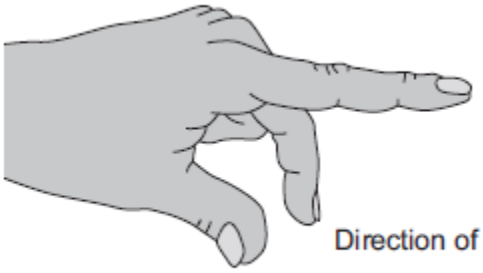
1 The left-hand rule can be used to identify the direction of the force acting on a current-carrying conductor in a magnetic field.

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

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

Figure 1



Direction of _____

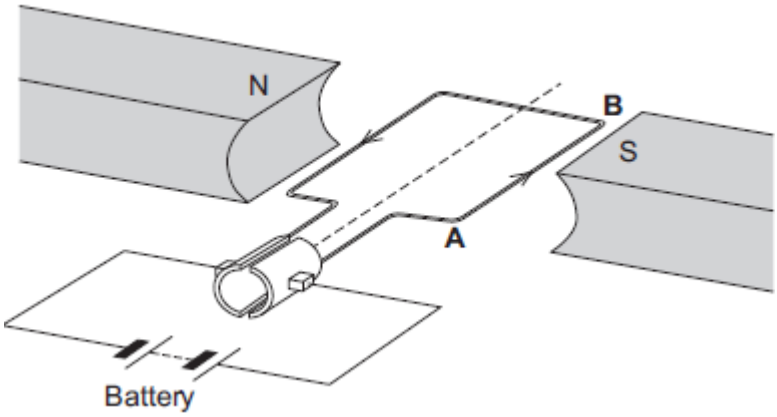
Direction of _____

Direction of _____

(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**.

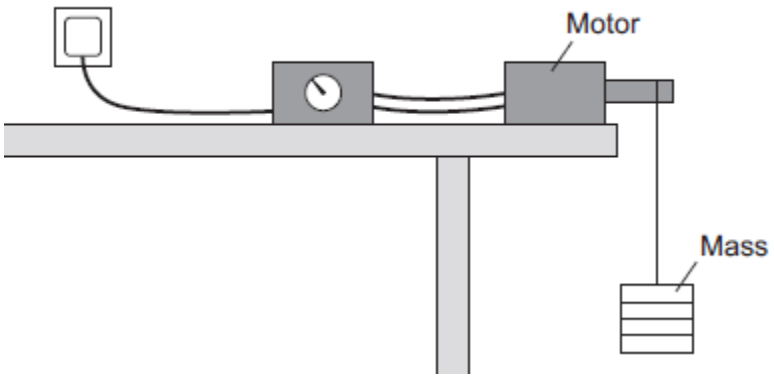
1. _____

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**.

_____

_____

Efficiency = _____

(2)

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

_____

_____

(1)

(iii) Suggest a reason for this anomalous result.

_____

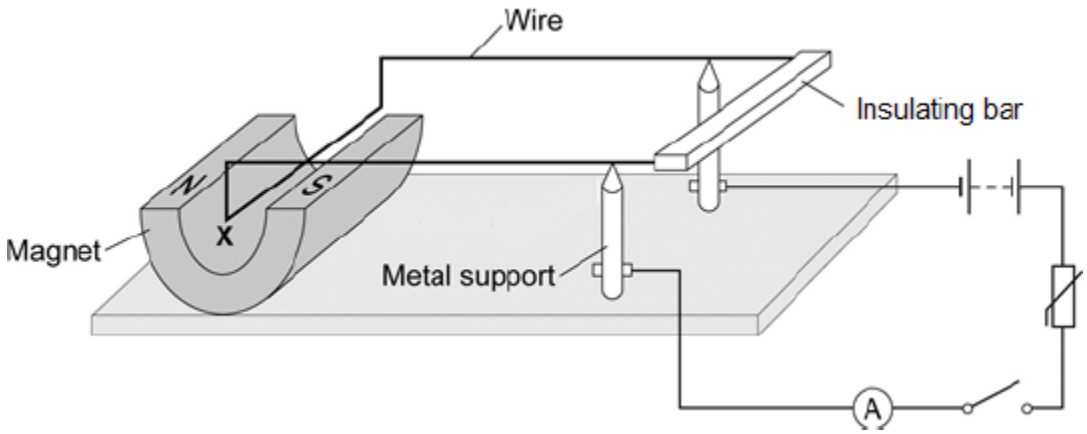
_____

(1)

