



New Document 1

Name: _____

Class: _____

Date: _____

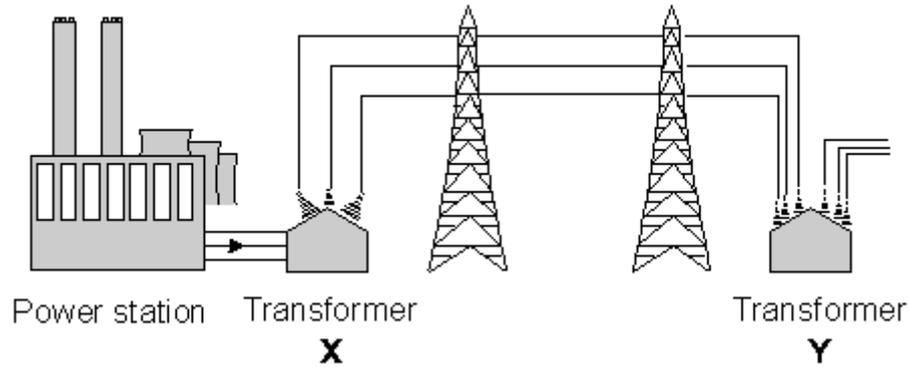
Time: **258 minutes**

Marks: **258 marks**

Comments:

Q1.

The outline diagram below shows part of the National Grid. At **X** the transformer increases the voltage to a very high value. At **Y** the voltage is reduced to 240 V for use by consumers.



- (i) At **X** a transformer increases the voltage. What happens to the current as the voltage is increased?

_____ (1)

- (ii) Why is electrical energy transmitted at very high voltages?

_____ (1)

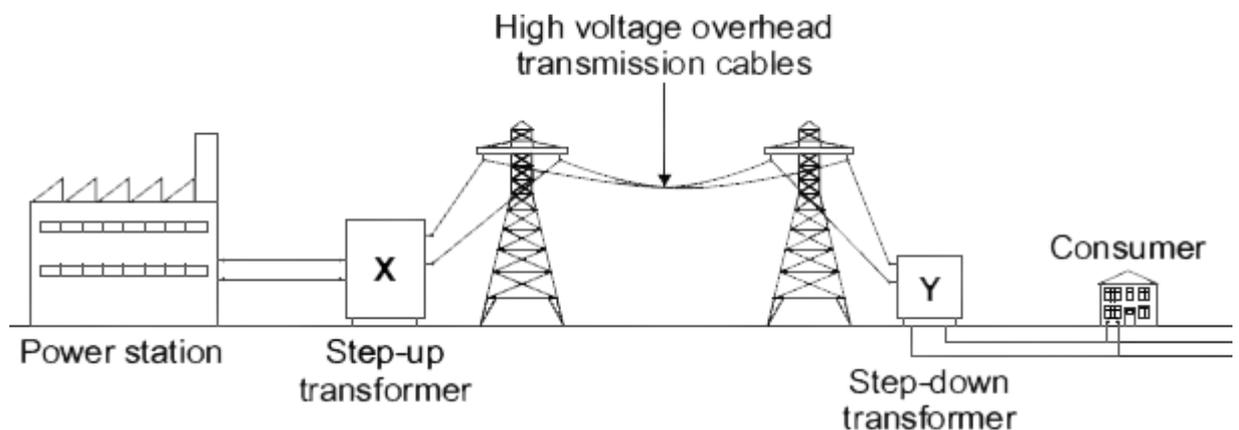
- (iii) The transformer at **Y** reduces the voltage before it is supplied to houses. Why is this done?

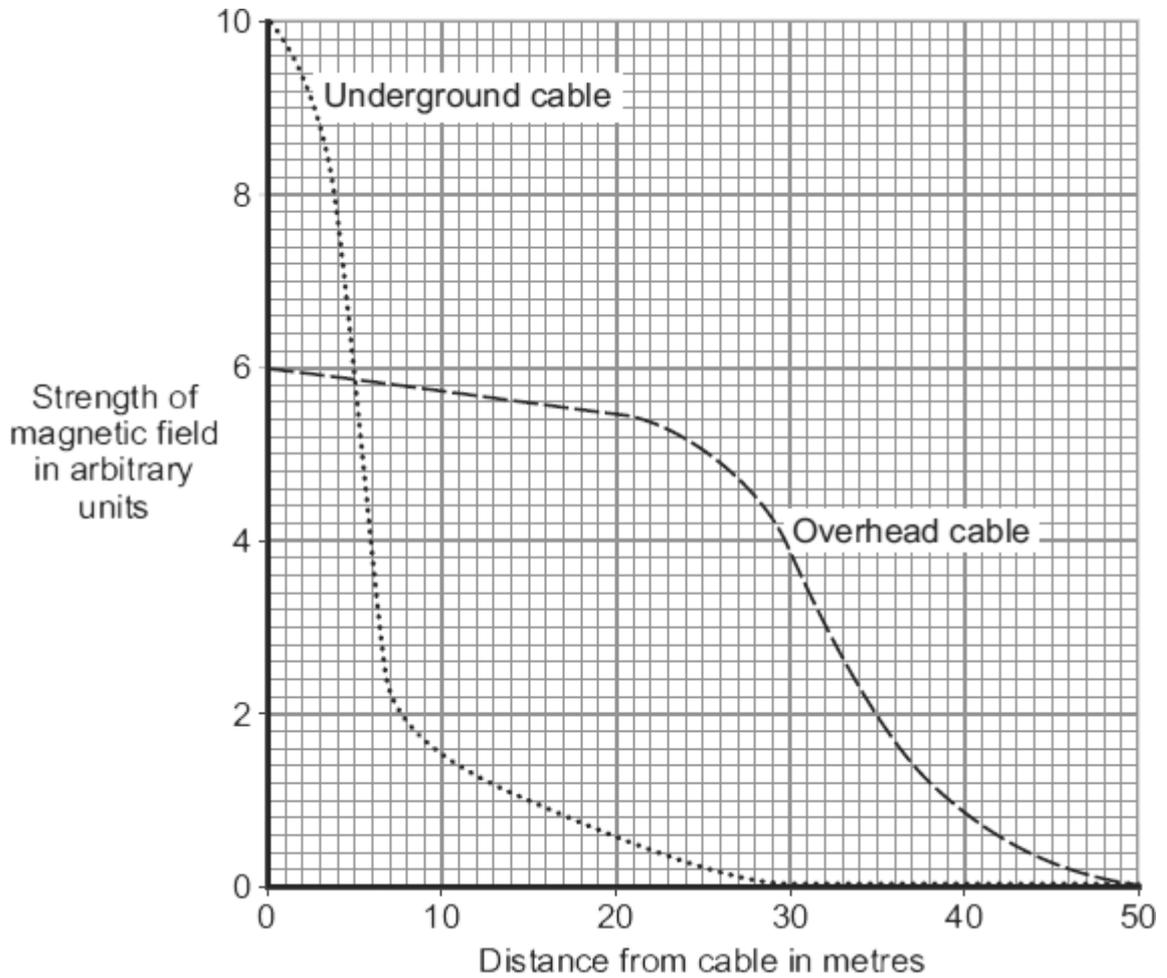
_____ (1)

(Total 3 marks)

Q2.

The diagram shows the National Grid system.





What conclusions may be drawn from this graph?

(2)

- (d) Some people think that, because of the magnetic fields, living close to transmission cables is dangerous to health. Laboratory studies on mice and rats exposed to magnetic fields for two or more years found that the magnetic fields had no effect on the animals' health.

Draw a ring around the correct answer in the box to complete the sentence.

Using animals in scientific research raises

economic

environmental

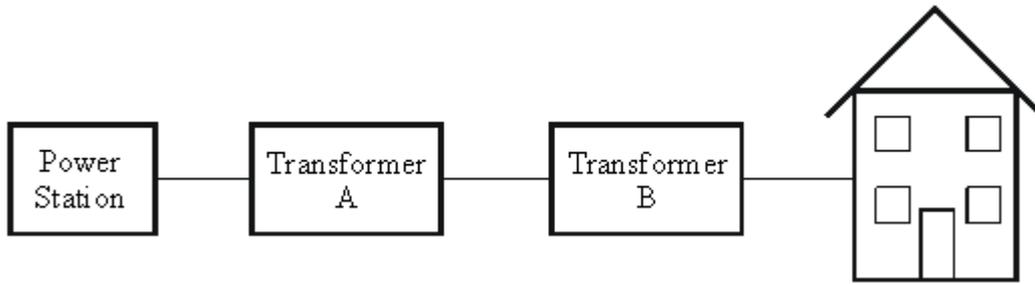
ethical

issues.

(1)

(Total 11 marks)

Q3.



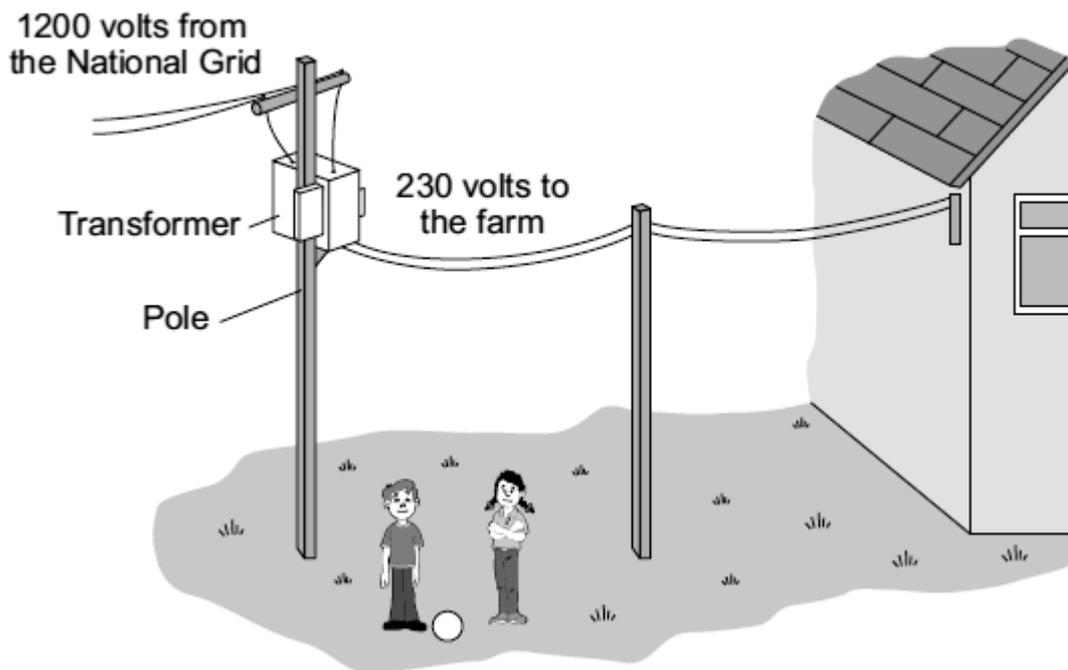
Transformer A produces a very high voltage to transmit the electrical energy through the National Grid.

Explain why electrical energy is transmitted at a very high voltage.

(Total 3 marks)

Q4.

The diagram shows part of the system used to supply a farm with electricity.



- (a) The core of the transformer is made of metal.

Complete the following sentence by drawing a ring around the correct word in the box.

The metal used for the core of the transformer is

copper.
iron.
steel.

(1)

- (b) (i) What sort of transformer is shown in the diagram?

(1)

- (ii) Complete the following sentence by drawing a ring around the correct line in the box.

In this transformer, the number of turns on the secondary coil is

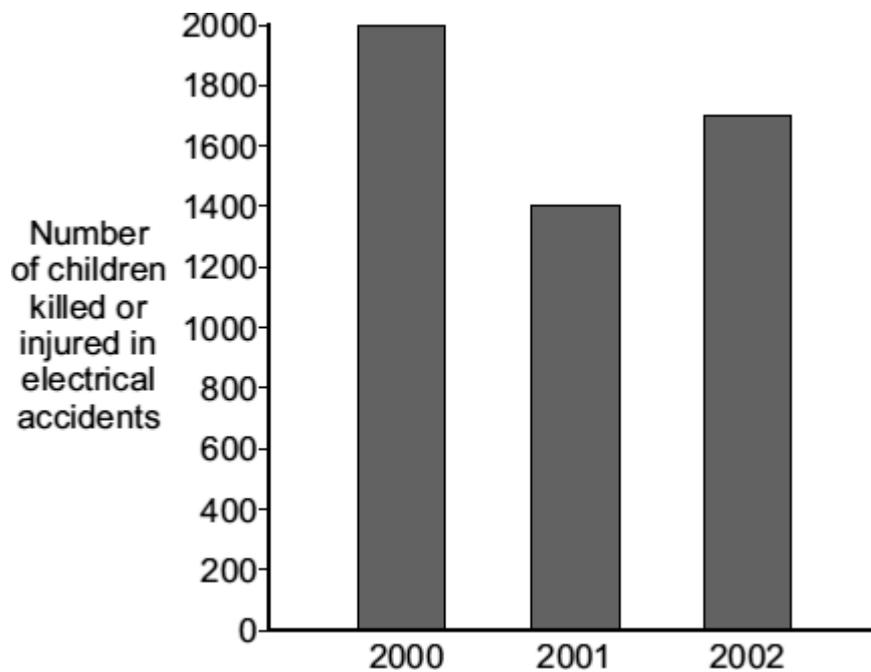
less than
the same as
greater than

the number of turns on the primary coil.

(1)

- (c) Transformers and other electrical equipment can be dangerous.

The following bar chart shows the numbers of children, aged 14 or under, killed or injured in electrical accidents in the UK in 2000, 2001 and 2002.



- (i) In which of these years were most children killed or injured in electrical accidents?

(1)

- (ii) A newspaper claims that the number of children killed or injured by electrical accidents will increase in 2011.

Which of the following gives a reason why the information given in the graph does not support this claim.

Put a tick (✓) in the box next to your answer.

The pattern shows an upward trend.

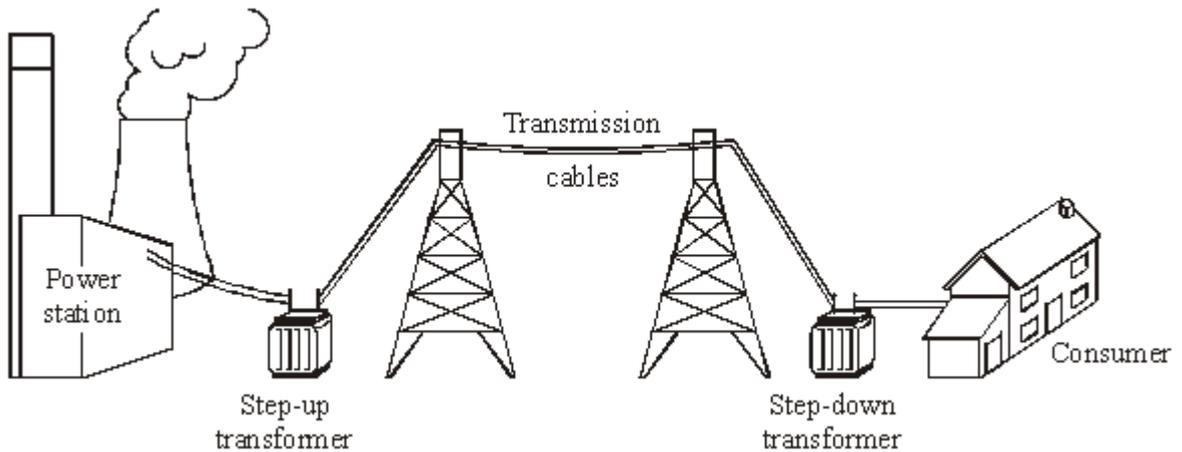
The pattern shows a downward trend.

There is no pattern.

(1)
(Total 5 marks)

Q5.

