Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012

Science: Double Award (Non-Modular)

Paper 3
Higher Tier

[G8406]

G8406

FRIDAY 15 JUNE, AFTERNOON

TIME

1 hour 45 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 twelve** questions.

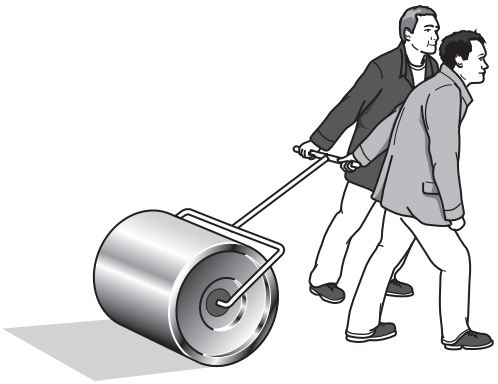
INFORMATION FOR CANDIDATES

The total mark for this paper is 120.
Quality of written communication will be assessed in question **11(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.

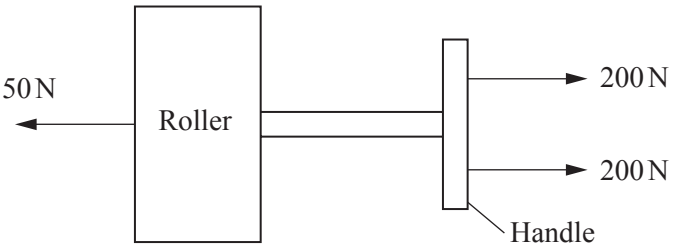
For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

1 Two men pull a roller over a football pitch.

Examiner Only	
Marks	Remark



The diagram below represents the forces that are exerted.



The men exert a force of 200 N each and the opposing forces add up to 50 N.

Calculate the acceleration of the roller if its mass is 500 kg.

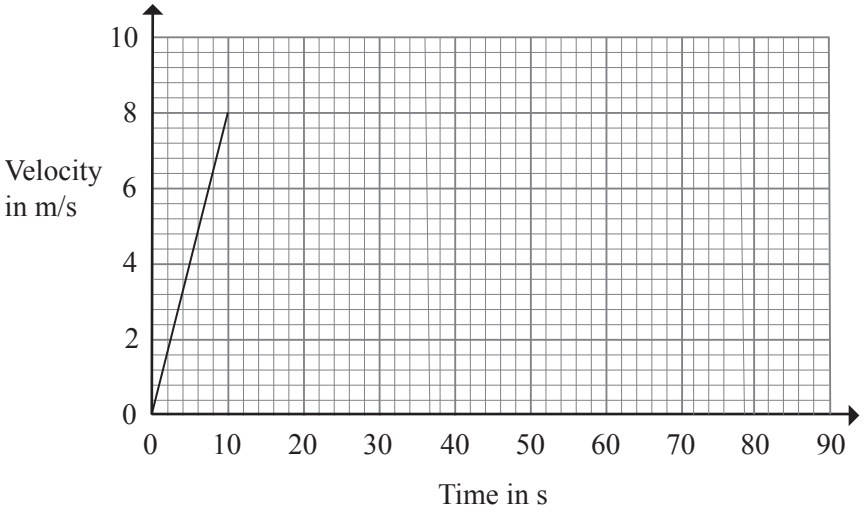
You are advised to show your working out.

Acceleration = _____ m/s^2 [4]

2 A train travels on a short journey from rest.

The train reaches a velocity of 8 m/s after 10 seconds.

It travels at a constant velocity of 8 m/s for another 40 seconds and then decelerates uniformly to rest in a further 20 seconds.



(i) Part of the graph has been drawn for you. Complete the graph for the journey. [2]

(ii) Calculate the acceleration of the train during the first 10 seconds of its journey.

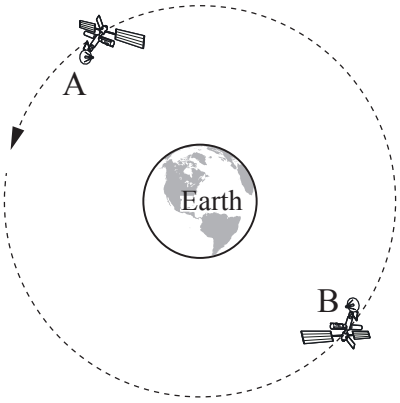
You are advised to show your working out.

