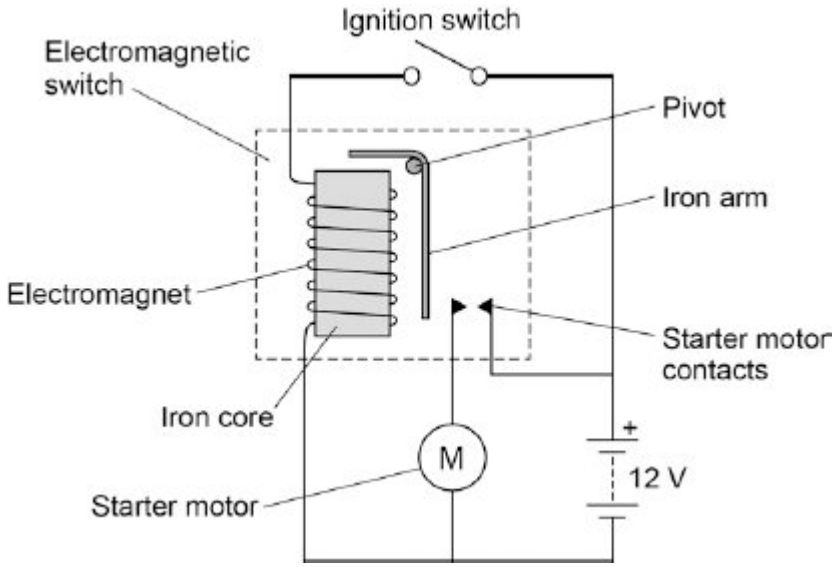
_____

(2)

(b) **Figure 2** shows the ignition circuit used to switch the starter motor in a car on.

The circuit includes an electromagnetic switch.

Figure 2



Explain how the ignition circuit works.

_____

_____

_____

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_____

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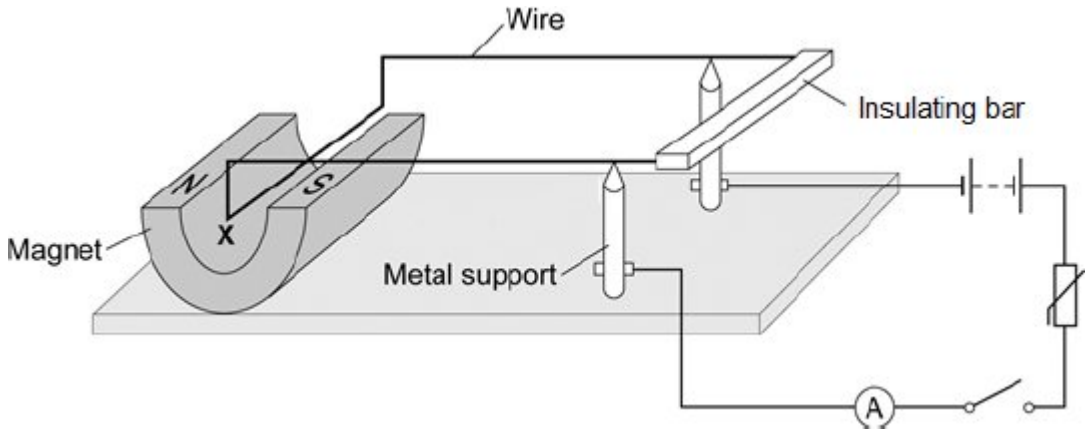
(4)

(Total 6 marks)

Q6.

Figure 1 shows a piece of apparatus called a current balance.

Figure 1



When the switch is closed, the part of the wire labelled **X** experiences a force and moves downwards.

(a) What is the name of the effect that causes the wire **X** to move downwards?

_____

(1)

(b) Suggest one change you could make to the apparatus in **Figure 1** that would increase the size of the force that wire **X** experiences.

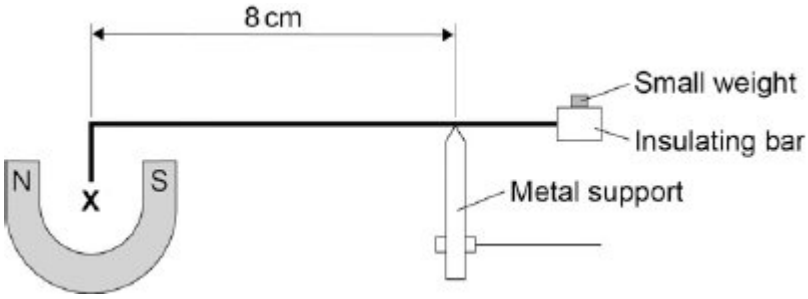
_____

(1)

(c) **Figure 2** shows how a small weight placed on the insulating bar makes the wire **X** go back and balance in its original position.

Figure 2

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The wire **X** is 5 cm long and carries a current of 1.5 A.

The small weight causes a clockwise moment of 4.8×10^{-4} Nm.

Calculate the magnetic flux density where the wire **X** is positioned

Give the unit.

_____

_____

_____

_____

_____

_____

_____

Magnetic flux density = _____ Unit _____

(6)

(Total 8 marks)

Q7.

(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.

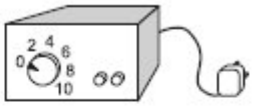
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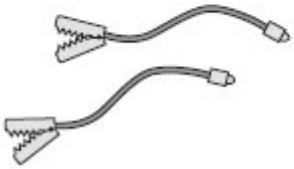
Insulated wire



Iron nail



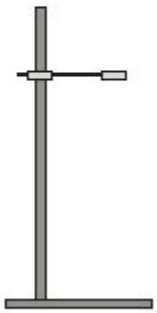
Power supply



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)

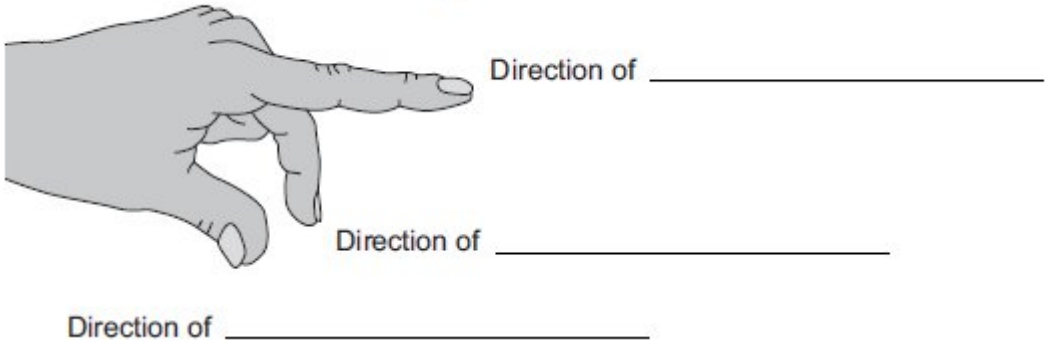
Q8.

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

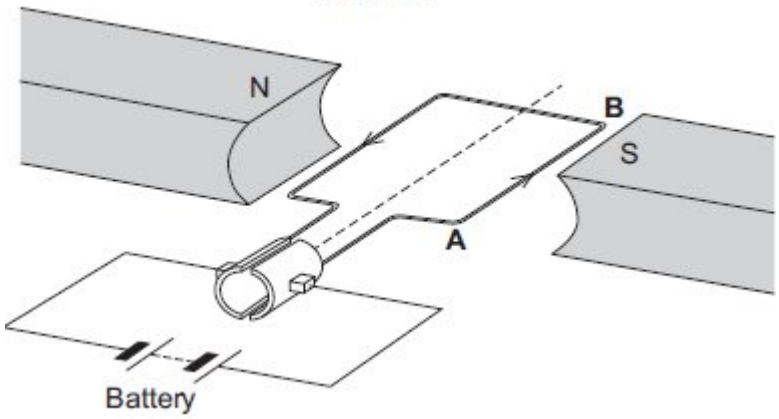


(3)

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

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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**.