The diagram shows how electricity gets from power stations to consumers.



(a) Complete the following sentences by drawing a ring around the correct line in each box.

(i) The network of cables and transformers linking power stations to consumers

is called the national

grid
line
network

(1)

(ii)

A step-up transformer

decreases voltage
increases current
increases voltage

(1)

(iii)

Electricity is supplied to consumers' homes at

230 V
25 000 V
400 000 V

(1)

(iv)

Making the current in the cables smaller will

increase
make no difference to
reduce

the energy lost in the cables.

(1)

(b) Transformers always waste some energy.

(i) What effect does the waste energy from a transformer have on the air around the transformer?

(1)

(ii) Which **one** of the following describes the efficiency of a transformer?

Draw a ring around your answer.

always 100 % less than 100 % more than 100%

(1)

(Total 6 marks)

Q6.

(a) In the National Grid, very large step-up transformers link power stations to the transmission cables.

A transformer used for this purpose has 800 turns on its primary coil and 12 800 turns on its secondary coil. The p.d. (potential difference) across its primary coil is 25 kV.

Use the equation in the box to calculate the p.d. across its secondary coil.

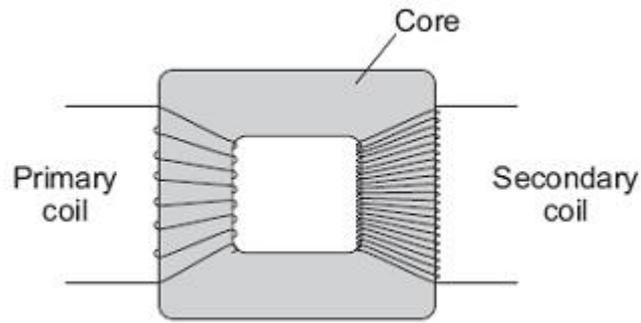
$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$

Show clearly how you work out your answer.

p.d. across secondary coil = _____ volts

(2)

(b) The diagram shows the structure of a transformer.



(i) The primary and secondary coils of a transformer are made of insulated wire.

Why is this insulation necessary?

(1)

(ii) Why is the core made of iron?

(1)

(iii) Explain how the transformer works.

(3)

(c) Before 1926, large towns had their own local power stations. After 1926, these power stations were connected to form the National Grid.

Give **two** advantages of having a National Grid system.

1. _____

2. _____

(2)

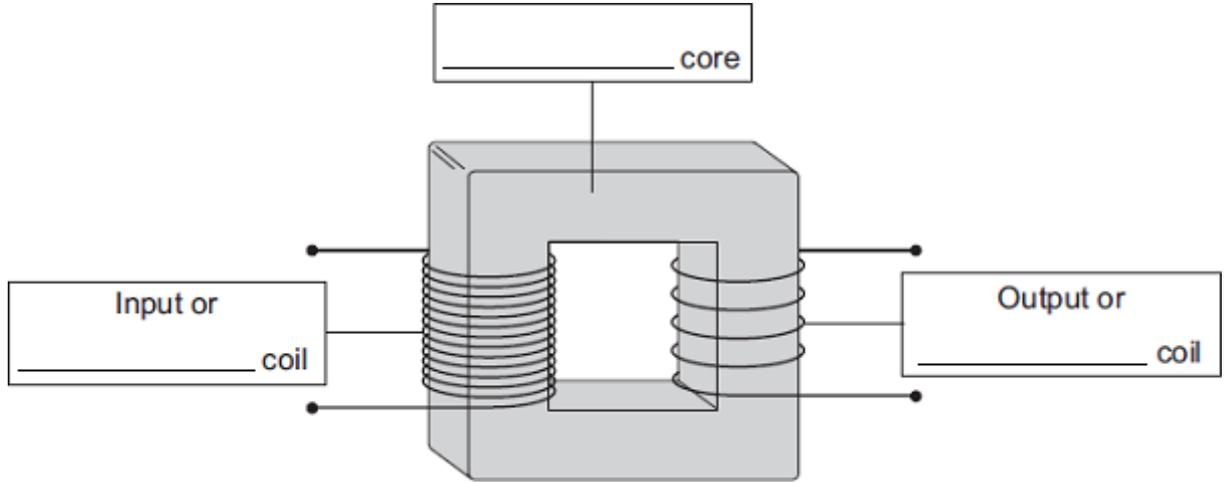
(Total 9 marks)

Q7.

(a) The diagram shows the structure of a traditional transformer.

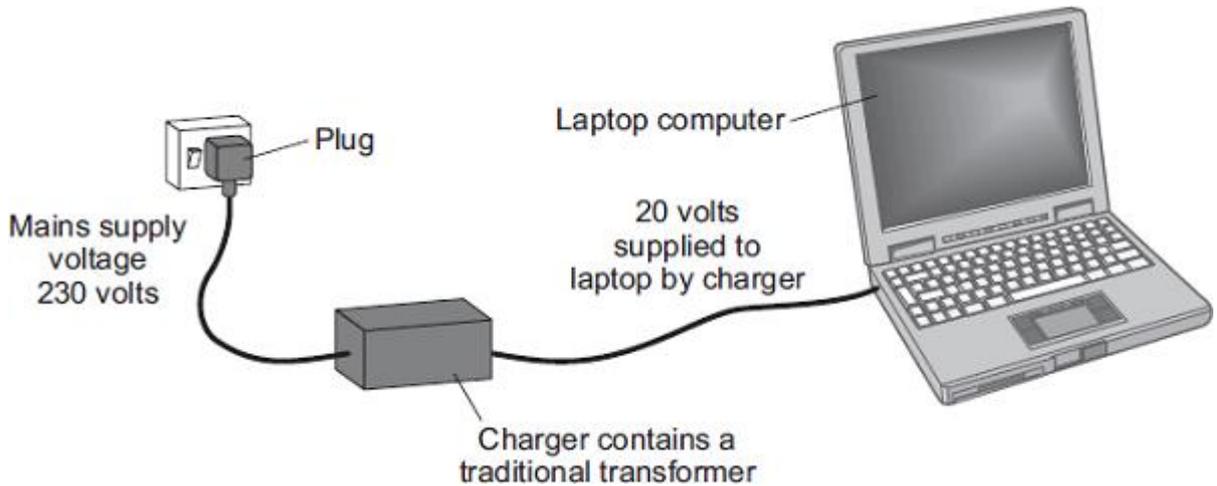
Use words from the box to label the diagram.

aluminium	brass	iron	large	primary	secondary
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(3)

(b) Batteries inside laptop computers are charged using laptop chargers. The laptop charger contains a traditional transformer.



The laptop charger contains a step-down transformer.

What does a step-down transformer do?

(1)

(c) Laptop batteries and mobile phone batteries can only be recharged a limited number of times. When a battery cannot be recharged, it is better to recycle the battery than to throw it away.

Draw a ring around the correct answer to complete the sentence.

The batteries are recycled mainly due to

- an environmental
- a political
- a social

consideration.

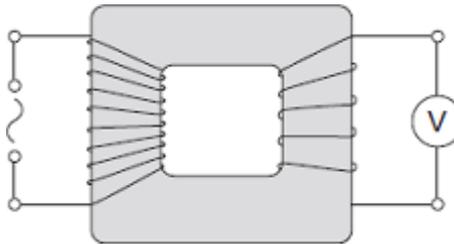
(1)

(Total 5 marks)

Q8.

The diagram shows a transformer with a 50 Hz (a.c.) supply connected to 10 turns of insulated wire wrapped around one side of the iron core.

A voltmeter is connected to 5 turns wrapped around the other side of the iron core.



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

Draw a ring around the correct answer.

step-down

step-up

switch mode

(1)

(b) The table shows values for the potential difference (p.d.) of the supply and the voltmeter reading.

p.d. of the supply in volts	Voltmeter reading in volts
6.4	3.2
3.2	
	6.4

(i) Complete the table.

(2)

(ii) Transformers are used as part of the National Grid.

How are the values of p.d. in the table different to the values produced by the National Grid?

(1)

(c) Transformers will work with an alternating current (a.c.) supply but will **not** work with a direct current (d.c.) supply.

(i) Describe the difference between a.c. and d.c.

(2)

(ii) Explain how a transformer works.

(4)

(Total 10 marks)

Q9.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

There are two types of traditional transformer; step-up and step-down.

Describe the similarities and differences between a step-up transformer and a step-down transformer.

You should include details of:

- construction, including materials used
- the effect the transformer has on the input potential difference (p.d.).

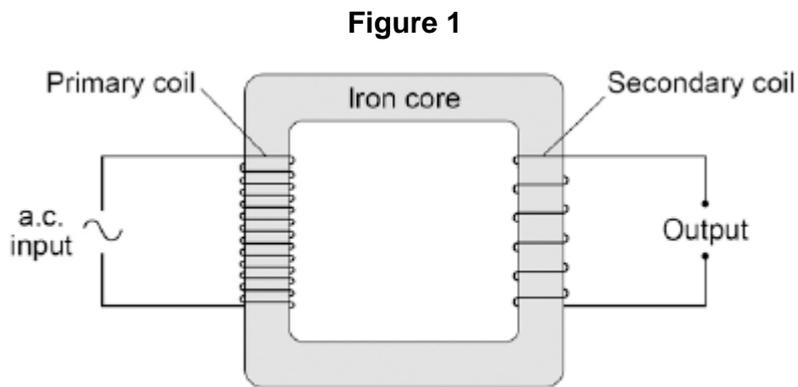
You should **not** draw a diagram.

Extra space _____

(Total 6 marks)

Q10.

Figure 1 shows the construction of a simple transformer.



(a) Why is iron a suitable material for the core of a transformer?

Tick **one** box.

It is a metal.

It will not get hot.

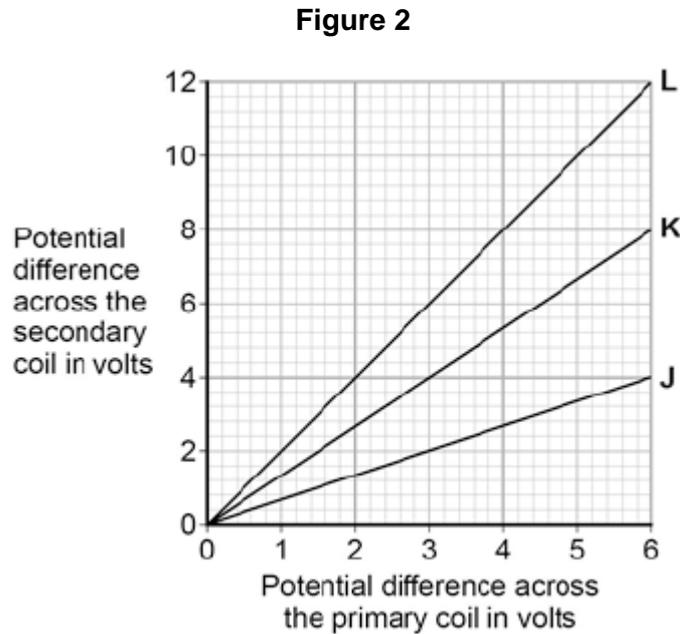
It is easily magnetised.

It is an electrical conductor.

(1)

- (b) A student makes three simple transformers, **J**, **K** and **L**.

Figure 2 shows how the potential difference across the secondary coil of each transformer varies as the potential difference across the primary coil of each transformer is changed.



How can you tell that transformer **J** is a step-down transformer?

(1)

- (c) Each of the transformers has 50 turns on the primary coil.

Calculate the number of turns on the secondary coil of transformer **L**.

Use the correct equation from the Physics Equations Sheet.

Number of turns on the secondary coil = _____

(3)

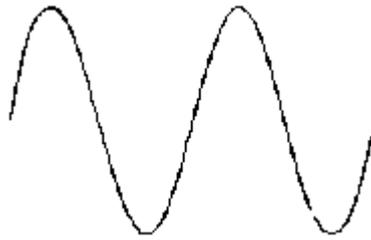
(Total 5 marks)

Q11.

Some students made a small hand-turned a.c. generator, similar to a bicycle dynamo. They connected it to the Y plates of a cathode ray oscilloscope, CRO, and turned the generator slowly. The trace on the CRO looked like this:



They then turned the generator faster and the trace looked like this:



(a) Why did the trace on the CRO show:

(i) an increase in frequency;

_____ (1)

(ii) a decrease in wavelength;

_____ (1)

(iii) an increase in amplitude?

_____ (1)

(b) One way to alter the output from the generator is to change the speed of turning. State **two** other ways to adapt parts of the generator to increase its output.

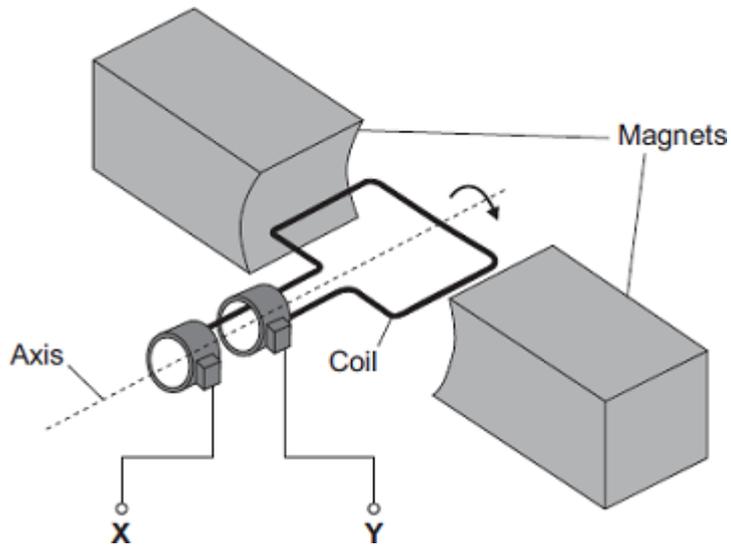
(2)

(Total 5 marks)

Q12.

The diagram shows an a.c. generator.

The coil rotates about the axis shown and cuts through the magnetic field produced by the magnets.



- (a) (i) A potential difference is induced between **X** and **Y**.

Use the correct answer from the box to complete the sentence.

electric	generator	motor	transformer
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This effect is called the _____ effect.

(1)

- (ii) What do the letters a.c. stand for?

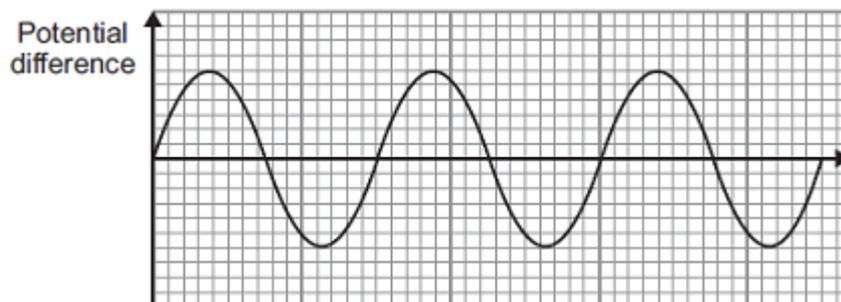
(1)

- (iii) Name an instrument that could be used to measure the potential difference between **X** and **Y**.

(1)

- (b) **Graph 1** shows the output from the a.c. generator.

Graph 1



- (i) One of the axes on **Graph 1** has been labelled 'Potential difference'.

What should the other axis be labelled?

(1)

(ii) The direction of the magnetic field is reversed.

On **Graph 1**, draw the output from the a.c. generator if everything else remains the same.

(2)

(c) The number of turns of wire on the coil is increased. This increases the maximum induced potential difference.

State **two** other ways in which the maximum induced potential difference could be increased.

