Motor Effect

Trilogy

Name: ______________________

Class: ______________________

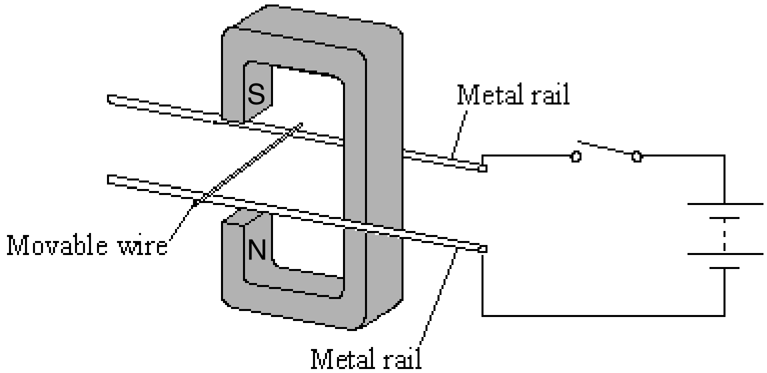
Date: ______________________

Time: **105 minutes**

Marks: **102 marks**

Comments:

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



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

(1)

(ii) Explain why the wire moves.

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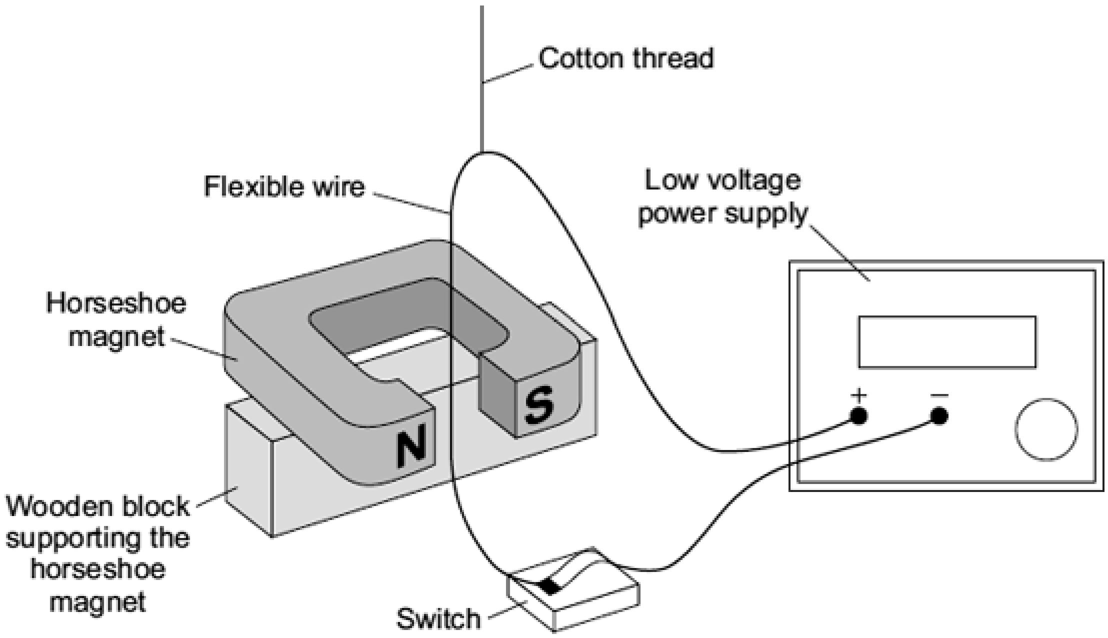
(2)

(Total 3 marks)

2 (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.

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(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.

