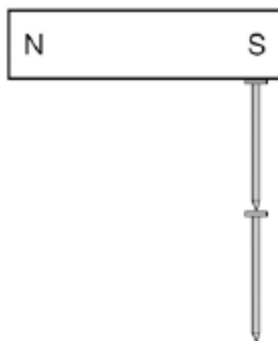


1

Figure 1 shows two iron nails hanging from a bar magnet.

The iron nails which were unmagnetised are now magnetised.

Figure 1



(a) Complete the sentence.

Use a word from the box.

forced

induced

permanent

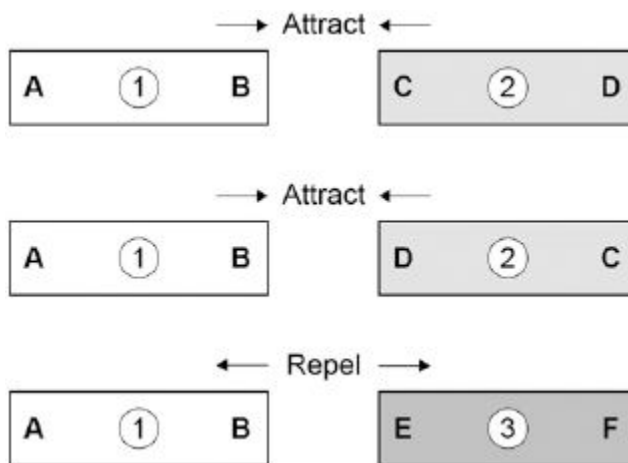
The iron nails have become magnets.

(1)

- (b) Each of the three metal bars in **Figure 2** is either a bar magnet or a piece of unmagnetised iron.

The forces that act between the bars when different ends are placed close together are shown by the arrows.

Figure 2



Which **one** of the metal bars is a piece of unmagnetised iron?

Tick **one** box.

Bar 1

☐

Bar 2

☐

Bar 3

☐

Give the reason for your answer.

.....

.....

(2)

- (c) A student investigated the strength of different fridge magnets by putting small sheets of paper between each magnet and the fridge door.

The student measured the maximum number of sheets of paper that each magnet was able to hold in place.

Why was it important that each small sheet of paper had the same thickness?

.....

.....

.....

(1)

- (d) Before starting the investigation the student wrote the following hypothesis:

'The bigger the area of a fridge magnet the stronger the magnet will be.'

The student's results are given in the table below.

Fridge magnet	Area of magnet in mm ²	Number of sheets of paper held
A	40	20
B	110	16
C	250	6
D	340	8
E	1350	4

Give **one** reason why the results from the investigation **do not** support the student's hypothesis.

.....

.....

(1)

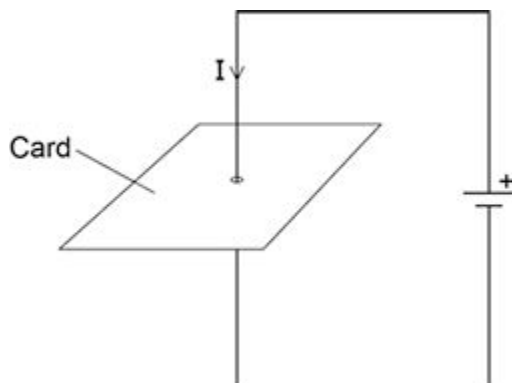
(Total 5 marks)

2

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

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

Figure 1



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

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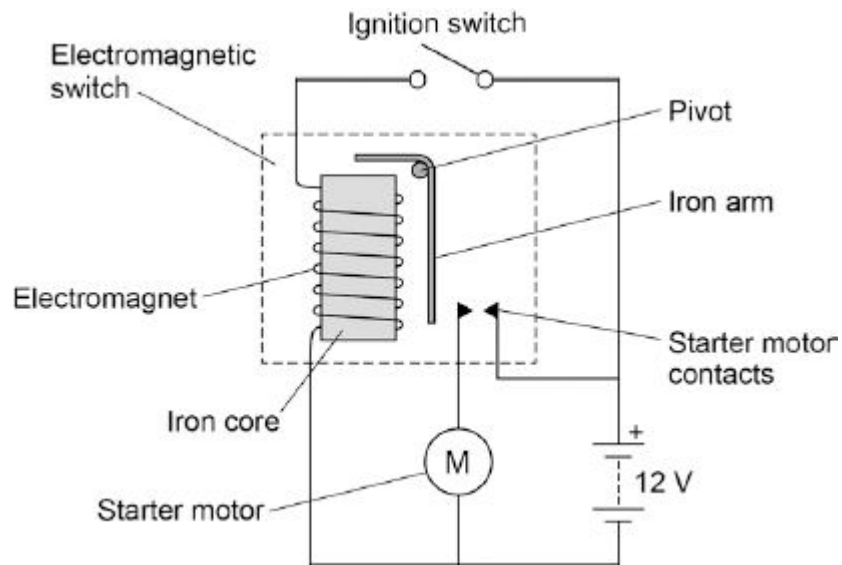
.....

(2)

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

The circuit includes an electromagnetic switch.

Figure 2



Explain how the ignition circuit works.

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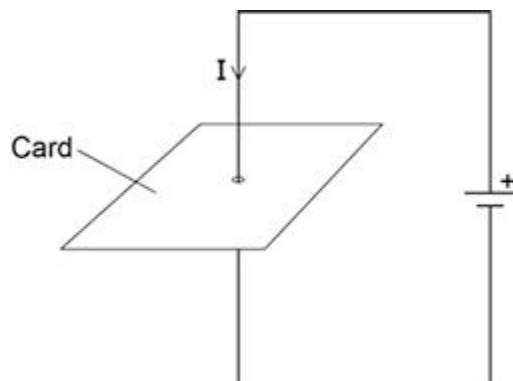
(4)
(Total 6 marks)

3

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

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

Figure 1



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

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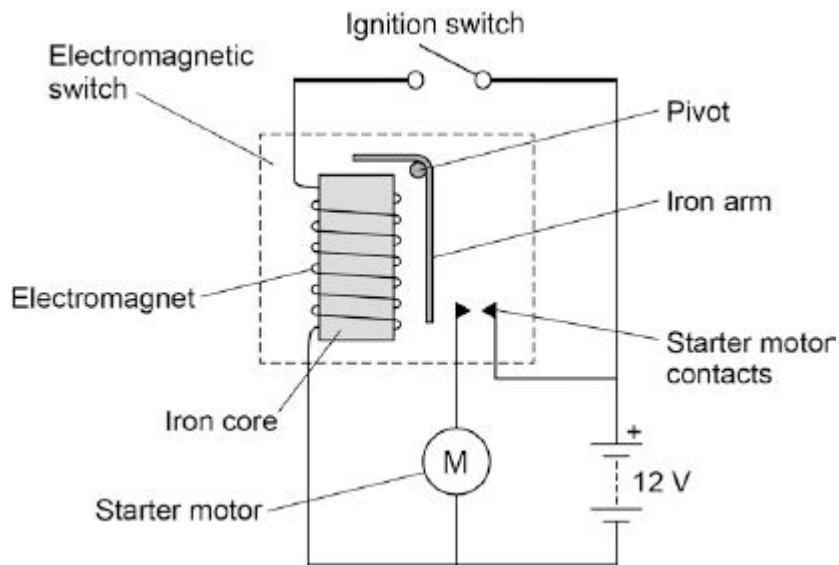
.....

(2)

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

The circuit includes an electromagnetic switch.

Figure 2



Explain how the ignition circuit works.

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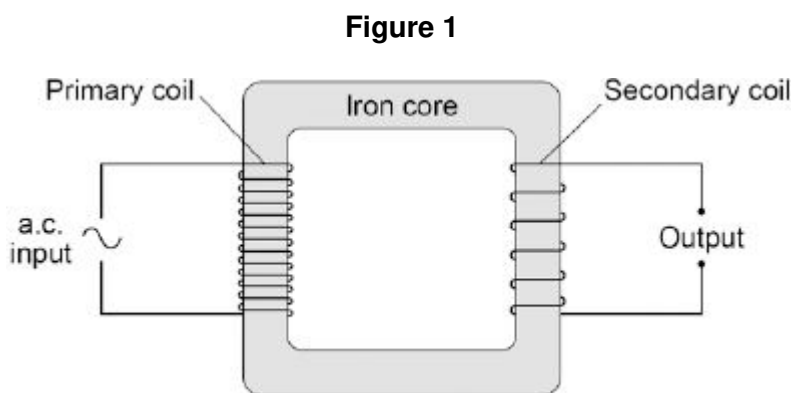
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(4)
(Total 6 marks)

4

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.

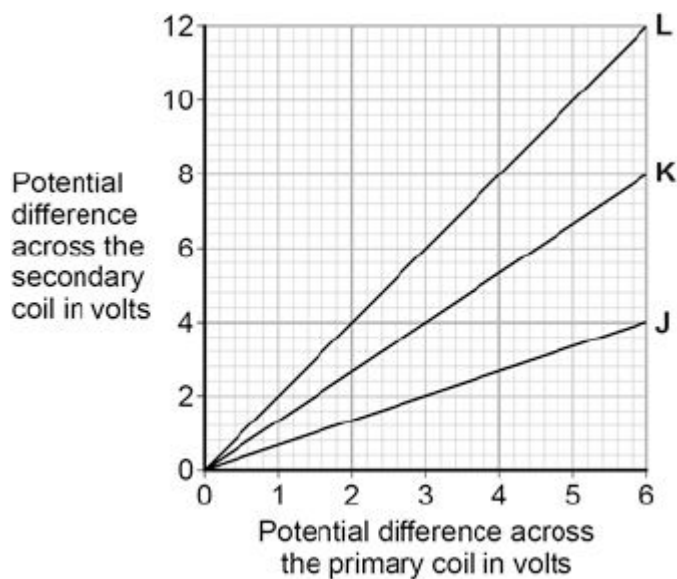
<input type="checkbox"/>
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(1)

- (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.

Figure 2



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)

5

Waves may be either longitudinal or transverse.

- (a) Describe the difference between a longitudinal and a transverse wave.

.....

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(2)

- (b) Describe **one** piece of evidence that shows when a sound wave travels through the air it is the wave and not the air itself that travels.

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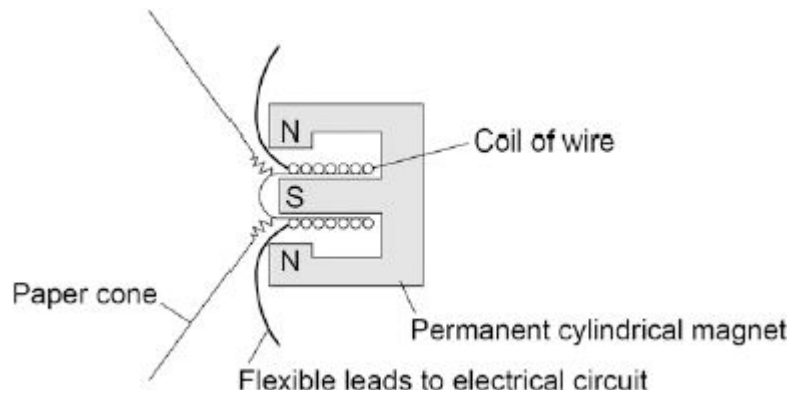
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(1)

- (c) The figure below shows the parts of a moving-coil loudspeaker.

A coil of wire is positioned in the gap between the north and south poles of the cylindrical magnet.



Explain how the loudspeaker converts current in an electrical circuit to a sound wave.

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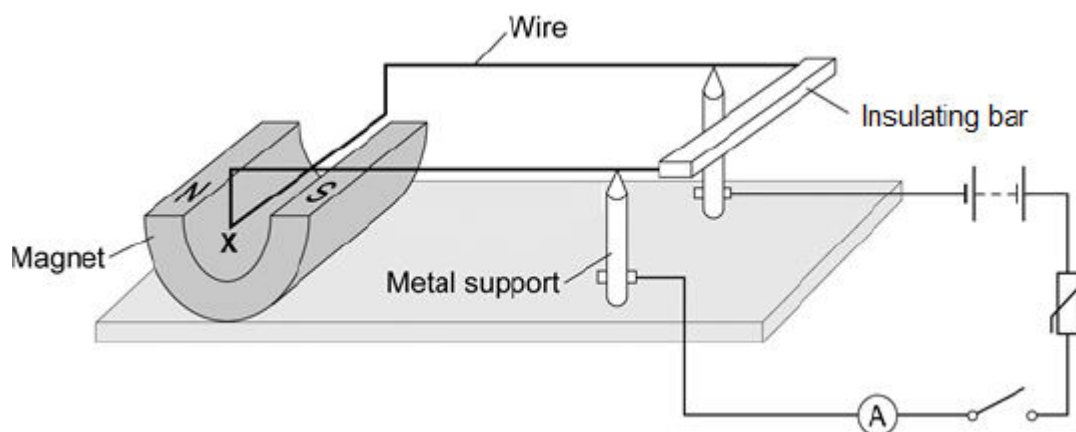
.....

(6)
(Total 9 marks)

6

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

Figure 1



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

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

.....

(1)

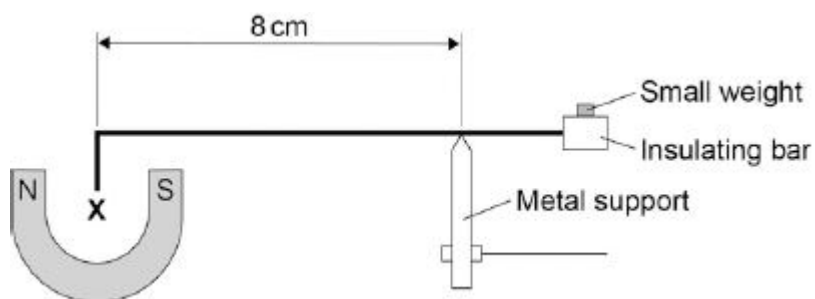
- (b) Suggest one change you could make to the apparatus in **Figure 1** that would increase the size of the force that wire **X** experiences.

.....

(1)

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

Figure 2



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

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

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

Give the unit.

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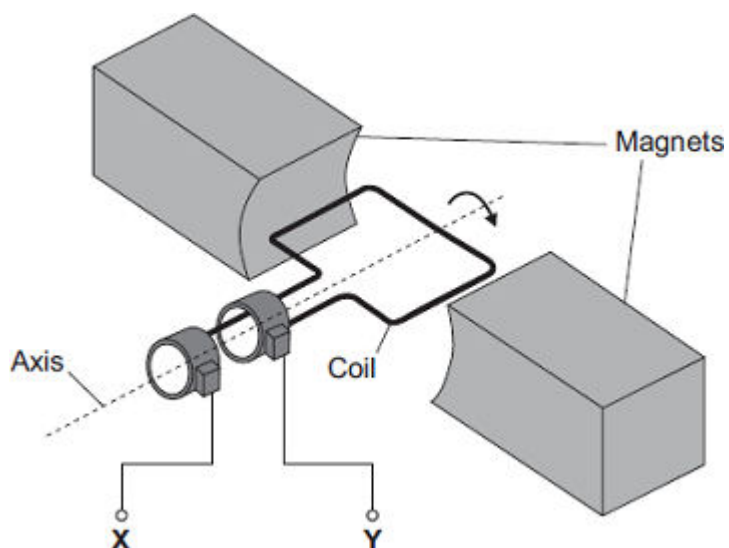
Magnetic flux density = Unit

(6)
(Total 8 marks)

7

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

This effect is called the effect.

(1)

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

.....

(1)

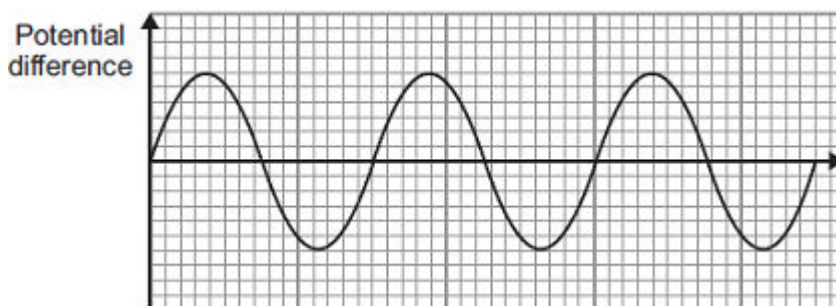
- (iii) Name an instrument that could be used to measure the potential difference between **X** and **Y**.