1. _____

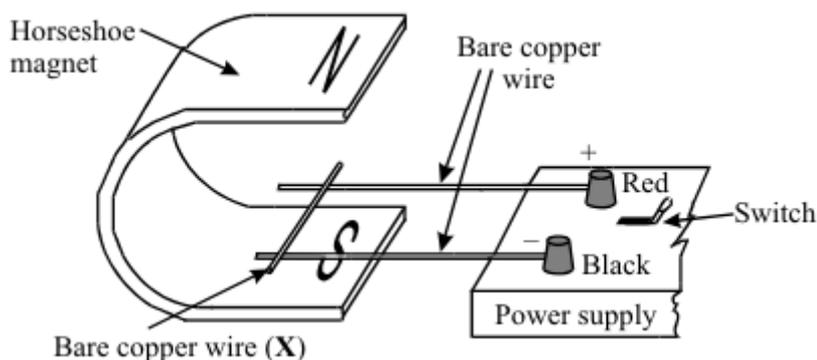
2. _____

(2)

(Total 8 marks)

Q13.

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.

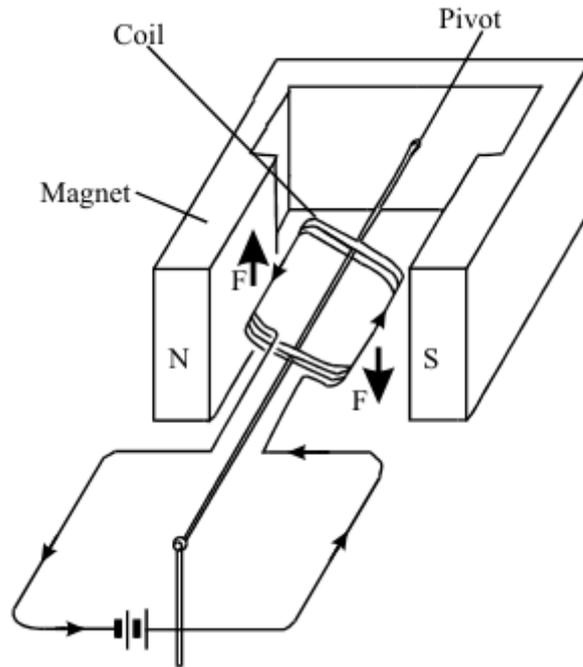
(ii) What difference do you notice if the following changes are made?

A The magnetic field is reversed.

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. _____

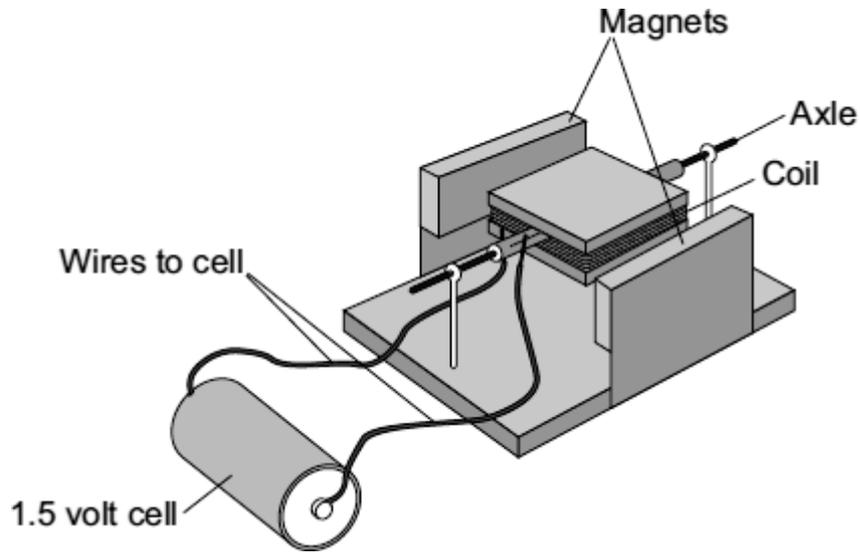
3. _____

(3)

(Total 9 marks)

Q14.

- (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.

(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. _____

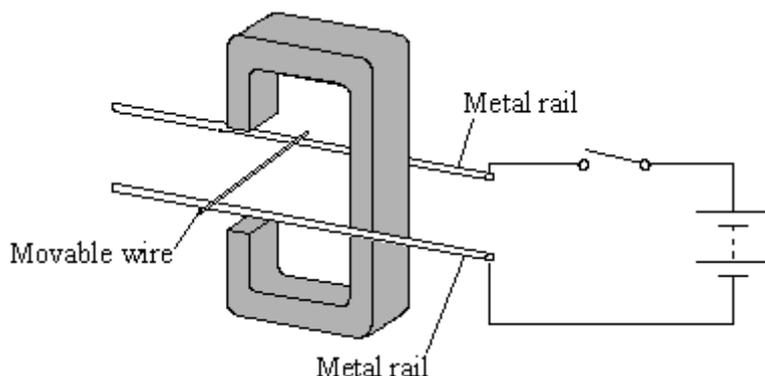
2. _____

(2)

(Total 6 marks)

Q15.

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



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

(1)

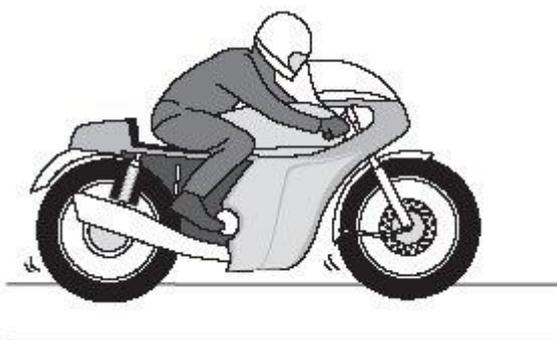
(ii) Explain why the wire moves.

(2)

(Total 3 marks)

Q16.

The diagram shows a motorbike of mass 300 kg being ridden along a straight road.



The rider sees a traffic queue ahead. He applies the brakes and reduces the speed of the motorbike from 18 m/s to 3 m/s.

(a) Calculate the kinetic energy lost by the motorbike.

Show clearly how you work out your answer.

Kinetic energy lost = _____ J

(2)

- (b) (i) How much work is done on the motorbike by the braking force?

(1)

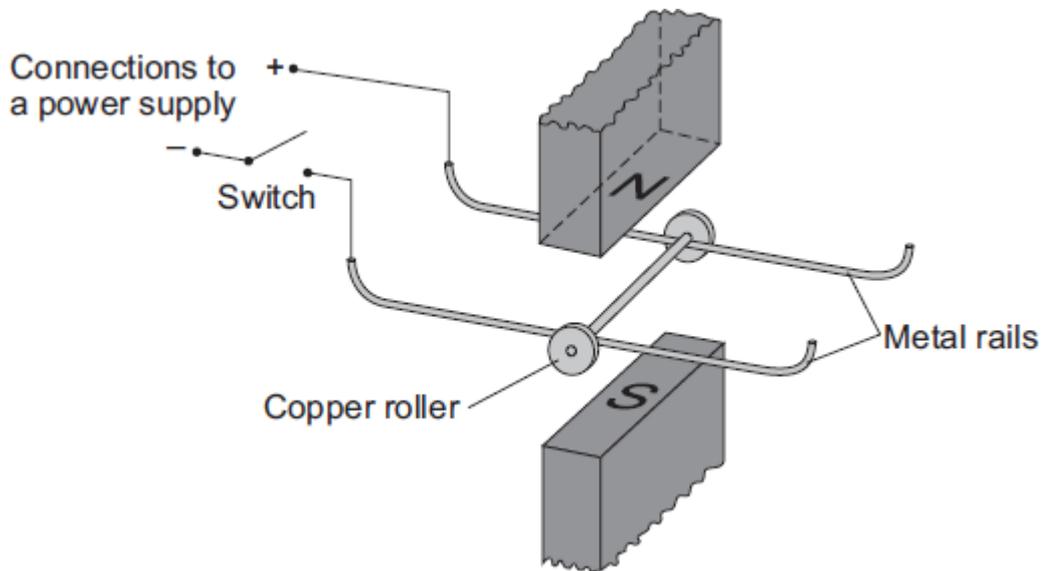
- (ii) What happens to the kinetic energy lost by the motorbike?

(1)

(Total 4 marks)

Q17.

- (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. _____

(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.

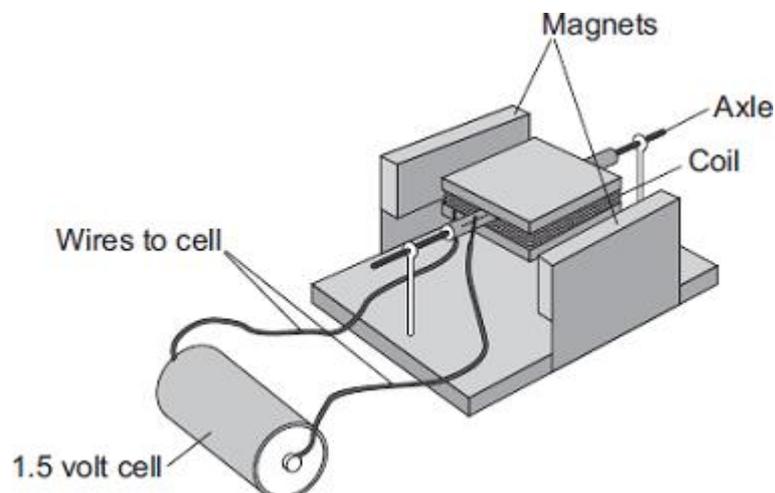
What type of issue does this inequality between people in different countries raise?

(1)

(Total 6 marks)

Q18.

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	and
the coil	
a force	

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. _____

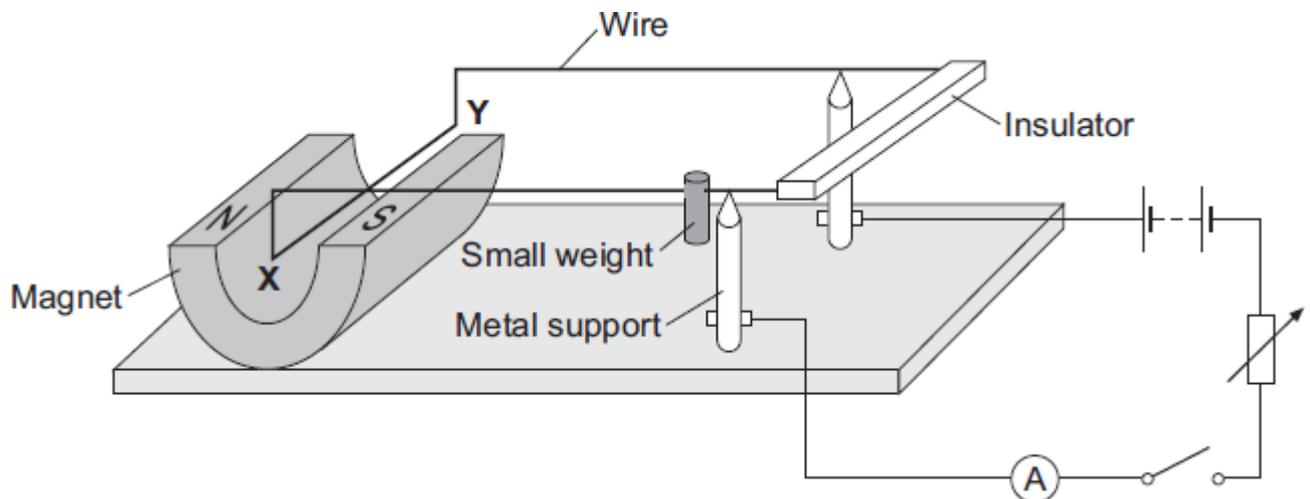
2. _____

(2)

(Total 5 marks)

Q19.

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?

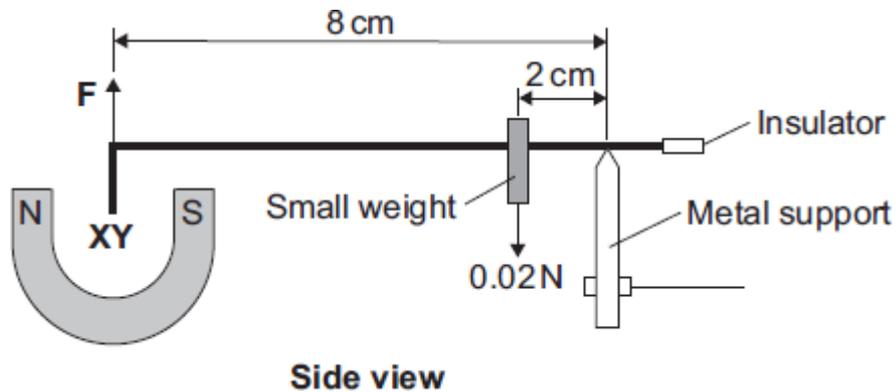
(1)

(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.

(2)

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



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

$\text{moment} = \text{force} \times \begin{array}{l} \text{perpendicular distance from the line of} \\ \text{action of the force to the axis of} \\ \text{rotation} \end{array}$

Show clearly how you work out your answer.

Force = _____ N

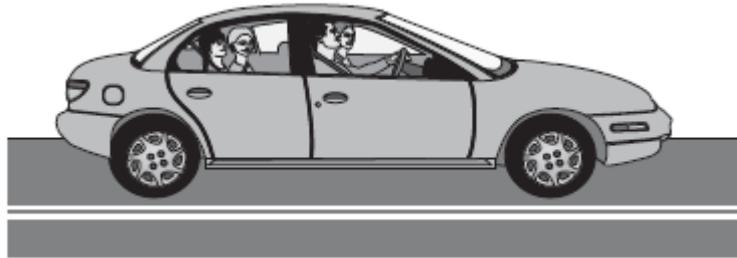
(3)

(Total 8 marks)

Q20.

The figure below shows a car with an electric motor.

The car is moving along a flat road.



(a) (i) Use the correct answers from the box to complete each sentence.

light	electrical	kinetic	potential	sound
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The car's motor transfers _____ energy
into useful _____ energy as the car moves.
Some energy is wasted as _____ energy.

(3)

(ii) What happens to the wasted energy?

(1)

(b) The electric motor has an input energy of 50 000 joules each second.

The motor transfers 35 000 joules of useful energy each second.

Calculate the efficiency of the electric motor.

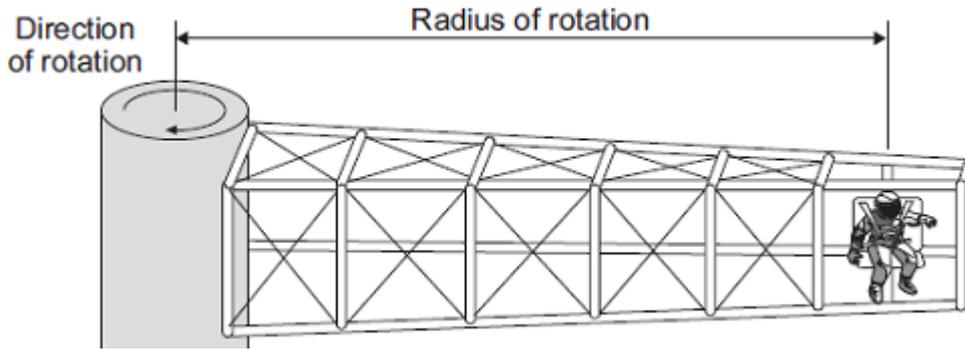
Efficiency = _____

(2)

(Total 6 marks)

Q21.

