Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2014–2015

Science: Single Award

Unit 3 (Physics)

Higher Tier

[GSS32]

GSS32

FRIDAY 14 NOVEMBER 2014, MORNING

TIME

1 hour 15 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 eleven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 75.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Questions **4(c)** and **8(b)**.

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

Examiner Only	
Marks	Remark

1 **(a)** Given below are the names of some telescopes and the electromagnetic wave they detect.

Name of telescope	Electromagnetic wave
Lovell	radio
COBE	microwave
Spitzer	infrared
Hubble	visible
Galaxy Evolution Explorer	ultraviolet
XMM Newton	X-rays
Fermi Large Area	gamma

(i) All electromagnetic waves can travel through a vacuum. Give **one** other feature of all electromagnetic waves.

_____

_____ [1]

Each type of electromagnetic wave comes from a main source in Space as shown in the table below.

Source	Electromagnetic wave
cool gas	radio
background radiation	microwave
cool stars	infrared
surface of stars	visible
very hot stars	ultraviolet
hot gas	X-rays
materials around black holes	gamma

Use the information from both tables to answer the following questions.

(ii) Name the telescope which could be used to observe very hot stars.

_____ [1]

(iii) Which **source** will be detected using the XMM Newton telescope?

_____ [1]

(b) European astronomers have discovered a planet the same size as Earth orbiting a star in the Alpha Centauri system. The Alpha Centauri system is 4.3 light years away. Explain fully why astronauts could not travel to this planet.

_____

_____

_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

2 **(a)** The table below shows the amount of natural radiation which occurs in some foods. This forms part of the radiation that constantly surrounds us.

	Radioactive isotope	
Food	**Potassium/ pCi/kg**	**Radon/ pCi/kg**
Bananas	3520	1.00
Carrots	3400	1.30
Potatoes	3400	1.75
Lima beans	4640	3.50

(i) What name is given to this radiation that constantly surrounds us?

_____ [1]

(ii) Name the food which gives the **lowest** combined dose of radiation.

_____ [1]

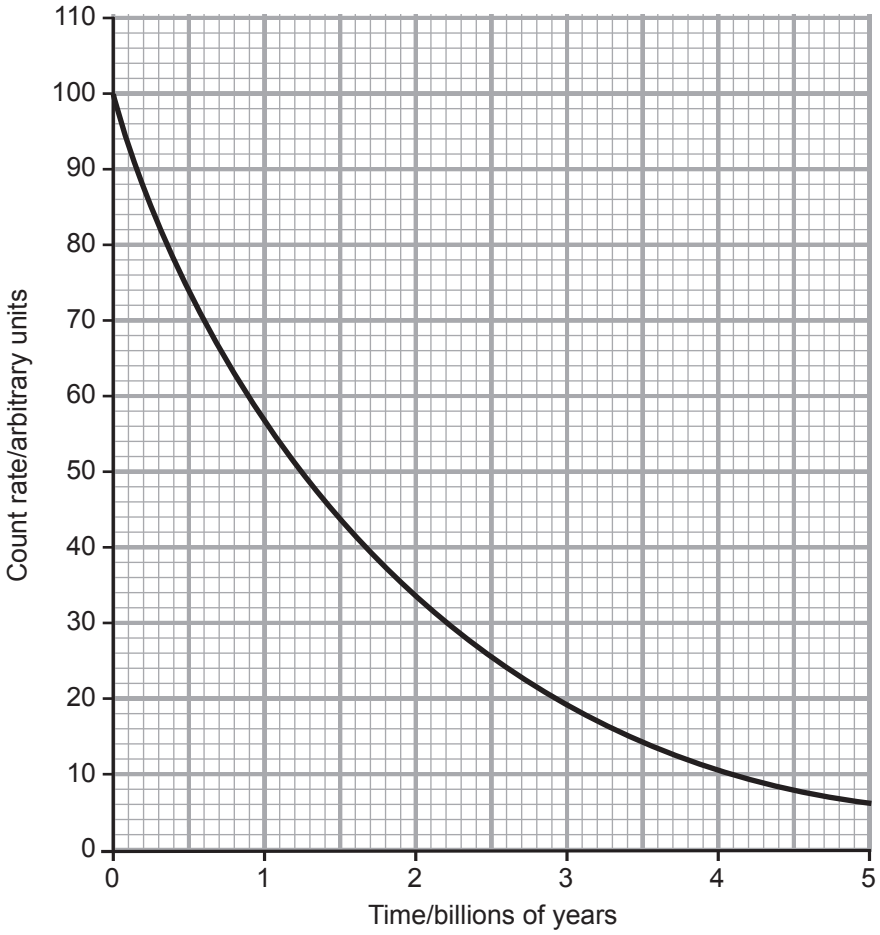
(b) A person receives about 30 millirem of radiation each year from these sources. Radiation of 1 millirem shortens a person's life by 70 seconds.