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(1)

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

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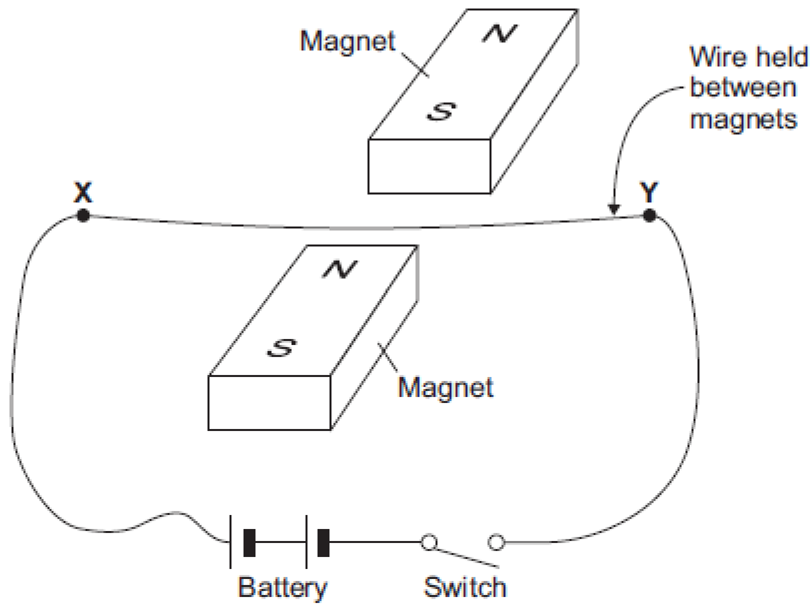
(1)

(Total 3 marks)

3 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.

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(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.

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(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.

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(1)

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

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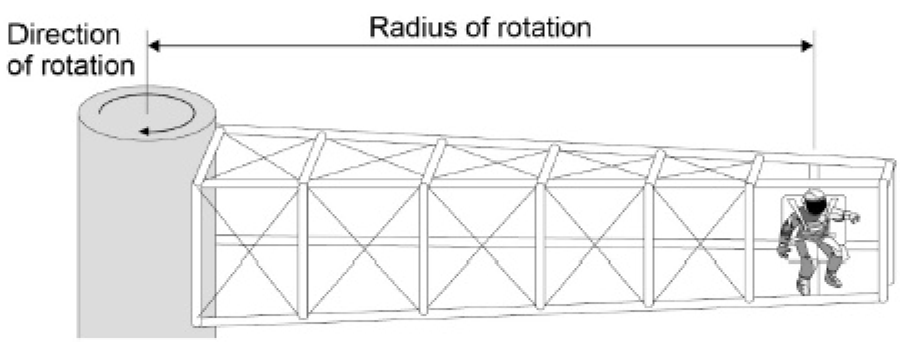
(1)

(Total 7 marks)

4 **Figure 1** shows a 'G-machine'.

The G-machine is used in astronaut training.

Figure 1



(a) The astronaut travels at constant speed in a circle.

Explain why the astronaut is accelerating.

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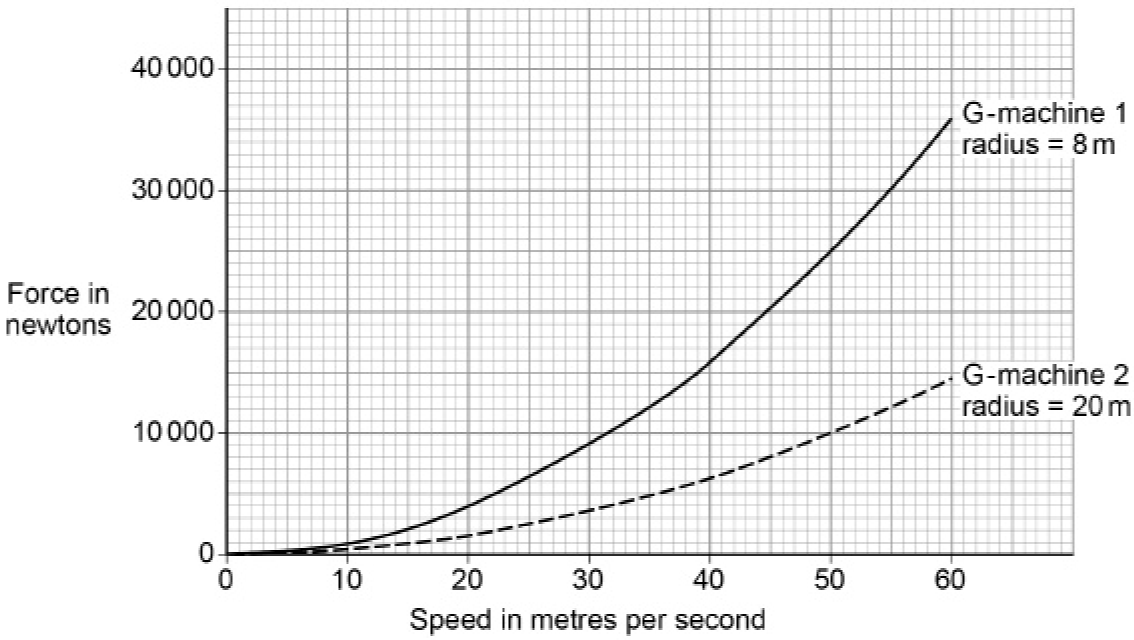
(3)