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

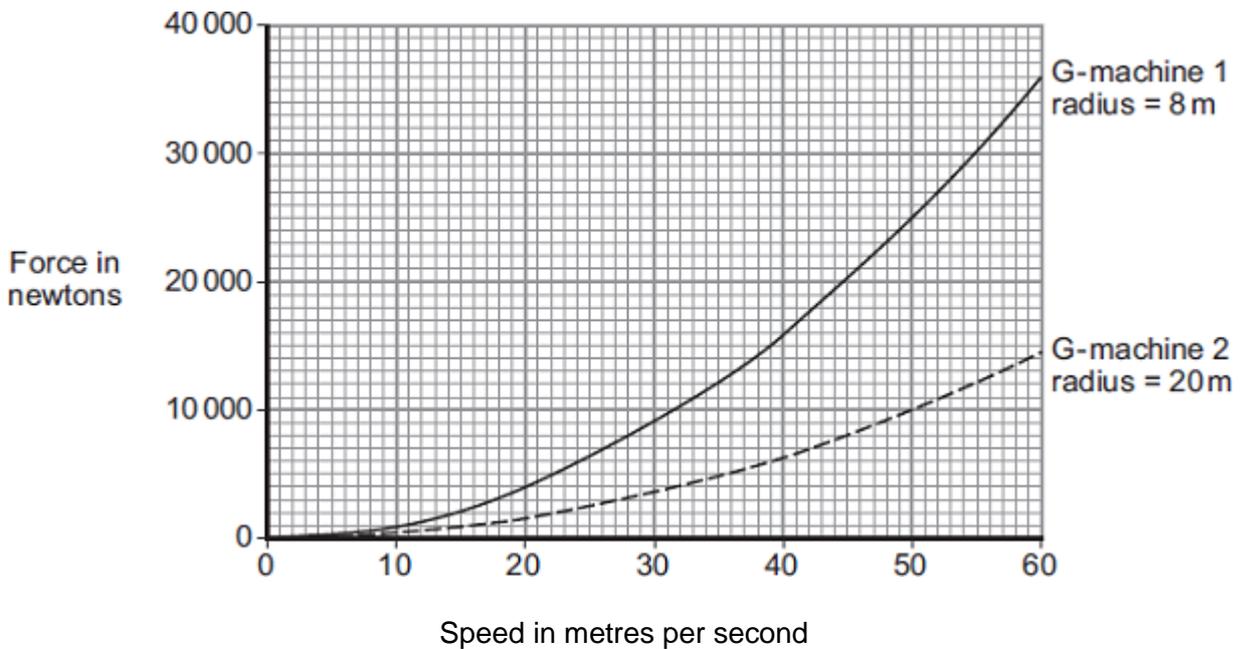


The G-machine moves the astronaut in a horizontal circle.

- (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)

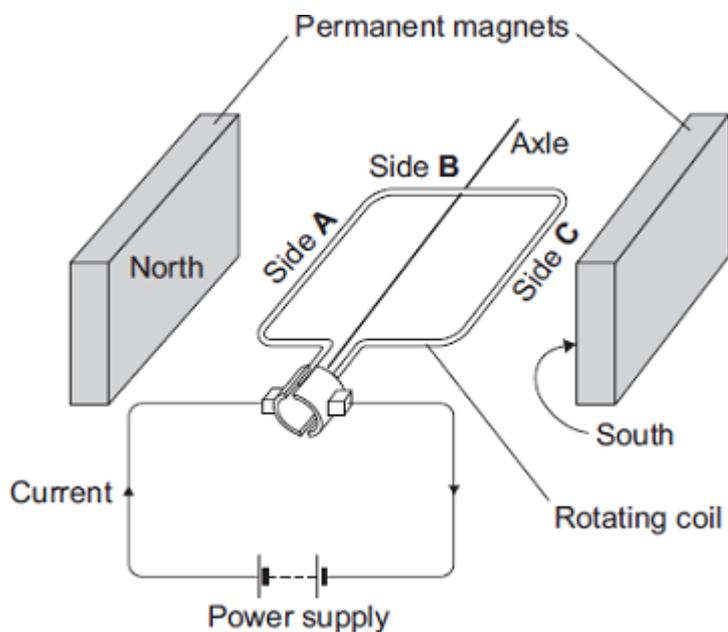
- (ii) The speed of rotation of G-machine 1 is increased from 20 m/s to 40 m/s.

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

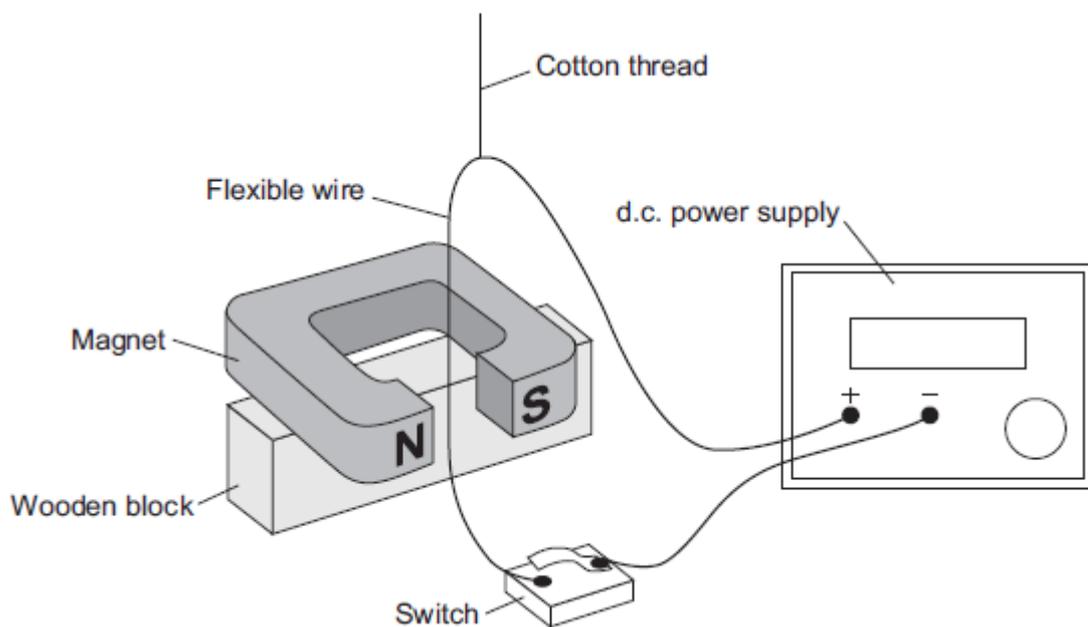
Give a reason for your answer.

(1)

(Total 10 marks)

Q22.

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
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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.

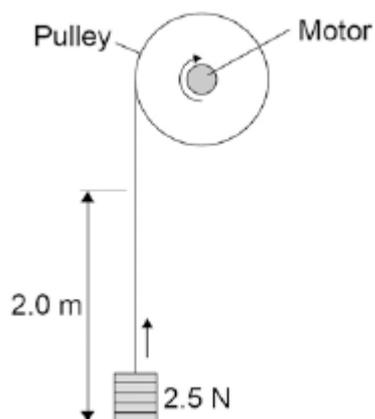
(1)

(Total 5 marks)

Q23.

A student investigated the efficiency of a motor using the equipment in **Figure 1**.

Figure 1



He used the motor to lift a weight of 2.5 N a height of 2.0 m.

He measured the speed at which the weight was lifted and calculated the efficiency of the energy transfer.

He repeated the experiment to gain two sets of data.

(a) Give **one** variable that the student controlled in his investigation.

_____ (1)

(b) Give **two** reasons for taking repeat readings in an investigation.

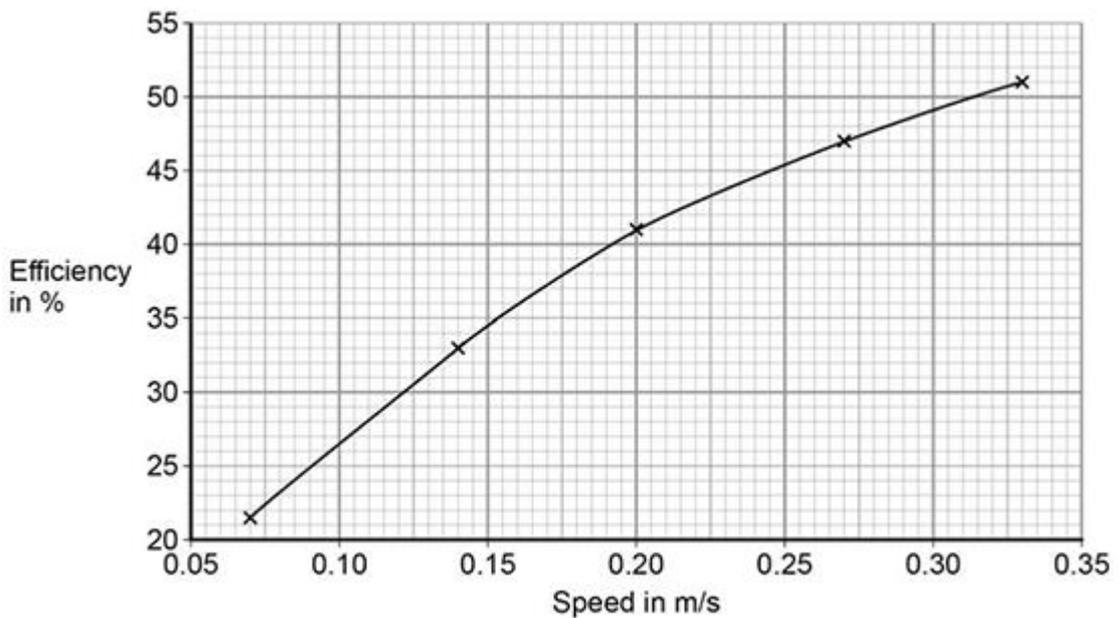
1. _____

2. _____

_____ (2)

(c) **Figure 2** shows a graph of the student's results.

Figure 2



Give **two** conclusions that could be made from the data in **Figure 2**.

(2)

(d) Give the main way that the motor is likely to waste energy.

(1)

(e) When the total power input to the motor was 5 W the motor could not lift the 2.5 N weight.

State the efficiency of the motor.

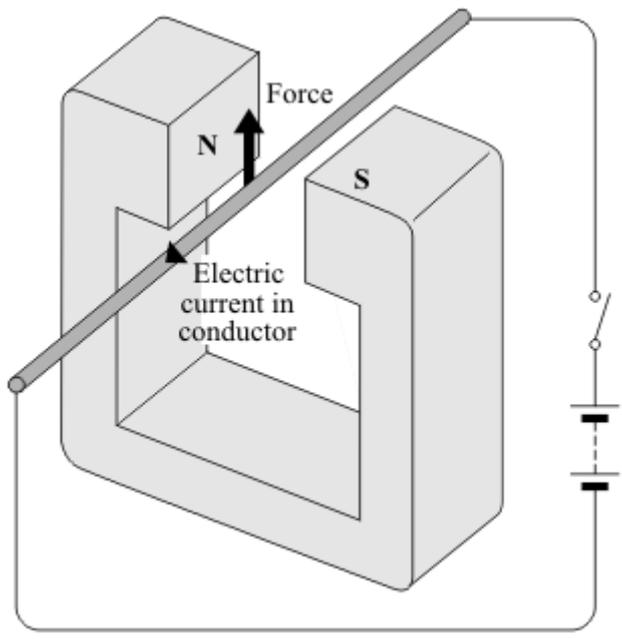
Efficiency = _____ %

(1)

(Total 7 marks)

Q24.

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)

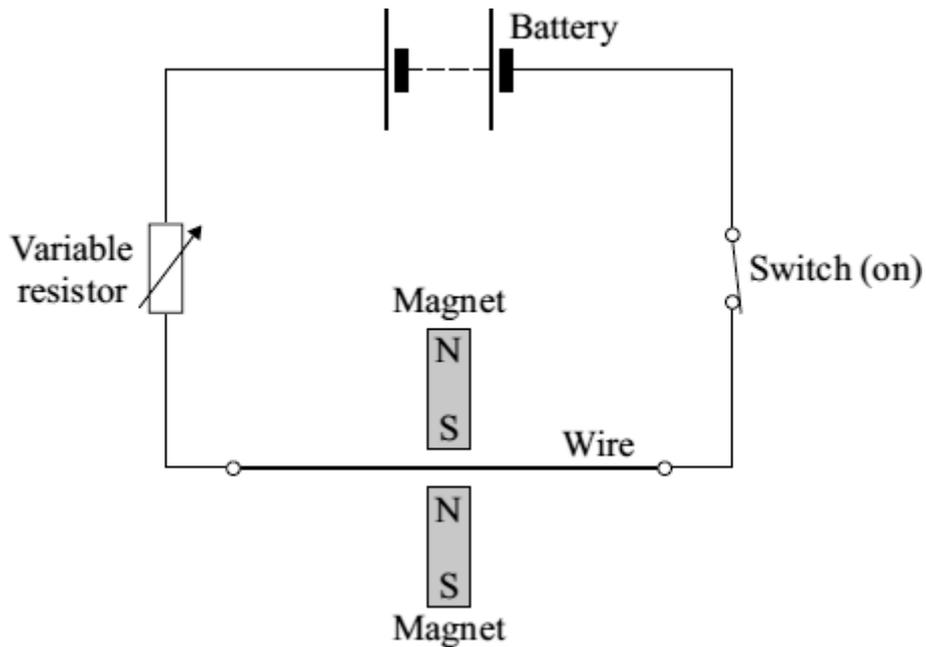
(c) In what circumstance will **no** force act on a conductor carrying an electric current and in a magnetic field?

Q25.

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.



(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.

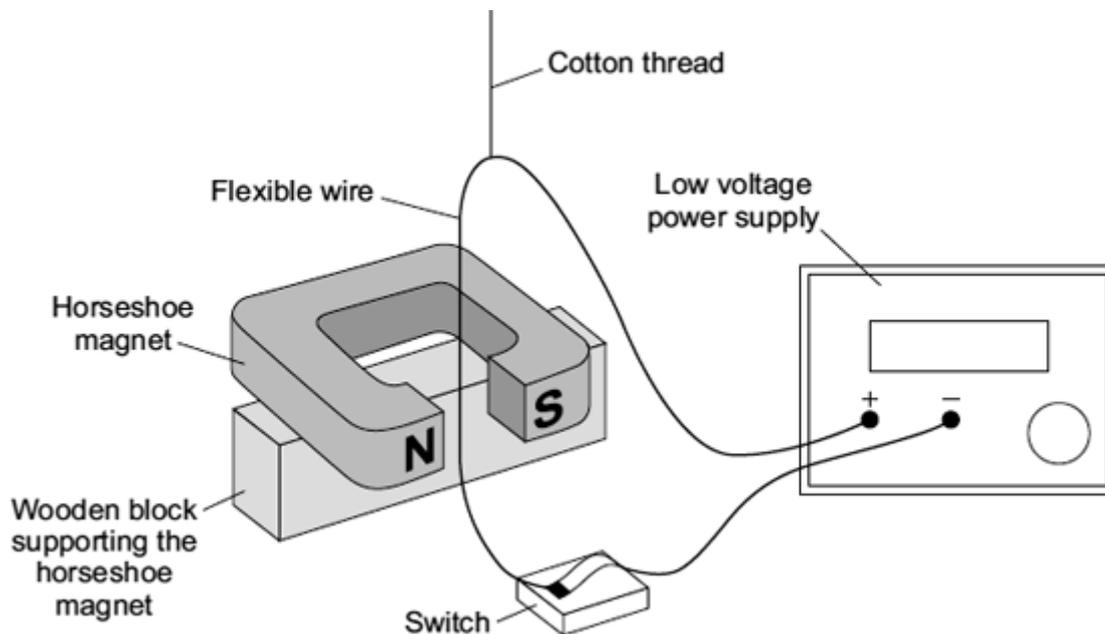
(1)

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

(1)

Q26.

- (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.

_____ (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)

Q27.