.....

(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)

8

- (a) **Diagram 1** shows a magnetic closure box when open and shut. It is a box that stays shut, when it is closed, due to the force between two small magnets.

These boxes are often used for jewellery.

Diagram 1

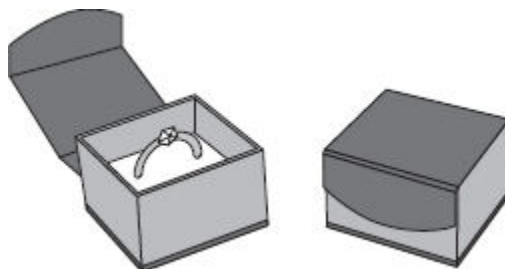
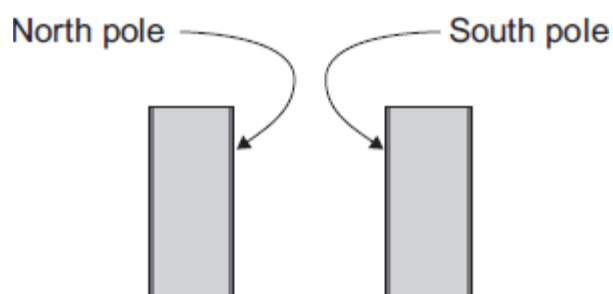


Diagram 2 shows the two magnets. The poles of the magnets are on the longer faces.

Diagram 2



- (i) Draw, on **Diagram 2**, the magnetic field pattern between the two facing poles. (2)
- (ii) The magnets in the magnetic closure box must **not** have two North poles facing each other.

Explain why.

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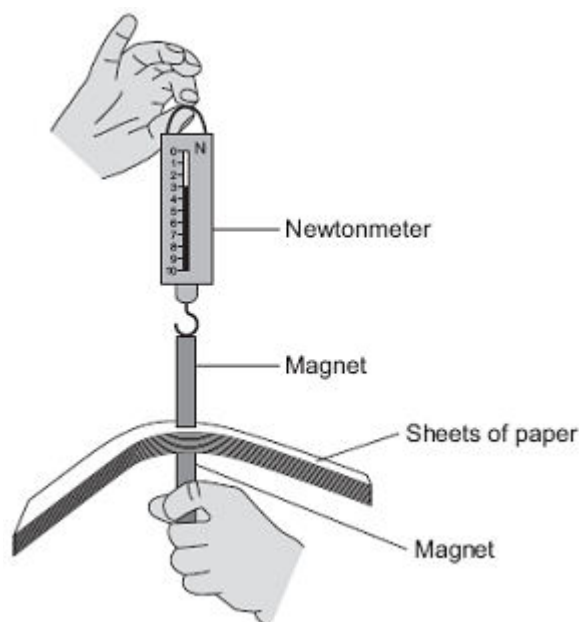
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(2)

- (b) A student is investigating how the force of attraction between two bar magnets depends on their separation.

She uses the apparatus shown in **Diagram 3**.

Diagram 3



She uses the following procedure:

- ensures that the newtonmeter does not have a zero error
- holds one of the magnets
- puts sheets of paper on top of the magnet
- places the other magnet, with the newtonmeter magnetically attached, close to the first magnet
- pulls the magnets apart
- notes the reading on the newtonmeter as the magnets separate
- repeats with different numbers of sheets of paper between the magnets.

The results are shown in the table.

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.

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(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?

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.....

(1)

- (iii) The student is unable to experiment with fewer than 10 sheets of paper without glueing the magnet to the newtonmeter.

Suggest why.

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(2)

- (iv) Suggest **three** improvements to the procedure that would allow the student to gain more accurate results.

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(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)

- 9** The current in a circuit depends on the potential difference (p.d.) provided by the cells and the total resistance of the circuit.

- (a) Using the correct circuit symbols, draw a diagram to show how you would connect 1.5 V cells together to give a p.d. of 6 V.

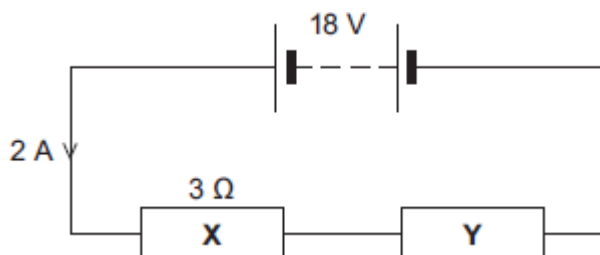
(2)

- (b) **Figure 1** shows a circuit containing an 18 V battery.

Two resistors, **X** and **Y**, are connected in series.

- X** has a resistance of $3\ \Omega$.
- There is a current of 2 A in **X**.

Figure 1



- (i) Calculate the p.d. across **X**.

.....

.....

P.d. across **X** = V

(2)

- (ii) Calculate the p.d. across **Y**.

.....

.....

.....

P.d. across **Y** = V

(2)

- (iii) Calculate the total resistance of **X** and **Y**.

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.....

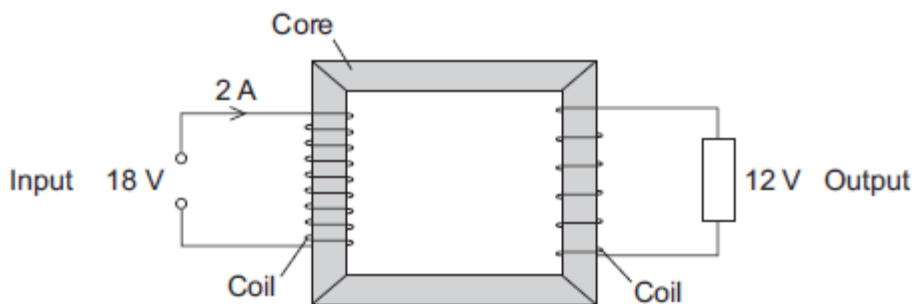
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Total resistance of **X** and **Y** = Ω

(2)

- (c) **Figure 2** shows a transformer.

Figure 2



- (i) An 18 V battery could **not** be used as the input of a transformer.

Explain why.

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(2)

- (ii) The transformer is 100% efficient.

Calculate the output current for the transformer shown in **Figure 2**.

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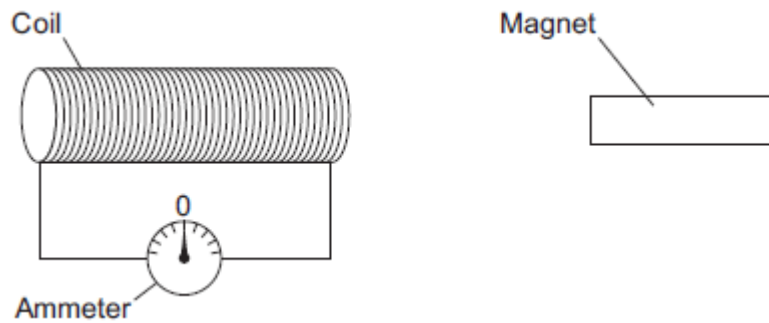
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Output current = A

(2)
(Total 12 marks)

10

The figure below shows a coil and a magnet. An ammeter is connected to the coil.



The ammeter has a centre zero scale, so that values of current going in either direction through the coil can be measured.

- (a) A teacher moves the magnet slowly towards the coil.

Explain why there is a reading on the ammeter.

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(6)

- (b) The table below shows some other actions taken by the teacher.

Complete the table to show the effect of each action on the ammeter reading.

Action taken by teacher	What happens to the ammeter reading?
Holds the magnet stationary and moves the coil slowly towards the magnet	
Holds the magnet stationary within the coil	
Moves the magnet quickly towards the coil	
Reverses the magnet and moves it slowly towards the coil	

(4)

- (c) The magnet moves so that there is a steady reading of 0.05 A on the ammeter for 6 seconds.

Calculate the charge that flows through the coil during the 6 seconds.

Give the unit.

.....

Charge =

(3)

(Total 13 marks)

11

If a fault develops in an electrical circuit, the current may become too great. The circuit needs to be protected by being disconnected.

A fuse or a circuit breaker may be used to protect the circuit.

One type of circuit breaker is a Residual Current Circuit Breaker (RCCB).

- (a) (i) Use the correct answer from the box to complete the sentence.

earth**live****neutral**

A fuse is connected in the wire.

(1)

- (ii) Use the correct answer from the box to complete the sentence.

are bigger**are cheaper****react faster**

RCCBs are sometimes preferred to fuses because they

(1)

- (iii) RCCBs operate by detecting a difference in the current between two wires.

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

earth and live**earth and neutral****live and neutral**

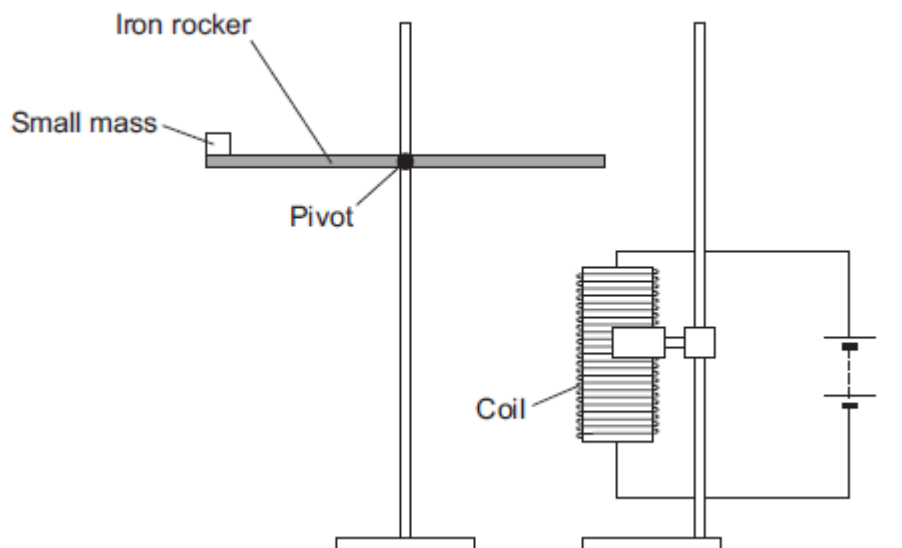
The two wires are the wires.

(1)

- (b) An RCCB contains an iron rocker and a coil.

A student investigated how the force of attraction, between a coil and an iron rocker, varies with the current in the coil.

She supported a coil vertically and connected it in an electrical circuit, part of which is shown in the figure below .



She put a small mass on the end of the rocker and increased the current in the coil until the rocker balanced. She repeated the procedure for different masses.

Some of her results are shown in the table below.

Mass in grams	Current needed for the rocker to balance in amps
5	0.5
10	1.0
15	1.5
20	2.0

- (i) State **two** extra components that must have been included in the circuit in the figure above to allow the data in the above table to be collected.

Give reasons for your answers.

.....

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(4)

- (ii) A teacher said that the values of current were too high to be safe.

Suggest **two** changes that would allow lower values of current to be used in this investigation.

Change 1

.....

Change 2

.....

(2)

(Total 9 marks)

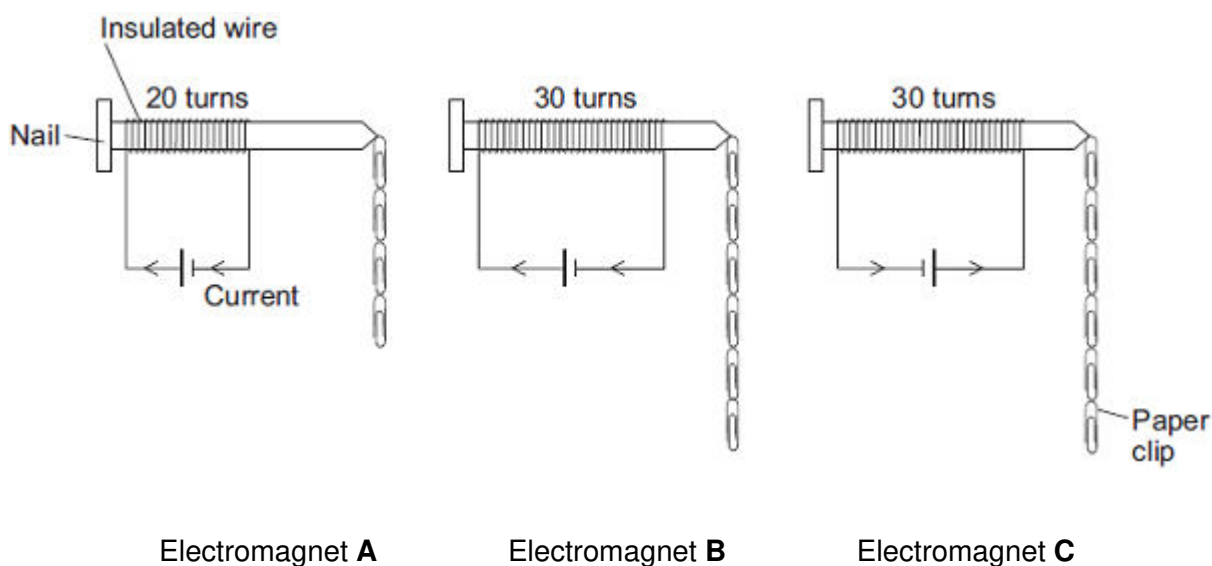
12

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

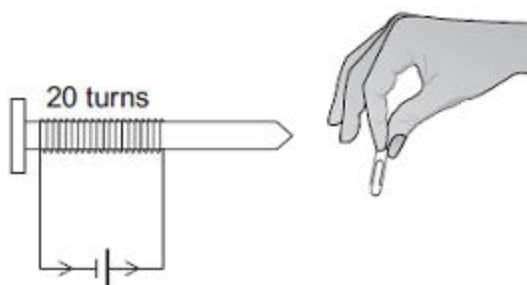


No more paper clips can be hung from the bottom of each line of paper clips.

- (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)

13

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.

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Extra space

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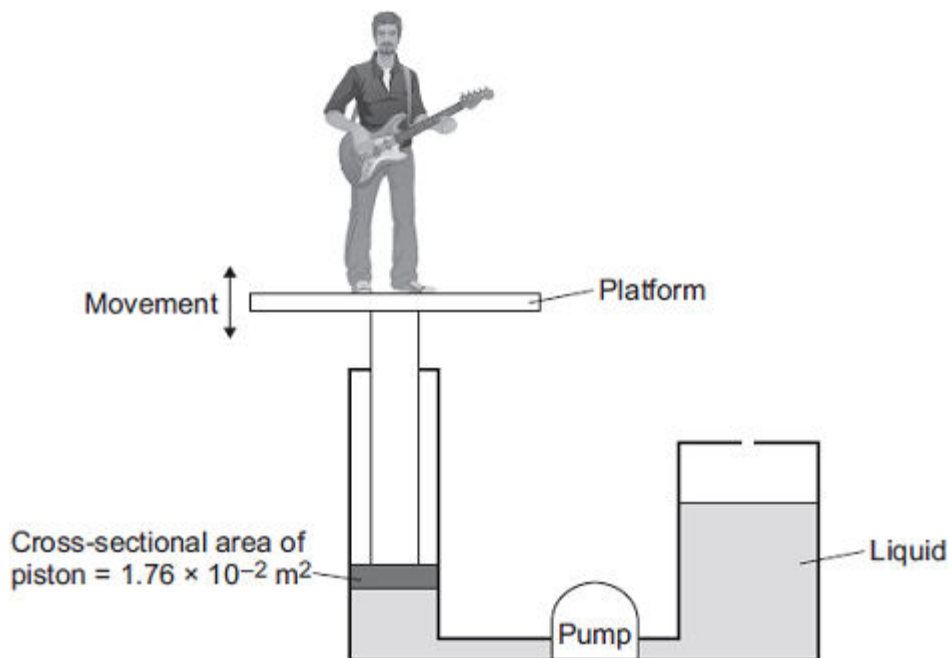
(Total 6 marks)

14

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 8.75×10^4 Pa to move the platform upwards.
Calculate the force that the liquid applies to the piston.

.....

.....

.....

Force = N

(2)

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

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

Suggest an environmental advantage of using plant oil.