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

Figure 2 shows how the speed of the astronaut affects the force causing the astronaut to move in a circle.

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

Figure 2



Give **three** conclusions about the factors affecting the size of the force required to move the astronaut in a circle.

1. ____

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2. ____

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3. ____

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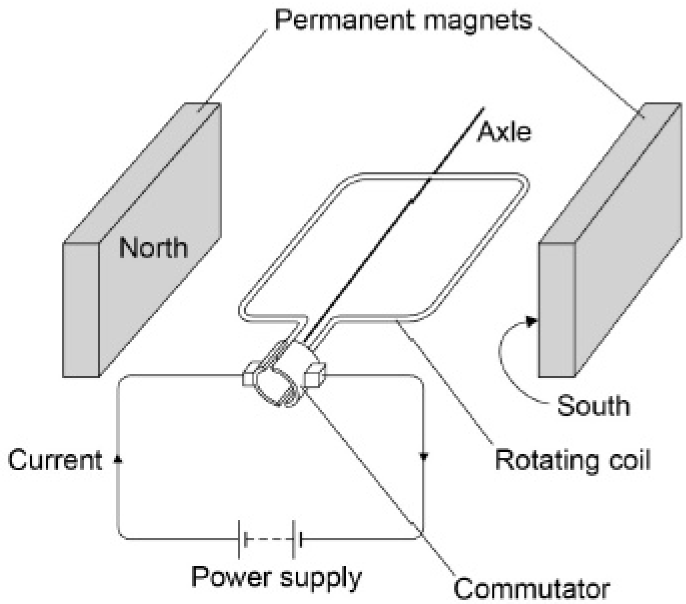
(3)

(c) Each G-machine is rotated by an electric motor.

Figure 3 shows a simple electric motor.

Figure 3



Explain why the coil rotates when there is a current in the circuit.

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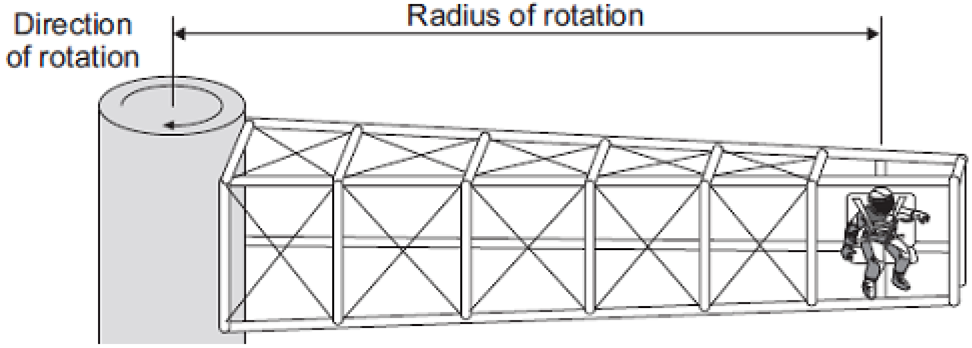
(3)

(Total 9 marks)