- (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

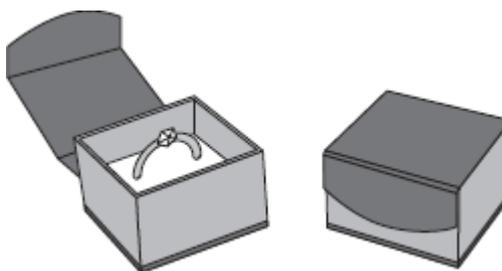
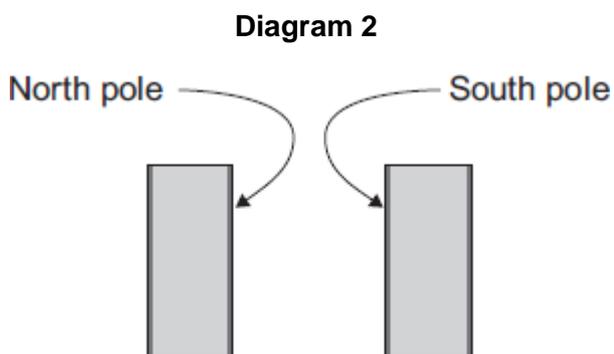


Diagram 2 shows the two magnets. The poles of the magnets are on the longer faces.



- (i) Draw, on **Diagram 2**, the magnetic field pattern between the two facing poles. (2)

- (ii) The magnets in the magnetic closure box must **not** have two North poles facing each other.

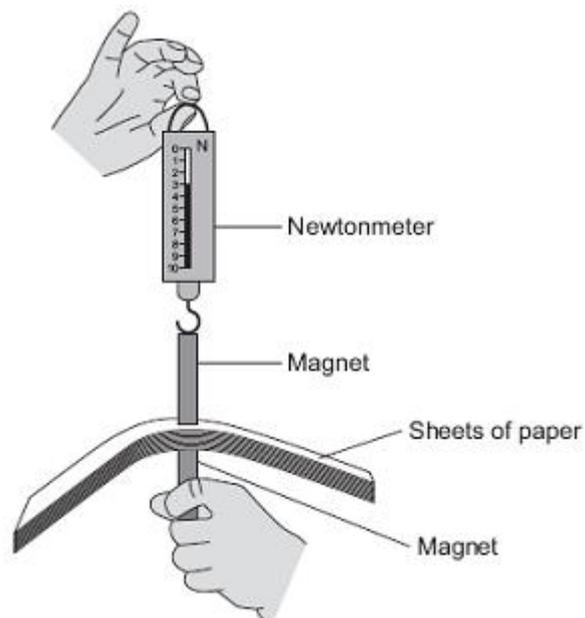
Explain why.

(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.

Number of sheets of paper between the magnets	10	20	30	40	50	60	70	80	120
Newtonmeter reading as the magnets separate	3.1	2.6	2.1	1.5	1.1	1.1	1.1	1.1	1.1

- (i) Describe the pattern of her results.

(2)

- (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)

- (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)

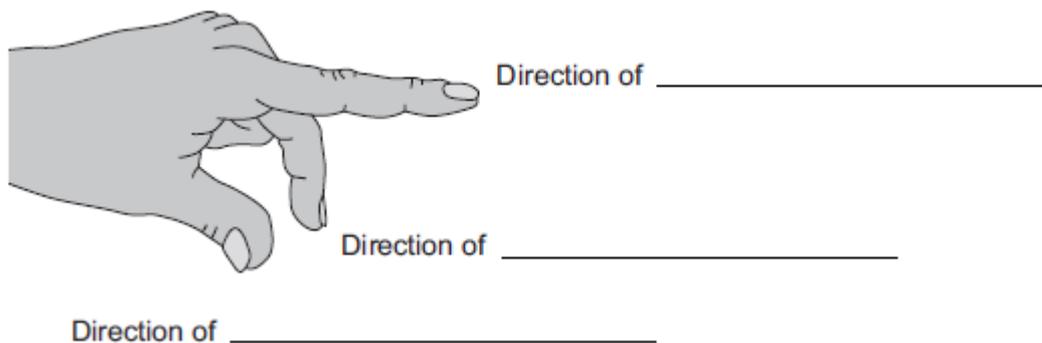
(Total 15 marks)

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
---------	-------	-------	----------------------

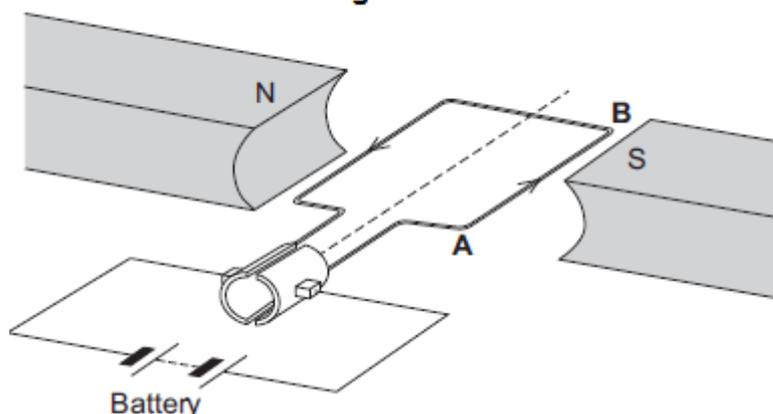
Figure 1



(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**.

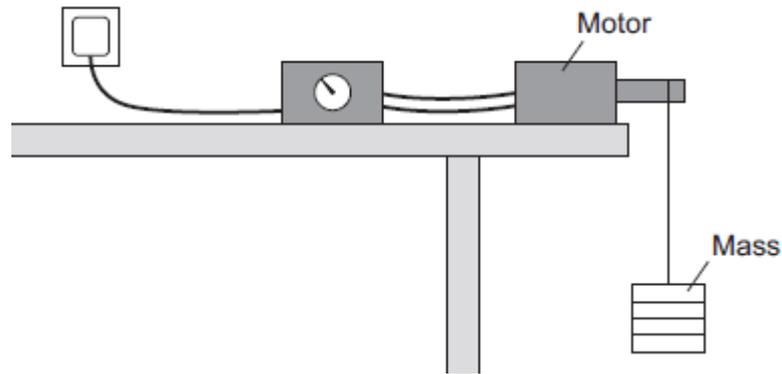
1. _____

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**.

Efficiency = _____

(2)

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

(1)

- (iii) Suggest a reason for this anomalous result.

(1)

(Total 12 marks)

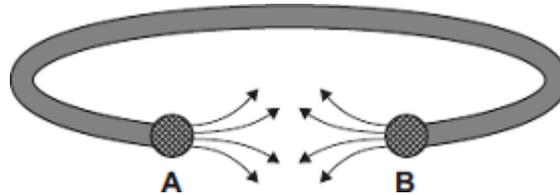
Q29.

- (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



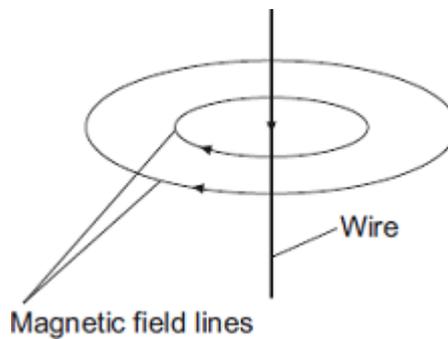
What is the pole at **A**? _____

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.

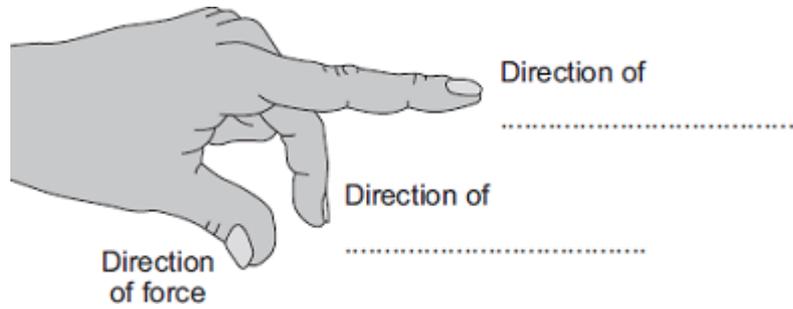
What happens to the direction of the lines in the magnetic field pattern?

(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

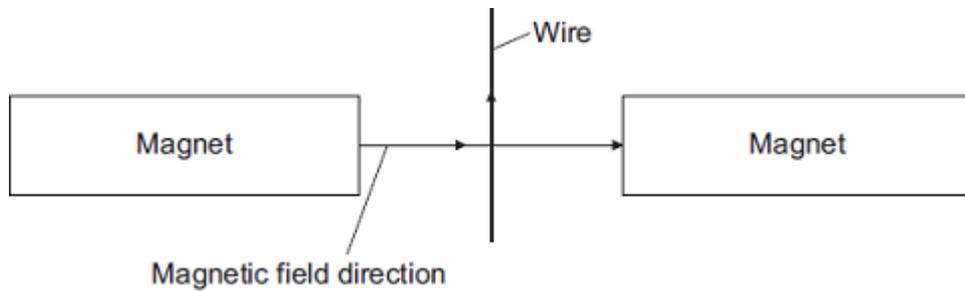


(2)

(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?

(1)

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

1. _____

2. _____

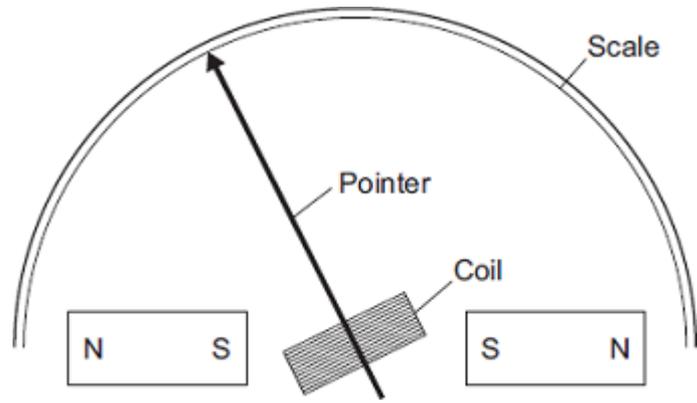
3. _____

(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



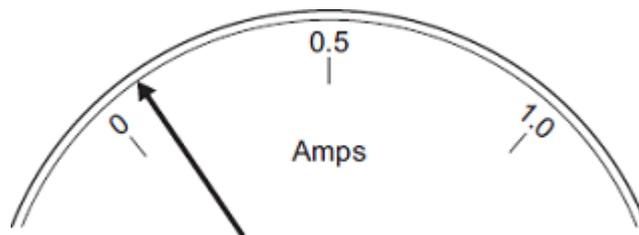
- (i) The equipment has **not** been set up correctly.

What change would make it work?

(1)

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

Figure 6



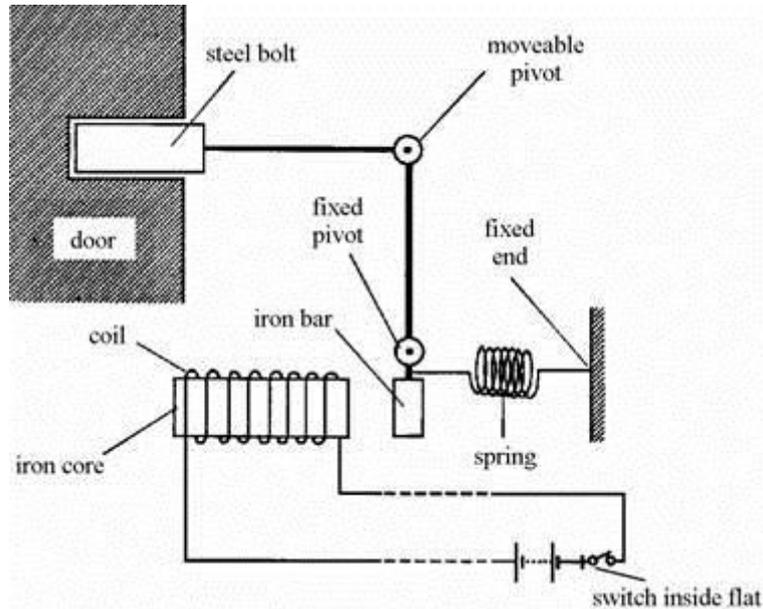
What type of error does the ammeter have?

(1)

(Total 10 marks)

Q30.

The diagram below shows a door lock which can be opened from a flat inside a building.



(a) Explain how the door is unlocked when the switch is closed.

(4)

(b) State **two** changes which would increase the strength of the electromagnet.

1. _____

2. _____

(2)

(c) Why is the spring needed in the lock?

(1)

(d) The connections to the coil were accidentally reversed. Would the lock still work?

Explain your answer.

(2)

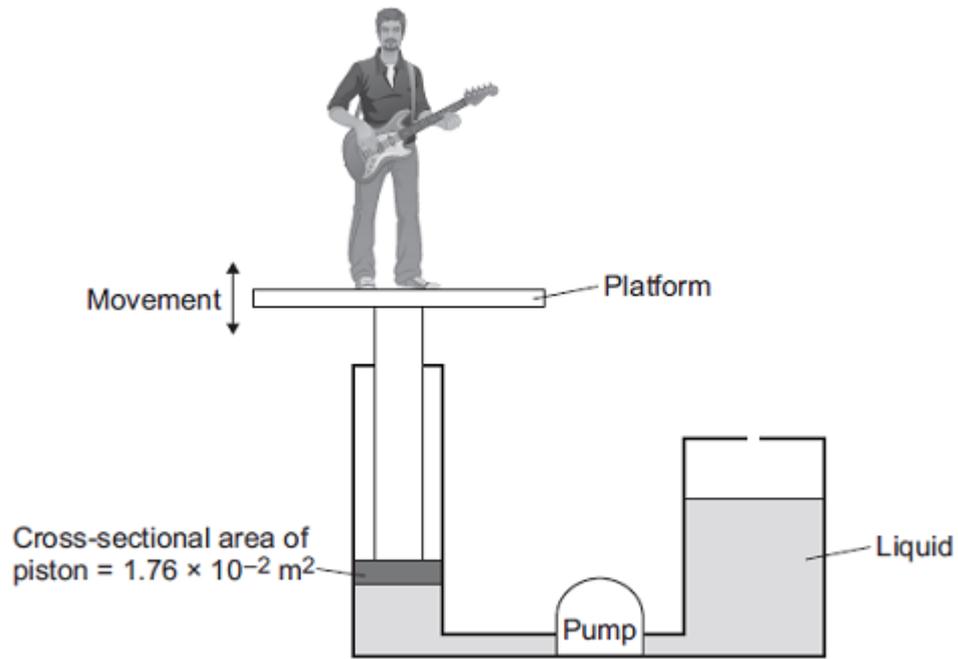
(Total 9 marks)

Q31.

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



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

(1)

- (b) The pump creates a pressure in the liquid of $8.75 \times 10^4 \text{ Pa}$ 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.

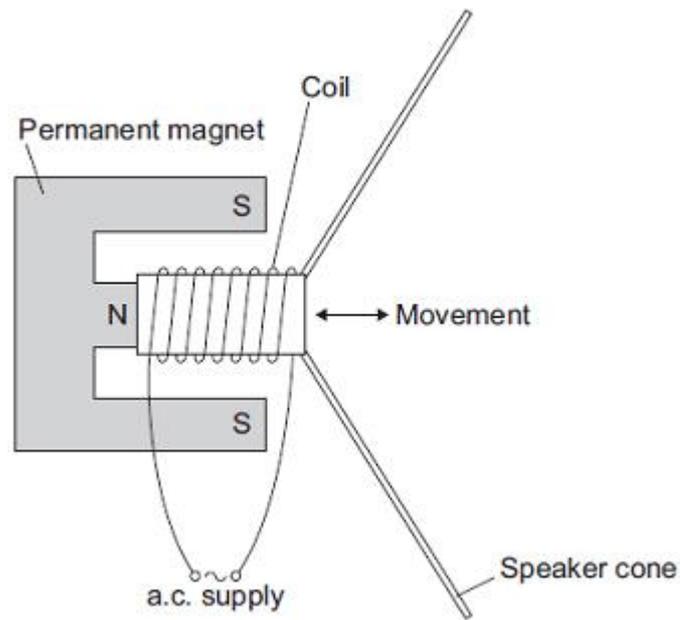
Suggest an environmental advantage of using plant oil.