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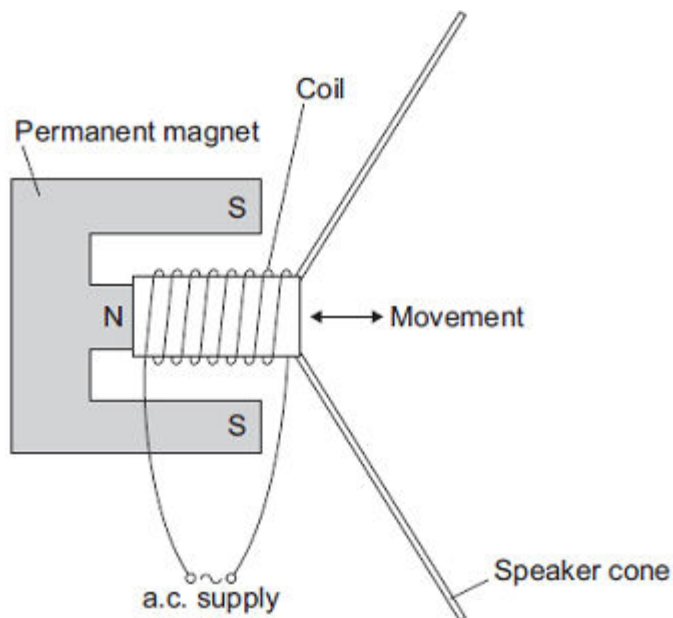
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(1)

- (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.

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(4)
(Total 8 marks)

15

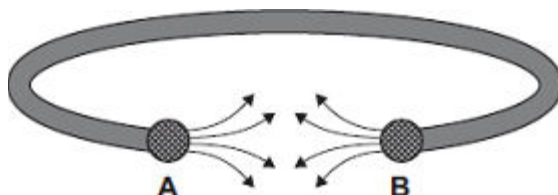
- (a) Some people wear magnetic bracelets to relieve pain.

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



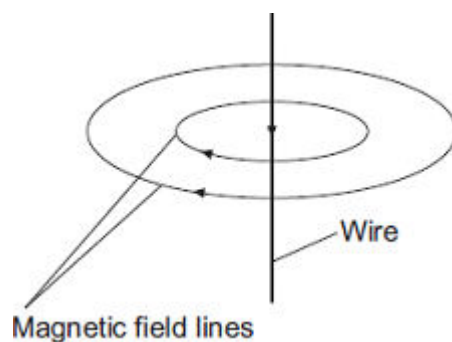
What is the pole at **A**?

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?

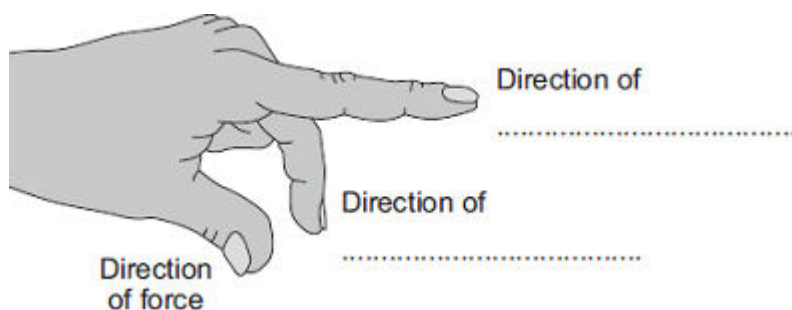
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(1)

- (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

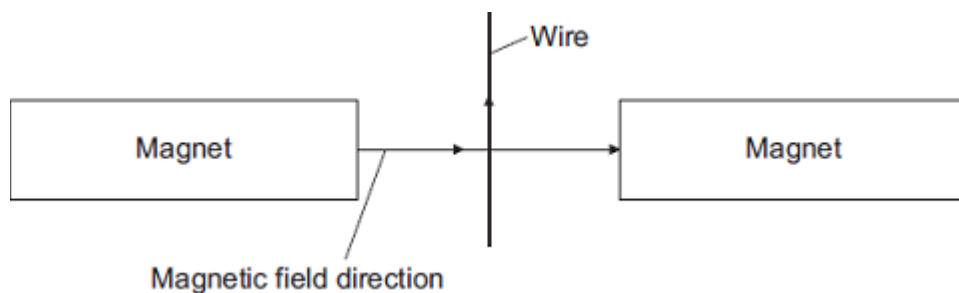


(2)

- (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?

.....

(1)

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

1

2

3

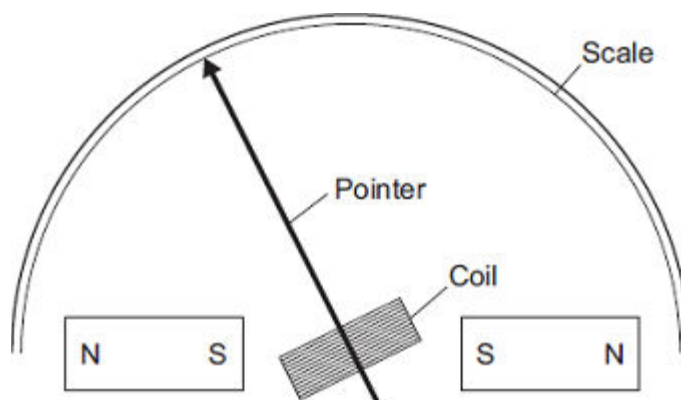
(3)

- (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.

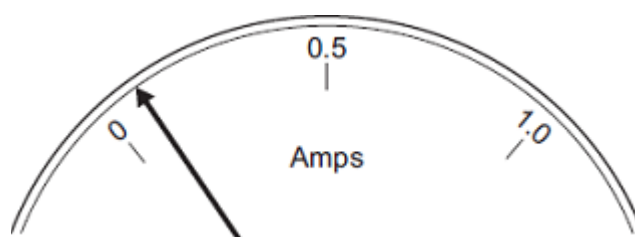
What change would make it work?

.....

(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?

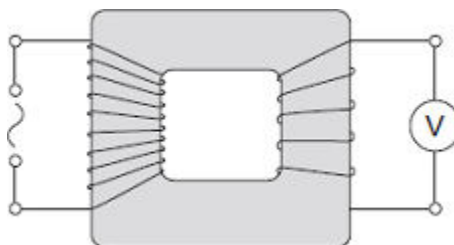
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(1)
(Total 10 marks)

16

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.

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(2)

- (ii) Explain how a transformer works.

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(4)

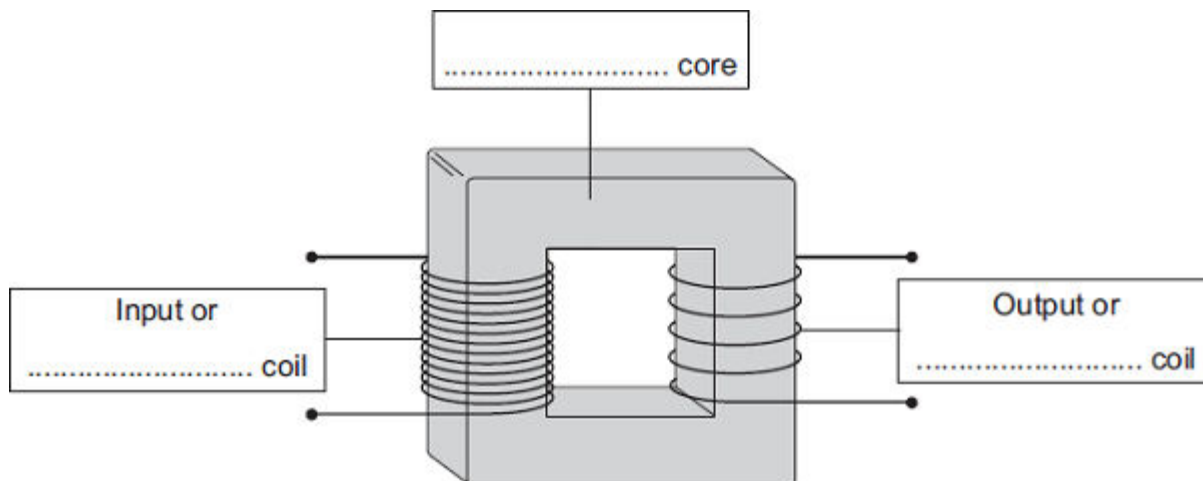
(Total 10 marks)

17

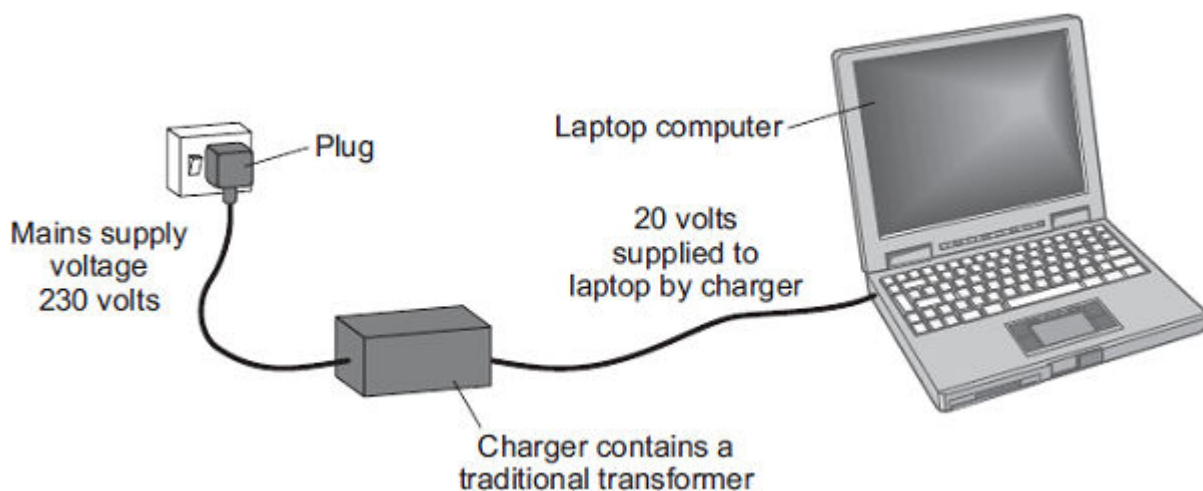
- (a) The diagram shows the structure of a traditional transformer.

Use words from the box to label the diagram.

aluminium	brass	iron	large	primary	secondary
-----------	-------	------	-------	---------	-----------



- (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

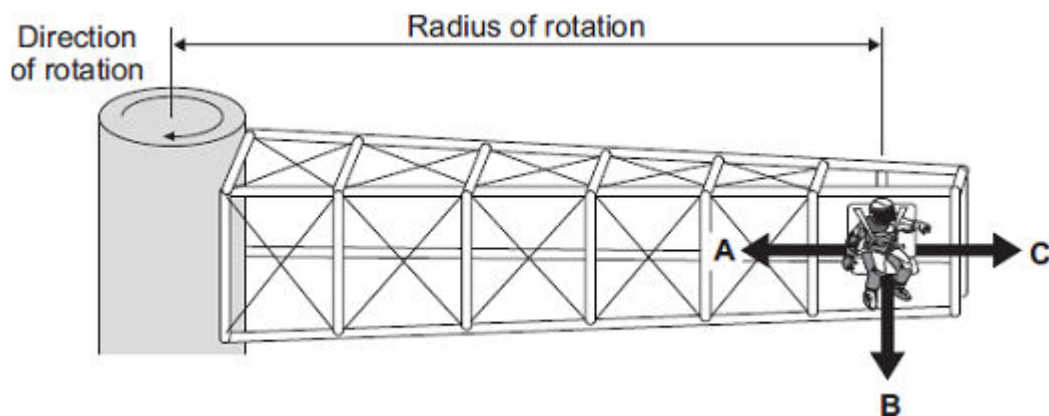
an environmental
a political
a social

consideration.

(1)
(Total 5 marks)

18

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

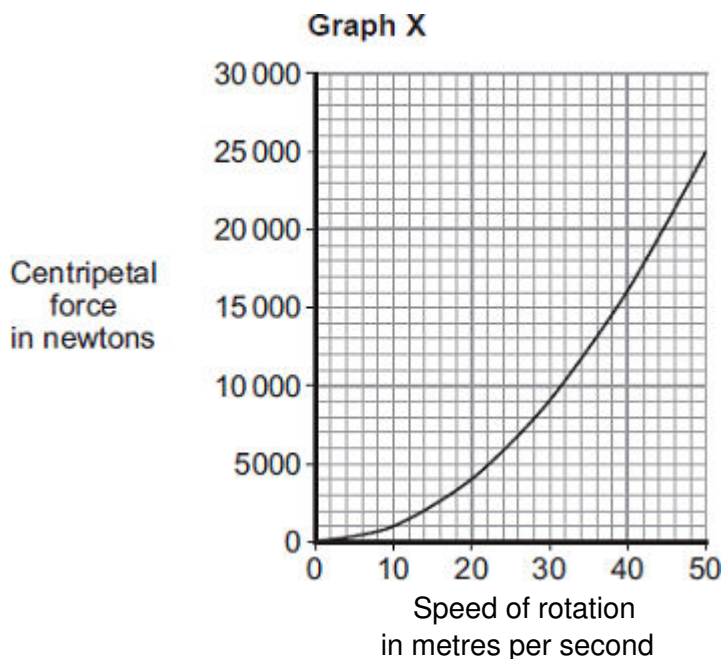


The G-machine moves the astronaut in a horizontal circle.

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

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

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



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

Centripetal force = newtons

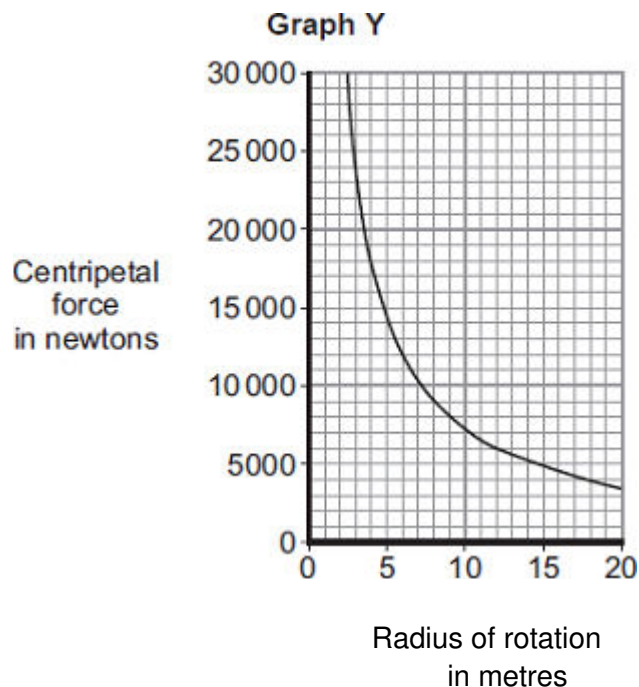
(1)

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

Increasing the speed of rotation of a G-machine will
the centripetal force on the astronaut.

(1)

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

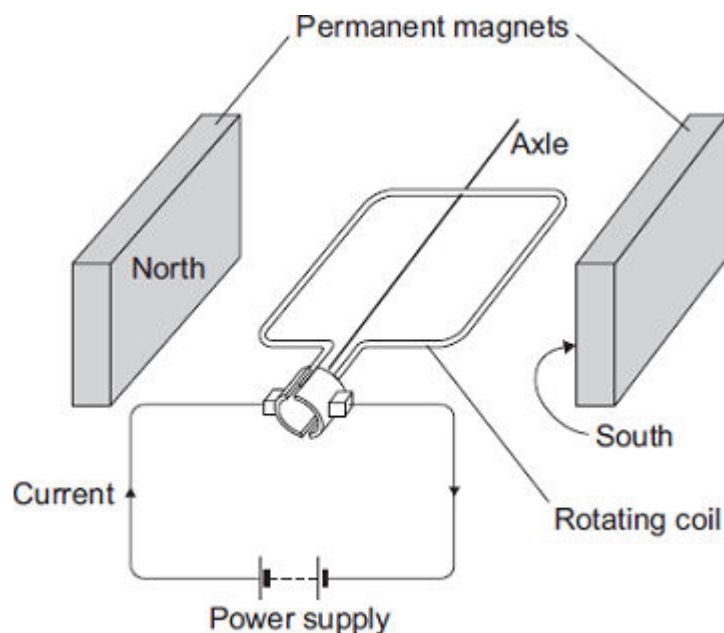


Complete the following sentence to give the conclusion that can be made from **Graph Y**.