Acceleration = _____ m/s^2 [3]

Examiner Only

Marks	Remark

3 The diagram shows two satellites A and B orbiting the Earth on the same circular path and in the same direction.



(a) Draw an arrow on satellite A to show the direction of the force acting on it due to the Earth. [1]

(b) Satellite B has a greater mass than satellite A. How does the force on satellite A compare with the force on satellite B?

Tick (✓) the correct answer.

The force on A is greater than the force on B.	
The force on A is equal to the force on B.	
The force on A is less than the force on B.	

[1]

(c) Name the force on the satellites which keeps them moving in a circle.

_____ [1]

(d) The radius of satellite A's orbit is reduced. How will this affect the force between satellite A and the Earth?

Tick (✓) the correct answer.

The force on A will decrease.	
The force on A will remain the same.	
The force on A will increase.	

[1]

(e) Draw an arrow on satellite B to show the direction of its velocity. [1]

Examiner Only

Marks	Remark

4 The Sun is a star.

(a) What is the name given to a collection of stars?

_____ [1]

(b) There are four stages in the formation of a star.

Use the numbers 1, 3 and 4 to complete the order in which the stages occur.

Gas ball begins to spin	2
Hydrogen particles are pulled together by gravitational forces	
The star generates energy	
The temperature rises	

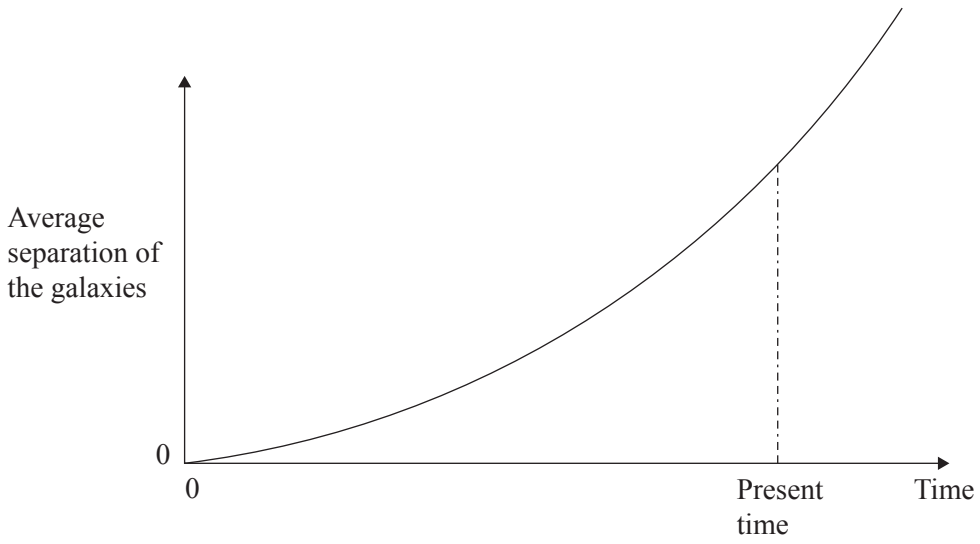
[2]

(c) State two types of radiation emitted by a star.

1. _____

2. _____ [2]

5 The Big Bang theory explains the origin and expansion of the universe.



The graph above shows how the average separation of the galaxies has increased over time, according to the Big Bang theory.

(a) What other feature of the graph supports the Big Bang theory?

_____ [1]

(b) Name the other scientific theory which attempts to explain the origin of the universe.

_____ [1]

(c) State two reasons, not related to cost, why it is difficult to send a manned spacecraft to another planet outside our solar system.

1. _____

2. _____ [2]

(d) What nuclear process in stars generates energy?

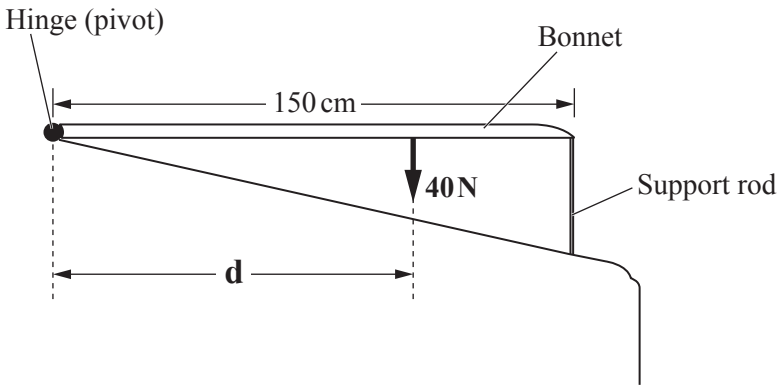
_____ [1]

6 **(a)** State the Principle of Moments.