(1)

- (d) Musicians often use loudspeakers.

Figure 2 shows how a loudspeaker is constructed.

Figure 2



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

Explain why.

(4)
(Total 8 marks)

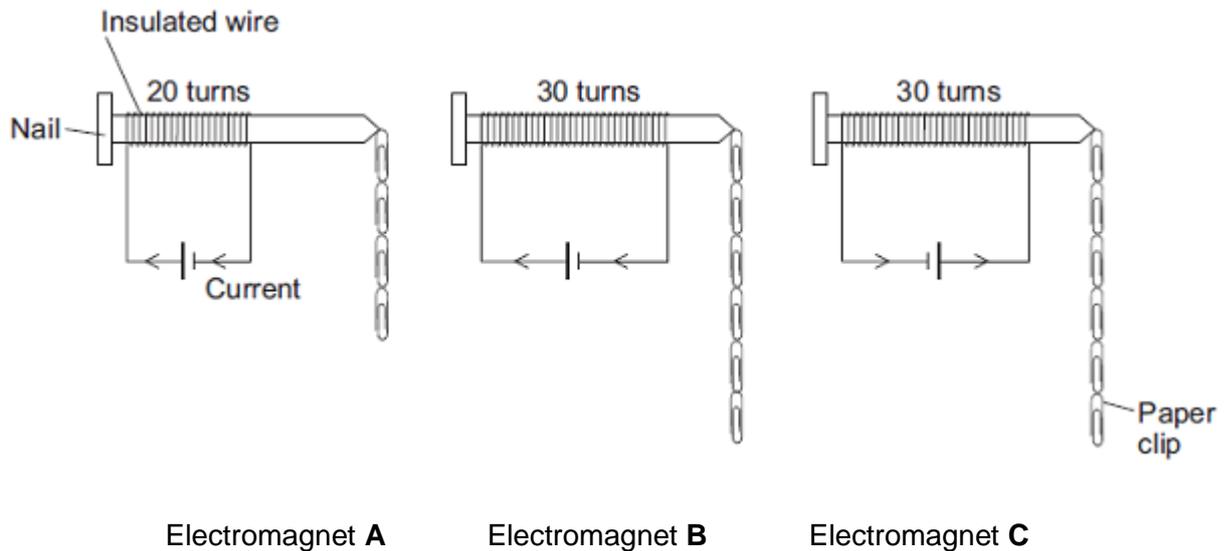
Q32.

A student is investigating the strength of electromagnets.

Figure 1 shows three electromagnets.

The student hung a line of paper clips from each electromagnet.

Figure 1



No more paper clips can be hung from the bottom of each line of paper clips.

(a) (i) Complete the conclusion that the student should make from this investigation.

Increasing the number of turns of wire wrapped around the nail will
 _____ the strength of the electromagnet.

(1)

(ii) Which **two** pairs of electromagnets should be compared to make this conclusion?

Pair 1: Electromagnets _____ and _____

Pair 2: Electromagnets _____ and _____

(1)

(iii) Suggest **two** variables that the student should control in this investigation.

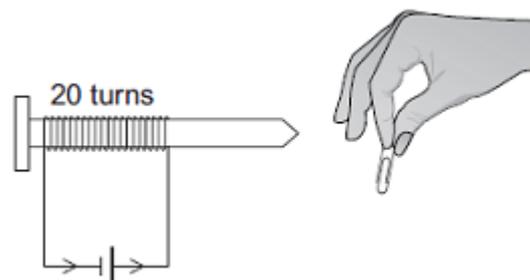
1. _____

2. _____

(2)

(b) The cell in electromagnet **A** is swapped around to make the current flow in the opposite direction. This is shown in **Figure 2**.

Figure 2



What is the maximum number of paper clips that can now be hung in a line from this electromagnet?

Draw a ring around the correct answer.

fewer than 4 4 more than 4

Give **one** reason for your answer.

(2)

- (c) Electromagnet **A** is changed to have only 10 turns of wire wrapped around the nail.

Suggest the maximum number of paper clips that could be hung in a line from the end of this electromagnet.

Maximum number of paper clips = _____

(1)

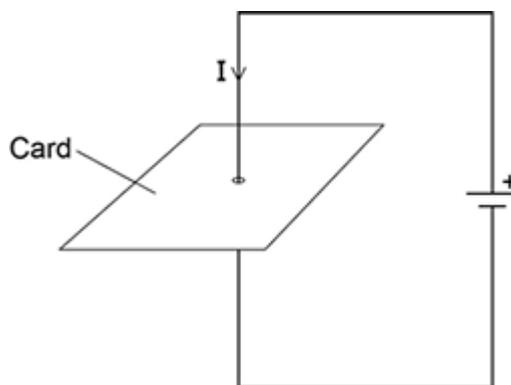
(Total 7 marks)

Q33.

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

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

Figure 1



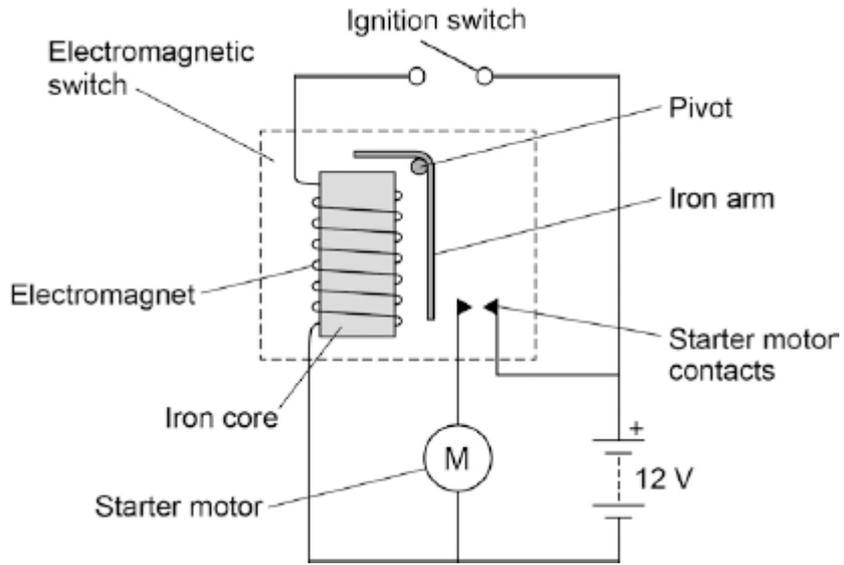
- (a) Describe how you could show that a magnetic field has been produced around the wire.

(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)

Q34.

- (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.

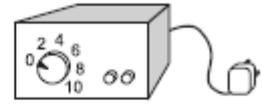
The students have the equipment shown below.



Insulated wire



Iron nail



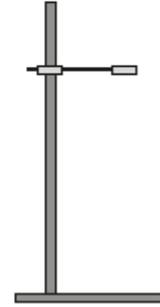
Power supply



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)

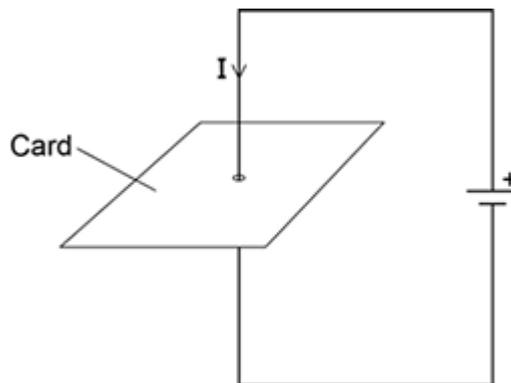
(Total 7 marks)

Q35.

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

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

Figure 1



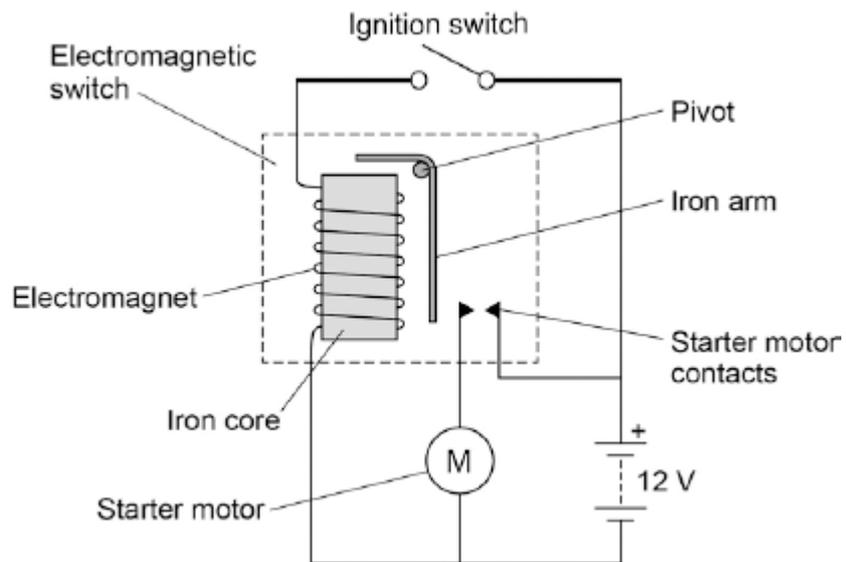
- (a) Describe how you could show that a magnetic field has been produced around the wire.

(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



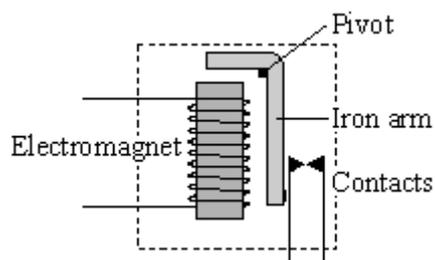
Explain how the ignition circuit works.

(4)

(Total 6 marks)

Q36.

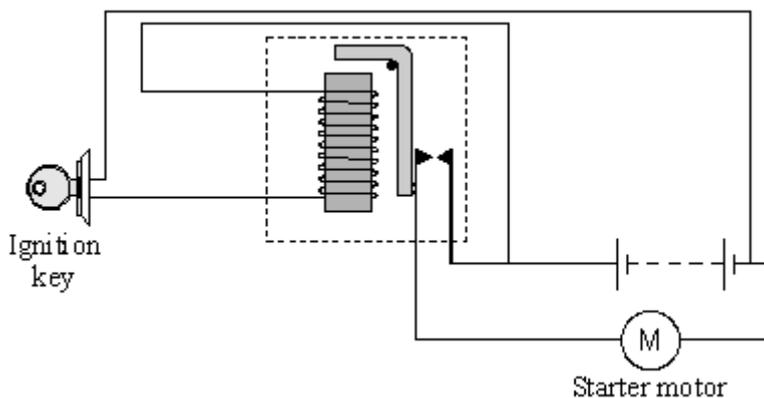
The diagram shows a switch that is operated by an electromagnet.



(i) What is this type of switch called?

(1)

- (ii) The switch is used in a car starter motor circuit.



Explain how turning the ignition key makes a current flow in the starter motor. The explanation has been started for you.

When the ignition key is turned _____

(3)

(Total 4 marks)

Q37.

The figure below shows an incomplete electromagnetic spectrum.



- (a) What name is given to the group of waves at the position labelled **A** in the figure above?

Tick **one** box.

infrared

radio

visible light

X-ray

(1)

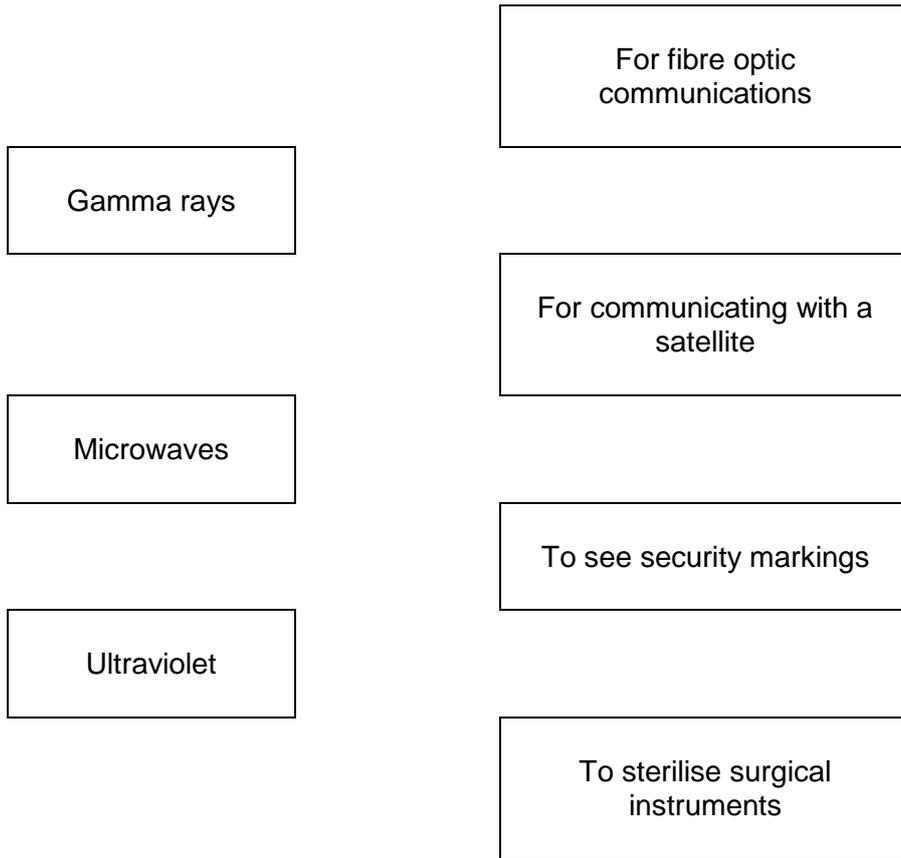
- (b) Electromagnetic waves have many practical uses.

Draw **one** line from each type of electromagnetic wave to its use.

Electromagnetic

Use

wave



(3)

(c) Complete the sentence.

Use an answer from the box.

black body	ionising	nuclear
-------------------	-----------------	----------------

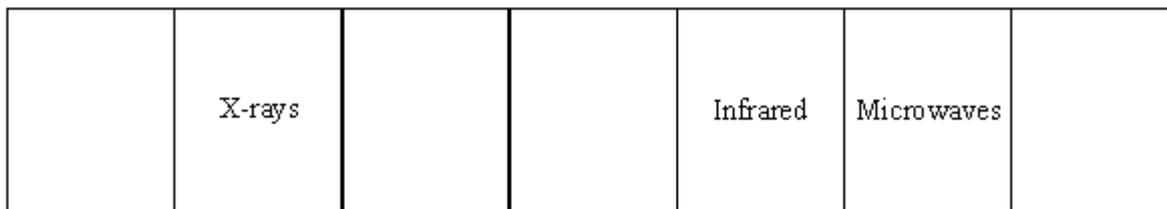
X-rays can be dangerous to people because X-rays are _____ radiation.

(1)

(Total 5 marks)

Q38.

(a) The diagram represents the electromagnetic spectrum. Four of the waves have not been named. Draw lines to join each of the waves to its correct position in the electromagnetic spectrum. One has been done for you.



Ultraviolet

Gamma rays

Radio

Light

(2)

- (b) Complete the following sentence by choosing the correct answer and crossing out in the box the two lines which are wrong.

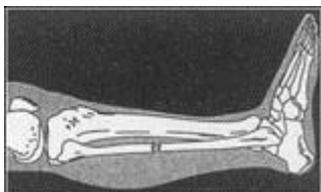
The speed of radio waves through a vacuum is

faster than
the same as
slower than

 the speed of light through a vacuum.

(1)

- (c) The diagram shows an X-ray photograph of a broken leg.



