Rewarding Learning

Centre Number

| 71 | |
|---|---|

Candidate Number

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| |

General Certificate of Secondary Education
2010

# Science: Double Award (Modular)

## Paper 3
## Higher Tier

**[G8206]**

G8206

**FRIDAY 28 MAY, MORNING**

**TIME**

1 hour 30 minutes.

**INSTRUCTIONS TO CANDIDATES**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all six** questions.

**INFORMATION FOR CANDIDATES**

The total mark for this paper is 110.
Quality of written communication will be assessed in questions **1(e)** and **5(a)(i)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Details of calculations should be shown.
Units must be stated in numerical answers where appropriate.

| For Examiner's use only | |
|---|---|
| Question Number | Marks |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| Total Marks | |

| Examiner Only | |
|---|---|
| Marks | Remark |
| | |

**1** **(a)** **(i)** What is at the centre of the solar system?

_____ [1]

Name the planet which is:

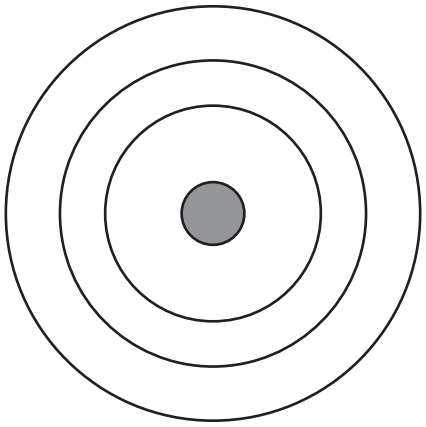
**(ii)** closest to the centre of the solar system.

_____ [1]

**(iii)** most distant from the centre of the solar system.

_____ [1]

In ancient times a theory was put forward to describe the structure of the solar system.



**(b)** According to this ancient theory, what was at the centre of the solar system?

_____ [1]

The universe is made up of a number of galaxies.

| Examiner Only | |
|---|---|
| Marks | Remark |

**(c)** What is a galaxy?

_____ [1]

**(d)** What is the name of our galaxy?

_____ [1]

**(e)** Give one reason, other than cost, why it is unlikely that a manned spacecraft will ever visit a planet outside our solar system.

_____

_____ [1]

Quality of written communication [1]

**(f)** **(i)** Name the gas which is required for the formation of a star.

_____ [1]

**(ii)** What force pulls the particles together?

_____ [1]

**(iii)** What happens to the particles when they are compressed?

_____ [1]

**(iv)** Name the nuclear reaction that takes place within a star.

_____ [1]

**(v)** Name a type of energy released by a star which reaches the Earth.

_____ [1]

**(g)** Name the two theories for the formation of the universe.

1. _____ 2. _____ [2]

| Examiner Only | |
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| Marks | Remark |
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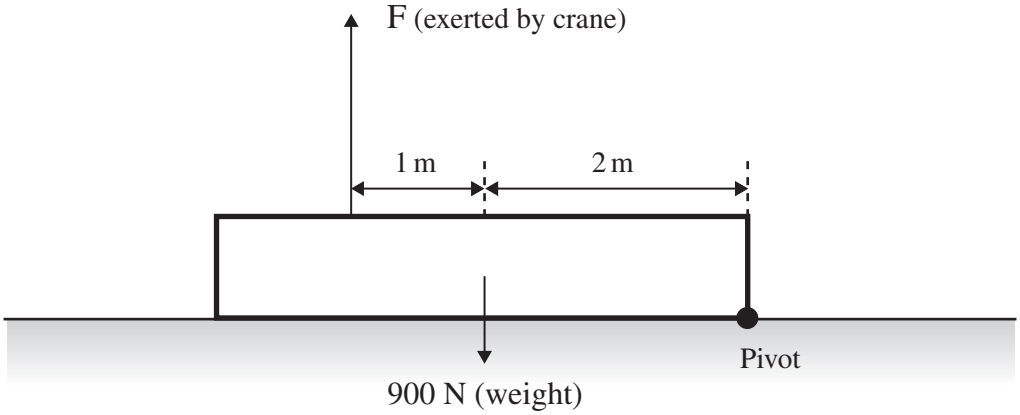
**2** **(a)** A crane is used to lift one end of a steel beam of weight 900 N. The weight of the beam is marked on the diagram for you.