_____

_____ [2]

(b) The bonnet of a truck is held in a horizontal position by a support rod.



The support rod exerts an upward force of 24 N and the bonnet has a weight of 40 N. Calculate the distance **d** of the centre of gravity of the bonnet from the hinge.

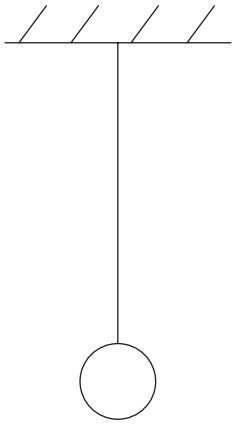
You are advised to show your working out.

Distance = _____ cm [4]

Examiner Only

Marks	Remark

7 An experiment on heat transfer is carried out in the laboratory. A metal ball is heated until it is red hot and then suspended as shown.



(a) Which one of the following statements is correct?

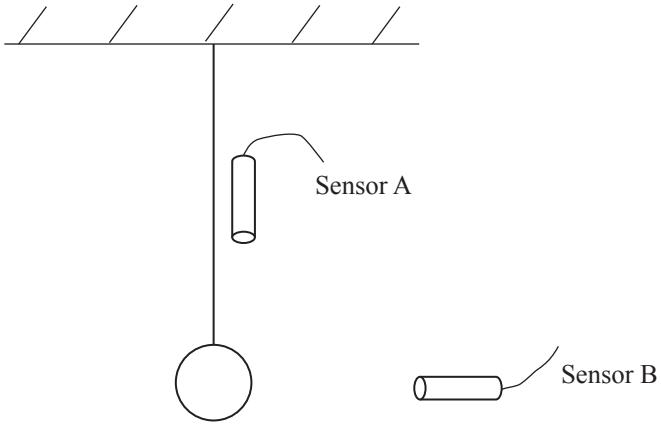
Tick (✓) the correct box.

We see both the infrared and the red light. ☐

We feel the infrared and see the red light. ☐

We feel both the infrared and the red light. ☐ [1]

Two heat sensors are placed at equal distances from the red hot ball as shown below.



(b) Explain fully why sensor A gives a higher reading than sensor B.

_____

_____ [2]

(c) The experiment is now repeated but this time the apparatus is placed in a vacuum.

(i) How does the reading of sensor A now compare with the reading of sensor B?

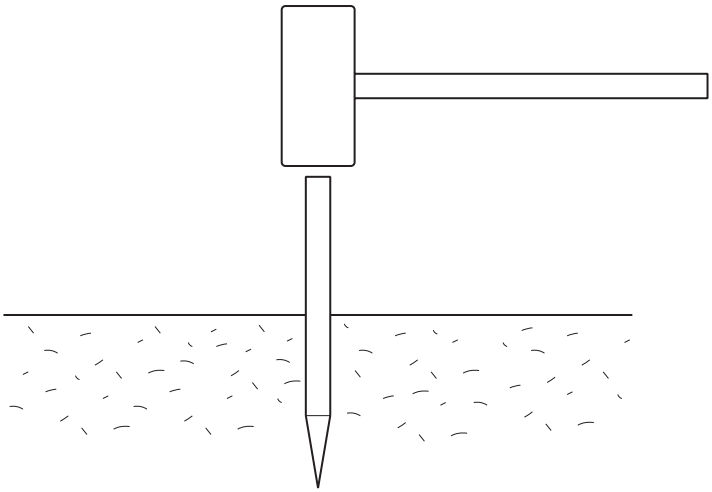
_____ [1]

(ii) Explain your answer.

_____ [1]

Examiner Only	
Marks	Remark

8 A hammer is used to drive a stake into the ground.



One strike of the hammer drives the stake a distance of 0.2 m into the ground. The average resistance force exerted by the ground is 320 N.

(i) Show that the work done on the stake is 64 J.