Explain why we should **not** be concerned about eating foods containing natural radiation.

_____

_____ [1]

(c) The graph below shows how the count rate of potassium-40 varies with time.



(i) Describe fully the trend shown by these results.

_____

_____

_____ [2]

(ii) Use the graph to find the half-life of potassium-40.

Answer _____ billion years [1]

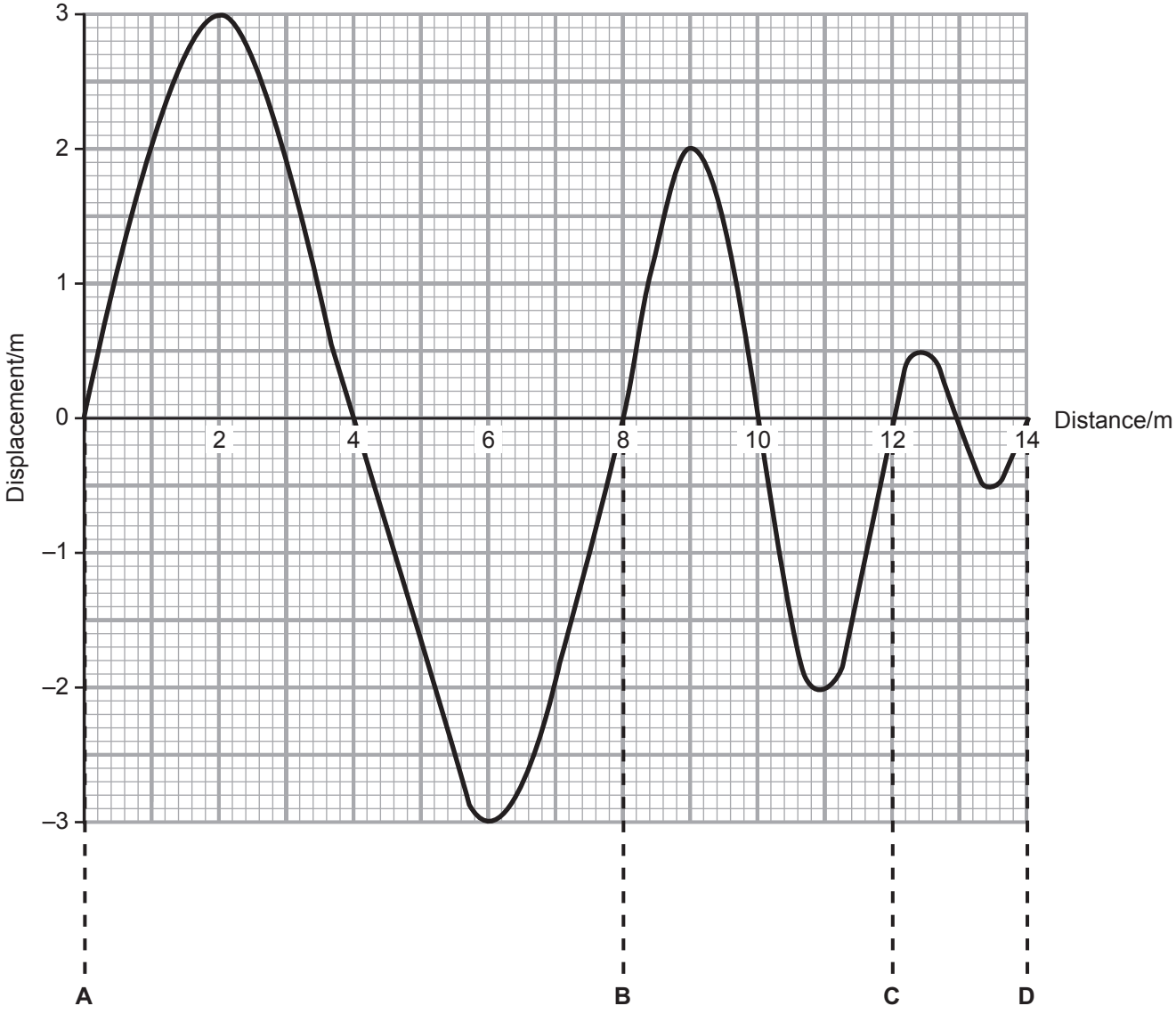
(iii) A radioactive source has a half-life of five days.
What fraction of the original source will be left after ten days?