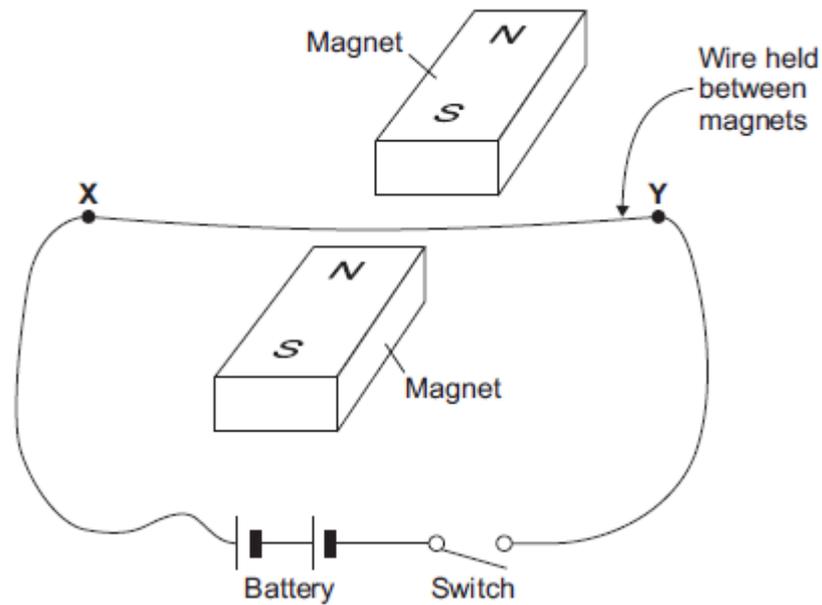
Bones show up white on the photographic film. Explain why.

(2)

(Total 5 marks)

Q39.

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)

Mark schemes

Q1.

- (i) reduces
for 1 mark 1
- (ii) less heat/energy/power wasted (in power lines)
for 1 mark 1
- (iii) for safety
for 1 mark 1

[3]

Q2.

- (a) increases the voltage (across the cables)
or
decreases the current (through the cables) 1

reducing energy losses (in cables)
accept heat for energy
*do **not** accept electricity for energy*
*do **not** accept no energy loss*
accept wires do not get as hot

or
increases efficiency of (electricity / energy) transmission
ignore reference to travel faster 1

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the Marking Guidance, and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1-2 marks)

There is a brief description of one advantage or disadvantage of using either overhead or underground cables.

Level 2 (3-4 marks)

There is a description of some of the advantages **and / or** disadvantages for both overhead and underground cables, with a minimum of three points made. There must be at least **one** point for each type of cable.

Level 3 (5-6 marks)

There is a clear and detailed description of the advantages and disadvantages of overhead **and** underground cables, with a minimum of five points made. At least one advantage and one disadvantage for each type of cable.

examples of the points made in the response

marks may be gained by linking an advantage for one type of cable with a disadvantage for the other type of cable

eg

overhead cables are easy to repair = 1 mark

overhead cables are easier to repair = 1 mark

overhead cables are easier to repair than underground cables = 2 marks

Overhead Advantages

- (relatively) quick / easy to repair / maintain / access
easy to install is insufficient
*do **not** accept easy to spot / see a fault*
- less expensive to install / repair / maintain
less expensive is insufficient
- cables cooled by the air
accept thermal energy / heat removed by the air
- air acts as electrical insulator
accept there is no need for electrical insulation (around the cables)
- can use thinner cables
difficult to reach is insufficient
land beneath cables can still be used is insufficient

Disadvantages

- spoil the landscape
- greater risk of (fatal) electric shock
- damaged / affected by (severe) weather
accept specific examples eg high winds, ice
more maintenance is insufficient
- hazard to low flying aircraft / helicopters
kites / fishing lines can touch them is insufficient
hazard to aircraft is insufficient

Underground Advantages

- cannot be seen
- no hazard to aircraft / helicopters
- unlikely to be / not damaged / affected by (severe) weather
less maintenance is insufficient

(normally) no / reduced shock hazard
installed in urban areas is insufficient

Disadvantages

- repairs take longer / are more expensive
accept harder to repair / maintain
have to dig up for repairs is insufficient
- (more) difficult to access (cables)
hard to locate (cables) is insufficient
faults hard to find is insufficient
- (very) expensive to install
- thicker cables required
- need cooling systems
- need layers of electrical insulation
- land disruption (to lay cables)
accept damage to environment / habitat(s)
or
cannot use land either side of cable path
accept restricted land use

6

(c) examples of acceptable responses:

allow 1 mark for each correct point

- closest to cables field from underground is stronger
- field from overhead cables stronger after 5 metres
- field from underground cables drops rapidly
- field from overhead cables does not drop much until after 20 metres
accept values between 20 and 30 inclusive
- overhead field drops to zero at / after 50 metres
- underground field drops to zero at / after 30 metres
- (strength of) field decreases with distance for both types of cable
if suitably amplified this may score both marks

2

(d) ethical

1

[11]

Q3.

the higher the voltage the smaller the current
small current gives small energy loss
in the form of heat

(or efficiency greater, or energy/heat losses low – gets 1)

for 1 mark each

[3]

Q4.

- (a) iron
accept any unambiguous correct indication 1
- (b) (i) step-down (transformer)
*do **not** accept down step or a description* 1
- (ii) less than
accept any unambiguous correct indication 1
- (c) (i) 2000 1
- (ii) There is no pattern. 1

[5]

Q5.

- (a) (i) grid
accept any way of indicating correct answer 1
- (ii) increases voltage
accept any way of indicating correct answer 1
- (iii) 230 V
accept any way of indicating correct answer 1
- (iv) reduce
accept any way of indicating correct answer 1
- (b) (i) increases the temperature
accept make it hotter / heat goes into the air
accept convection currents
accept sensible comment eg sound energy / it buzzes
ignore pollutes the air 1
- (ii) less than 100% 1

[6]

Q6.

- (a) 400 000
allow 1 mark for correct substitution ie

$$\frac{25000}{?} = \frac{800}{12800}$$

or

$$\frac{25}{?} = \frac{800}{12800}$$

2

(b) (i) any **one** from:

*do **not** accept any response in terms of heat insulation, safety or electric shock*

- (so that there is) no short circuit
- (so that the) current goes around the coil
*do **not** accept electricity for current*
- (so that the) current does not enter the core

1

(ii) (easily) magnetised (and demagnetised)

accept '(it's) magnetic'
*do **not** accept 'because it's a conductor'*

1

(iii) alternating current in the primary (coil)

1

produces a changing magnetic field (in the core)

1

this induces an (alternating) potential difference across the secondary (coil)

1

(c) any **two** from:

- if the (local) power station breaks down / fails / demand / load exceeds supply
- electricity / power can be switched from elsewhere in the system / from other power station(s)
- electricity can be generated in places remote from customers
- (in total) fewer power stations are needed
- power available in rural / remote areas
- National Grid allows for (better) control of supply and demand

2

[9]

Q7.

(a) iron

correct positions only

1

primary

- 1
- secondary 1
- (b) (i) decreases the p.d. 1
- accept it would increase current*
- accept voltage for p.d.*
- the voltage goes from 230(V) to 20(V) is insufficient*
- do **not** accept decreases current / energy / power*
- do **not** accept decreases p.d. / voltage and current*
- 1
- (c) an environmental 1

[5]

Q8.

- (a) step-down 1
- (b) (i) 1.6 1
- correct order only*
- 12.8 1
- (ii) values of p.d. are smaller than 230 V 1
- (c) (i) a.c. is constantly changing direction 1
- accept a.c. flows in two / both directions*
- accept a.c. changes direction(s)*
- a.c. travels in different directions is insufficient*
- d.c. flows in one direction only 1
- (ii) an alternating current / p.d. in the primary creates a changing / alternating magnetic field 1
- (magnetic field) in the (iron) core
- current in the core negates this mark*
- accept voltage for p.d.*
- (and so) an alternating p.d. 1
- (p.d.) is induced across secondary coil 1

[10]

Q9.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks

No relevant / correct content.

Level 1 (1–2 marks)

Either there is an attempt at a description of the construction of a transformer

or

a correct statement of the effect of one type of transformer on the input p.d.

Level 2 (3–4 marks)

There is a description of the construction of a transformer

and

a correct statement of the effect of one type of transformer on the input p.d.

Level 3 (5–6 marks)

There is a clear description of the construction of a transformer

and

there is a correct description of how transformers affect the input p.d.

details of construction:

extra information

a (laminated) core

core is made from a magnetic material / iron

2 coils

the coils are made from an electrical conductor / copper

the coils are covered in plastic / insulation

the coils are (usually) on opposite sides

step-up transformer has more turns on secondary coil than (its) primary (or vice versa)

step-down transformer has fewer turns on secondary coil than (its) primary (or vice versa)

effect on input p.d. :

step-up transformer, the output p.d. is greater (than the input p.d.)

accept voltage for p.d.

step-down transformer, the output p.d. is lower (than the input p.d.)

6

[6]

Q10.

(a) It is easily magnetised.

1

(b) p.d. across the secondary coil is smaller (than p.d. across the primary coil)

(c) ratio $\frac{V_p}{V_s} = \frac{6}{12}$

$\frac{6}{12} = \frac{50}{N_p}$

accept any other correct ratio taken from the graph

$\frac{6}{12} = \frac{50}{N_p}$

$N_p = 100$

use of the correct turns ratio and substitution or correct transformation and substitution

$N_p = 100$

allow 100 with no working shown for 3 marks

[5]

Q11.

(a) (i) more turns **or** waves per second
*accept spinning **or** turning **or** faster*

(ii) less time spent cutting field lines
*accept shorter time in field **or** when the frequency increases (the wavelength decreases)*

(iii) more energy given
*accept more KE put in
accept a higher voltage produced
do not credit more power*

(b) more coils

more powerful magnets
*accept put in better bearings
do not credit reduce friction **or** add soft iron core*

[5]

Q12.

(a) (i) generator

(ii) alternating current

(iii) voltmeter / CRO / oscilloscope / cathode ray oscilloscope

(b) (i) time

(ii) peaks and troughs in opposite directions 1
amplitude remains constant
dependent on first marking point 1

(c) any **two** from:
• increase speed of coil
• strengthen magnetic field
• increase area of coil
do not accept larger 2

[8]

Q13.

(a) (i) it moves or experiences a force horizontally to the right
for 1 mark 1

(ii) A – moves in opposite direction or force reversed e.c.f.
B – faster movement or larger force
(**not** move further)
for 1 mark each 2

(b) turns clockwise
oscillates/reverses
comes to rest facing field/at 90° to field/vertically
for 1 mark each 3

(c) number of turns or linear number density of turns current core
for 1 mark each 3

[9]

Q14.

(a) (i) an electric motor 1

(ii) force 1

(b) any **two** from:
• more powerful magnet
do not allow 'bigger magnet'
• reduce the gap (between magnet and coil)
• increase the area of the coil
• more powerful cell
do not allow 'bigger cell'
accept battery for cell

accept add a cell
accept increase current / potential difference

- more turns (on the coil)
allow 'more coils on the coil'
*do **not** allow 'bigger coil'*

2

- (c) reverse the (polarity) of the cell
allow 'turn the cell the other way round'
accept battery for cell

1

reverse the (polarity) of the magnet
allow 'turn the magnet the other way up'

1

[6]

Q15.

- (i) away from magnet
arrow should be perpendicular to field lines and current as judged by eye

1

- (ii) current in wire creates magnetic field around wire

1

two fields interact **or** combine giving a resultant force (on the wire)

1

[3]

Q16.

- (a) 47250

answers of 1350/ 33750/ 48600 gain 1 mark
allow 1 mark for correct substitution using both 18 and 3

2

- (b) (i) 47250 or their (a)
accept statement 'same as the KE (lost)'
ignore any units

1

- (ii) transformed into heat/ thermal energy
sound on its own is insufficient
accept transferred/ lost/ for transformed
*do **not** accept any other form of energy included as a list*

1

[4]

Q17.

- (a) (i) an electrical conductor

1

- (ii) increase current

- accept increase p.d. / voltage*
- or**
- use stronger magnets
- accept move magnets closer*
- do **not** accept use larger magnets*
- 1
- (iii) reverse the poles / ends (of the magnet)
- either order*
- 1
- reverse the connections (to the power supply)
- 1
- (b) (i) environmental
- 1
- (ii) ethical
- allow political (instability)*
- allow economic (migration)*
- 1

[6]

Q18.

- (a) a force
- 1
- (b) any **two** from:
- more powerful magnet
 - do **not** allow 'bigger magnet'*
 - reduce the gap (between magnet and coil)
 - increase the area of the coil
 - more powerful cell
 - do **not** allow 'bigger cell'*
 - accept battery for cell*
 - accept add a cell*
 - accept increase current / potential difference*
 - more turns (on the coil)
 - allow 'more coils on the coil'*
 - do **not** allow 'bigger coil'*
- 2
- (c) reverse the (polarity) of the cell
- allow 'turn the cell the other way round'*
- accept battery for cell*
- 1
- reverse the (polarity) of the magnet
- allow 'turn the magnet the other way up'*
- 1

[5]

Q19.

- (a) (i) current produces a magnetic field (around XY)
accept current (in XY) is perpendicular to the (permanent) magnetic field 1
- (creating) a force (acting) on XY / wire / upwards
reference to Fleming's left hand rule is insufficient 1
- (ii) motor (effect) 1
- (iii) vibrate / move up and down 1
- 5 times a second
only scores if first mark point scores
allow for 1 mark only an answer 'changes direction 5 times a second' 1
- (b) 0.005
allow 1 mark for calculating moment of the weight as 0.04 (Ncm)
and
allow 1 mark for correctly stating principle of moments
or
allow 2 marks for correct substitution
ie $F \times 8 = 2 \times 0.02$ or $F \times 8 = 0.04$ 3

[8]

Q20.

- (a) (i) electrical 1
correct order only
- kinetic 1
- sound 1
- (ii) transferred into surroundings / atmosphere
accept warms the surroundings
allow released into the environment
becomes heat or sound is insufficient 1
- (b) 0.7 / 70 %
an answer of 70 without % or with the wrong unit or 0.7 with a unit gains 1 mark 2

[6]

Q21.

- (a) (i) the greater the speed (of a centrifuge), the greater the force
answers must be comparative
accept velocity for speed
accept positive correlation between speed and force
speed and force are not proportional – treat as neutral

1

the smaller the radius, the greater the force (at a given speed)
*allow (**G machine**) 1 has / produces a greater force (than **G machine 2**) at the same speed*
must be comparative, eg a small radius produces a large force = 0 marks on own

1

as the speed increases the rate of change in force increases
accept force is proportional to the square of the speed
or
doubling speed, quadruples the force
accept any clearly correct conclusion

1

- (ii) 12000 (N)

or

12 k(N)

1

- (b) (i) the current (in the coil) creates a magnetic field (around the coil)
accept the coil is an electromagnet

1

so the magnetic field of the coil interacts with the (permanent) magnetic field of the magnets (producing a force)

accept the two magnetic fields interact (producing a force)

if no marks scored an answer in terms of current is

perpendicular to the (permanent) magnetic field is worth max 1 mark

1

- (ii) vertically downwards arrow on side A
one arrow insufficient

and

vertically upwards arrow on side C

1

- (iii) the current is parallel to the magnetic field
allow the current and magnetic field are in the same direction
allow it / the wire is parallel to the magnetic field

1

- (c) increase the current / p.d. (of the coil)
accept decrease resistance
accept voltage for p.d.

accept increase strength of magnetic field / electromagnet

1

(d) yes with suitable reason

or

no with suitable reason

eg

yes – *it has increased our knowledge*

yes – *It has led to more (rapid) developments / discoveries (in technology / materials / transport) accept specific examples*

no – *the money would have been better spent elsewhere on such things as hospitals (must quote where, other things not enough)*

no mark for just **yes** / **no**

reason must match yes / no

1

[10]

Q22.