[2]

(ii) Assume that the kinetic energy of the hammer is 64 J at the point of impact and that the mass of the hammer is 0.5 kg.

Calculate the velocity of the hammer at impact.

You are advised to show your working out

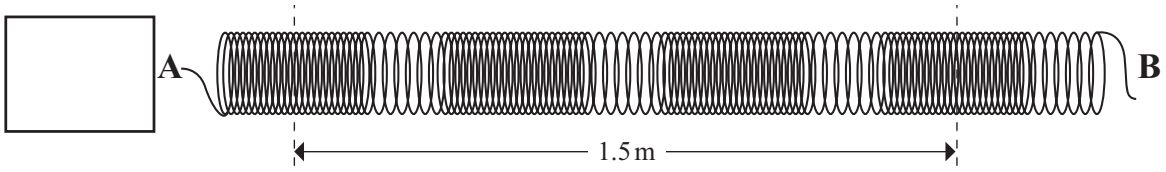
Velocity = _____ m/s [3]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

9 **(a)** Shauna uses a stretched slinky to make longitudinal waves.



(i) What do the longitudinal waves transfer from **A** to **B**?

_____ [1]

(ii) In the box, draw a double-headed arrow to indicate the direction Shauna would have to move end **A** to make longitudinal waves. [1]

(iii) Shauna sends 18 waves along the slinky in 6 seconds.
How many waves does she make in 1 second?

_____ [1]

(iv) Use your answer to part **(iii)** to state the frequency of the waves.

Frequency = _____ Hz [1]

(v) What is the wavelength of the longitudinal waves?

Wavelength = _____ m [1]

(vi) Use your answers to parts **(iv)** and **(v)** to calculate the speed of the longitudinal waves.

You are advised to show your working out.

Speed = _____ m/s [3]

(vii) Give another example of a longitudinal wave.

_____ [1]

Examiner Only	
Marks	Remark

(b) Transverse waves can also be made with a slinky spring.

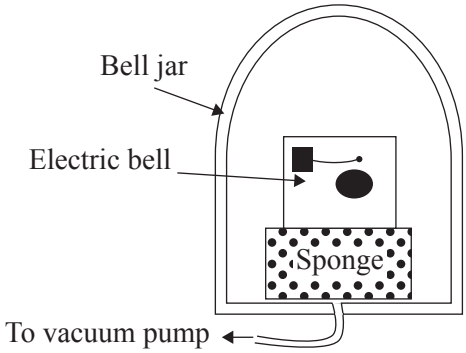
(i) How would the vibrations of the slinky spring be different if Shauna made a transverse wave?

_____ [1]

(ii) Give another example of a transverse wave.

_____ [1]

(c) An electric bell is set ringing inside a bell jar.



When the hammer strikes the gong, sound is produced.

(i) Why is sound produced by the gong?

_____ [1]

(ii) What happens to the loudness of the sound from the gong when the vacuum pump is switched on?

_____ [1]

(iii) What does this experiment demonstrate about sound waves?

_____ [1]

(iv) If the experiment is repeated without the sponge, the sound of the electric bell can always be heard. Explain why this is so.

_____

_____ [1]

(d) What are the frequency limits of human hearing?

(i) Lower limit = _____ Hz [1]

(ii) Upper limit = _____ Hz [1]

(iii) How, if at all, does the upper limit change with increasing age?

_____ [1]

(iv) What damage can long exposure to loud sound cause to the ears?

_____ [1]

(v) How can people who operate very noisy machines reduce damage to their ears?