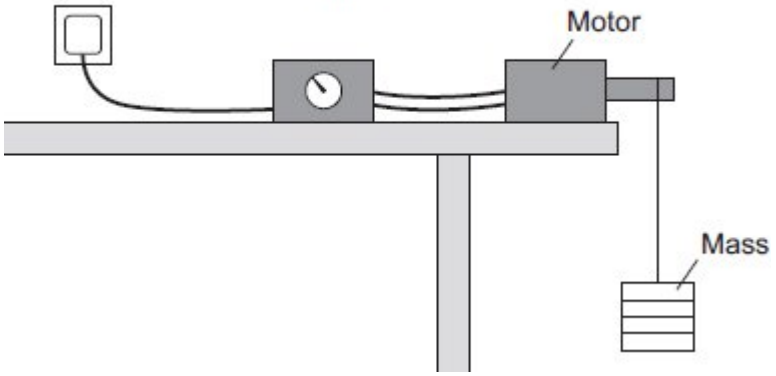
1. _____

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	Work done	Time taken to	Output

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	input power in watts	lifting the mass in joules	lift the mass in seconds	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**.

_____

_____

Efficiency = _____

(2)

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

_____

_____

(1)

(iii) Suggest a reason for this anomalous result.

_____

_____

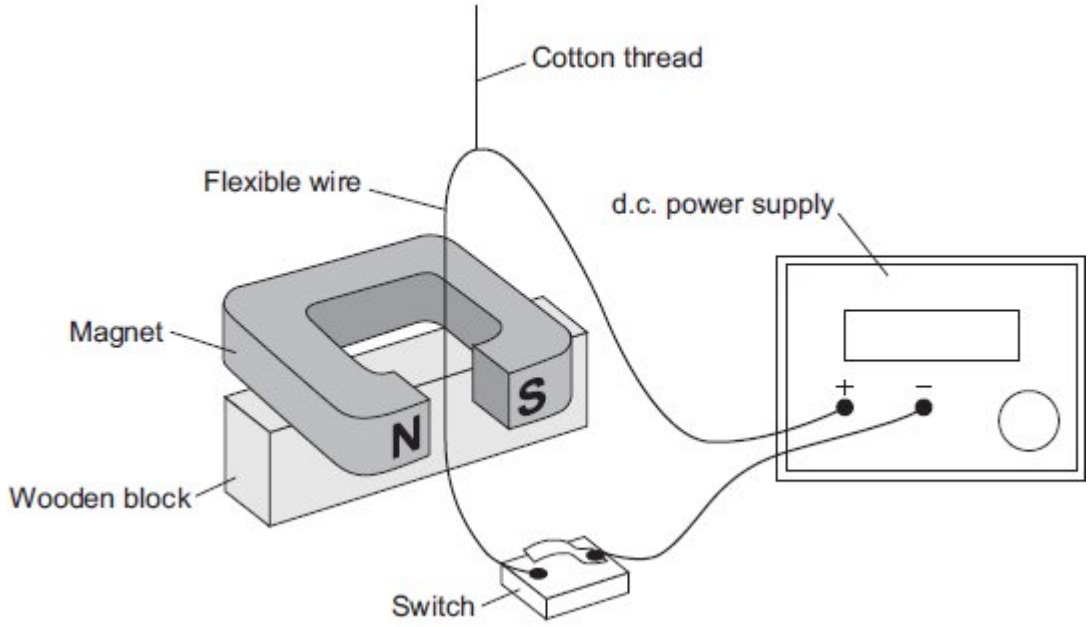
(1)

(Total 12 marks)

Q9.

The diagram shows a demonstration carried out by a teacher.

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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.

generator	**motor**	**transformer**

The demonstration shows the _____ effect.

(1)

(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. _____

_____

(2)

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

_____

_____

(1)

(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.

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The wire is at 90° to the direction of the magnetic field. ☐

The wire is at 45° to the direction of the magnetic field. ☐

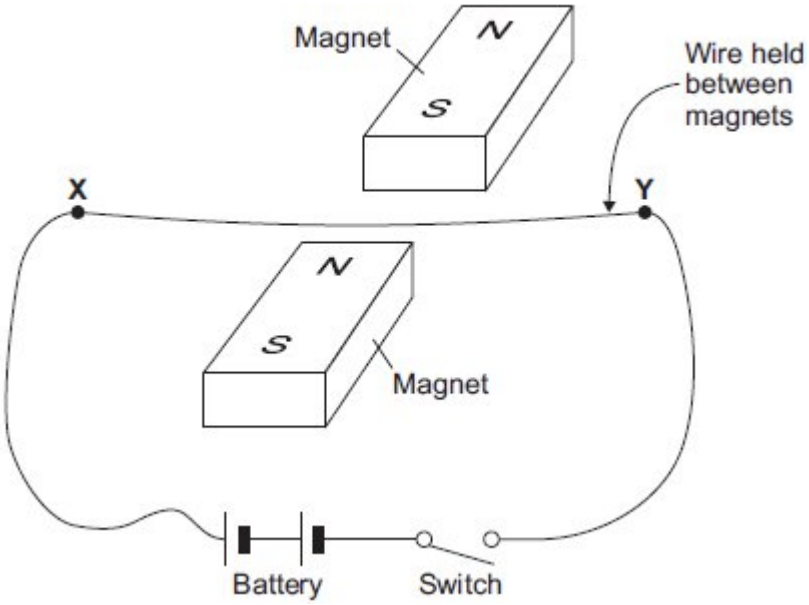
The wire is parallel to the direction of the magnetic field. ☐

(1)

(Total 5 marks)

Q10.

The diagram shows apparatus set up by a student.



Closing the switch creates a force that acts on the wire **XY**.

(a) (i) Explain why a force acts on the wire **XY** when the switch is closed.

_____

_____

_____

_____

_____

_____

(3)

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(ii) The force causes the wire **XY** to move.
Draw an arrow on the diagram above to show the direction in which the wire **XY** will move.

(1)

(iii) State the effect that this experiment demonstrates.

_____

(1)

(b) The student replaced the battery with a low frequency alternating current (a.c.) power supply.

The student closed the switch.

(i) Describe the movement of the wire.

_____

(1)

(ii) Give a reason for your answer to part (i).

_____

_____

_____

(1)

(Total 7 marks)

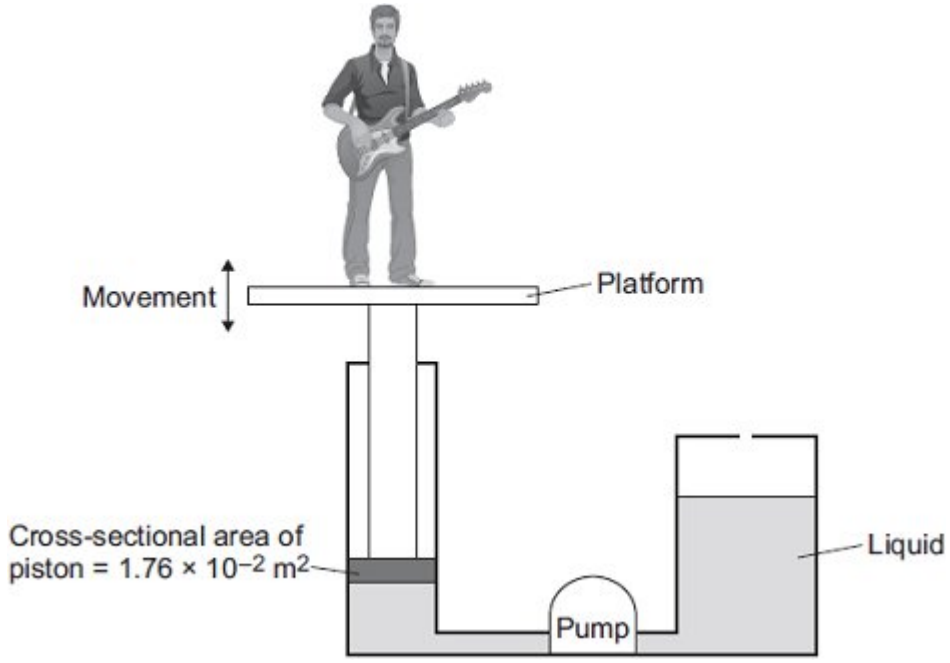
Q11.