The greater the radius of rotation, the the centripetal force
on the astronaut.

(1)

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



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

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

N – A magnetic field is created around the coil.

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

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

Q – A current flows through the coil.

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



(2)

- (c) The electric motor produces a turning force.

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

- 1
-
- 2
-

(2)

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

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

This is

an economic

an environmental

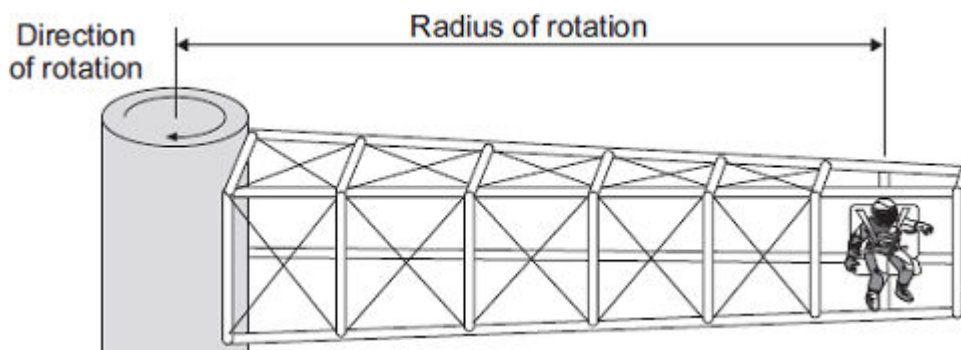
a social

issue.

(1)
(Total 8 marks)

19

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

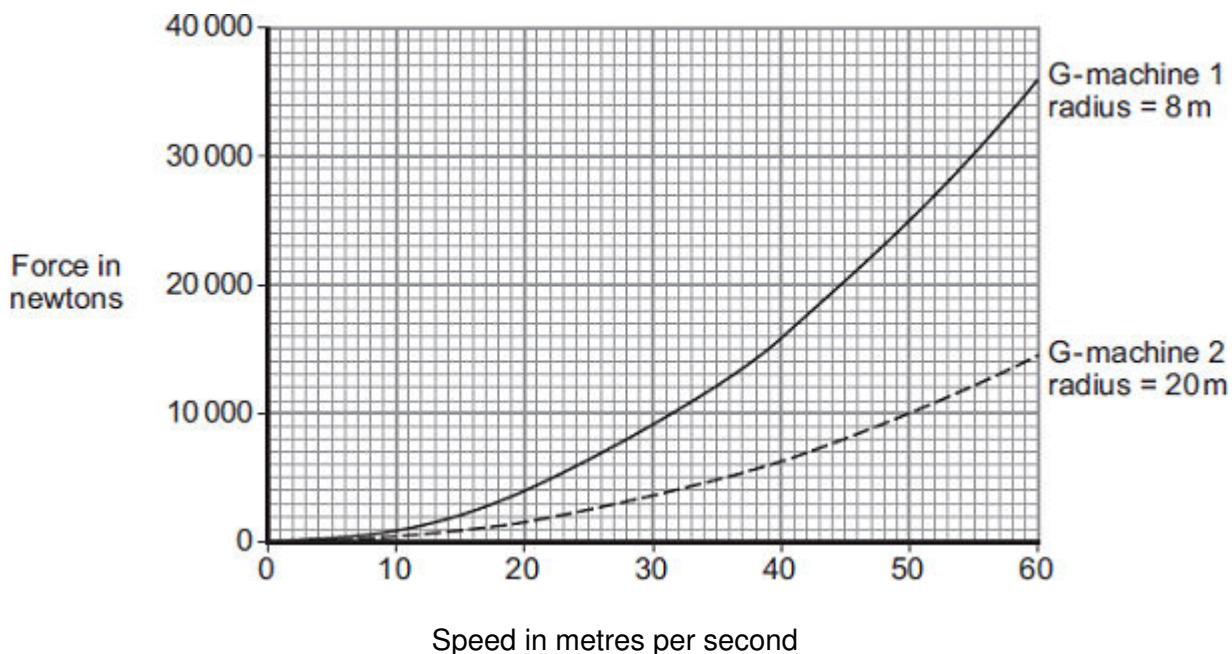


The G-machine moves the astronaut in a horizontal circle.

- (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.

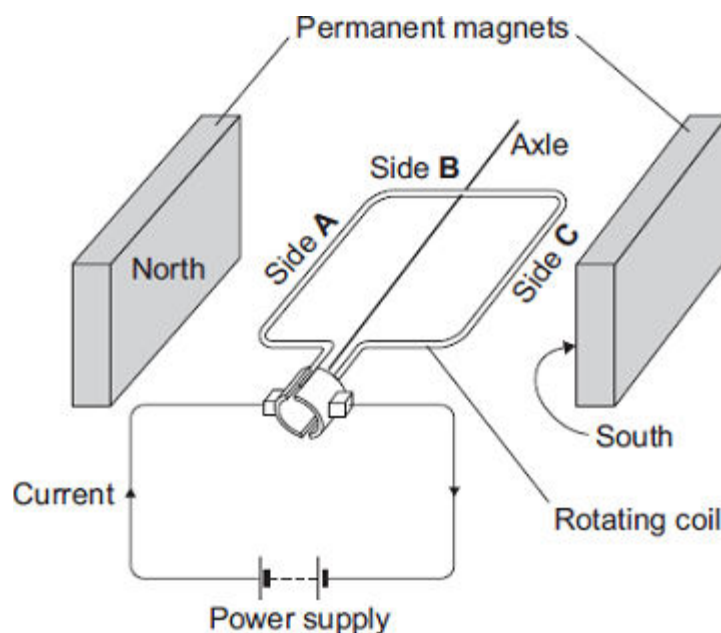
Determine the change in force on the astronaut.

.....

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.

.....

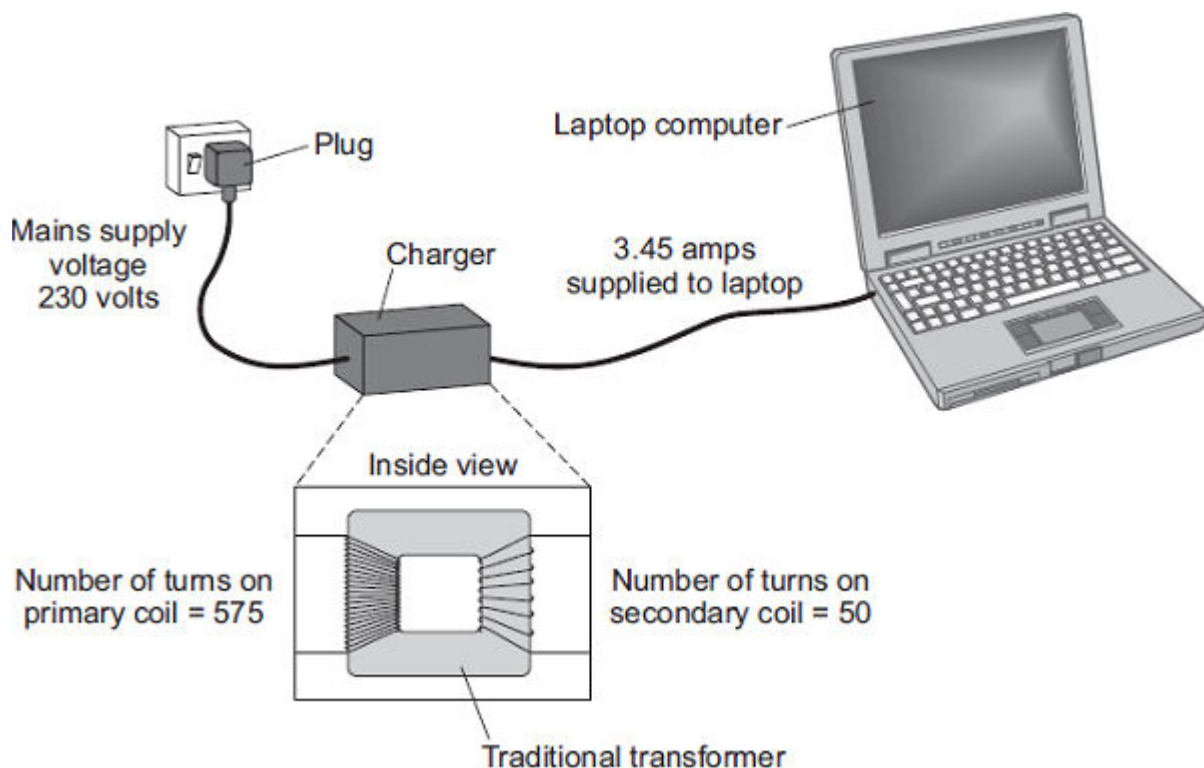
.....

(1)

(Total 10 marks)

20

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



- (a) The alternating current flowing through the primary coil of the transformer creates an alternating current in the secondary coil.

Explain how.

.....

.....

.....

.....

.....

.....

.....

.....

(3)

- (b) (i) Use information from the diagram to calculate the potential difference the charger supplies to the laptop.

.....

.....

.....

.....

Potential difference = V

(2)

- (ii) Calculate the current in the primary coil of the transformer when the laptop is being charged.

Assume the transformer is 100% efficient.

.....

.....

.....

.....

Current = A

(2)

- (c) Laptop batteries and mobile phone batteries can only be recharged a limited number of times. After this, the batteries cannot store enough charge to be useful. Scientists are developing new batteries that can be recharged many more times than existing batteries.

Suggest **one** other advantage of developing these new batteries.

.....

.....

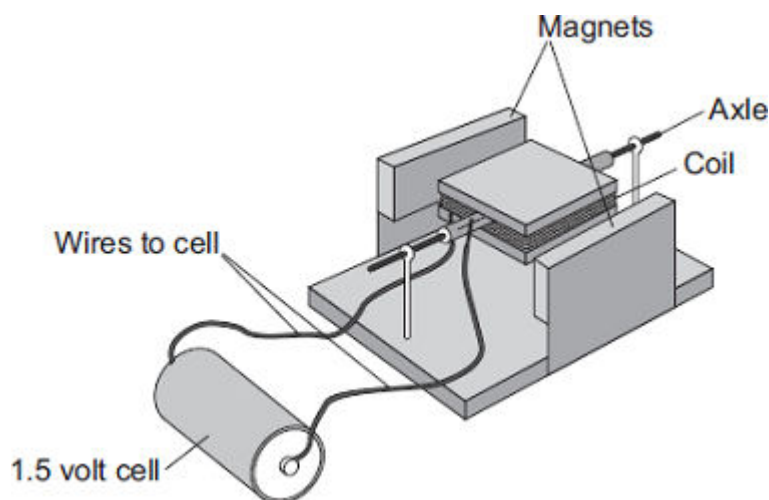
.....

(1)

(Total 8 marks)

21

A student has made a simple electric motor. The diagram shows the electric motor.



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

Once the coil is spinning, one side of the coil is pushed by

the cell

the coil

a force

and the other

side is pulled, so the coil continues to spin.

(1)

- (b) Suggest **two** changes to the electric motor, each one of which would make the coil spin faster.

1

.....

2

.....

(2)

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

1

.....

2

.....

(2)

(Total 5 marks)

22

- (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.

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

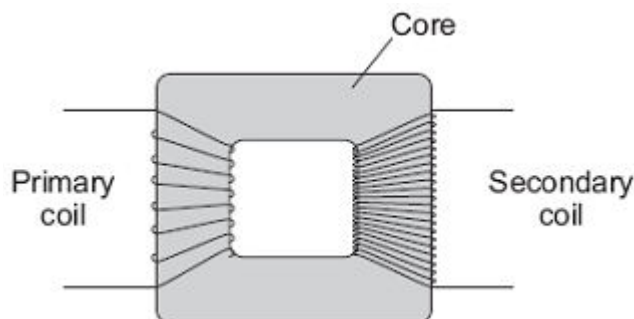
Show clearly how you work out your answer.

.....

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

.....

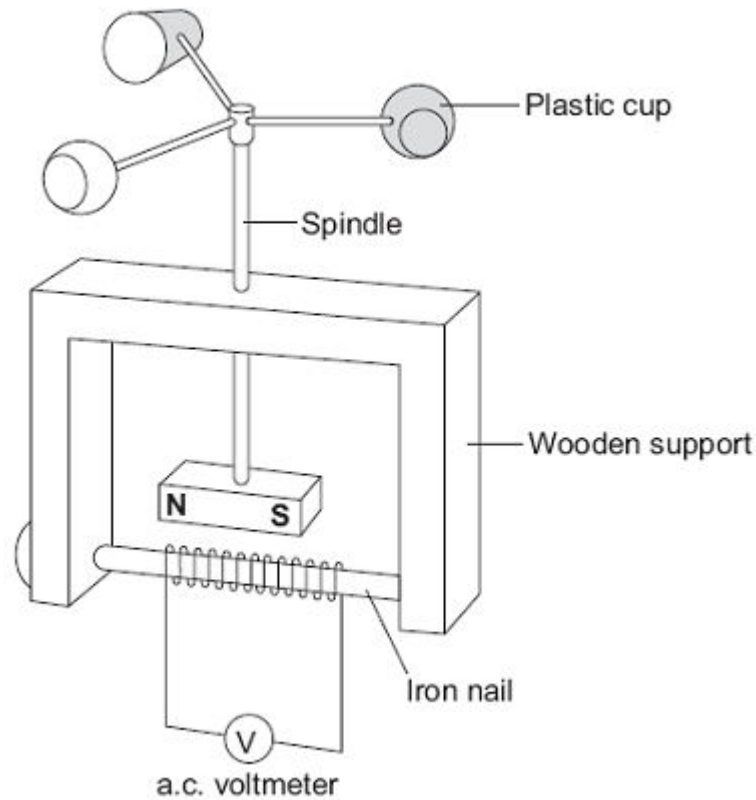
2

.....

(2)
(Total 9 marks)

23

The diagram shows a student's design for a simple wind speed gauge.



- (a) Explain why the wind causes the a.c. voltmeter to give a reading. The explanation has been started for you.

The wind causes the plastic cups to turn.

.....

.....

.....

.....

.....

.....

(3)

- (b) The gauge is not sensitive enough to measure light winds.

Suggest **one** way that the design can be modified to make the gauge more sensitive.

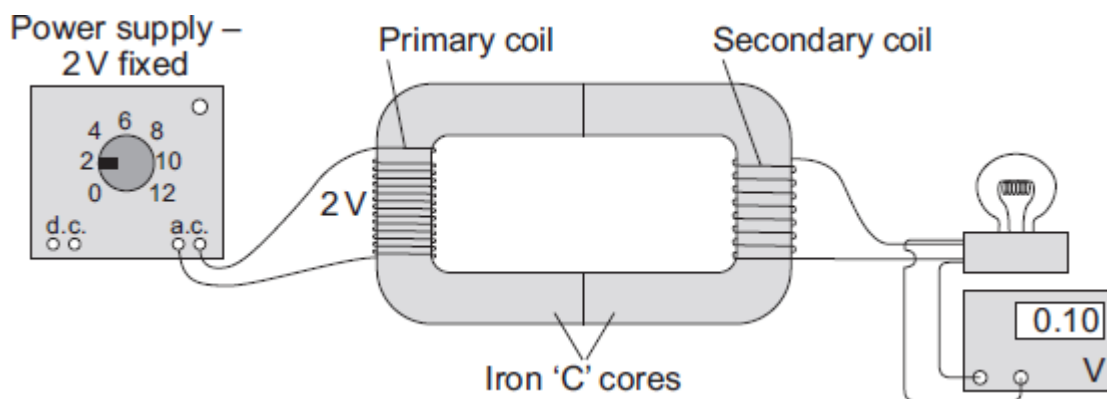
.....

.....

(1)
(Total 4 marks)

24

The diagram shows the apparatus used by a student to investigate a transformer.