The crane exerts a force, F, to lift the end of the steel beam off the ground.

**(i)** Use the principle of moments to calculate the smallest force F, needed to lift the left end of the beam off the ground.

**You are advised to show your working out.**

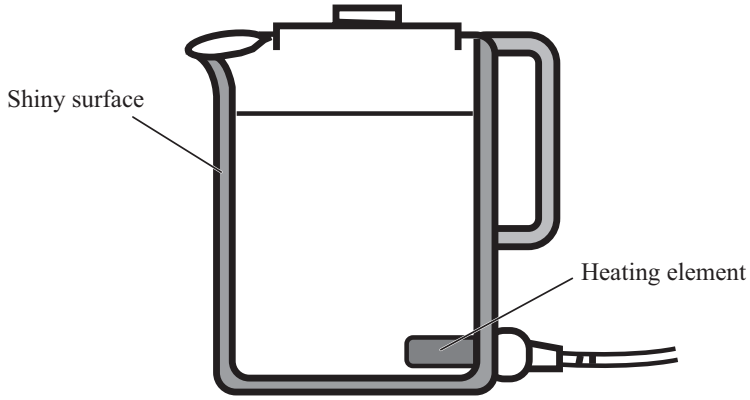
Force F = _____ N [4]

**(ii)** In what direction is the moment of the force F exerted by the crane about the pivot?

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Remark |

**(b)** The diagram shows an electric kettle.



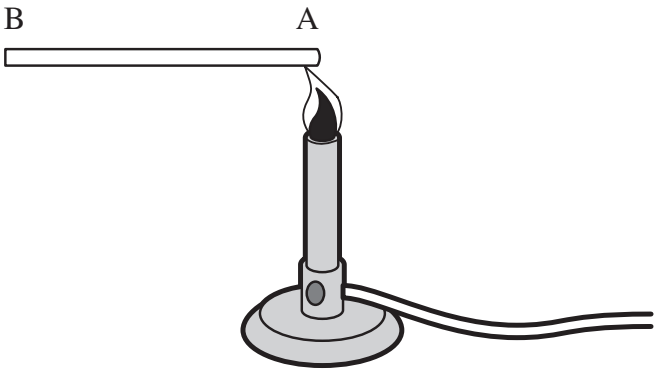

**(i)** Draw a convection current starting at the heating element and show its direction. [2]

**(ii)** Explain why the outer surface of the kettle is a shiny colour rather than a dull black surface.

_____

_____ [2]

One end of a glass rod is heated as shown.




**(c)** Complete the statement to compare the behaviour of the molecules at end A with the molecules at end B.

**(i)** The molecules at end A _____

_____ [1]

**(ii)** How is the heat energy transferred along the rod?

_____ [1]

| Examiner Only | |
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| Marks | Remark |
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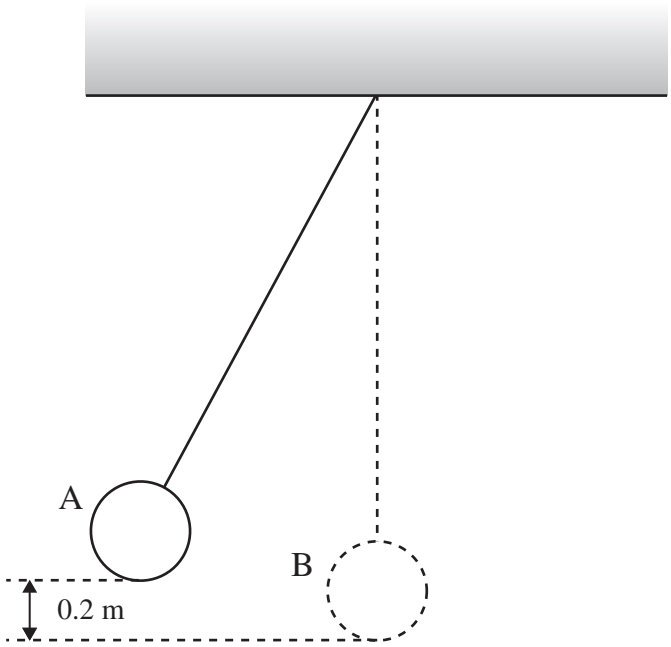
**(d)** The diagram shows a large pendulum, which has been pulled to one side and held at position A. Shown dotted is the position of the pendulum as it swings through the mid-point, position B.