Answer _____ [1]

Examiner Only

Marks	Remark

3 The diagram below shows a sound wave travelling through the air.



Examiner Only	
Marks	Remark

(a) What is the amplitude of the section labelled **A**–**B**?

Answer _____ m [1]

(b) (i) What is the wavelength of the section labelled **B**–**C**?

Answer _____ m [1]

(ii) Sound waves travel at a speed of 330 m/s in air.

Use the equation:

$$\textbf{frequency} = \frac{\textbf{speed}}{\textbf{wavelength}}$$

to calculate the frequency of the section labelled **B**–**C**.

(Show your working out.)

Answer _____ Hz [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

4 **(a)** Explain fully how fossil fuels are formed.

_____

_____

_____

_____ [3]

(b) The table below shows the electrical energy (GWh) generated in Northern Ireland from different energy sources between 2008–2012.

Year / Energy source	2008	2009	2010	2011	2012
Coal	2077	1402	1858	1450	2403
Hydroelectric	26	31	36	20	21
Wind, wave, solar	568	754	639	893	1047
Oil	369	112	107	88	79
Gas	6568	5674	4884	5397	3732
Total	**9608**	**7973**	**7524**	**7848**	**7282**

(i) Name all the fossil fuels shown in the table above.

_____ [1]

(ii) Give the trend in **total** energy generated between 2008–2012. Describe the significant changes in the energy sources used over this period.

_____

_____

_____

_____ [3]

(c) A company is proposing to develop an offshore wind farm fifteen kilometres off the coast of Northern Ireland. This would involve up to 100 turbines.
Discuss the advantages and disadvantages of the plan to build this wind farm.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

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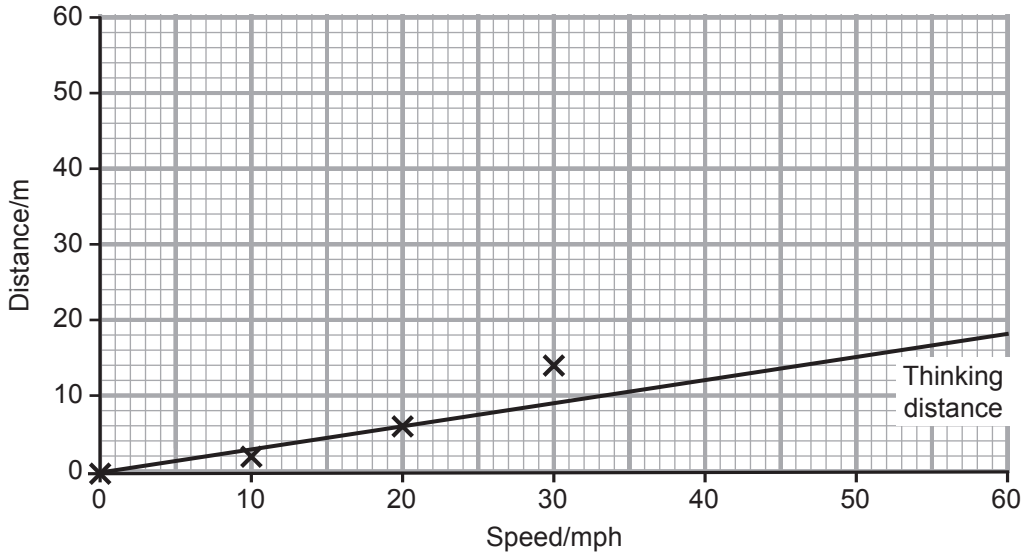
_____ [6]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

5 **(a)** The graph below shows how thinking distance changes with speed.