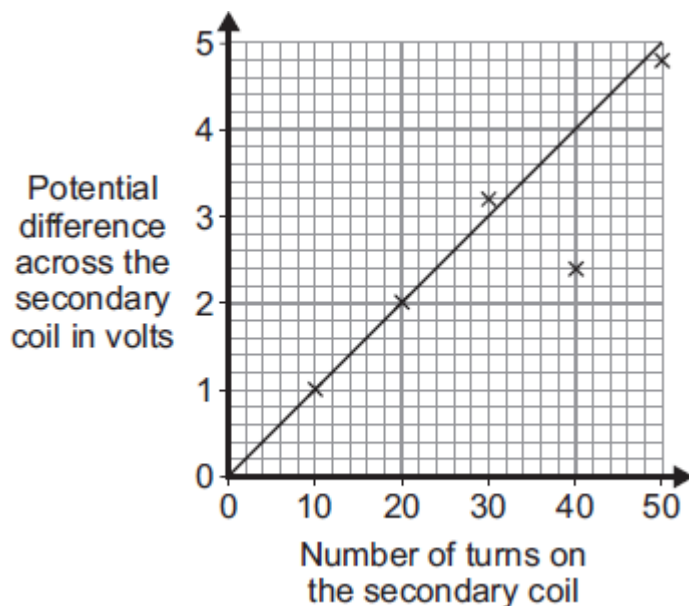
- (a) The transformer made by the student would not have worked if the core had been made from aluminium and not iron.

Why?

.....

(1)

- (b) The student made changes to the number of turns used to make the secondary coil. He then measured the potential difference across the secondary coil after each change. The graph shows the student's results.



- (i) What range of values was used for the number of turns on the secondary coil?

From to

(1)

- (ii) When he drew the line of best fit, the student ignored one of the data points.

Why?

.....

.....

(1)

- (iii) What is the minimum number of turns needed on the secondary coil for the transformer to act as a step-up transformer?

.....

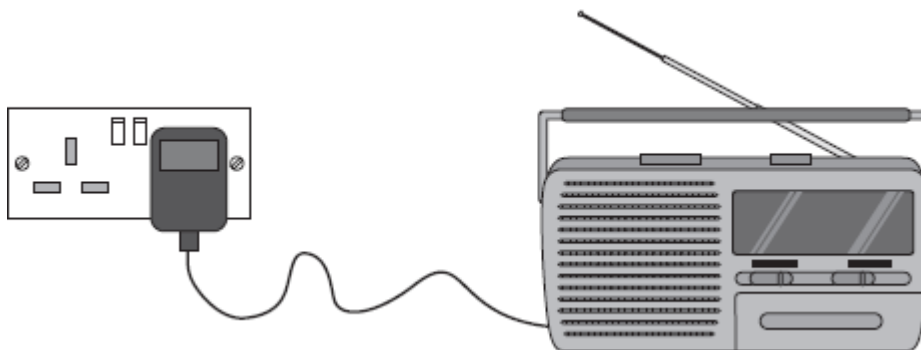
Give a reason for your answer.

.....

.....

(2)

- (c) A radio can be used with a 9 V battery or it can be plugged into the 230 V mains electricity supply using an adapter. The mains adapter contains a transformer.



Why must the mains adapter contain a transformer?

.....

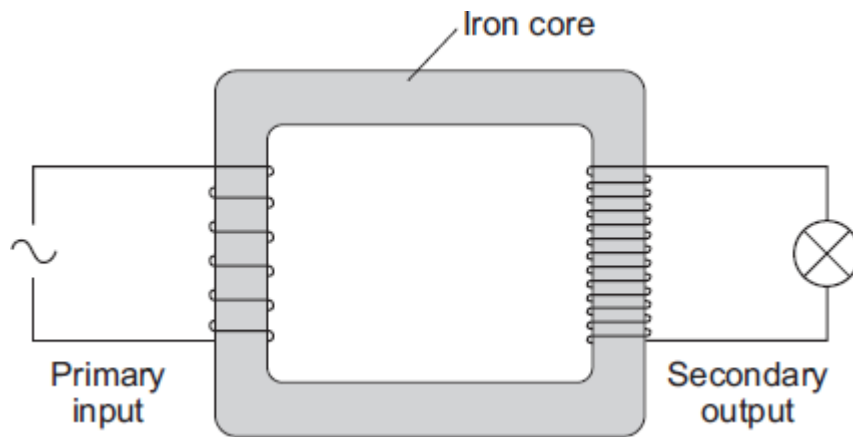
.....

(1)

(Total 6 marks)

25

The diagram shows a transformer.



- (a) (i) Is the transformer in the diagram being used as a step-up transformer or as a step-down transformer?

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

a step-up transformer

☐

a step-down transformer

☐

Give a reason for your answer.

.....

.....

(1)

- (ii) Why is the core made of iron?

.....

.....

(1)

- (b) The power supply to a laptop computer contains a transformer designed to change the 230 V mains input to a 15 V output. The transformer has 920 turns on its primary coil.

Use the equation in the box to calculate the number of turns on the 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.

.....

.....

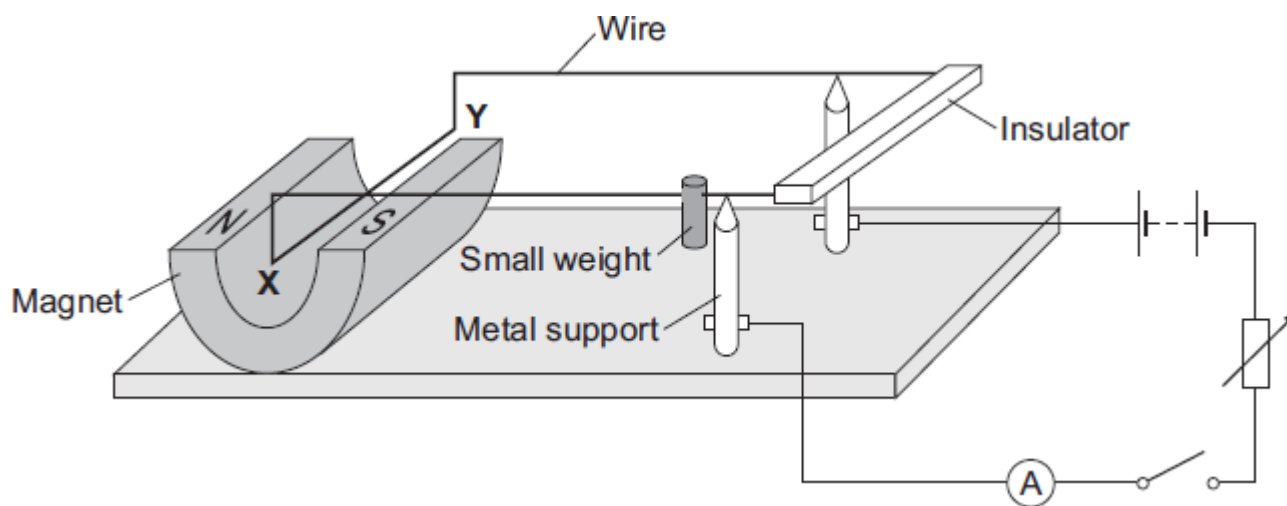
.....

Number of turns on the secondary coil =

(2)
(Total 4 marks)

26

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.

.....

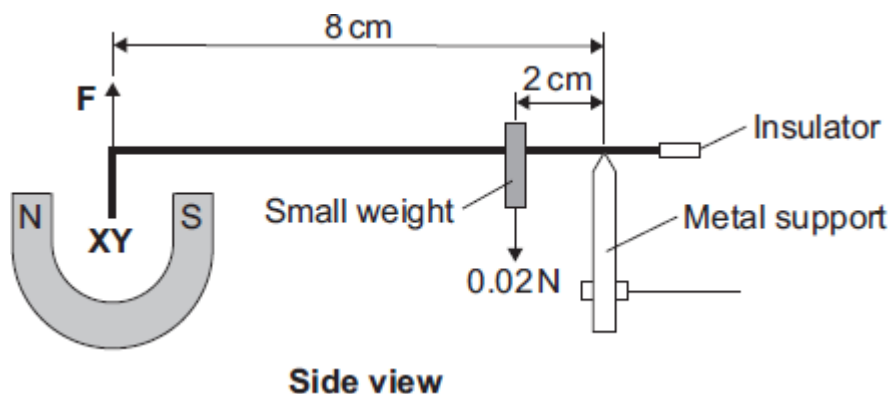
.....

.....

.....

(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**.

$\text{moment} = \text{force} \times \text{perpendicular distance from the line of action of the force to the axis of rotation}$
--

Show clearly how you work out your answer.

.....

.....

.....

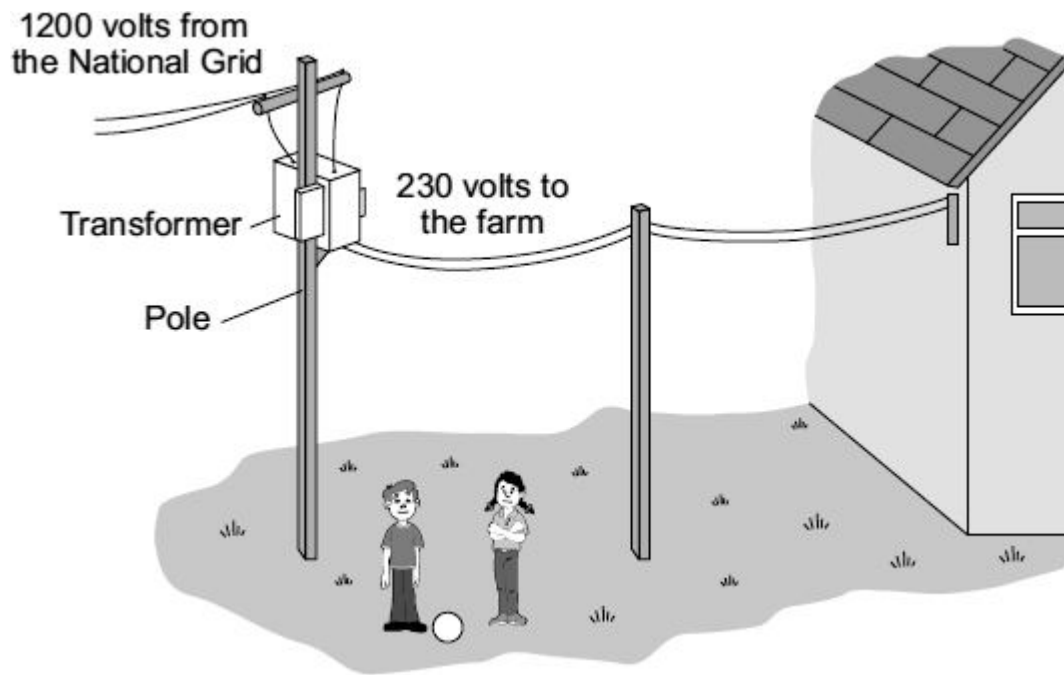
.....

Force = N

(3)
(Total 8 marks)

27

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

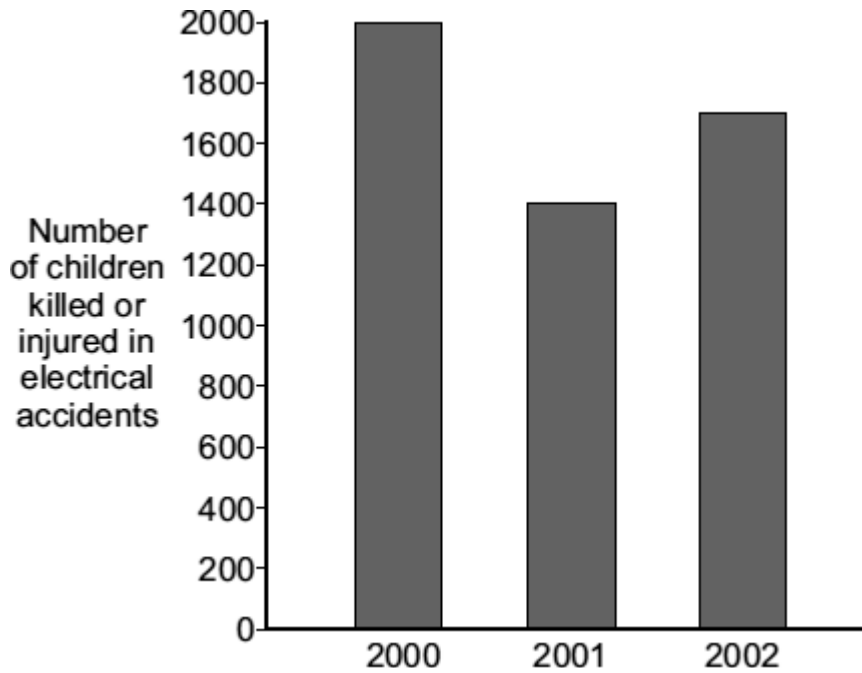
greater than

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.

☐

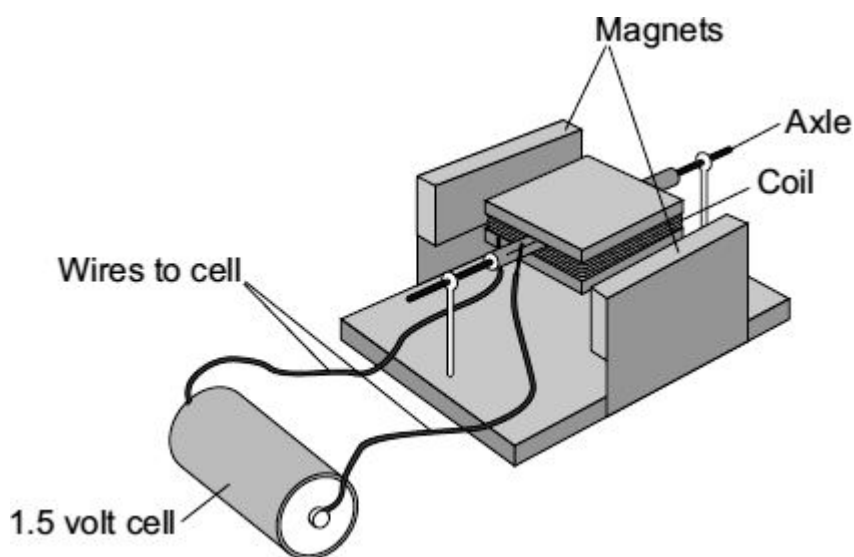
There is no pattern.

☐

(1)
(Total 5 marks)

28

- (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

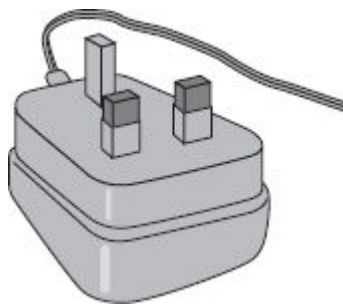
.....

(2)

(Total 6 marks)

29

- (a) The drawing shows the plug for operating a radio from the mains.



This plug contains a transformer. There are 4600 turns on its primary coil and 200 turns on its secondary coil. The plug is used on the mains supply and has a potential difference (p.d.) of 230 V across its primary coil.

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

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

Show clearly how you work out your answer.

.....

.....

.....

.....

p.d. across secondary = V

(2)

- (b) The coils of the transformer are made of insulated wire.

Why is the wire insulated?

.....

.....

(1)

- (c) (i) What material is the core of a transformer made from?

.....

(1)

(ii) Why is the core made from this material?

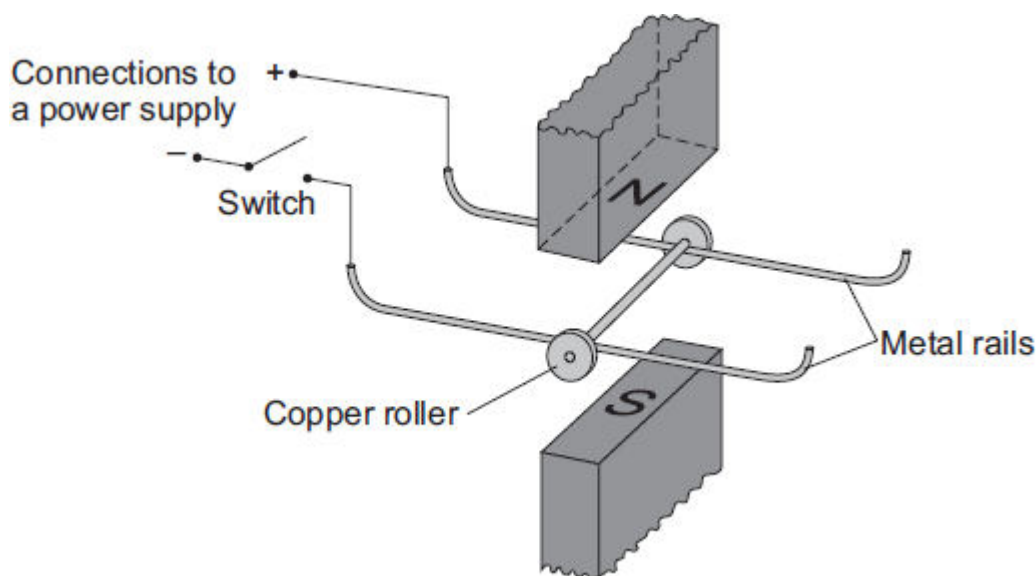
.....