Musicians sometimes perform on a moving platform.

Figure 1 shows the parts of the lifting machine used to move the platform up and down.

Figure 1

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(a) What type of system uses a liquid to transmit a force?

_____

(1)

(b) The pump creates a pressure in the liquid of 8.75 x 10^4 Pa to move the platform upwards.

Calculate the force that the liquid applies to the piston.

_____

_____

_____

Force = _____ N

(2)

(c) The liquid usually used in the machine is made by processing oil from underground wells. A new development is to use plant oil as the liquid.

Extracting plant oil requires less energy than extracting oil from underground wells.

Suggest an environmental advantage of using plant oil.

_____

_____

_____

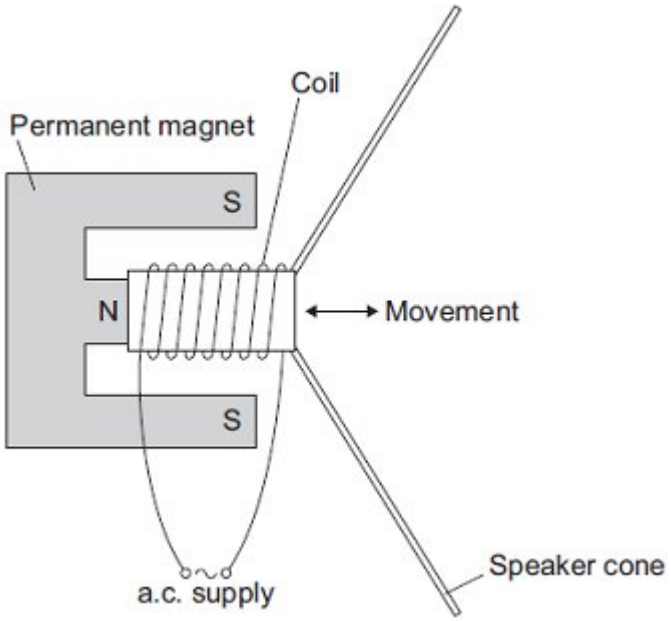
(1)

(d) Musicians often use loudspeakers.

Figure 2 shows how a loudspeaker is constructed.

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Figure 2



The loudspeaker cone vibrates when an alternating current flows through the coil.

Explain why.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 8 marks)

Q12.

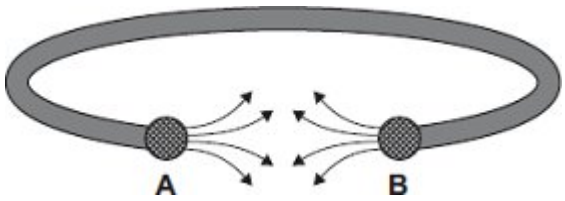
(a) Some people wear magnetic bracelets to relieve pain.

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

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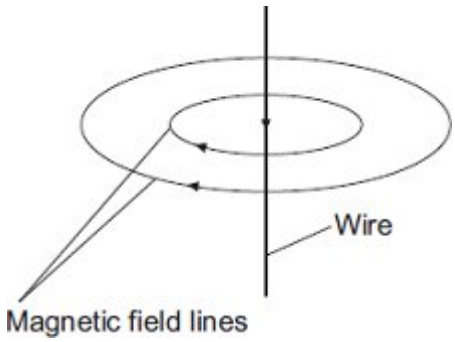
What is the pole at **A**? _____

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?

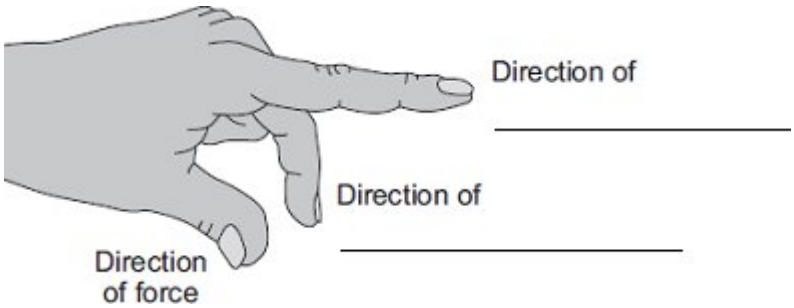
_____

(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



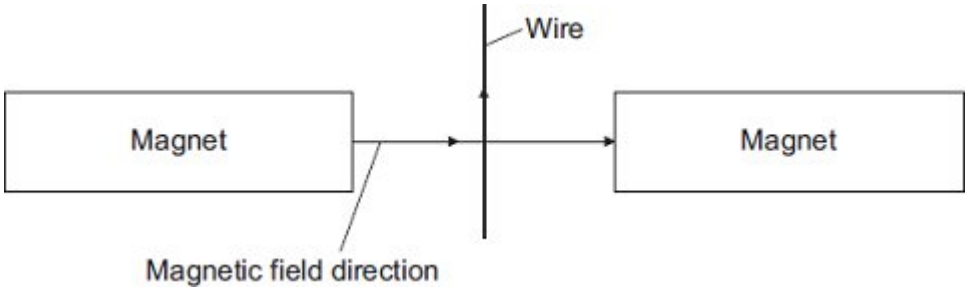
(2)

(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.

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Figure 4



In which direction does the force on the wire act?

_____

(1)

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

1. _____

2. _____

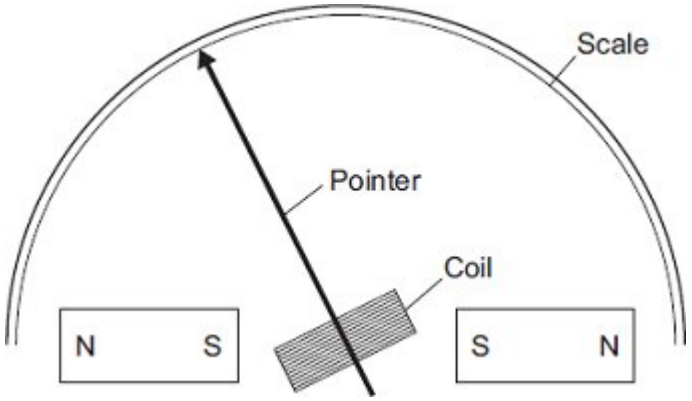
3. _____

(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?

_____

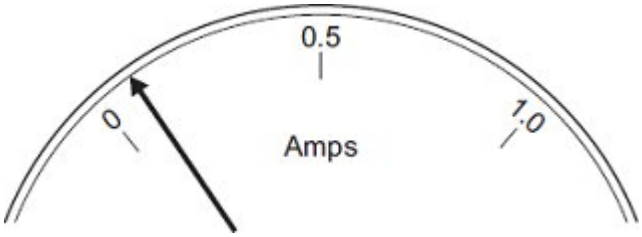
_____

(1)

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

Figure 6



What type of error does the ammeter have?