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

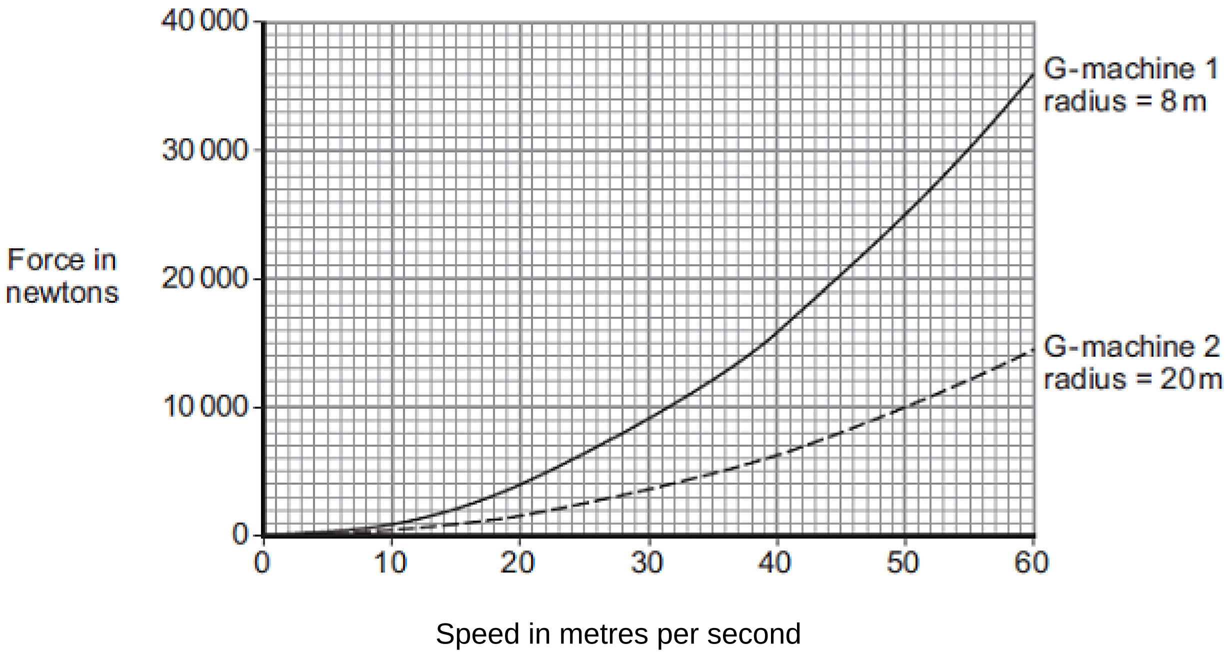


The G-machine moves the astronaut in a horizontal circle.

(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. ____

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2. ____

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3. ____

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(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.

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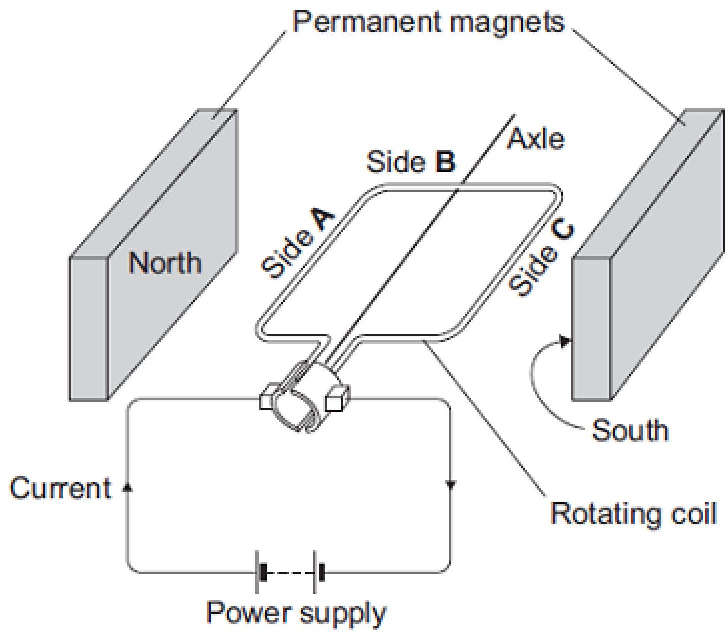
Change in force = ______________________________ N

(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.