.....

(1)
(Total 5 marks)

30

- (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	issue.
	an environmental	
	a political	

(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)

31

- (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 **and** give the unit.

.....

p.d. across secondary coil =

(3)

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

Why is this insulation necessary?

.....

(1)

- (c) Describe what happens when an alternating potential difference is applied across the primary coil of a transformer.

.....

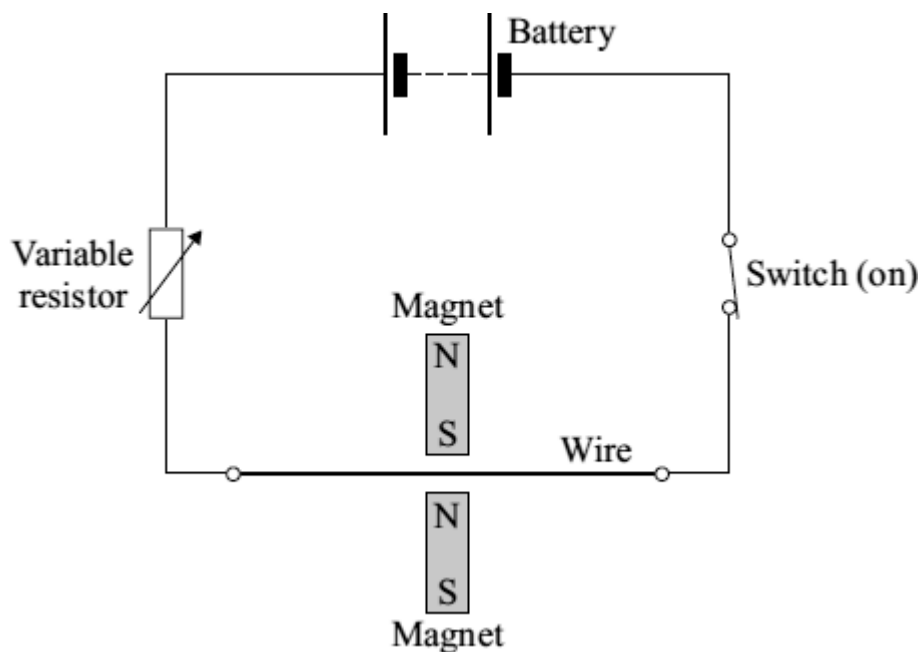
(3)**(Total 7 marks)**

32

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.

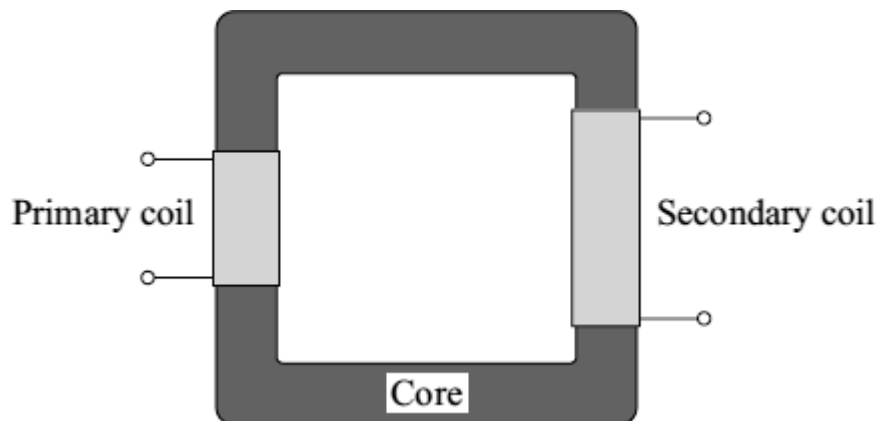
.....

.....

(1)
(Total 4 marks)

33

- (a) The diagram shows the basic structure of a step-up transformer.



- (i) What is the core made of?

.....

(1)

- (ii) Explain how an alternating input produces an alternating output.

.....

.....

.....

.....

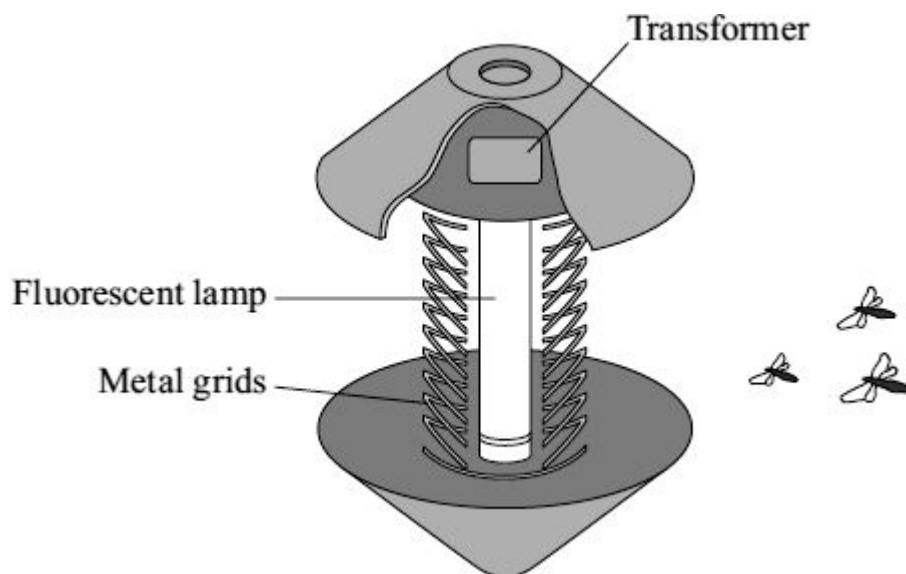
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.....

(3)

- (b) Fly killers are used in kitchens and food stores because flying insects carry diseases which cause food poisoning.

The diagram shows the inside of one design. Insects are attracted to a fluorescent lamp. The metal grids have a high potential difference (p.d.) between them. The insects are killed as they fly between the grids.



A transformer is used in the fly killer. There is a p.d. of 230 V across the primary coil. There are 300 turns of wire on the primary coil and 4000 turns on the secondary coil.

Use the equation in the box to calculate the p.d. across the 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.

.....

.....

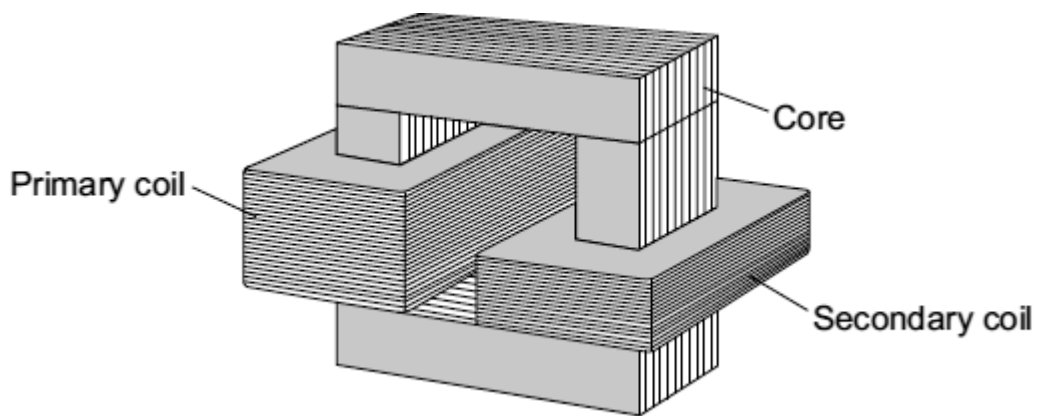
.....

.....

.....

Potential difference =V

(3)
(Total 7 marks)



- (a) (i) What is the core made of?

Draw a ring around the correct word in the box.

aluminium	copper	iron
-----------	--------	------

(1)

- (ii) The potential difference (p.d.) across the secondary coil is less than the p.d. across the primary coil.

What sort of transformer is it?

.....

(1)

- (b) Where is a step-up transformer used as part of the National Grid?

.....

(1)

- (c) The teacher writes a note about the transformer but leaves **five** spaces.

Use the correct words from the box to complete the spaces.

coil	core	current	ends	field	wire
-------------	-------------	----------------	-------------	--------------	-------------

A transformer works because an alternating in the primary produces a changing magnetic in the and then in the secondary coil.

This induces an alternating potential difference across the of the secondary coil.

(5)
(Total 8 marks)

35

The diagram shows a USB power adapter which plugs into a 230 V a.c. mains socket.



The adapter contains a small step-down transformer.

- (a) The core of the transformer is made of laminated soft iron.

Why is iron used?

.....
.....

(1)

- (b) The coils of the transformers are made of insulated copper wire.

Why is the wire insulated?

.....
.....

(1)

- (c) There are 500 turns on one coil of the transformer and 20 000 turns on the other coil.

Use the equation in the box to calculate the p.d. across the 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 and give the unit.

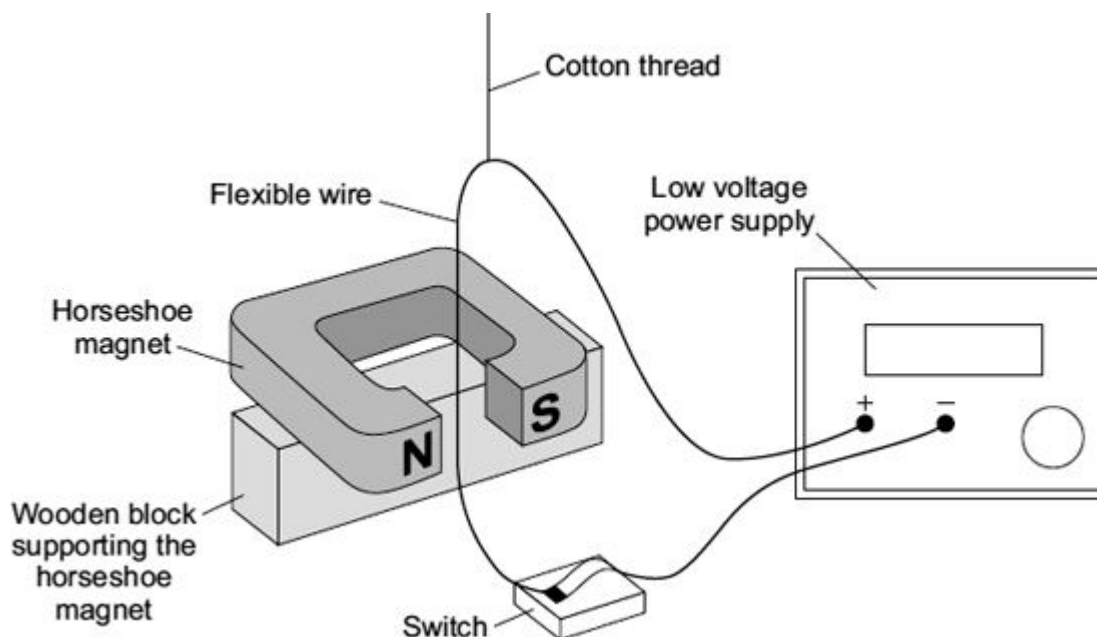
.....

p.d. across the secondary =

(3)
 (Total 5 marks)

36

- (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)

37

Many electrical appliances use the circular motion produced by their electric motor.

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

electric drill

☐

electric fan

☐

electric food mixer

☐

electric iron

☐

electric kettle

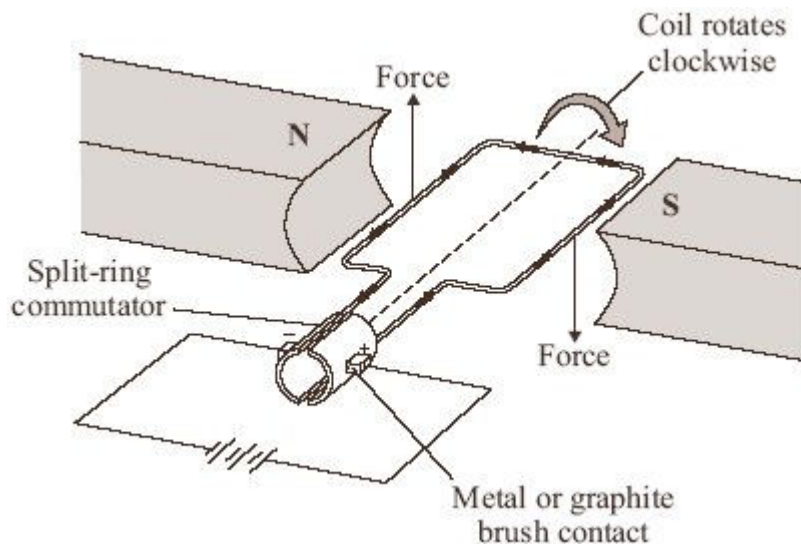
☐

electric screwdriver

☐

(2)

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



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

1

.....

2

.....

(2)

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

1

.....

2

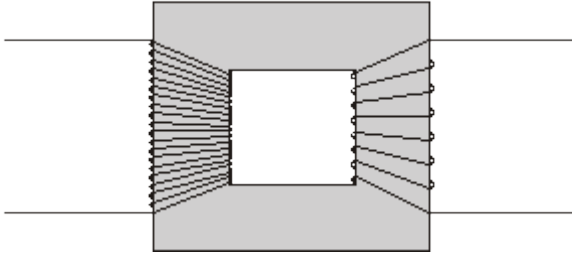
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(2)

(Total 6 marks)

38

- (a) The basic structure of a transformer is a primary coil of insulated wire, an iron core and a secondary coil of insulated wire.



- (i) Why is the core made of iron?

.....

.....

(1)

- (ii) Explain how a transformer works.

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.....

(4)

- (b) A small step-down transformer is used in the charger for an electric screwdriver.

The input to the transformer is 230 V a.c. mains supply and the output is 5.75 V a.c.
There are 3200 turns on the primary coil.

Use the equation in the box to calculate the number of turns on the transformer's 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.

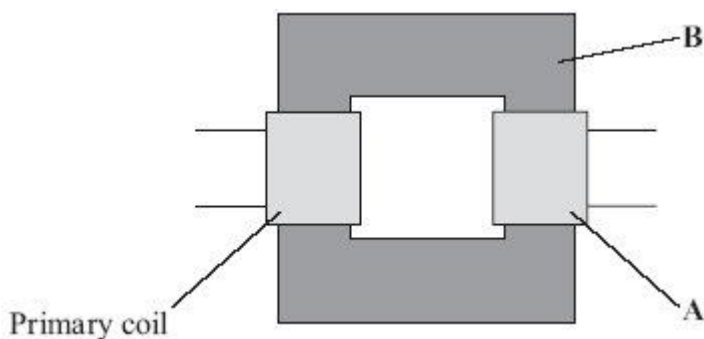
.....
.....

Number of turns =

(2)
(Total 7 marks)

39

- (a) The diagram shows a transformer.



- (i) What is part **A**?

.....

(1)

- (ii) What is part **B** and what is it made of?

.....

.....

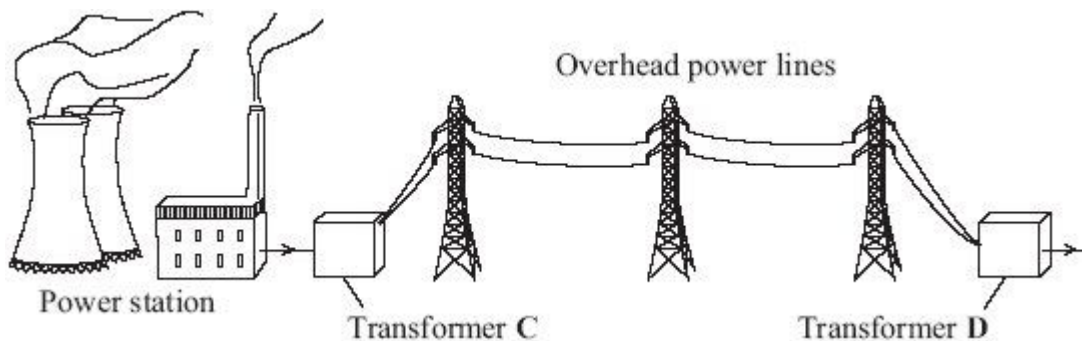
(2)

- (iii) When there is an alternating current in the primary coil, what is produced in part **B**?