**(i)** Complete the following sentence.

As the pendulum swings from position A to position B, gravitational potential energy changes to

_____energy. [1]

**(ii)** The pendulum, which has a mass of 3 kg, is released. Use the principle of conservation of energy to calculate its velocity when it reaches point B.

**You are advised to show your working out.**

Velocity at B = _____ m/s [4]

| Examiner Only | |
|---|---|
| Marks | Remark |
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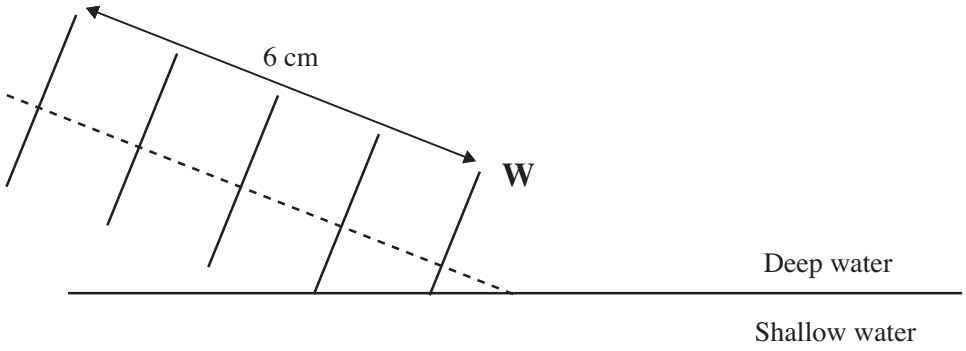
**3** **(a)** The following diagram (not to scale) shows water waves travelling through deep water.




**(i)** Part of wave **W** has not been completed as it enters the shallow water.
Complete wave **W** in the shallow water. [1]

**(ii)** Use the diagram to find the wavelength of the waves in deep water.
Remember the diagram is not drawn to scale.

Wavelength = _____ cm [1]

**(iii)** If 12 waves reach the edge of the shallow water in 2 seconds, what is the frequency of the waves?

Frequency = _____ Hz [1]

**(iv)** Use your answers to parts **(a)(ii)** and **(a)(iii)** to calculate the speed of waves in deep water.
Give your answer in cm/s.

**You are advised to show your working out.**

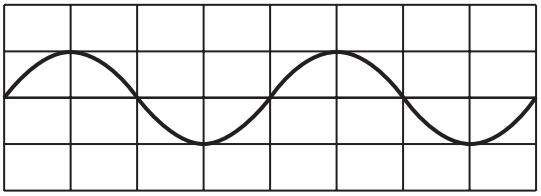
Speed = _____cm/s [3]

**(v)** What, if anything, happens to the wavelength of the water waves as they leave deep water and enter shallow water?

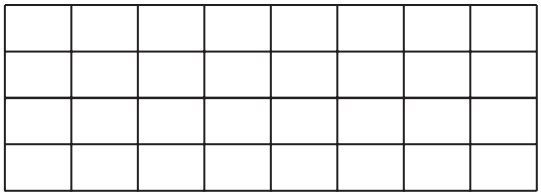
_____ [1]

| Examiner Only | |
|---|---|
| Marks | Remark |

**(b)** The outline of water waves is shown below.



**(i)** On the following grid draw waves with half the wavelength and double the amplitude.

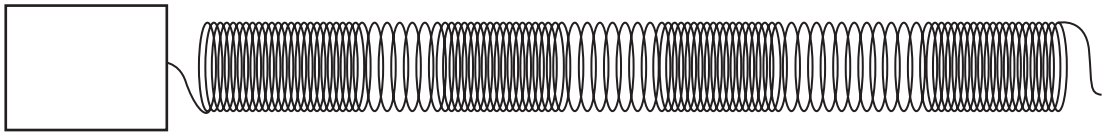


[2]