_____ [1]

Examiner Only	
Marks	Remark

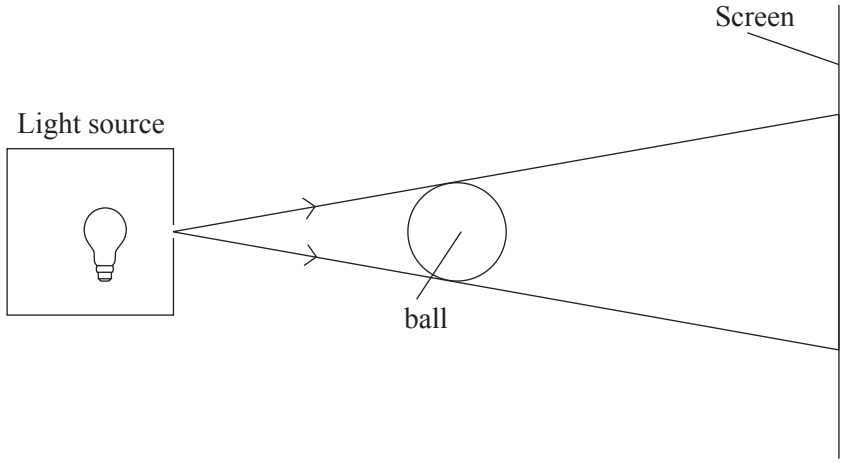
Examiner Only
Marks | Remark

10 (a) (i) Indicate with a tick (✓) on the table below whether the object is luminous or non-luminous.

Object	Luminous	Non-luminous
Star		
Moon		
Planet		
White paper		

[4]

The diagram below shows a shadow of a ball being formed on a screen by a point source of light.



(ii) Which statement below best describes the shadow formed on the screen?

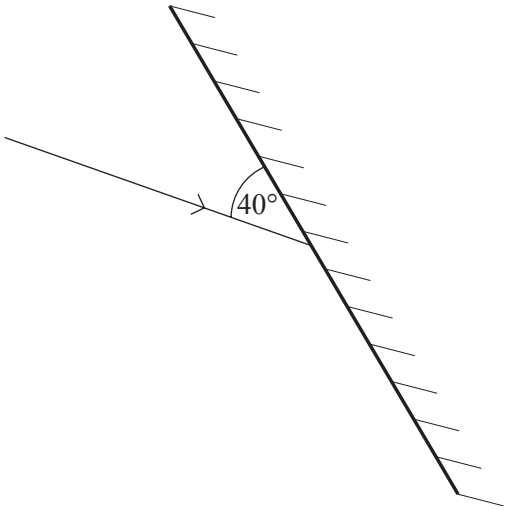
A The shadow is uniformly black.

B The shadow contains partial shadow AND uniformly black shadow.

C The entire shadow is partial shadow.

Answer _____ [1]

A ray of light is incident on a plane mirror as shown.



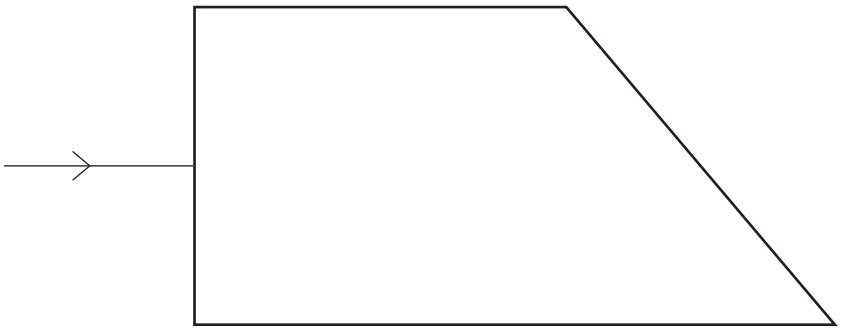
(b) (i) Draw and label the normal. [1]

(ii) What size is the angle of reflection?

Angle of reflection = _____ ° [1]

Different shapes of glass prism are often used to change the direction of light rays.

(c) (i) Continue the path of the ray shown until it emerges into the air.



[3]

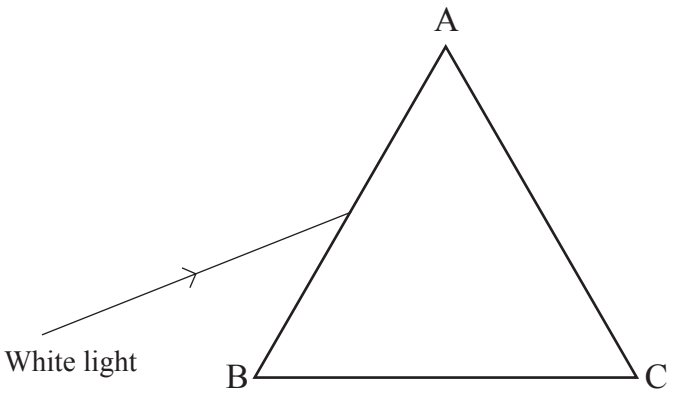
(ii) Does the speed of light increase, decrease or remain the same as it enters the glass?