.....

(2)

- (b) Transformers are used in the National Grid. The diagram shows part of the National Grid.

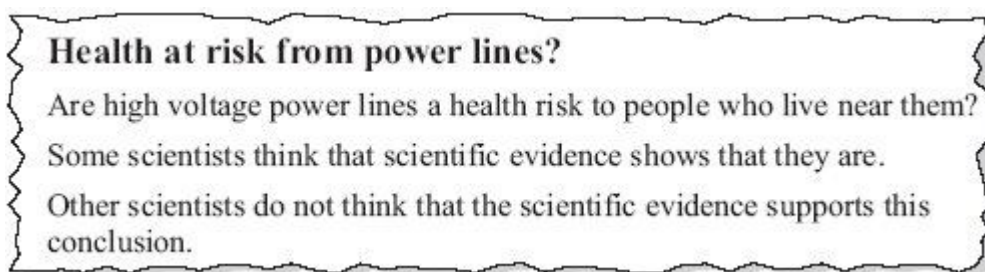


Complete the **two** spaces in the sentence.

Transformer **C** is a transformer and transformer **D** is
 a transformer.

(1)

- (c) This is an item from a newspaper.



Which **two** suggestions would reduce the possible risk to people's health?
Put a tick (✓) in the box next to your answers.

Do not build new houses near to existing power lines.

☐

Move the power lines so that they take the shortest routes.

☐

Move each power station to the centre of the nearest city.

☐

Build new power lines away from where people live.

☐

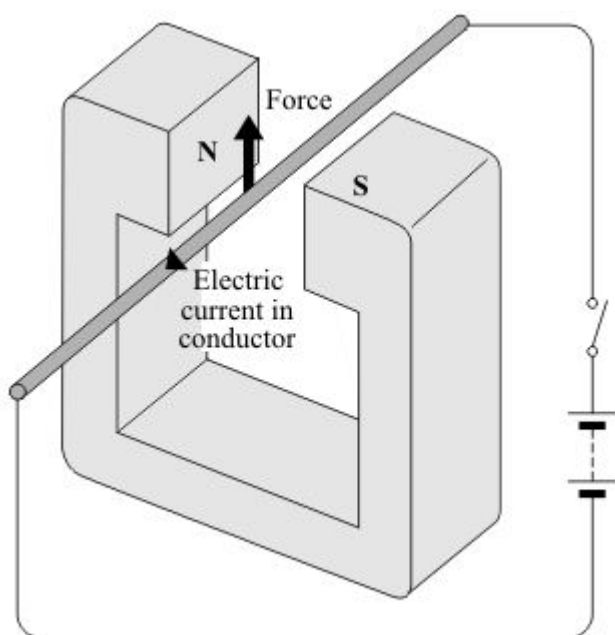
Use more transformers in the National Grid.

☐

(2)
(Total 8 marks)

40

When a conductor carrying an electric current is placed in a magnetic field a force may act on it.



- (a) State **two** ways in which this force can be increased.

1

2

(2)

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

1

2

(2)

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

.....

.....

(1)

(Total 5 marks)

Show clearly how you work out your answer.

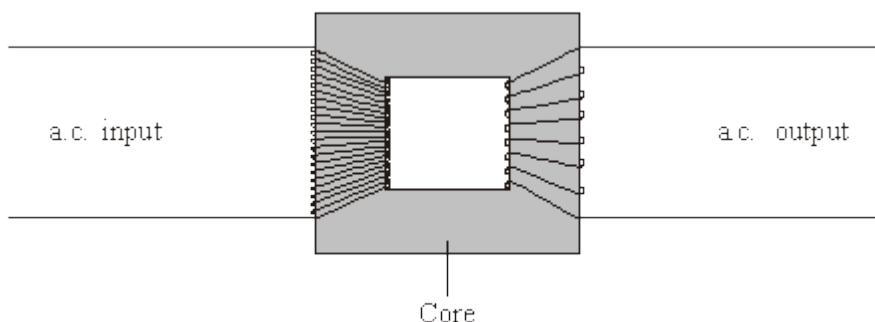
.....

Kinetic energy = J

(2)
 (Total 7 marks)

41

(a) The diagram shows a transformer.



(i) Is the transformer in the diagram being used as a step-up transformer or as a step-down transformer?

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

a step-up transformer

☐

a step-down transformer

☐

Explain your answer.

.....

(1)

(ii) Why is insulated wire, and not uninsulated wire, used to make the coils?

.....

(1)

(iii) Why is the core made of iron?

.....

.....

(1)

- (b) A transformer has 500 turns on its primary coil and 7500 turns on its secondary coil. The potential difference across the primary coil is 150 volts.

Use the equation in the box to calculate the potential difference across the 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.

.....

.....

.....

Potential difference across the secondary coil = volts

(2)

- (c) Step-down transformers are used between power lines and people's houses.

Explain why.

.....

.....

.....

(2)

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

Explain the advantage of having a National Grid system.

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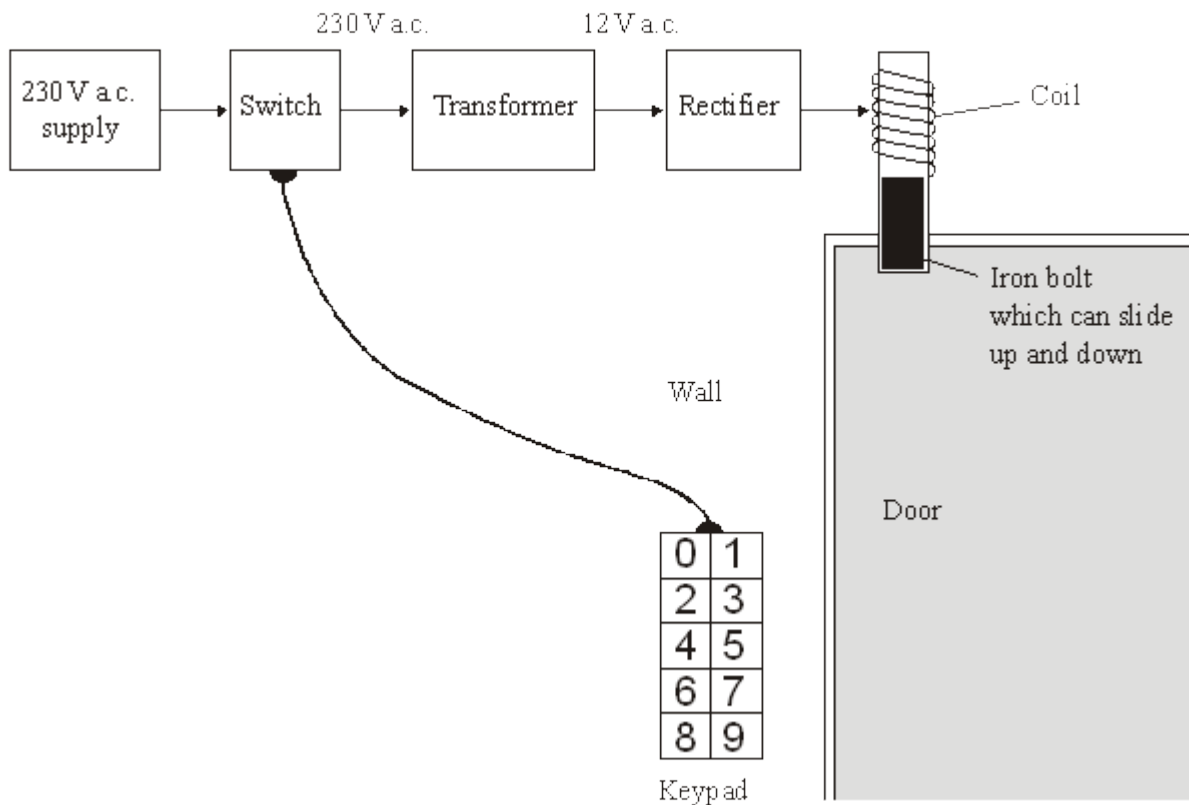
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(2)
(Total 9 marks)

42

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

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



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

.....

(1)

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

.....

(1)

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

attracts	downwards	magnet	reflects	repels
sideways	switch	transformer	upwards	

- (i) When a current flows in the coil, the coil becomes a
- (ii) The coil the iron bolt which moves

(3)

(Total 5 marks)

43

- (a) This notice is on the back of a television set.



The transformer used in the television set has 75 turns on its primary coil. The potential difference (p.d.) across the primary coil is 230 volts and the p.d. across the secondary coil is 32 200 volts.

Use the equation below to calculate the number of turns on the 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.

.....

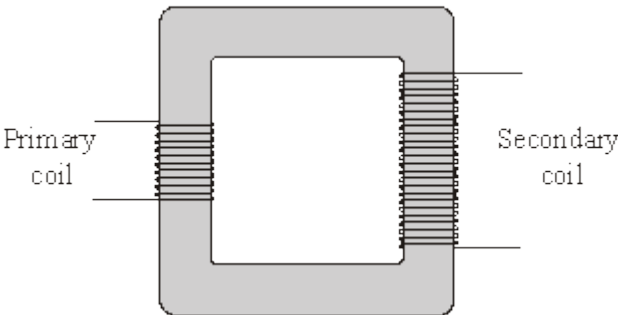
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Number of turns on the secondary coil =

(2)

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



Explain how the transformer works.

.....

.....

.....

.....

.....

.....

(3)
(Total 5 marks)

44

- (a) Name a material that could be used to make the outside case of the plug.

.....

Give a reason for your choice.

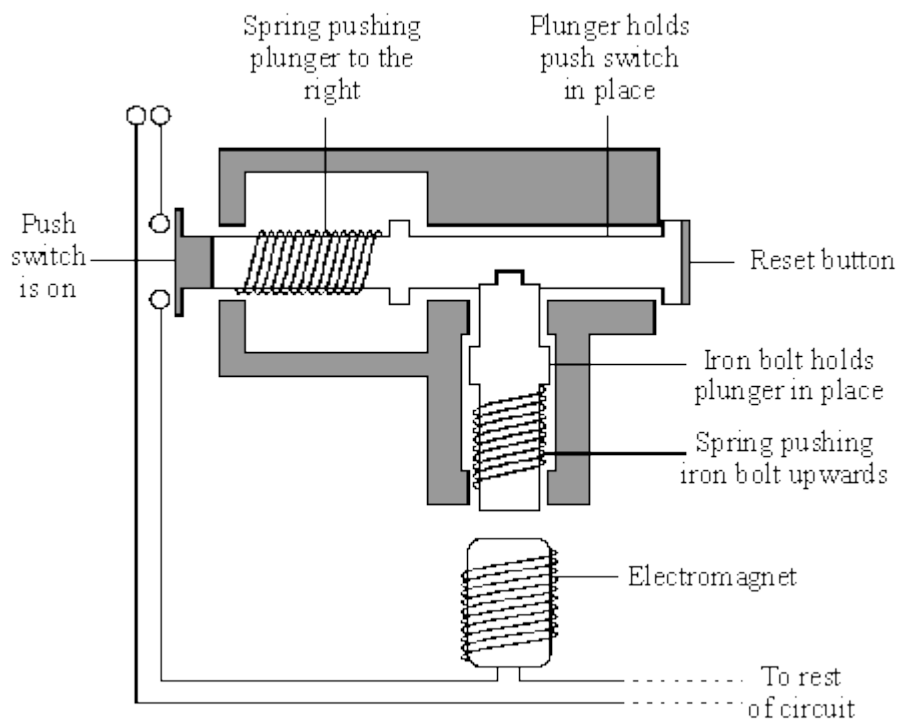
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(2)

- (b) *To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Some electrical circuits are protected by a circuit breaker. These switch the circuit off if a fault causes a larger than normal current to flow. The diagram shows one type of circuit breaker. A normal current (15 A) is flowing.



Source: adapted from V. PRUDEN and K. HIRST, *AQA GCSE Science*
 Reproduced by permission of Hodder and Soughton Educational Ltd

Explain what happens when a current larger than 15A flows. The answer has been started for you.

When the current goes above 15 A, the electromagnet becomes stronger and

.....

.....

.....

.....

.....

.....

(3)
(Total 5 marks)

45

A transformer is used to reduce the 230 V a.c. mains to the 12 V supply required for the lighting system. The transformer has 1150 turns on its primary coil.

Calculate the number of turns on the secondary coil of the transformer. Show clearly how you work out your answer.

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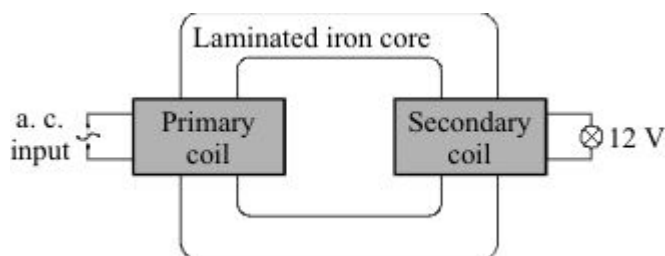
.....

number of turns on the secondary coil =

(2)
(Total 2 marks)

46

- (a) The diagram represents a simple transformer used to light a 12 V lamp. When the power supply is switched on the lamp is very dim.



- (i) Give **one** way to increase the voltage at the lamp without changing the power supply.

.....

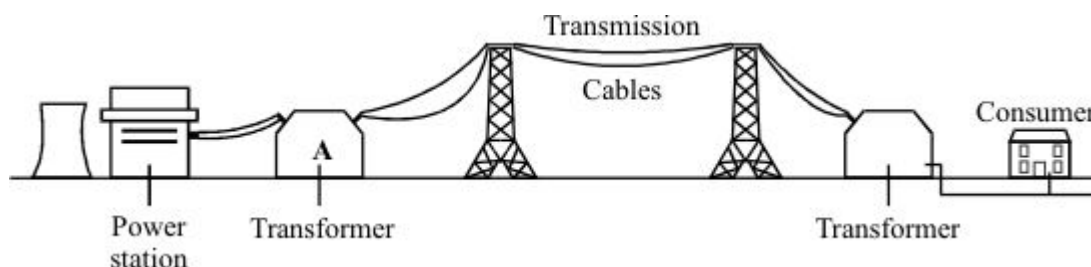
(1)

- (ii) What is meant by the iron core being *laminated*?

.....

(1)

- (b) Electrical energy is distributed around the country by a network of high voltage cables.



- (i) For the system to work the power is generated and distributed using alternating current rather than direct current. Why?

.....

(1)

- (ii) Transformers are an essential part of the distribution system. Explain why.

.....

(2)

- (iii) The transmission cables are suspended high above the ground. Why?

.....

(1)

- (c) The power station generates 100 MW of power at a voltage of 25 kV. Transformer **A**, which links the power station to the transmission cables, has 44 000 turns in its 275 kV secondary coil.

- (i) Write down the equation which links the number of turns in each transformer coil to the voltage across each transformer coil.

.....

(1)

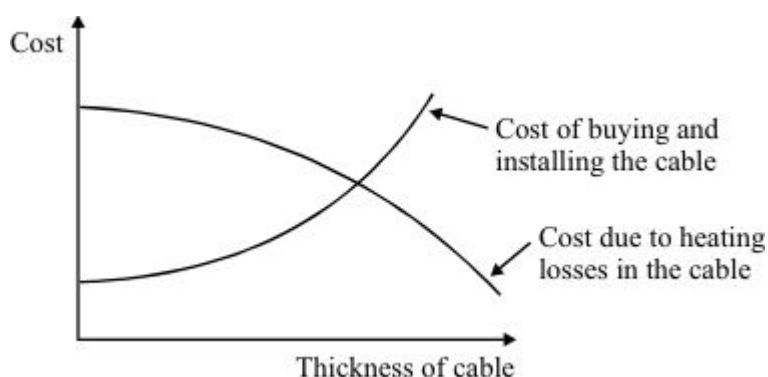
- (ii) Calculate the number of turns in the primary coil of transformer **A**. Show clearly how you work out your answer.