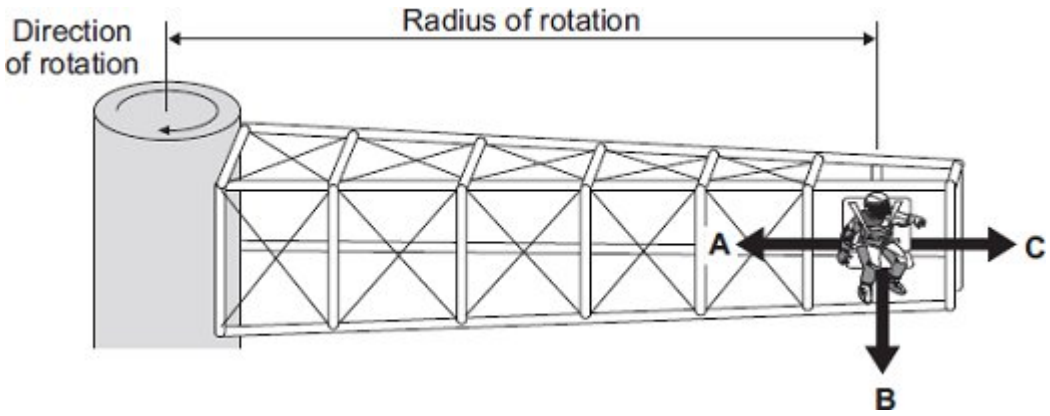
_____

(1)

(Total 10 marks)

Q13.

The diagram shows a 'G-machine'. The G-machine is used in astronaut training.



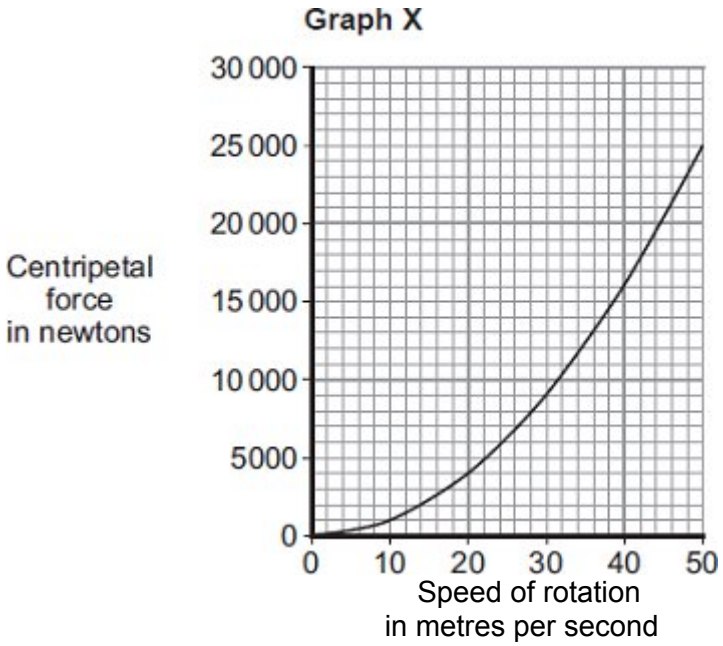
The G-machine moves the astronaut in a horizontal circle.

Force A is known as the **centripetal** force acting on the astronaut

(a) The centripetal force on the astronaut is measured.

Graph X shows how the centripetal force is affected by the speed of rotation. The radius of rotation is kept the same.

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(i) Use **Graph X** to determine the centripetal force on the astronaut when rotating at a speed of 30 metres per second.

Centripetal force = _____ newtons

(1)

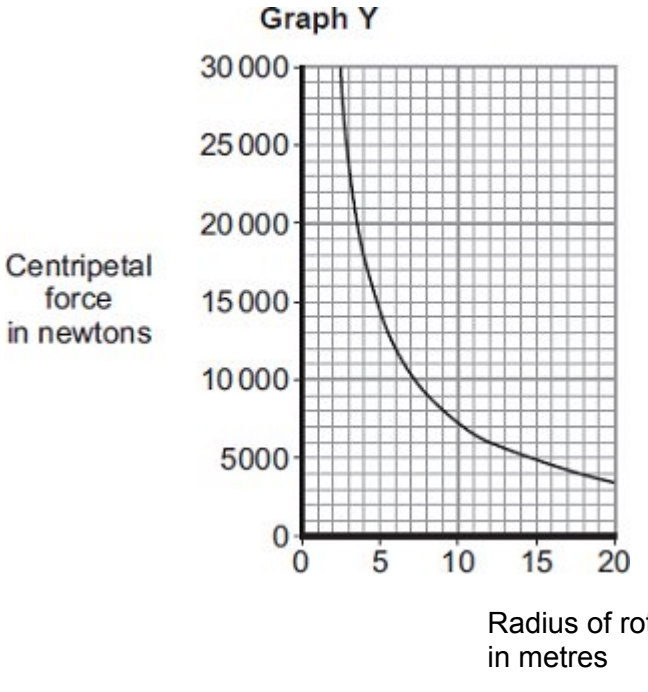
(ii) Complete the following sentence to give the conclusion that can be made from **Graph X**.

Increasing the speed of rotation of a G-machine will _____

the centripetal force on the astronaut.

(1)

(iii) **Graph Y** shows how the centripetal force is affected by the radius of rotation, when the speed of rotation is kept the same.



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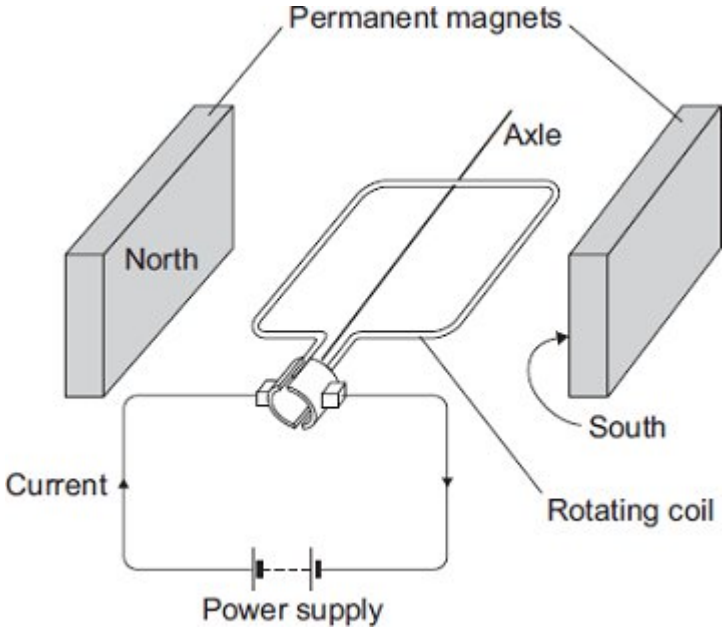
Complete the following sentence to give the conclusion that can be made from **Graph Y**.

The greater the radius of rotation, the _____ the

centripetal force on the astronaut.

(1)

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



The following statements explain how the motor creates a turning force. The statements are in the wrong order.

M – The magnetic field interacts with the magnetic field of the permanent magnets.

N – A magnetic field is created around the coil.

O – The power supply applies a potential difference across the coil.

P – This creates a force that makes the coil spin.

Q – A current flows through the coil.

Arrange the statements in the correct order. Two of them have been done for you.



(2)

(c) The electric motor produces a turning force.

Give **two** ways of increasing the turning force.

1. _____

_____

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2. _____

_____

(2)

(d) Draw a ring around the correct answer to complete the sentence.

It costs a lot of money to send astronauts into space.