**(ii)** Water waves are classified as transverse waves.
Give two more examples of transverse waves.

1. _____ 2. _____ [2]

**(c)** Longitudinal waves can be demonstrated using a slinky spring.



**(i)** In the box, draw the direction in which the end of the spring is moved to produce longitudinal waves. [1]

**(ii)** Give another example of a longitudinal wave.

_____ [1]

**(iii)** What do the waves transfer as they move from left to right?

_____ [1]

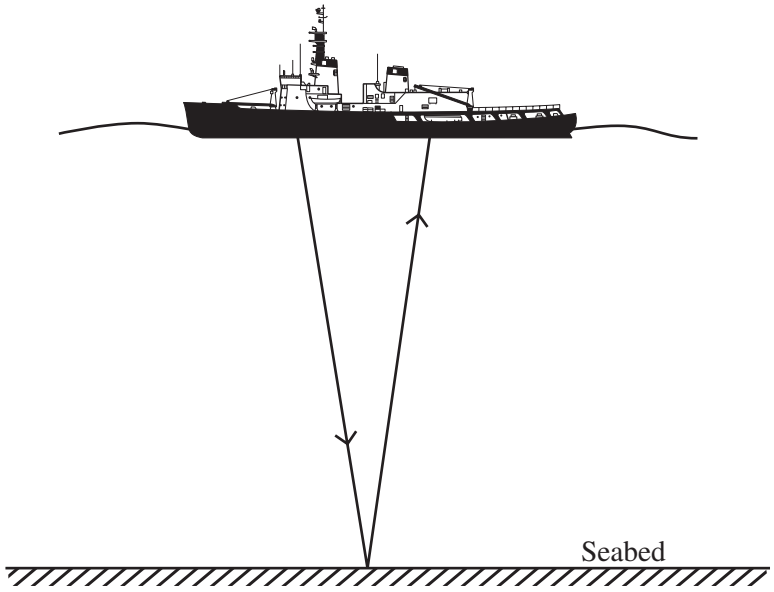
**(d) (i)** State the lower frequency limit for a child's hearing.

_____Hz [1]

**(ii)** What happens to the upper frequency limit of hearing in old age?

_____[1]

**(iii)** Ultrasound can be used to determine the depth of the sea.
The speed of ultrasound in seawater is 1500 m/s. A pulse of ultrasound, sent out from the ship, is reflected from the seabed and travels back again to the ship in a total time of 0.8 s.




Calculate the distance between the ship and the seabed.

**You are advised to show your working out.**

Distance = _____ m [4]