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(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.

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(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?

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(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.

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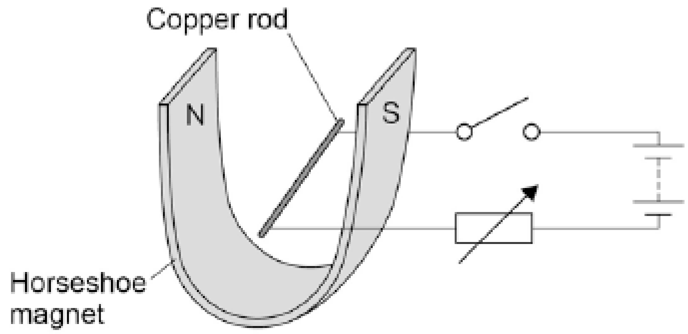
(1)

(Total 10 marks)

6 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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(4)

(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.

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(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

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Magnetic flux density = ____________________ T

(5)

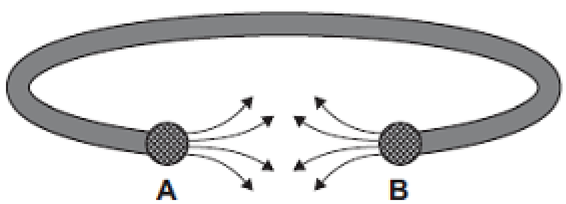
(Total 10 marks)

7 (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



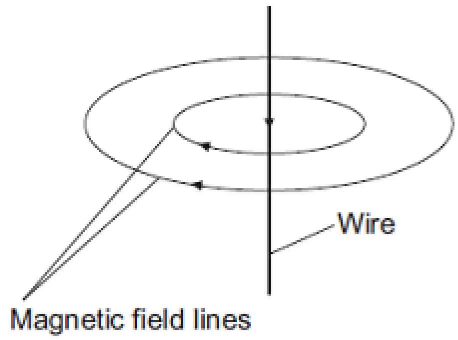
What is the pole at **A**? ________________________

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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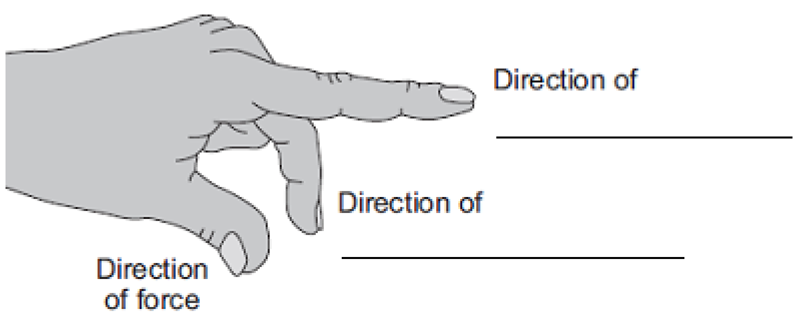
(1)

(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

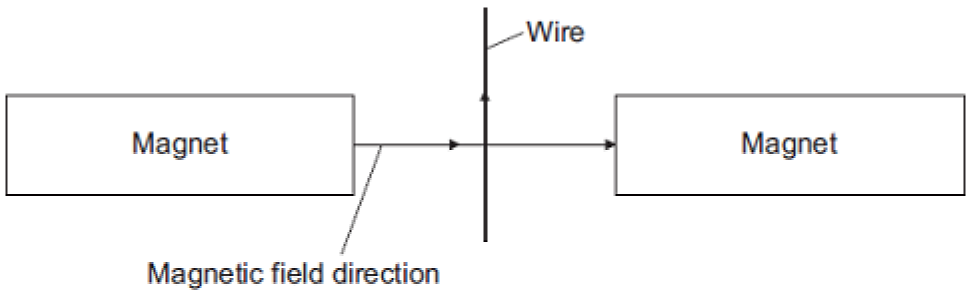


(2)