This is

an economic
an environmental
a social

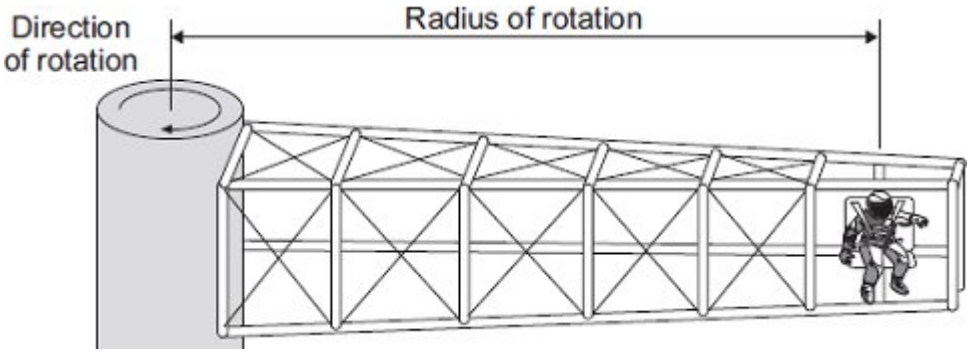
issue.

(1)

(Total 8 marks)

Q14.

The diagram shows a 'G-machine'. The G-machine is used in astronaut training.



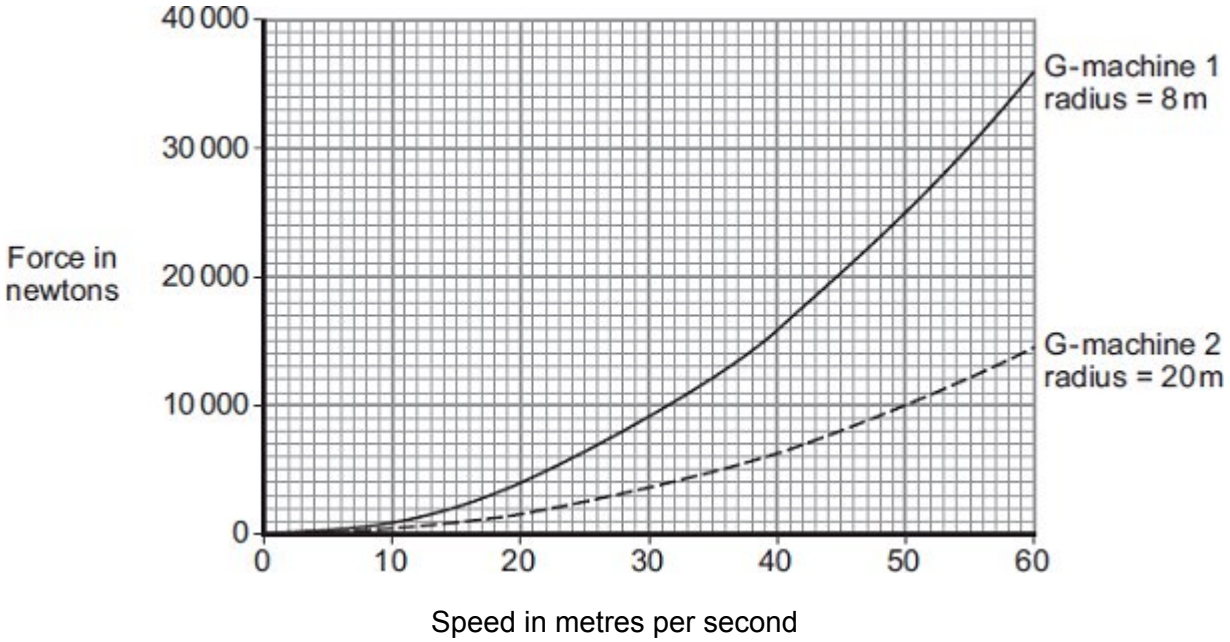
The G-machine moves the astronaut in a horizontal circle.

(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.

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

1. _____

_____

2. _____

_____

3. _____

_____

(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.

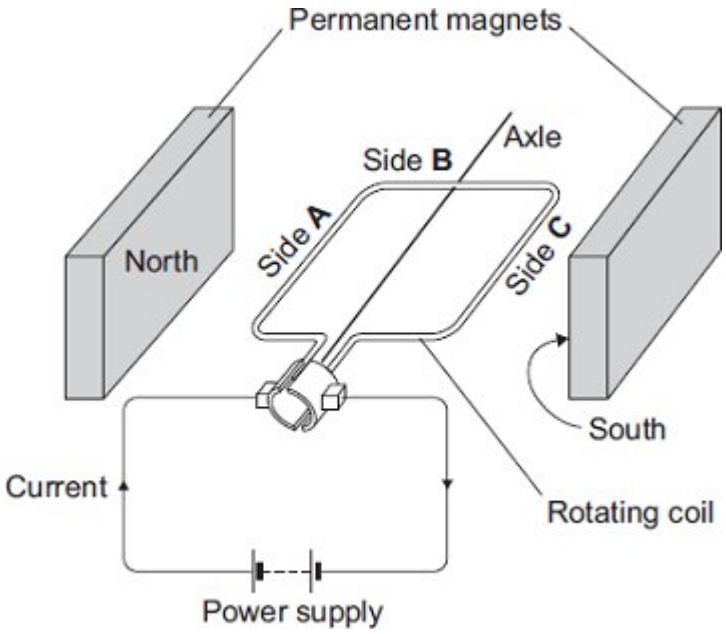
_____

Change in force = _____ N

(1)

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

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(i) A current flows through the coil of the motor.

Explain why side **A** of the coil experiences a force.

_____

_____

_____

_____

(2)

(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.

(1)

(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?

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Draw a ring around your answer.

Yes **No**

Give a reason for your answer.

_____

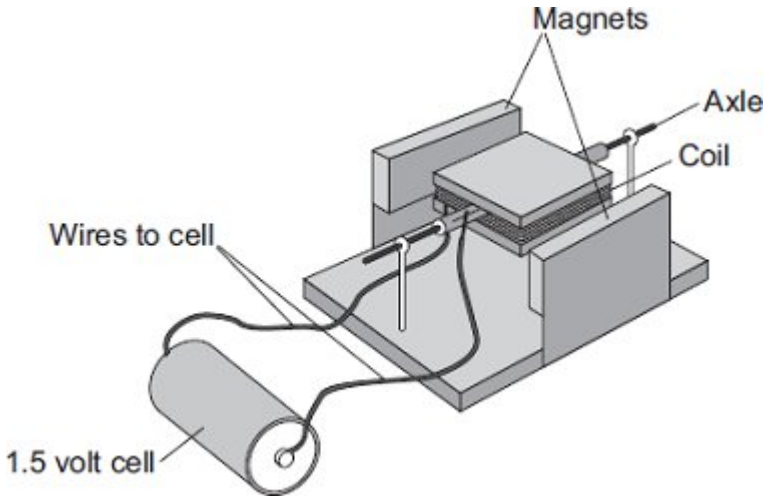
_____

(1)

(Total 10 marks)

Q15.