Examiner Only

| Marks | Remark |
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| Examiner Only | |
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| Marks | Remark |
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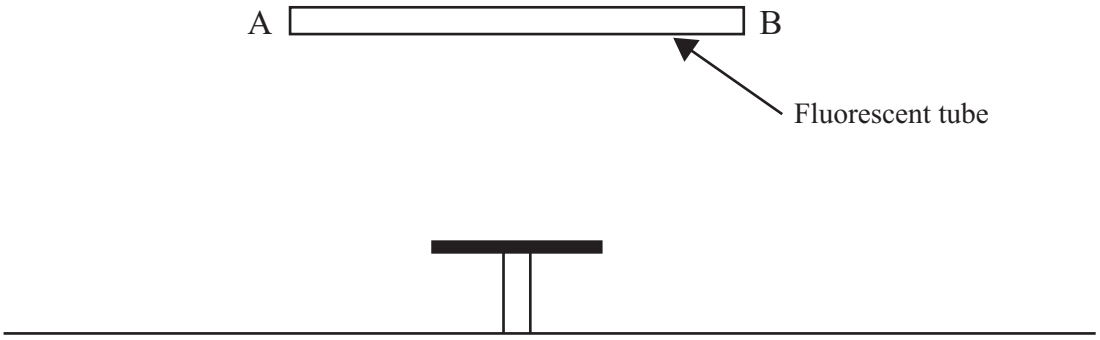
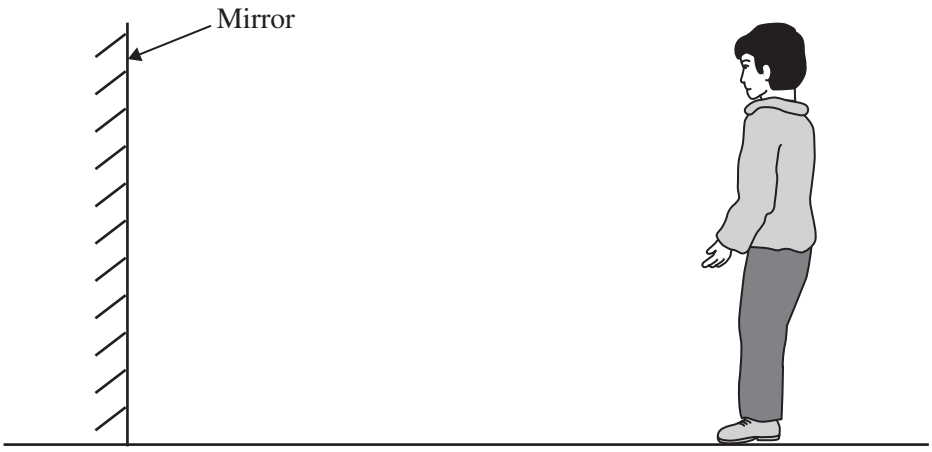
**4** Light from a fluorescent tube forms a shadow of a table on the floor below.




**(a) (i)** Draw four rays, two from each end (A and B) of the fluorescent tube, to show how the shadow is formed. [4]

**(ii)** Label a region of partial shadow with the letter **P**. [1]

Nathan observes his shoes in a mirror.




**(b) (i)** Draw an incident ray from the tip of the shoe to the mirror and the reflected ray into Nathan's eye.
Remember to include the normal and arrows to indicate the direction of the rays. [4]

Nathan observes his hand in the mirror.

**(ii)** Will the angle of incidence in this case be less than, equal to, or greater than the angle of incidence for his shoe?

_____ [1]

**(c) (i)** Explain fully what dispersion of light means.

Examiner Only

| Marks | Remark |
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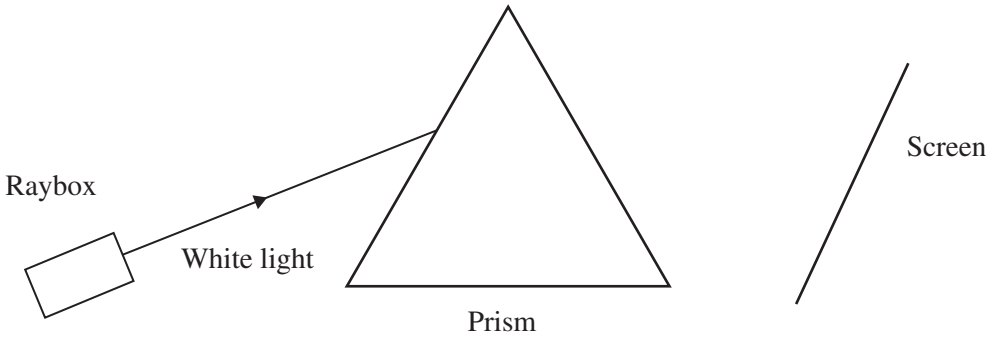
_____

_____ [2]

The incomplete diagram below shows the apparatus that can be used to demonstrate dispersion.