_____ [1]

Examiner Only

Marks	Remark

White light enters a prism.



A prism may be used to split white light into its component colours.

(d) (i) What is this process called?

_____ [1]

(ii) List the component colours produced **beginning with** the colour nearest the corner C.

_____ [2]

(iii) What name is given to this group of colours?

_____ [1]

Examiner Only	
Marks	Remark

The box contains the names of some electromagnetic waves.

Ultraviolet	Gamma rays	Microwaves	Radio waves	Infrared

Examiner Only

Marks	Remark

(e) **(i)** Which one has the shortest wavelength?

_____ [1]

(ii) Which one comes from a coal fire?

_____ [1]

(iii) Which one can be used to sterilise medical equipment?

_____ [1]

(iv) Which one can cause skin cancer?

_____ [1]

(v) Which one has the longest wavelength?

_____ [1]

Examiner Only	
Marks	Remark

11 **(a)** James was wearing a woollen sweater and a nylon shirt. When he removes the sweater he sees a spark.

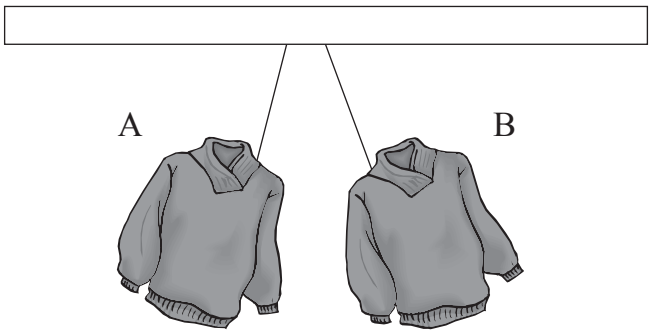
(i) Explain fully in terms of charge movement how the sweater became charged.

_____

_____ [2]

Quality of written communication [1]

When two charged sweaters (A and B) were suspended on threads they moved apart as shown below.



(ii) What does this indicate about the charges on the sweaters?

_____ [1]

(iii) Explain your answer to part **(ii)**.

_____ [1]

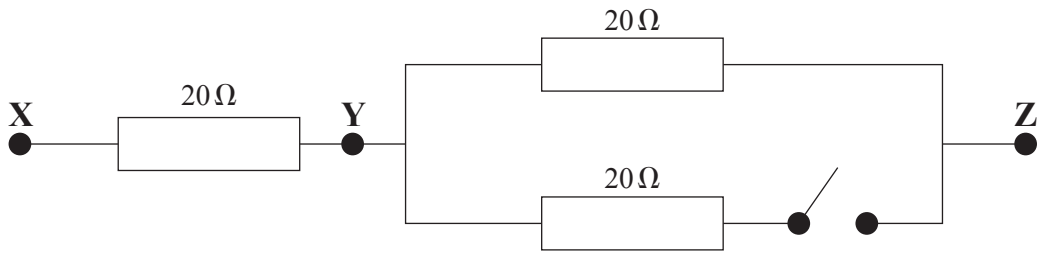
Examiner Only	
Marks	Remark

(b) A charge of 0.6 C is transferred from a charged sweater through a conductor in 0.2 seconds.
What current flows through the conductor?

You are advised to show your working out.

Current = _____ A [3]

(c) Three 20 Ω resistors are connected as shown below.



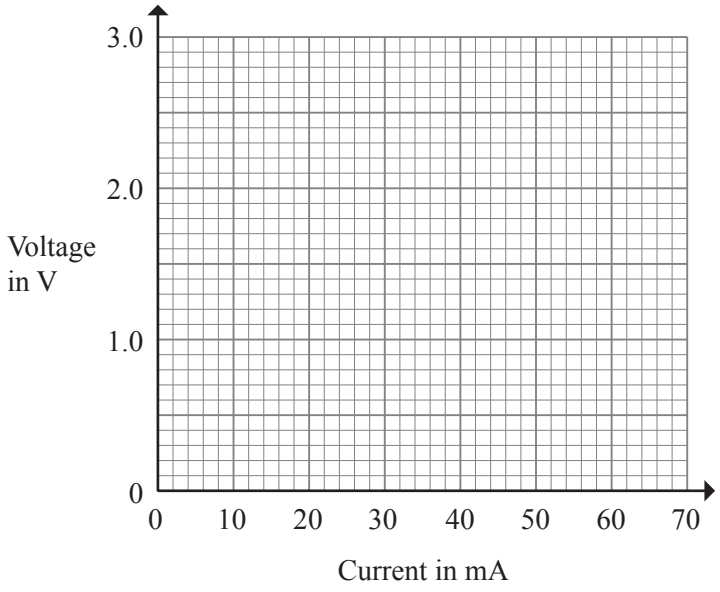
Complete the following table to show the total resistance between the different points for the switch settings indicated.