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)

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

1. _____

_____

2. _____

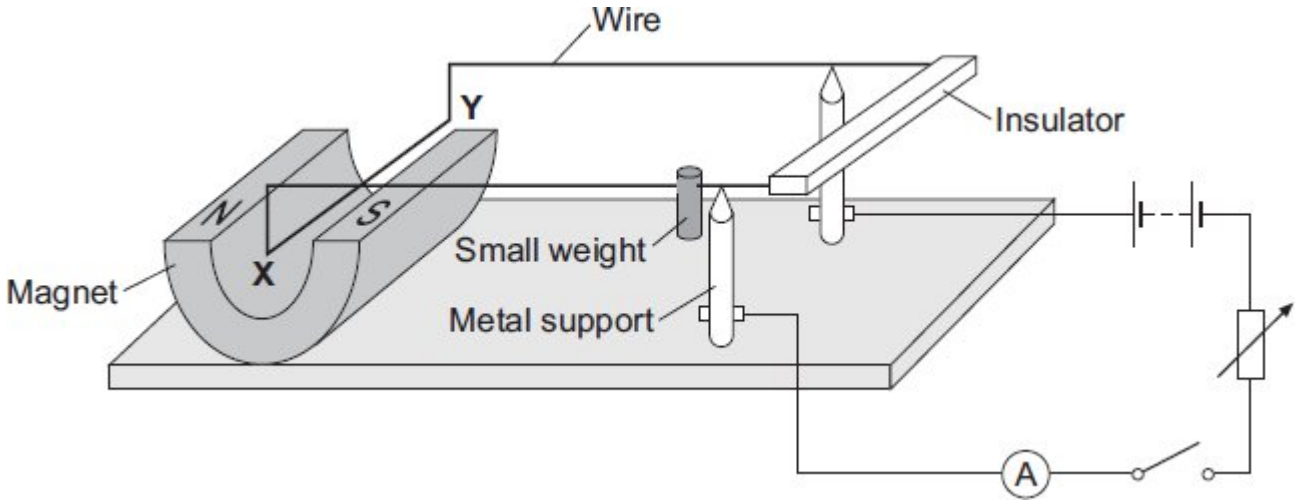
_____

(2)

(Total 5 marks)

Q16.

The diagram shows a device called a current balance.



(a) (i) When the switch is closed, the part of the wire labelled **XY** moves upwards.

Explain why.

_____

_____

_____

_____

(2)

(ii) What is the name of the effect that causes the wire **XY** to move?

_____

(1)

(iii) An alternating current (a.c.) is a current which reverses direction. How many times the current reverses direction in one second depends on the frequency of the alternating supply.

Describe the effect on the wire **XY** if the battery is replaced by an a.c. supply having a frequency of 5 hertz.

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_____

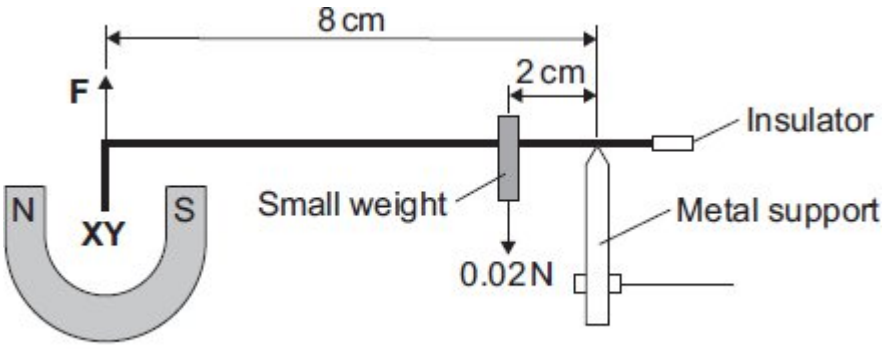
_____

_____

_____

(2)

(b) The diagram shows how a small weight can be used to make the wire **XY** balance horizontally.



Side view

Use the data in the diagram and the equation in the box to calculate the force, **F**, acting on the wire **XY**.

moment = force × perpendicular distance from the line of action of the force to the axis of rotation

Show clearly how you work out your answer.

_____

_____

_____

_____

Force = _____ N

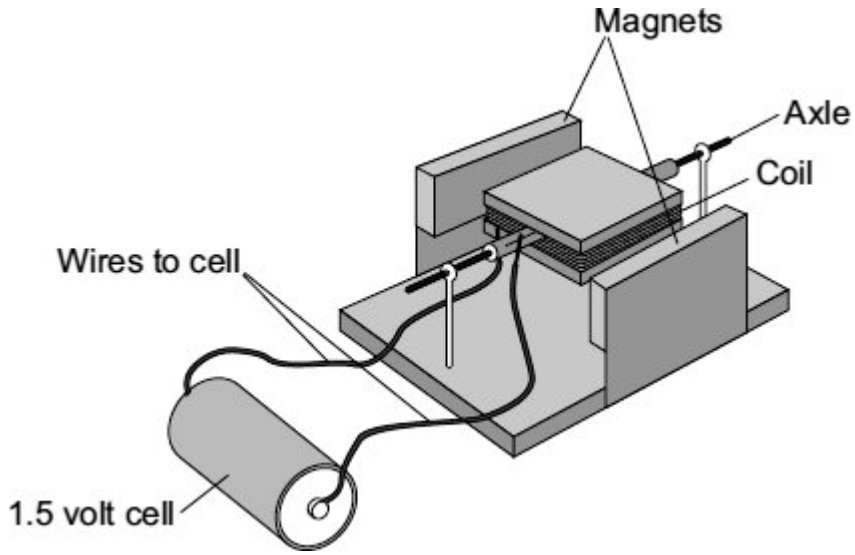
(3)

(Total 8 marks)

Q17.

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

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(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. _____

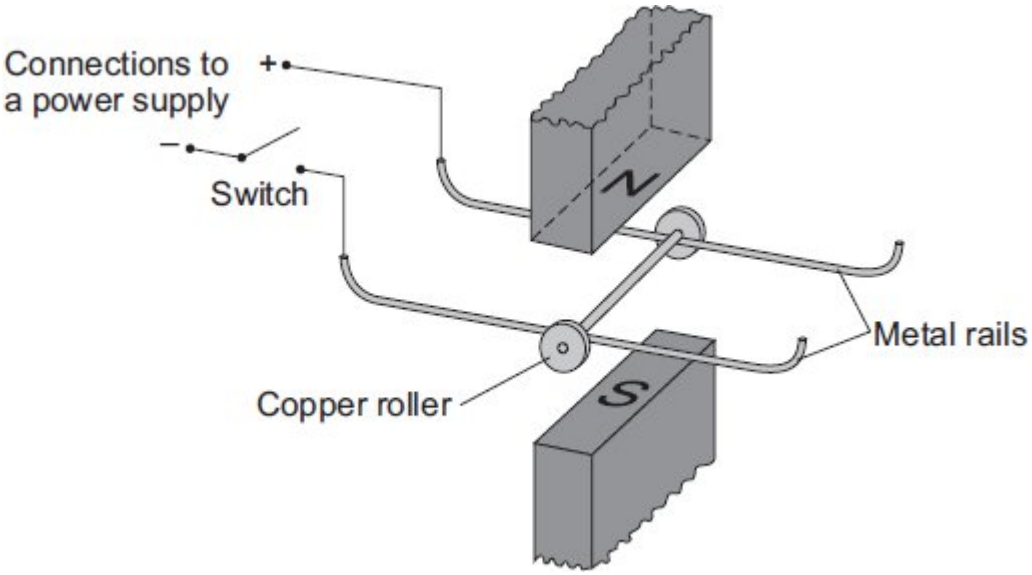
_____

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(2)
(Total 6 marks)

Q18.

(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.

(1)

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

_____

_____

(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. _____

_____

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(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.

(1)

(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?