**(ii)** Indicate exactly with a point labelled P where dispersion begins. [1]

**(iii)** Indicate a region where the light travels at a smaller speed. Label the region with the letter Q. [1]

**(iv)** In what direction does the light travel when it emerges from the prism? Choose from the statements below.

Place a tick (✓) in the correct box.

It travels along the normal ☐

It bends towards the normal ☐

It bends away from the normal ☐

[1]

A diagram of the electromagnetic spectrum is shown.

| Gamma rays | | Ultra-violet rays | Visible rays | Infra-red rays | Micro-waves | Radio waves |
|---|---|---|---|---|---|---|

**(d) (i)** Name the missing member of the electromagnetic spectrum by writing its name in the box. [1]

**(ii)** All the members of this spectrum are electromagnetic waves. Give two other properties which they all have in common.

1. _____

2. _____ [2]

**(iii)** Apart from radio waves, give two other regions of the spectrum which can be used for communication purposes.

1. _____

2. _____ [2]

Examiner Only

| Marks | Remark |
|---|---|
| | |

| Examiner Only | |
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| Marks | Remark |
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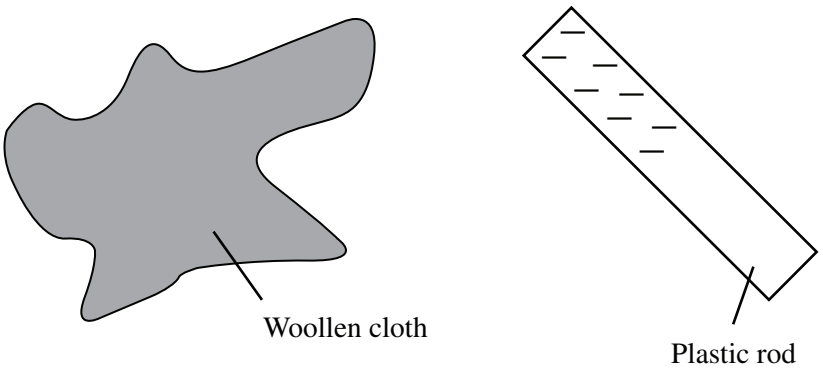
**5** **(a)** When insulators are rubbed together, static electricity is produced.

A plastic rod becomes negatively charged when it is rubbed with a woollen cloth.




**(i)** Explain fully why the plastic rod becomes negatively charged.

_____

_____[2]

Quality of written communication [1]

A garage uses a spray gun to paint a car. Positively charged paint drops from the spray gun are directed at the body of the car.


**(ii)** Why do the positively charged paint drops move apart when they leave the spray gun?

_____ [1]

**(iii)** Why should the car body be negatively charged?

_____[1]

| Examiner Only | |
|---|---|
| Marks | Remark |
| | |

**(b)** A current of 0.2 A flows through a resistor. How much charge passed in five **minutes**?

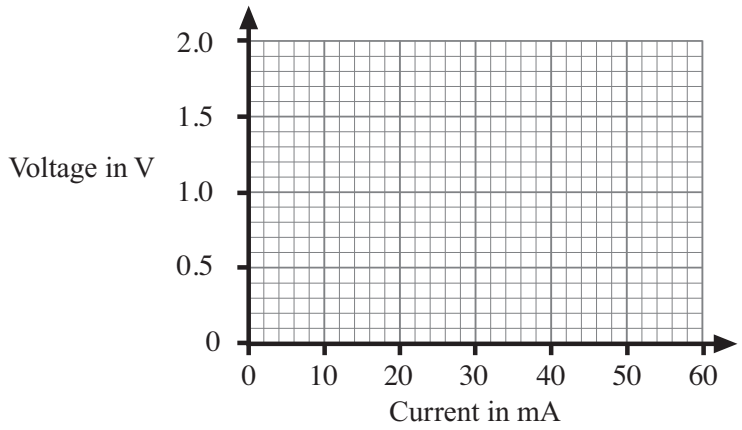
Remember to include the correct unit for charge.