Points	Switch	Resistance in Ω
Y and **Z**	Closed	
X and **Z**	Open	
X and **Z**	Closed	

[3]

(d) A pupil investigates the variation of current with voltage for a resistor. The results are given below.

Voltage in V	0	0.8	1.2	1.8	2.0	2.8
Current in mA	0	20	30	40	50	70



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

(ii) Draw the best fit straight line through the points. [1]

(iii) Use your graph to find the voltage when the current is 60 mA

Voltage = _____ V [1]

(iv) Convert 60 mA to A. Remember 1 mA = 0.001 A

Current = _____ A [1]

Examiner Only

Marks	Remark

(v) Use your answer to parts **(iii)** and **(iv)** to calculate the resistance of the resistor.

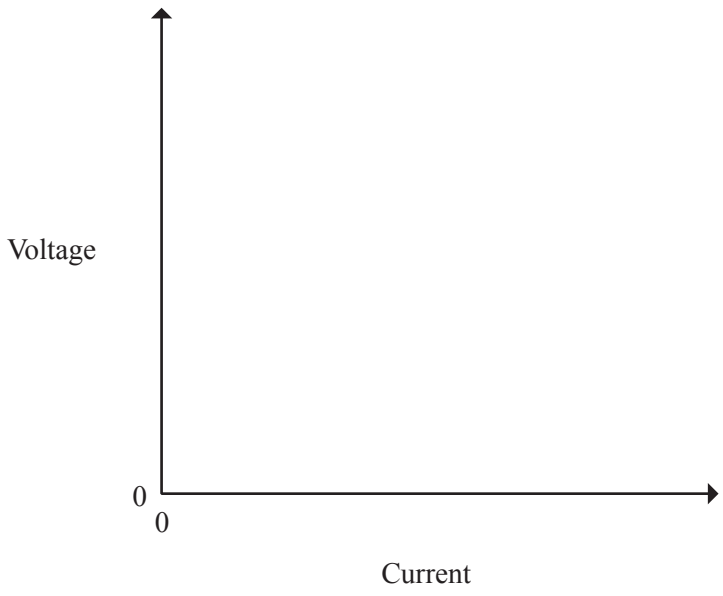
You are advised to show your working out.

Examiner Only

Marks	Remark

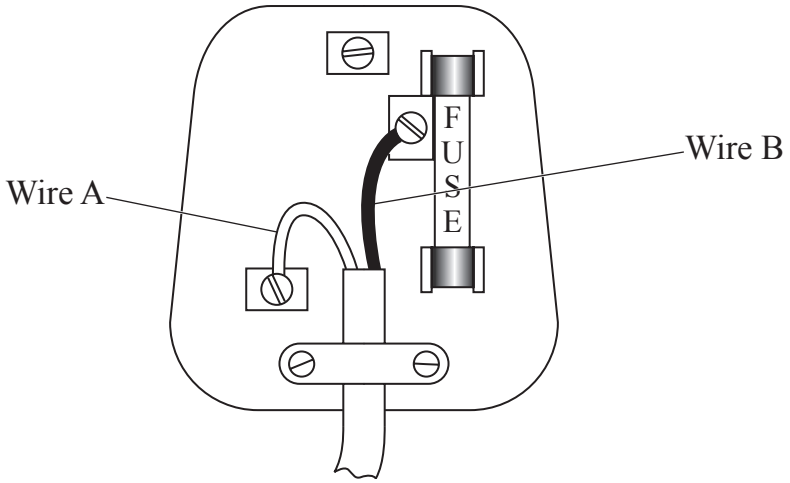
Resistance = _____ Ω [3]

(e) Sketch below a graph to show how voltage varies with current for an electric light bulb.



[2]

12 The diagram shows the wiring in an electrical plug.



(a) (i) Which terminal has no wire connected?