_____

(1)

(Total 6 marks)

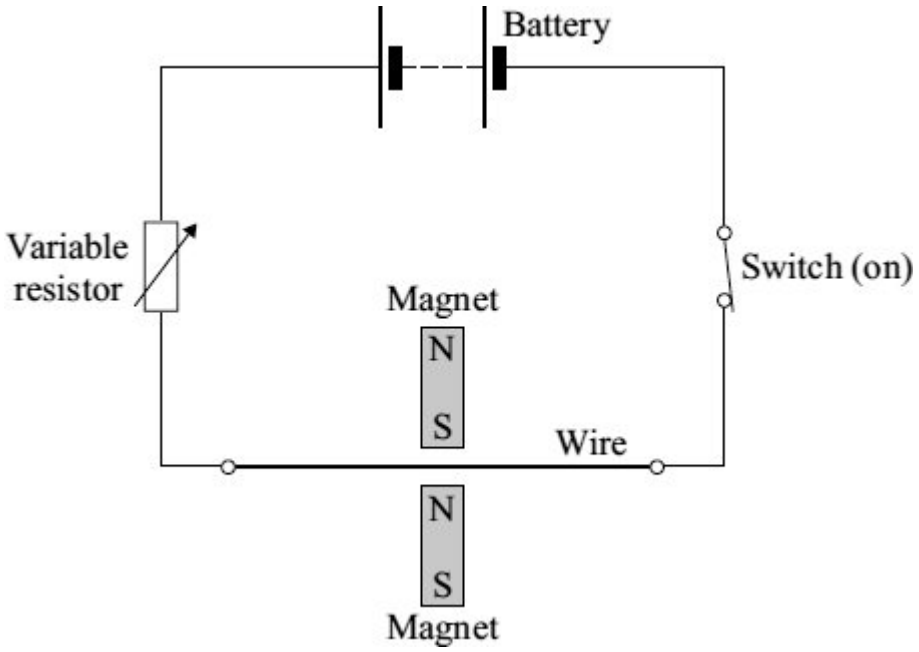
Q19.

A student investigates the electromagnetic force acting on a wire which carries an electric current. The wire is in a magnetic field.

The diagram shows the circuit which the student uses.

(a) Draw an **X** on the diagram, with the centre of the **X** in the most strongest part of the magnetic field.

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(1)

(b) Give **one** change that she can make to the magnets to **decrease** the electromagnetic force on the wire.

_____

_____

(1)

(c) The student wants to change the electromagnetic force on the wire without changing the magnets or moving their position.

(i) Give **one** way in which she can **increase** the electromagnetic force.

_____

_____

(1)

(ii) Give **one** way in which she can **reverse** the direction of the electromagnetic force.

_____

_____

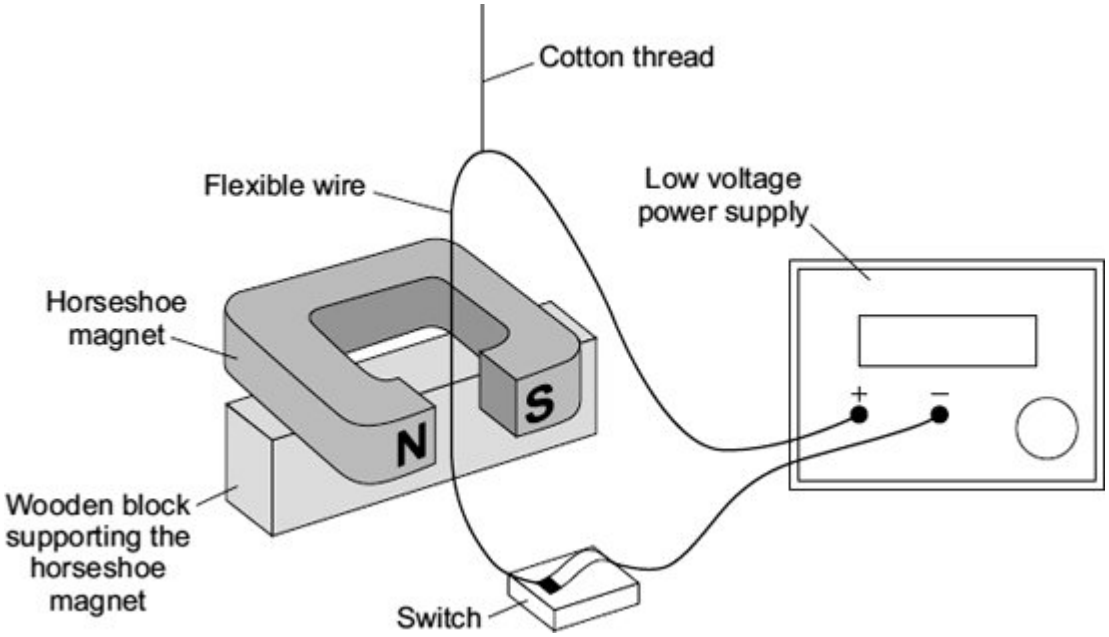
(1)

(Total 4 marks)

Q20.

(a) A laboratory technician sets up a demonstration.

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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.

_____

(1)

(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)

Q21.

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 ☐

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electric fan ☐

electric food mixer ☐

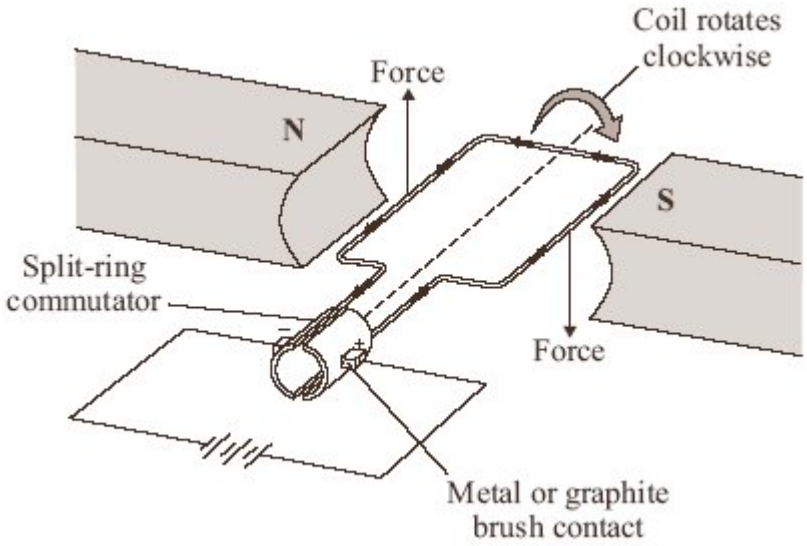
electric iron ☐

electric kettle ☐

electric screwdriver ☐

(2)

(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. _____

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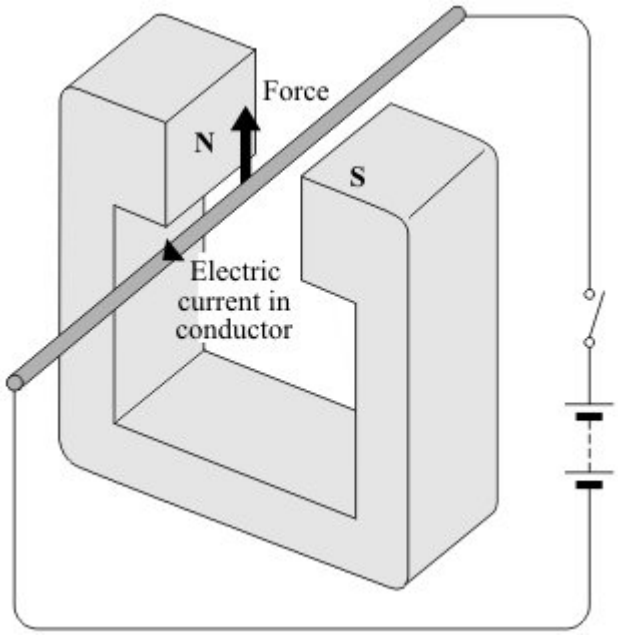
_____

(2)

(Total 6 marks)

Q22.