(a) motor

1

(b) increase the strength of the magnetic field

accept use a stronger magnet

use a larger / bigger magnet is insufficient

*do **not** accept move magnets closer*

1

increase the (size of the) current

accept use a current greater than 2 (A)

accept increase the p.d. / voltage (of the power supply)

increase the power supply is insufficient

1

(c) any **one** from:

- (reverse the) direction of the current

accept swap the wires at the power supply connections

swap the wires around is insufficient

- (change the) direction of the magnetic field

accept turn the magnet around

*do **not** accept use an a.c. supply*

1

(d) The wire is parallel to the direction of the magnetic field.

1

[5]

Q23.

(a) weight (lifted)

or

height (lifted)

1

- (b) any **two** from:
- calculate a mean
 - spot anomalies
 - reduce the effect of random errors
- 2
- (c) as speed increases, the efficiency increases
- 1
- (but) graph tends towards a constant value
- or**
- appears to reach a limit
- accept efficiency cannot be greater than 100%*
- 1
- (d) heating the surroundings
- 1
- (e) 0 (%)
- 1

[7]

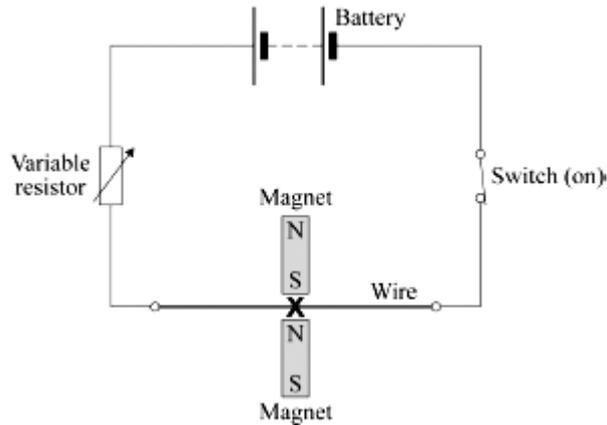
Q24.

- (a) increase the current (1)
- credit increase the p.d./voltage*
credit reduce the resistance
credit have thicker wiring
credit add extra / more cells
- 1
- increase the magnetic field (strength) (1)
- credit 'have stronger magnet(s)*
*do **not** credit 'bigger magnets' either order*
- 1
- (b) **either** reverse polarity
- or** connect the battery the other way round
- 1
- either** reverse direction of the magnetic field
- or** put the magnet the other way round / reverse the magnet
- do **not** give any credit to a response in which both are done*
at the same time
either order
- 1
- (c) **either**
- conductor parallel to the magnetic field
- or** lines of magnetic force and path of electricity do not cross
- 1

[5]

Q25.

- (a) centre of the **X** midway between the poles
intention correct as judged by eye
example



1

- (b) move the poles further apart
accept turn for move
accept ends / magnets for poles
accept use weaker magnets
do not accept use smaller magnets

1

- (c) (i) add more cells (to the battery)
do not accept 'use a bigger battery'
accept increase the potential difference / voltage
accept increase the current

or

reduce the resistance (of the variable resistor)
do not accept any changes to the magnets, to the wire or to their relative positions

1

- (ii) reverse (the polarity of) the battery
accept turn the battery / cells round
accept swap the connections to the battery
do not accept any changes to the magnets, to the wire or to their relative positions

1

[4]

Q26.

- (a) motor (effect)

1

- (b) (i) wire kicks further (forward)
accept moves for kicks
accept moves more
accept 'force (on the wire) increased'

1

- (ii) wire kicks back(wards) / into (the space in) the (horseshoe) magnet

accept moves for kicks
accept 'direction of force reversed'

1

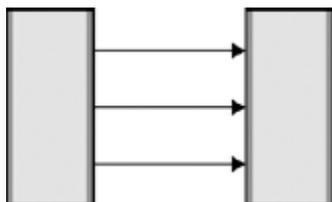
[3]

Q27.

- (a) (i) field pattern shows:
some straight lines in the gap

1

direction N to S



1

- (ii) north poles repel

1

(so) box will not close

1

- (b) (i) as paper increases (rapid) decrease in force needed

1

force levels off (after 50 sheets)

1

- (ii) the newtonmeter will show the weight of the top magnet

1

- (iii) (top) magnet and newtonmeter separate before magnets separate
accept reverse argument

1

(because) force between magnets is greater than force between magnet
and hook of newtonmeter

1

- (iv) any **three** from:

- means of reading value of force at instant the magnets are pulled apart
- increase the pulling force gently
- **or**
- use a mechanical device to apply the pulling force
- clamp the bottom magnet
- use smaller sheets of paper
- fewer sheets of papers between readings (smaller intervals)
- ensure magnets remain vertical
- ensure ends of magnet completely overlap
- repeat the procedure several times for each number of sheets and take a mean
- make sure all sheets of paper are the same thickness

3

- (v) 3 (mm)
30 × 0.1 ecf gains 2 marks
2.1 N corresponds to 30 sheets gains 1 mark

3
 [15]

Q28.

- (a) field
correct order only 1
- current 1
- force
accept motion
accept thrust 1
- (b) (i) arrow pointing vertically downwards 1
- (ii) increase current / p.d.
accept voltage for p.d. 1
- increase strength of magnetic field
accept move poles closer together 1
- (iii) reverse (poles of) magnets 1
- reverse battery / current 1
- (c) (i) 1.5 or 150%
efficiency = 120 / 80 (× 100)
gains 1 mark
an answer of 1.5 % or 150
gains 1 mark 2
- (ii) efficiency greater than 100%
or
 output is greater than input
or
 output should be 40 (W) 1
- (iii) recorded time much shorter than actual time
accept timer started too late
accept timer stopped too soon 1

[12]

Q29.

- (a) north (pole)
accept N
- north (pole)
both needed for mark 1
- (b) reverses
accept changes direction 1
- (c) (i) first finger:
(direction of) (magnetic) field 1
- second finger:
(direction of) (conventional) current 1
- (ii) into (plane of the) paper 1
- (iii) less current in wire
accept less current / voltage / more resistance / thinner wire 1
- weaker field
allow weaker magnets / magnets further apart
*do **not** accept smaller magnets* 1
- rotation of magnets (so) field is no longer perpendicular to wire 1
- (d) (i) reverse one of the magnets
*do **not** accept there are no numbers on the scale* 1
- (ii) systematic or zero error
accept all current values will be too big
accept it does not return to zero
accept it does not start at zero 1

[10]

Q30.

- (a) current flows
coil / core magnetised / electromagnet activated / energised / turned on
attracts iron bar causing bolt to be pulled out
each for 1 mark 4
- (b) more turns
bigger current / e.m.f
softer iron core
any two for 1 mark each 2

(c) to relock door / return iron bar / to lock door
for 1 mark

1

(d) iron bar would still be attracted / coil still magnetised so still works
for 1 mark each

yes + wrong answer
0 marks

yes + current still flows
1 mark

yes + still magnetised / iron bar still attracted
2 marks

2

[9]

Q31.

(a) hydraulic (system)

1

(b) 15.40×10^2
or
1540

allow 1 mark for correct substitution, ie

$$8.75 \times 10^4 = \frac{F}{1.76 \times 10^{-2}}$$

or

$$87\,500 = \frac{F}{0.0176}$$

or

$$F = 8.75 \times 10^4 \times 1.76 \times 10^{-2}$$

or

$$F = 87\,500 \times 0.0176$$

2

(c) any **one** environmental **advantage**:

stating a converse statement is insufficient, or a disadvantage of the usual oil, ie the usual oil is non-renewable

plant oil is renewable

using plant oil will conserve (limited) supplies or extend lifetime of the usual / crude oil.

plant oil releases less carbon dioxide (when it is being produced / processed)

plant oil will add less carbon dioxide to the atmosphere (when it is being produced / processed, than the usual oil)

plant oil removes carbon dioxide from or adds oxygen to the air when it is growing

stating that plant oil is carbon neutral is insufficient

(d) (the current flowing through the coil) creates a magnetic field (around the coil)

1

(this magnetic field) interacts with the permanent magnetic field

or

current carrying conductor is in a (permanent) magnetic field

it must be clear which magnetic field is which

1

1

this produces a (resultant) force (and coil / cone moves)

1

when the direction of the current changes, the direction of the force changes to the opposite direction

accept for 2 marks the magnetic field of the coil interacts with the permanent magnetic field

1

[8]

Q32.

(a) (i) increase

1

(ii) A and B
and
B and C

*both required for the mark
either order*

1

(iii) any **two** from:

- size of nail
or
nail material
allow (same) nail
- current
*allow (same) cell
allow p.d.
same amount of electricity is insufficient*
- (size of) paper clip
- length of wire
accept type / thickness of wire

2

(b) 4

1

B picks up the same number as C, so this electromagnet would pick up the same number as A

or

direction of current does not affect the strength of the electromagnet

allow it has got the same number of turns as A

(c) 2

allow 1 or 3

1

1

[7]

Q33.

(a) move a (magnetic / plotting) compass around the wire

1

the changing direction of the compass needle shows a magnetic field has been produced

OR

sprinkle iron filings onto the card (1)

tapping the card will move the filings to show the magnetic field (pattern) (1)

1

(b) **Level 2 (3–4 marks):**

A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that explain how the ignition circuit works.

Level 1 (1–2 marks):

Simple statements are made. The response may fail to make logical links between the points raised.

0 marks:

No relevant content.

Indicative content

- closing the (ignition) switch causes a current to pass through the electromagnet
- the iron core (of the electromagnet) becomes magnetised
- the electromagnet / iron core attracts the (short side of the) iron arm
- the iron arm pushes the (starter motor) contacts (inside the electromagnetic switch) together
- the starter motor circuit is complete
- a current flows through the starter motor (which then turns)

4

[6]

Q34.

(a) an electromagnet can be switched off

accept a permanent magnet cannot be switched off

or

an electromagnet is stronger

accept control the strength

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a 'best-fit' approach to the marking.

Level 3 (5 – 6 marks):

there is a description of how the electromagnet is made
and
there is a description of how the strength of the electromagnet can be varied
and
there is a description of how the strength of the electromagnet can be tested

Level 2 (3 – 4 marks):

there is a description of how the electromagnet is made
and either
there is a description of how the strength of the electromagnet can be varied
or
there is a description of how the electromagnet can be tested

Level 1 (1 – 2 marks):

there is a basic description of how to make an electromagnet
or
there is a basic description of how the strength of the electromagnet can be varied
or
there is a basic description of how the electromagnet can be tested

Level 0 (0 marks):

No relevant / correct content

examples of the points made in the response

Details of how to make an electromagnet

- wrap the wire around the nail
- connect the wire to the power supply (with connecting leads and croc clips)
- switch on the power supply

accept a current should be sent along the wire

Details of how to vary the strength of the electromagnet

- change the number of turns (on the coil)
- change the current (through the coil)
- change the separation of the turns

allow change the potential difference (across the coil)

accept wrap the coil more tightly

Details of how to test the electromagnet

- suspend paperclips from the electromagnet
- the more paperclips suspended, the stronger the electromagnet is
- clamp the electromagnet at different distances from the paperclip(s)
- the further the distance from which paperclips can be attracted the stronger the electromagnet is
- test before and after making alterations to change the strength
- compare the results from before and after making alterations
- use de-magnetised paper clips

accept count the number of paperclips

*with different current **or** p.d. **or** no. of turns*

***or** core and see if the number changes/increases*

6

[7]

Q35.

- (a) move a (magnetic / plotting) compass around the wire

1

the changing direction of the compass needle shows a magnetic field has been produced

OR

sprinkle iron filings onto the card (1)

tapping the card will move the filings to show the magnetic field (pattern) (1)

1

(b) **Level 2 (3–4 marks):**

A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that explain how the ignition circuit works.

Level 1 (1–2 marks):

Simple statements are made. The response may fail to make logical links between the points raised.

0 marks:

No relevant content

Indicative content

- closing the (ignition) switch causes a current to pass through the electromagnet
- the iron core (of the electromagnet) becomes magnetised
- the electromagnet / iron core attracts the (short side of the) iron arm
- the iron arm pushes the contacts (inside the electromagnetic switch) together
- the starter motor circuit is complete
- a current flows through the starter motor (which then turns)

4

[6]

Q36.

(i) relay

accept solenoid

*do **not** accept magnetic switch*

1

(ii) a current flows through the coil (of the electromagnet)

or a current flows through the electromagnet

or a (magnetic) field is produced

accept 'electricity' for 'current'

*accept the electromagnet is activated **or** magnetised **or** turned on*

*do **not** accept answer in terms of magnetic charge*

1

the (iron) arm is attracted to the electromagnet

*accept the arm pivots **or** moves towards the electromagnet*

1

the contacts are pushed together

*do **not** accept contacts attract*

1

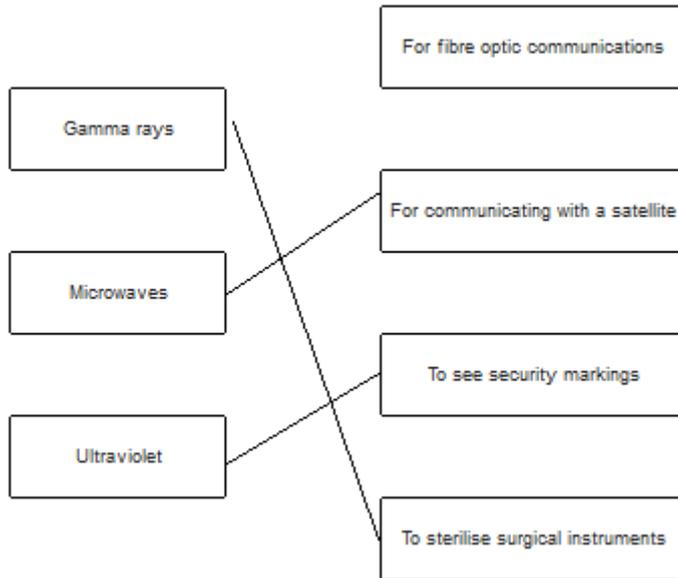
[4]

Q37.

(a) radio

1

(b)



*award 1 mark for each correct line
if more than one line is drawn from any em wave then none
of those lines gain credit*

3

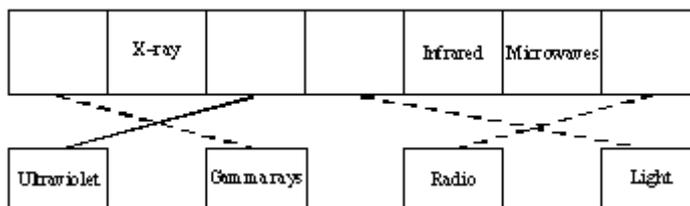
(c) ionising

1

[5]

Q38.

(a) all **three** correct



***one** only correct, 1 mark only
allow names in boxes
there should be only **one** line from **or** to each box*

2

(b) the same as

1

(c) any **two** from:

- bones absorb X-rays
- so film not exposed
- X-rays pass through flesh or skin or

- body or tissue (to expose film)
allow X-rays cannot pass through bones

2

[5]

Q39.

- (a) (i) (closing the switch makes) a current (through the wire) 1
- (the current flowing) creates a magnetic field (around the wire) 1
- this field interacts with the permanent magnetic field
accept links / crosses attracts / repels is insufficient 1
- (ii) arrow drawn showing upwards force on XY
judge vertical by eye the arrow must be on or close to the wire XY 1
- (iii) motor
accept catapult 1
- (b) (i) the wire moves up and down
or
the wire vibrates
back and forth or side to side is insufficient for vibrate 1
- (ii) the force (continually) changes direction (from upwards to downwards, on the wire)
accept the direction of the magnetic field (of the wire) changes 1

[7]