_____ [1]

Identify the two wires, A and B, and give their colours.

(ii) Wire A is the _____ wire and it is a _____ colour. [1]

(iii) Wire B is the _____ wire and it is a _____ colour. [1]

(iv) Why is the fuse connected to wire B in the plug?

_____ [1]

When the plug shown above is connected to a hairdryer, it is still safe for use.

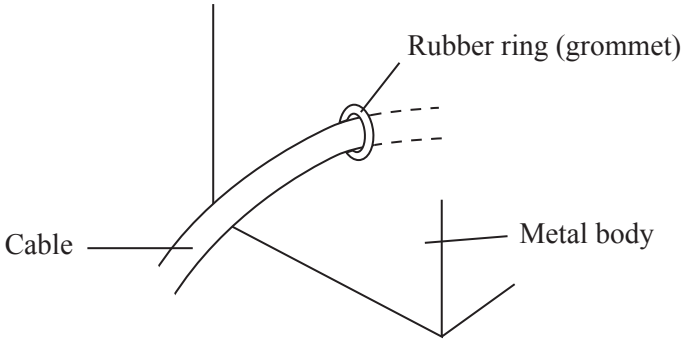
(v) What property of the hairdryer makes this possible?

_____ [1]

Examiner Only

Marks	Remark

When a **three core** electrical cable passes through the metal body of an electrical appliance a rubber ring (grommet) is inserted in the entry hole. This is done as a precaution to protect the cable from the sharp edge of the hole.



With use this grommet can wear away and the edge of the metal body can cut through the insulation in the electric cable.

(b) (i) What makes this dangerous?

_____ [1]

(ii) Explain fully how earthing reduces the danger.

_____

_____

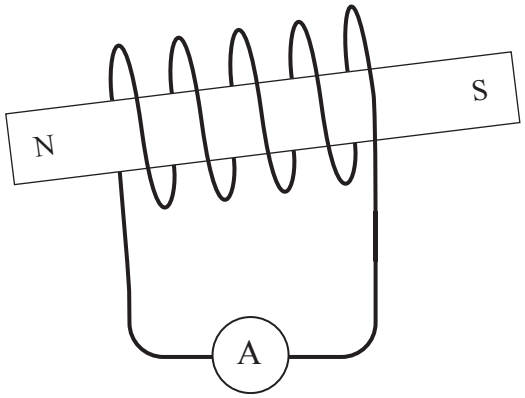
_____

_____ [3]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

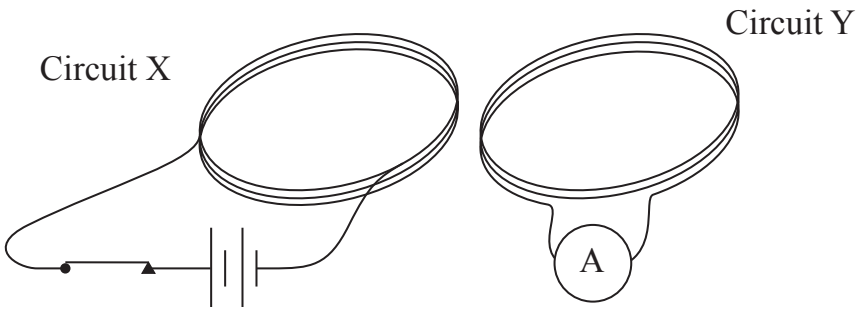
A coil of wire is connected to a very sensitive ammeter and a magnet is at rest inside the coil.



(c) (i) Why does no current flow in the coil?

_____ [1]

Another arrangement is shown below. No current flows in Circuit Y.



(ii) State three practical ways that a current can be induced in Circuit Y.

1. _____

2. _____

3. _____ [3]

Step-up transformers are used in electricity transmission.

Examiner Only	
Marks	Remark

(d) (i) What quantity is "stepped up" by such a transformer?
Circle the correct answer.

current

power

energy

voltage [1]

(ii) Explain why such a transformer is used in electricity transmission.

_____

_____ [2]

A transformer changes the voltage from 132 kV to 25 kV. The 132 kV supply is connected to one side of the transformer which has 10 560 turns.

(e) How many turns has the other coil?

You are advised to show your working out.

Number of turns = _____ [4]

THIS IS THE END OF THE QUESTION PAPER