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)

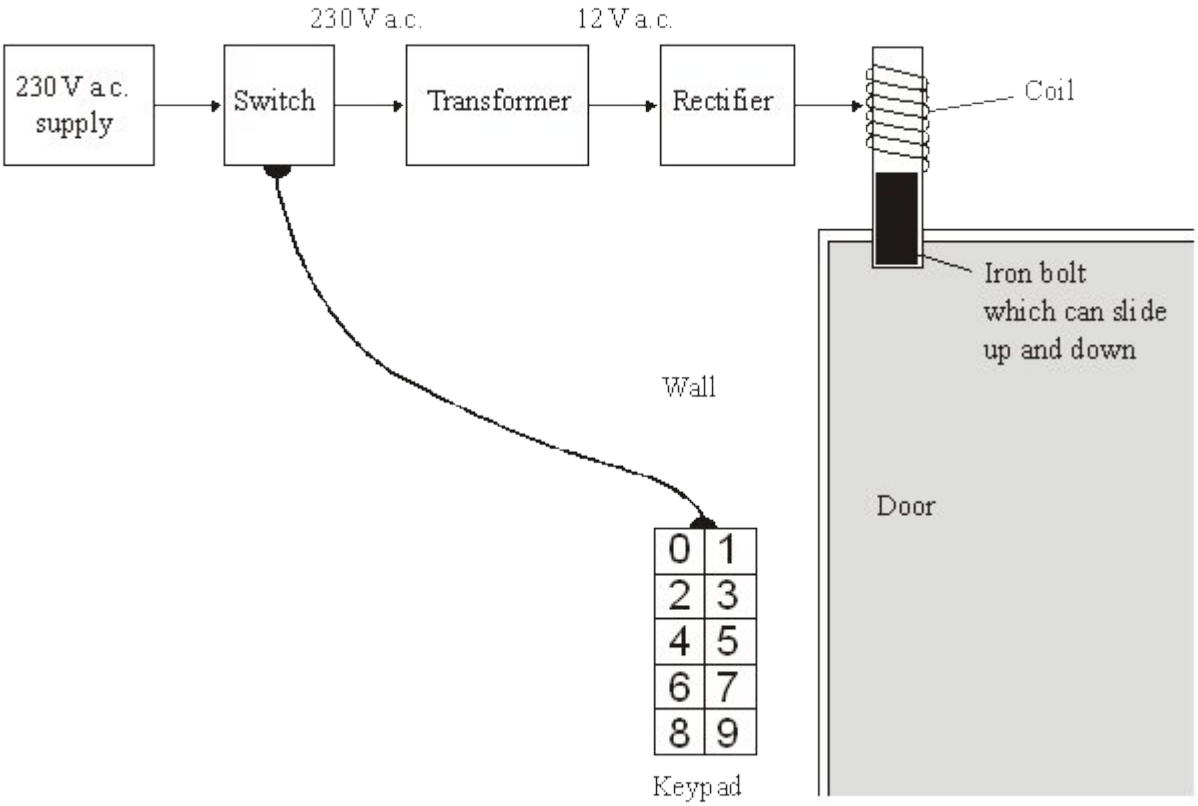
(Total 5 marks)

Q23.

The diagram shows the design for a remotely controlled door bolt.

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When the correct numbers are entered into the keypad the transformer switches on. Then the door can be opened.



(a) What kind of transformer is shown in the diagram?

_____

(1)

(b) What does the abbreviation a.c. stand for?

_____

(1)

(c) Complete the sentences using the correct words from the box.

attracts	**downwards**	**magnet**	**reflects**	**repels**
sideways	**switch**	**transformer**	**upwards**	

(i) When a current flows in the coil, the coil becomes a _____ .

(ii) The coil _____ the iron bolt which moves _____

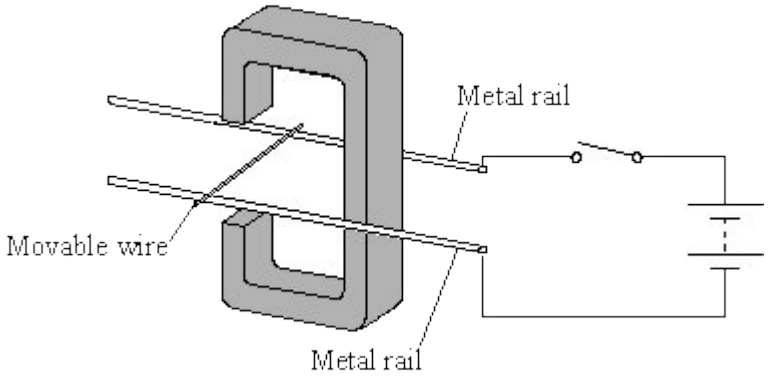
(3)

(Total 5 marks)

Q24.

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

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

(1)

(ii) Explain why the wire moves.

_____

_____

_____

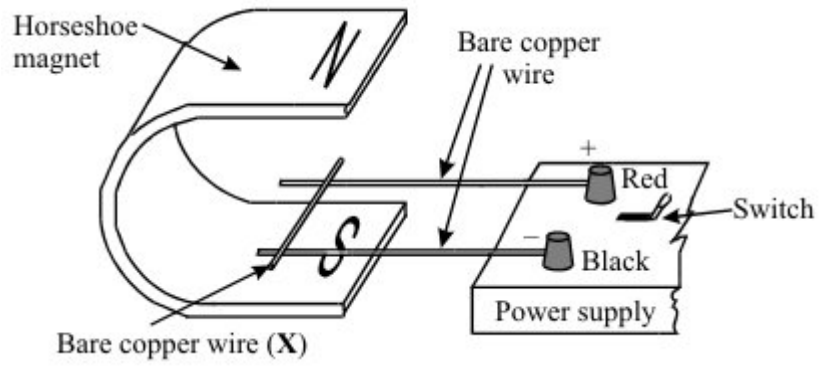
_____

(2)

(Total 3 marks)

Q25.

The diagram shows apparatus used to demonstrate the motor effect. **X** is a short length of bare copper wire resting on two other wires.



(a) (i) Describe what happens to wire **X** when the current is switched on.

_____

_____

_____

(ii) What difference do you notice if the following changes are made?

A The magnetic field is reversed.

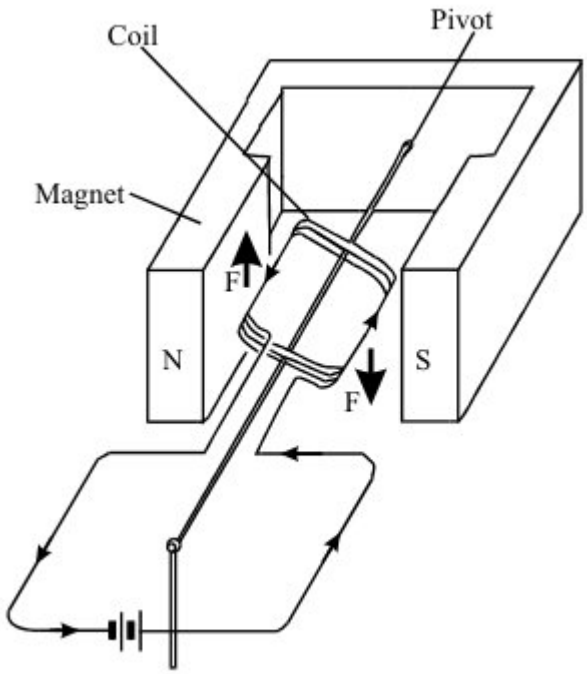
_____

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B The current is increased.

(3)

(b) The diagram shows a coil placed between the poles of a magnet. The arrows on the sides of the coil itself show the direction of the conventional current.



The arrows labelled **F** show the direction of the forces acting on the sides of the coil. Describe the motion of the coil until it comes to rest.

(3)

(c) Most electric motors use electromagnets instead of permanent magnets. State three of the features of an electromagnet which control the strength of the magnetic field obtained.

1.

2.

3.

(3)

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(Total 9 marks)

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