(Total 12 marks)

2 **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)

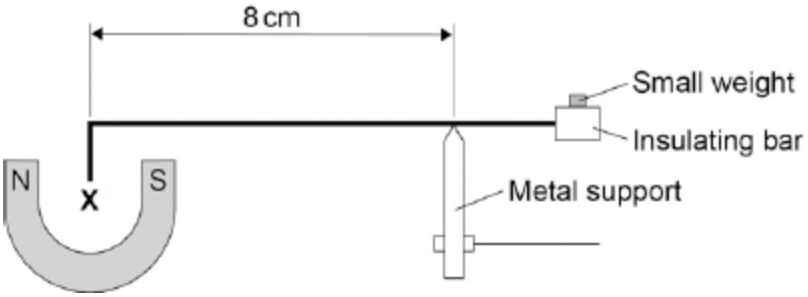
(b) Suggest one change you could make to the apparatus in **Figure 1** that would increase the size of the force that wire **X** experiences.

_____

(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



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

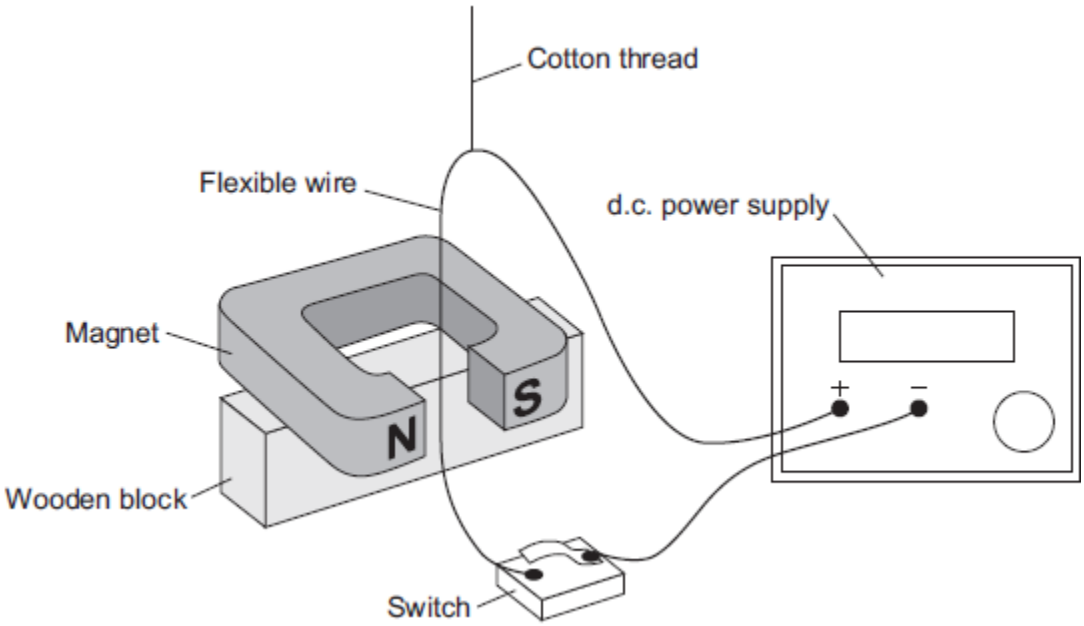
Give the unit.

Magnetic flux density = _____ Unit _____

(6)

(Total 8 marks)

3 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.

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.