**You are advised to show your working out.**

Charge = _____ [4]

**(c)** A pupil investigated the variation of voltage with current for a bulb. The results are given below.

| **Voltage in V** | 0 | 0.1 | 0.3 | 0.5 | 0.8 | 2.0 |
|---|---|---|---|---|---|---|
| **Current in mA** | 0 | 10 | 20 | 30 | 40 | 60 |




**(i)** Plot the points on the grid. [1]

**(ii)** Draw a smooth curve through the points. [1]

**(iii)** Use the graph to find the current in milliamps when the voltage is 1.3 V.

Current = _____ mA [1]

**(iv)** Convert your answer in **(c)(iii)** to amperes.
Remember 1 mA = 0.001 A.

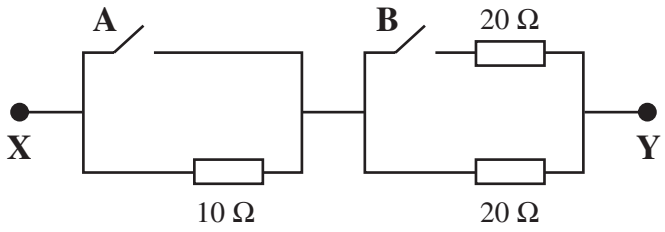
Current = _____ A [1]

**(v)** Use your answer to **(c)(iv)** to calculate the resistance of the bulb when the voltage is 1.3 V.

**You are advised to show your working out.**

Resistance = _____ Ω [3]

**(d)** Three resistors are connected between **X** and **Y** as shown below.




Complete the following table to show the total resistance between **X** and **Y** for the different switch settings.

| **Switch** | | Resistance between **X** and **Y** in Ω |
|---|---|---|
| **A** | **B** | |
| Open | Open | |
| Open | Closed | |
| Closed | Open | |
| Closed | Closed | |

[4]

Examiner Only

| Marks | Remark |
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| Examiner Only | |
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| Marks | Remark |
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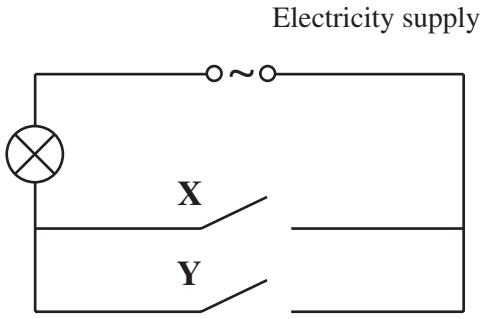
**6** Sarah is attempting to construct a two-way switch so that a light in a long hallway can be switched on or off from either end of the hallway.

Sarah considers the circuit below.