.....

Number of turns =

(2)

- (d) The diagram shows how the cost of transmitting the electricity along the cables depends upon the thickness of the cable.



- (i) Why does the cost due to the heating losses go down as the cable is made thicker?

.....

(1)

- (ii) By what process is most heat energy lost from the cables?

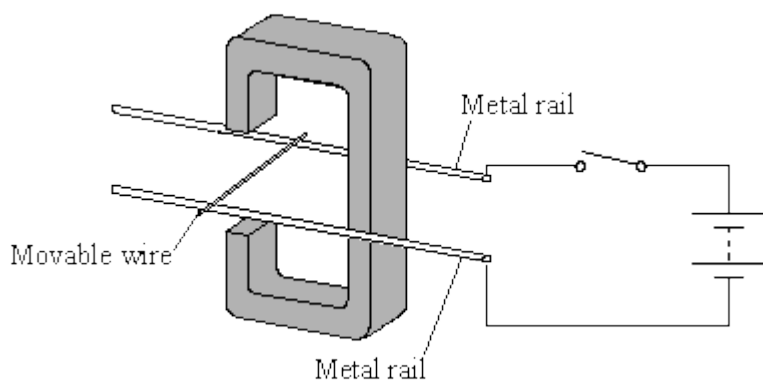
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(1)

(Total 11 marks)

47

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.

.....

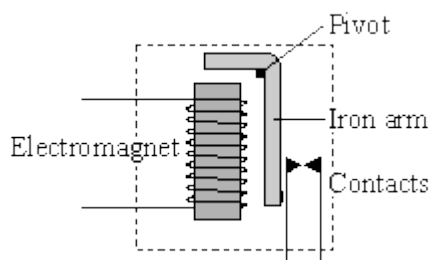
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(2)**(Total 3 marks)****48**

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

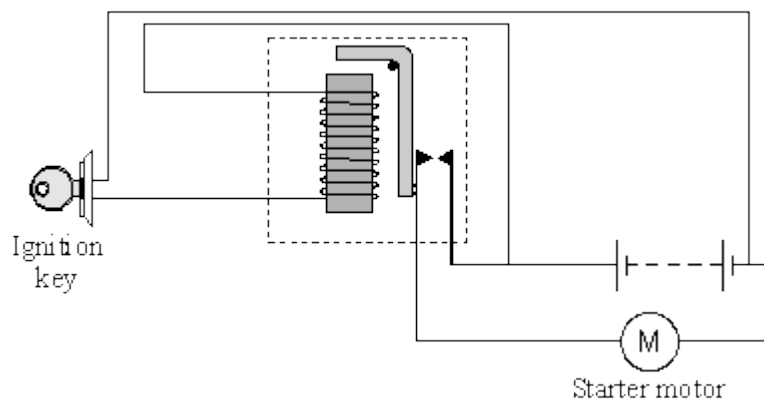


- (i) What is this type of switch called?

.....

(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

.....

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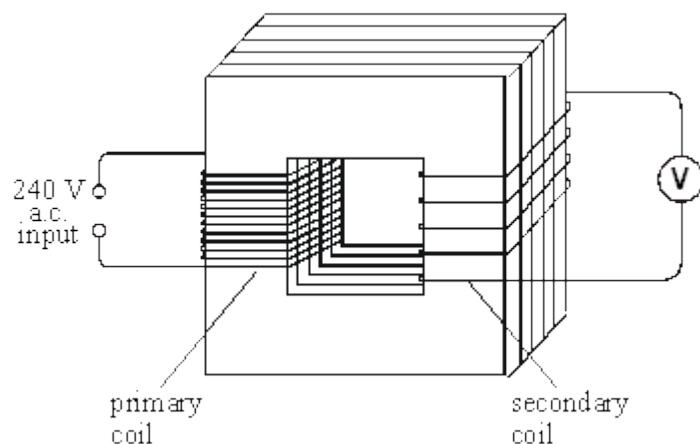
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.....

(3)
(Total 4 marks)

49

The diagram below shows a transformer.



- (i) Name the material used to make the core of the transformer.

.....

(1)

- (ii) The primary coil has 48 000 turns and the secondary coil 4000 turns.

If the input voltage is 240 V a.c., calculate the output voltage.

.....

Answer V

(2)

- (iii) Explain how the use of such a transformer could be adapted to transform a low voltage into a higher voltage.

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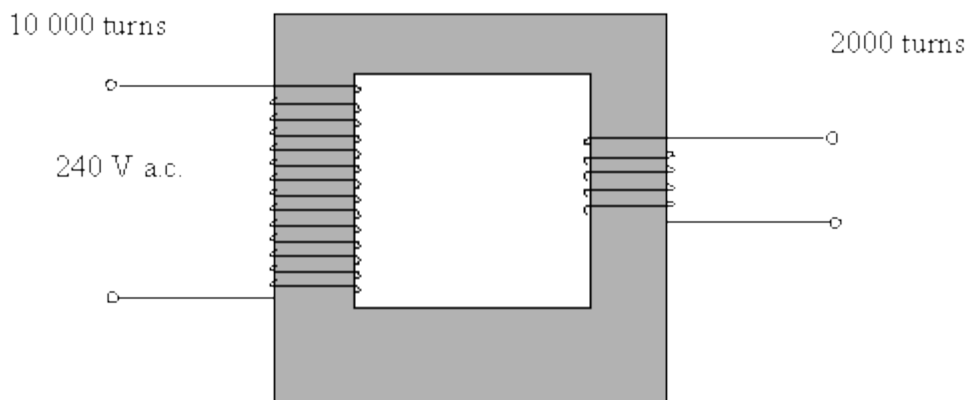
(1)

(Total 4 marks)

50

- (a) An appliance in a house has a transformer. The transformer is used to reduce the voltage to the level needed by the appliance.

The diagram shows the transformer.



- (i) Name the material used for the core of the transformer.

.....

(1)

- (ii) The transformer has 10 000 turns on the input side and 2000 turns on the output side.
If the mains voltage of 240 volts is applied to the input, calculate the output voltage.
You may find the following information helpful:

$$\frac{\text{output voltage}}{\text{input voltage}} = \frac{\text{number of turns on output coil}}{\text{number of turns on input coil}}$$

.....

.....

.....

.....

(3)

- (b) Explain, in terms of magnetic fields, how a transformer works.

.....

.....

.....

.....

.....

.....

(4)

- (c) A 12 V car battery is connected to the input leads of the transformer. It is hoped to reduce the voltage to 2.4 V in order to run a small motor. When the output voltage is measured it is found to be zero.

Explain why the output voltage is zero.

.....

.....

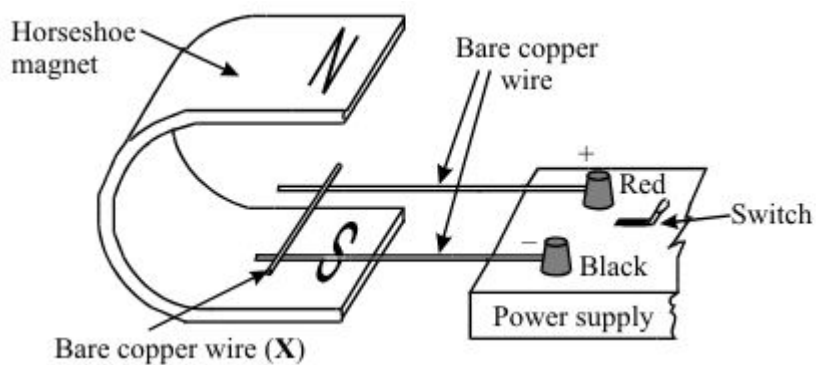
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(2)**(Total 10 marks)**

51

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.

.....

.....

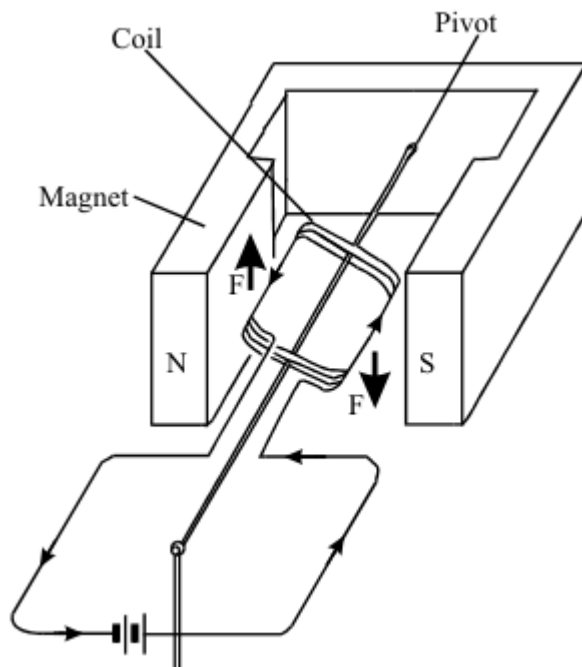
B The current is increased.

.....

.....

(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.

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(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

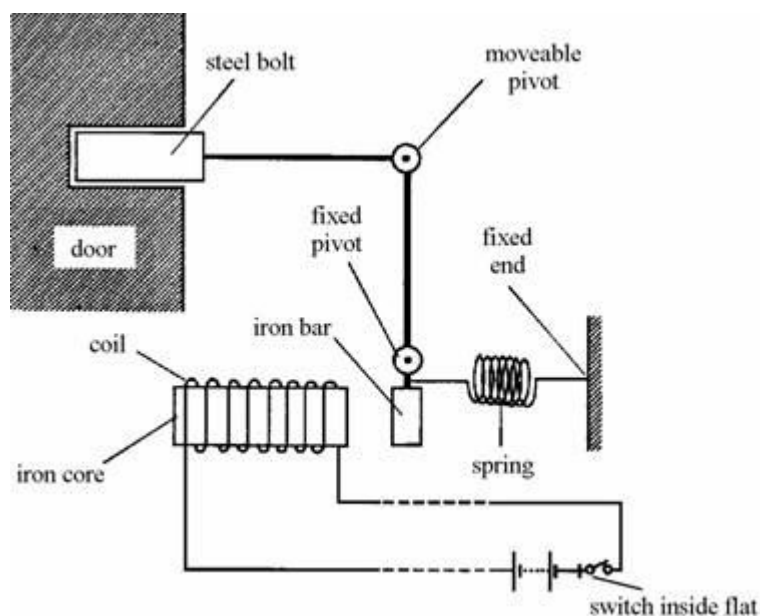
3

(3)

(Total 9 marks)

52

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.

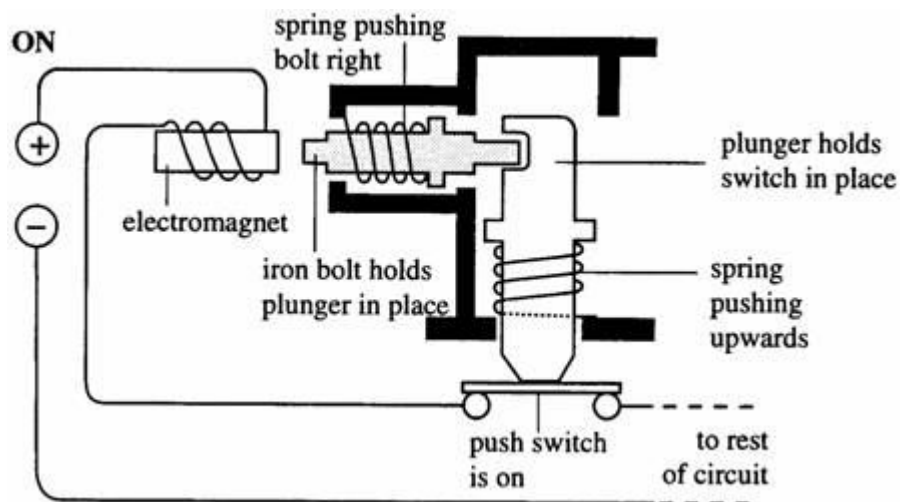
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(2)
(Total 9 marks)

53

A fault in an electrical circuit can cause too great a current to flow. Some circuits are switched off by a circuit breaker.



One type of circuit breaker is shown above. A normal current is flowing.
Explain, in full detail, what happens when a current which is bigger than normal flows.

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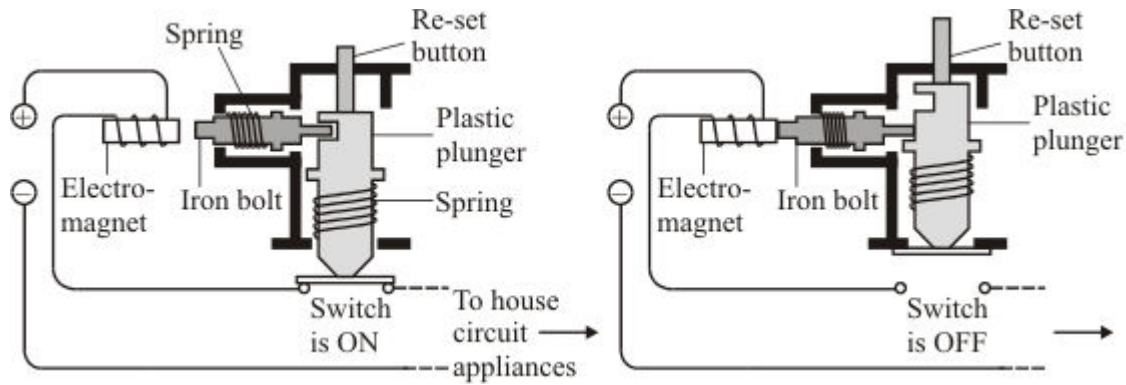
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(Total 4 marks)

54

Circuit breakers help to make the electricity supply in homes safer.

A circuit breaker is an automatic safety switch. It cuts off the current if it gets too big.



Describe, in as much detail as you can, how this circuit breaker works.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

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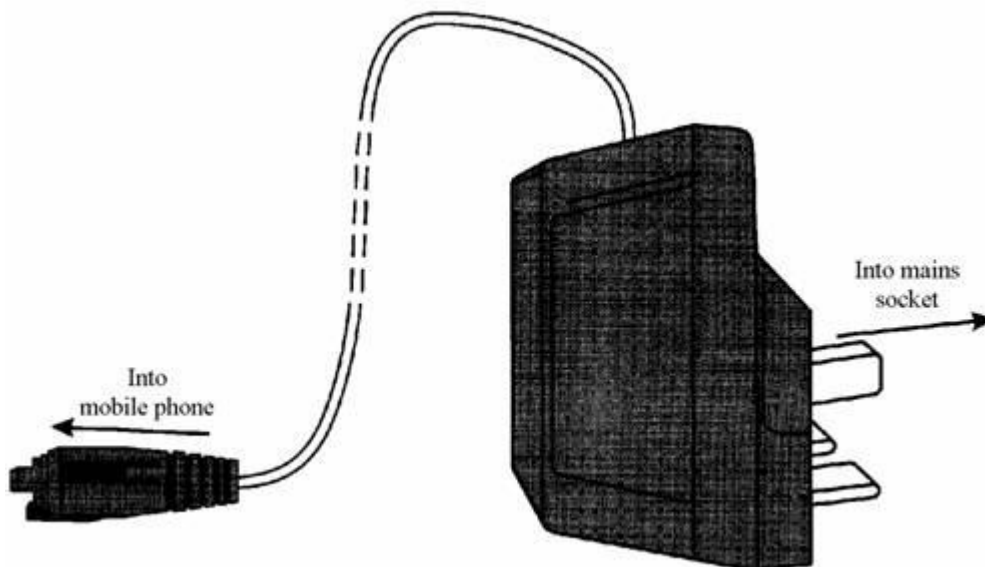
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(Total 6 marks)

55

- (a) The drawing shows a small transformer used to recharge the battery in a 4.2 V mobile phone from a 230 V mains supply.



Explain how you know that this is a *step-down* transformer.

.....

(1)

- (b) A transformer consists of an insulated coil of wire, called the primary coil, on one side of a core. Another coil of insulated wire, called the secondary coil, is on the other side.

Give **two** features of the *core*.

1
 2

(2)

(Total 3 marks)