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

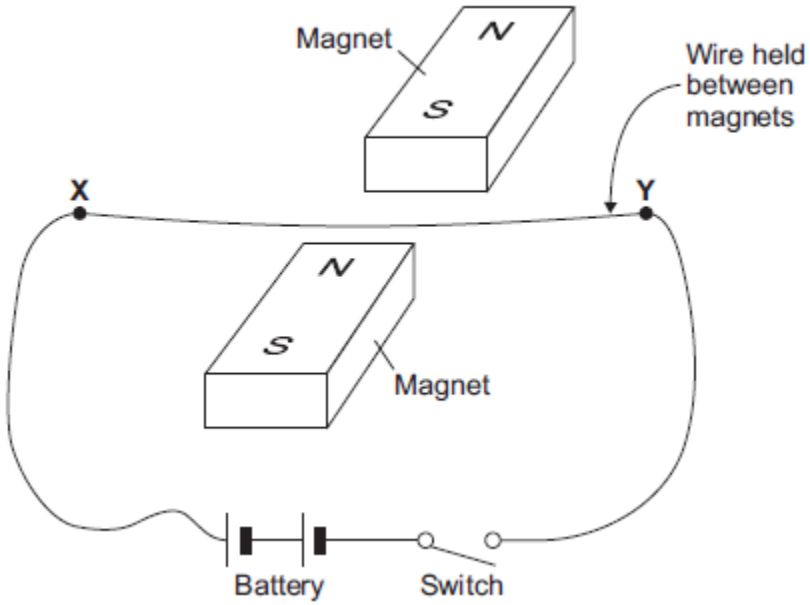
The wire is at 45° to the direction of the magnetic field. ☐

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

(1)

(Total 5 marks)

4 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)

(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).

_____

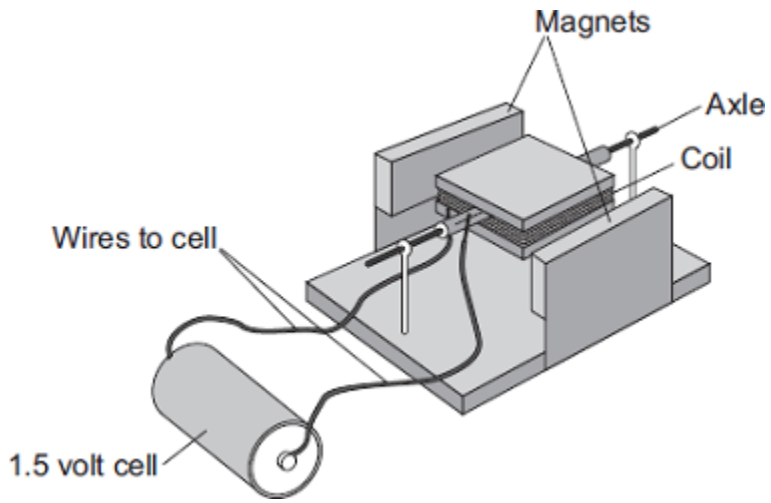
_____

_____

(1)

(Total 7 marks)

5 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)

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

1. _____

_____

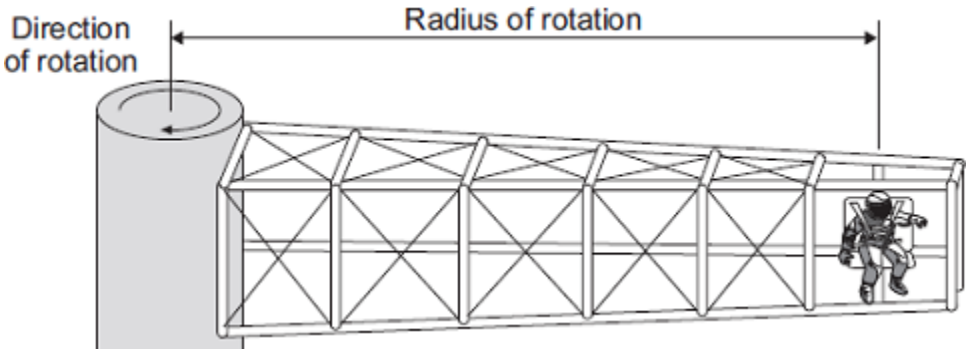
2. _____

_____

(2)

(Total 5 marks)