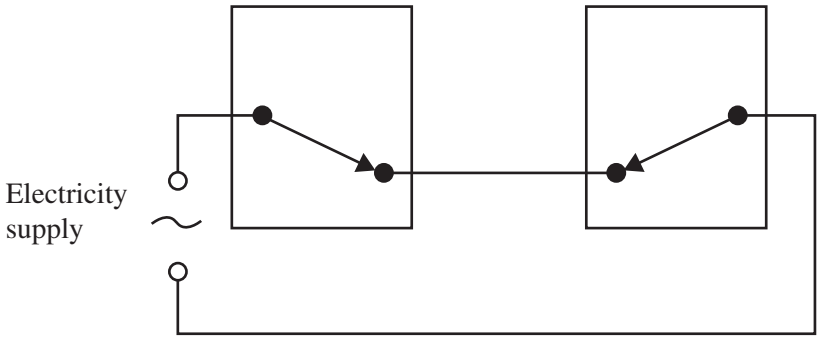



**(a) (i)** Explain why this circuit will not work as a two-way switch.

_____

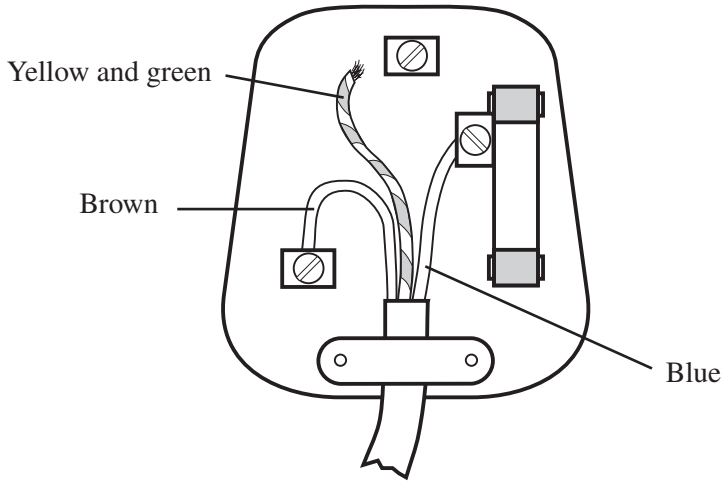
_____ [1]

The circuit shown below is incomplete for a two-way switch. For it to work, a bulb must be added and the switch completed.




**(ii)** Complete the circuit diagram and draw in the bulb. [2]

Arabella suspects that a plug connected to her hairdryer is faulty and so removes the cover. What she finds is shown below.




**(b) (i)** Apart from the cover being off, what two faults do you notice in the plug?

1. _____

2. _____ [2]

**(ii)** Which two wires carry the same current when the appliance is working normally?

_____ and _____ [1]

**(c)** A fuse is a safety device which works by creating an incomplete circuit.

**(i)** Name another safety device which works by creating an incomplete circuit.

_____ [1]

**(ii)** State two ways, other than cost, in which this device is better than a fuse.

1. _____

2. _____ [2]

Examiner Only

| Marks | Remark |
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| | |

A transformer transfers electrical energy from the primary coil to the secondary coil.

| Examiner Only | |
|---|---|
| Marks | Remark |

**(d) (i)** What is the name of this process?

_____ [1]

**(ii)** What type of current flows in the coils of a transformer? Choose your answer by placing a tick (✓) in the correct box.

| | |
|---|---|
| direct current | ☐ |
| alternating current | ☐ |
| direct current **or** alternating current | ☐ |

[1]

Bathrooms use a particular type of transformer called an isolating transformer. In this transformer, the voltage in the secondary coil is the **same** as the voltage in the primary coil.

**(iii)** How does the number of turns in the primary coil compare with the number of turns in the secondary coil?

_____ [1]

A mobile telephone is charged from the mains supply using a transformer. The mains supply is 240 V and the telephone needs 6 V to charge it. The secondary coil has 200 turns.


**(e)** Calculate the number of turns in the primary coil.

**You are advised to show your working out.**

Number of turns = _____ [4]

| Examiner Only | |
|---|---|
| Marks | Remark |
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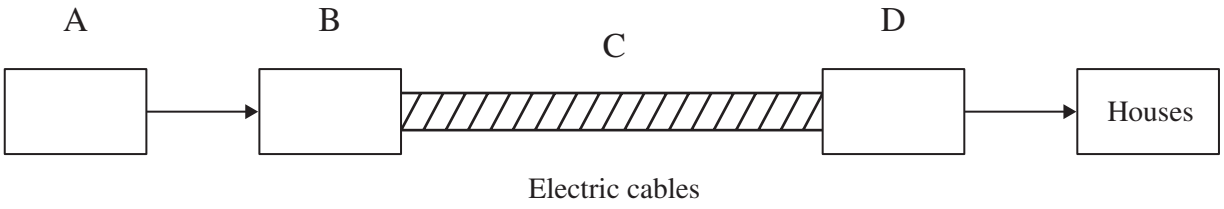
A block diagram of an electricity transmission system is shown below. Each block represents a different component in the transmission system.




**(f) (i)** Which component, A, B, C or D is included for safety reasons?

Component _____ [1]

**(ii)** Which component, A, B, C or D has fewer secondary turns than the primary?

Component _____ [1]

**(iii)** It is important that energy losses in the electric cables are kept to a minimum. Which component, A, B, C or D is mainly responsible for this?

Component _____ [1]

**THIS IS THE END OF THE QUESTION PAPER**

Examiner Only

| Marks | Remark |
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