(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. ____

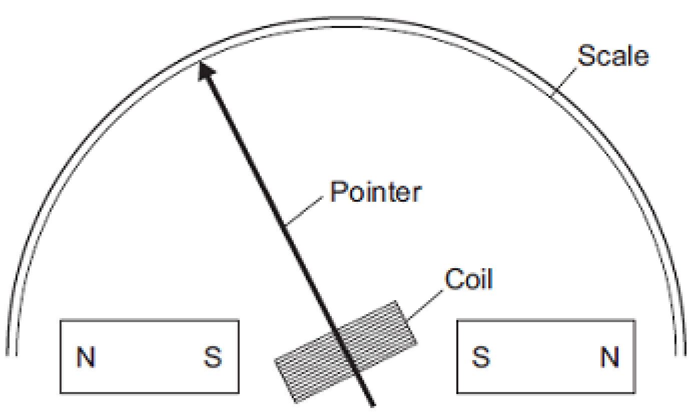
3. ____

(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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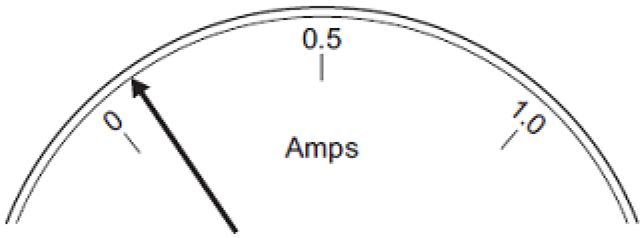
(1)

(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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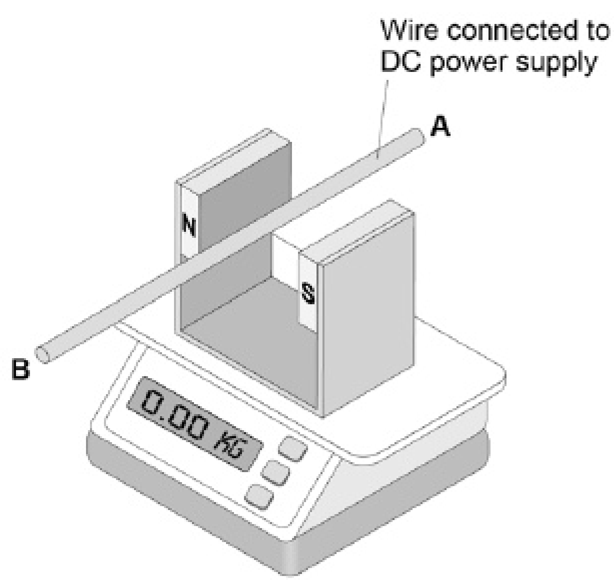
(1)
(Total 10 marks)

8 A student placed a permanent magnet on a top-pan balance.

He clamped a straight piece of wire so that it was suspended in the magnetic field.

Figure 1 shows the apparatus.

Figure 1



(a) When a current passed through the wire from **A** to **B**, the reading on the balance increased.

Explain why.

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(4)

(b) The student increased the current in the wire.

Sketch a graph on **Figure 2** to show the relationship between the current and magnetic force on the wire.

Label the axes, with the independent variable on the x-axis.

Figure 2

(2)

(c) The length of the wire in the magnetic field in **Figure 1** is 4.8×10^{-2} m

The current in the wire is 0.80 A

The reading on the balance is 1.2×10^{-3} kg

Gravitational field strength = 9.8 N/kg

Calculate the magnetic flux density of the permanent magnet.

Magnetic flux density = ____________________ tesla

(5)

(Total 11 marks)

9 When a conductor carrying a current is placed in a magnetic field a force is exerted on the conductor.

This is called the motor effect.

(a) Describe how the direction of the force can be determined using Fleming's Left Hand Rule.

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(4)

The photograph below shows apparatus to demonstrate the motor effect.

The piece of wire is fixed so that it cannot move.

This is the method used.

1. Place the pair of magnets in their holder on the balance.
2. Set the reading on the balance to zero.
3. Pass a current through the wire.
4. Record the new reading on the balance.

(b) When there is a current in the wire, the reading on the balance increases.

Explain in terms of forces why the reading increases.