6 The diagram shows a ‘G-machine’. The G-machine is used in astronaut training.

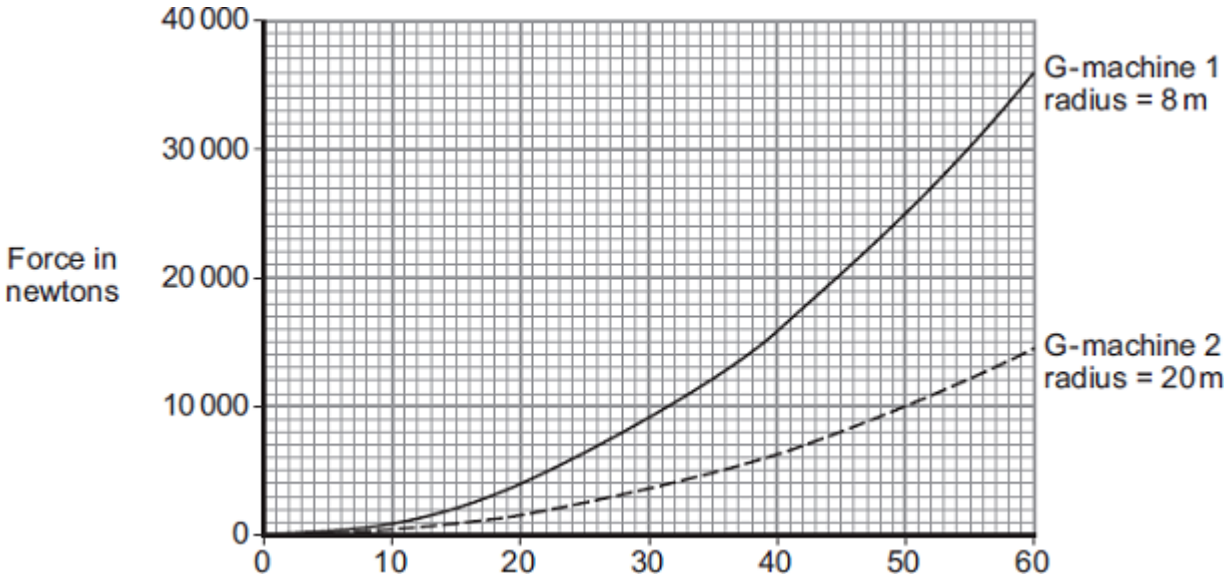


The G-machine moves the astronaut in a horizontal circle.

(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. _____

_____

(3)

(ii) The speed of rotation of G-machine 1 is increased from 20 m/s to 40 m/s.

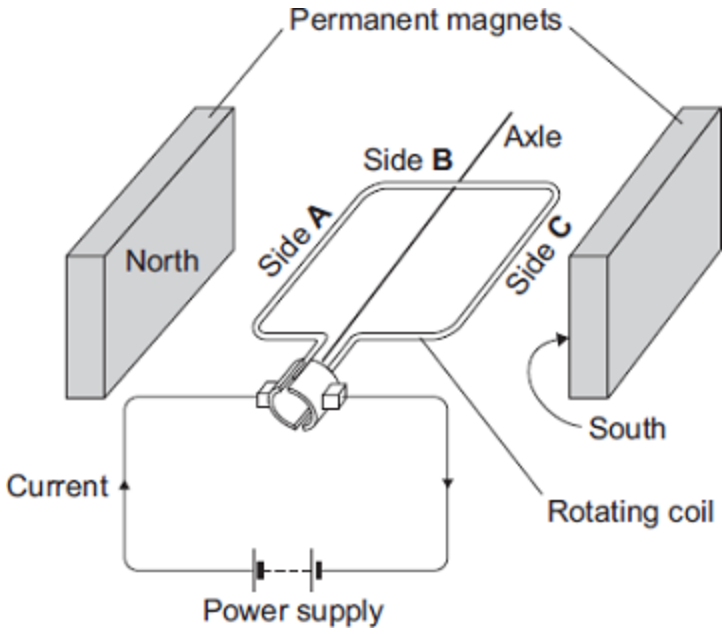
Determine the change in force on the astronaut.

_____

Change in force = _____ N

(1)

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



(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?

Draw a ring around your answer.

Yes **No**

Give a reason for your answer.

_____

_____

(1)

(Total 10 marks)