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(3)

(c) In one experiment, the teacher determined that the force on the wire was 2.14 mN

The current in the wire was 0.32 A

The length of wire within the magnetic field was 0.048 m

Calculate the magnetic flux density between the two magnets.

Use the Physics Equations Sheet.

Give your answer to 2 significant figures.

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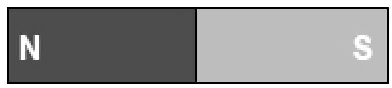
Magnetic flux density = ____________________ T

(4)

(Total 11 marks)

10 The diagram below shows a bar magnet.

(a) Complete the diagram to show the magnetic field lines around a bar magnet.



(2)

(b) Describe a method using a compass to plot the magnetic field lines around a bar magnet.

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(4)

(c) Explain why a compass needle moves when placed near the bar magnet.

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(2)

(d) Iron is a magnetic element.

Which of the following is also a magnetic **element**?

Tick **one** box.

Cobalt ☐

Copper ☐

Steel ☐

Zinc ☐

(1)

(e) Give **two** pieces of evidence that show the Earth's magnetic field is changing.

1. ____

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2. ____

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(2)

(f) Describe the most likely cause of the changes in the Earth's magnetic field.

(2)

(Total 13 marks)

11 Iron is a metal that has many uses.

(a) Iron is extracted from iron ore. Part of the process involves reduction of the ore with carbon monoxide.

Iron ore contains iron oxide (Fe_2O_3).

Write a balanced equation for the reaction of iron oxide with carbon monoxide.

(3)

(b) Explain why this reaction is a redox reaction.

(2)

Steel is an alloy of iron. Steel is used to make cars.

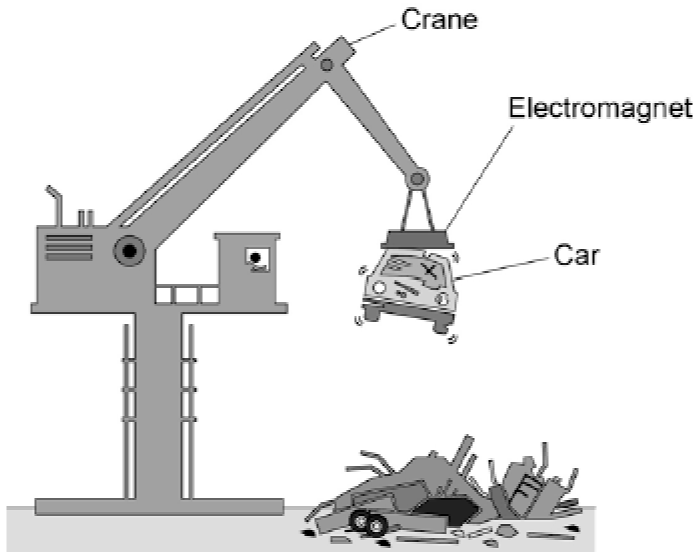
After its useful life a car is taken to a scrapyard for recycling.

(c) Suggest **four** benefits of recycling a car body.

(4)

(d) **Figure 1** shows an electromagnet being used to lift a car in a scrapyard.

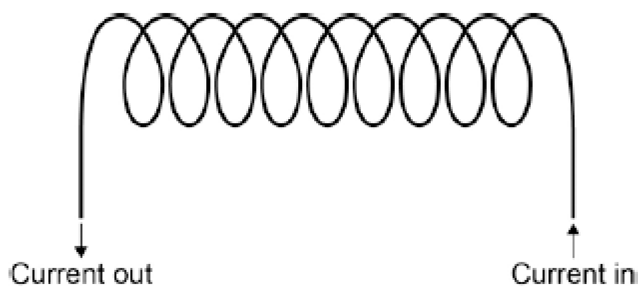
Figure 1



An electromagnet is made up of a solenoid.

Figure 2 shows a solenoid.

Figure 2



Draw the magnetic field of the solenoid on **Figure 2**.

(2)

(e) In a scrapyard, an electromagnet is used to lift and release cars so they can be moved around.

Suggest **two** ways a solenoid could be made to lift and release cars in a scrapyard.

Explain why each suggestion would be useful in the scrapyard.

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(4)

(Total 15 marks)