(i) On the same axes plot a graph for braking distance using the results below.
The first four points have already been plotted.

Speed/mph	Braking distance/m
0	0
10	2
20	6
30	14
40	24
50	38
60	55

[2]

(ii) Use the information to calculate the **stopping distance** for a car travelling at 60 mph.

Answer _____ m [1]

(b) The distances given in part **(a)** are for a car on a dry road.

What effect, if any, would a wet road have on:

1. thinking distance?

_____

2. braking distance? Explain your answer in terms of forces.

_____

_____

_____ [3]

(c) Explain fully why drinking alcohol may increase the risk of a driver being involved in a car crash.

_____

_____ [2]

(d) The table below shows the number of fatal accidents which occurred on different types of roads, in different conditions, in Great Britain during 2012.

	Daylight			Darkness		
	Dry	**Wet**	**Snow**	**Dry**	**Wet**	**Snow**
Motorway	27	8	1	22	21	1
Built up area	354	106	3	154	120	8
Countryside	355	119	12	160	153	11

Data taken from DFT STATS19

Compare the overall results shown for dry roads in daylight with dry roads in darkness and suggest **one** reason for the difference.

_____

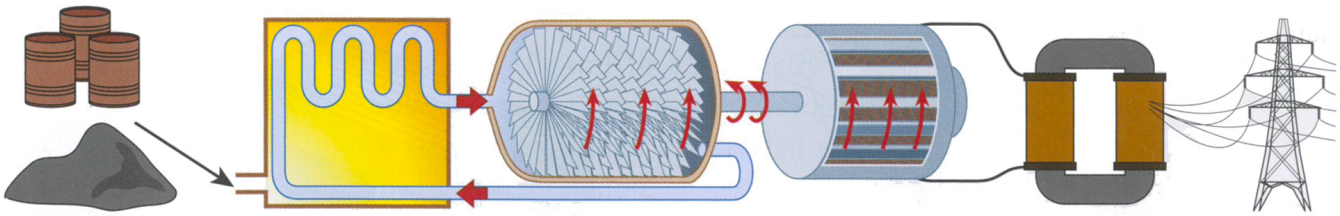
_____

_____ [2]

Examiner Only

Marks	Remark

6 The diagram below shows the parts of a fossil fuel power station including a step-up transformer.



Examiner Only	
Marks	Remark

(a) Explain fully why the electricity is passed through a step-up transformer before going into the grid.

_____

_____

_____

_____ [3]

(b) State the energy changes which take place:

when the fuel is burnt _____

_____

in the boiler _____

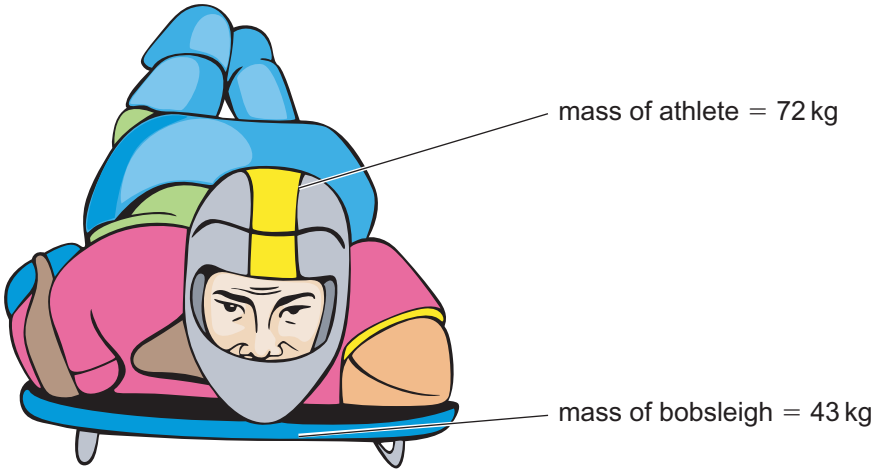
_____

in the generator _____

_____ [3]

Examiner Only	
Marks	Remark

7 The diagram below shows a bobsleigh and athlete.



(a) The athlete and bobsleigh had a momentum of 4140 kg m/s.

Use the equation:

momentum = mass × velocity

to calculate the velocity of the bobsleigh.

(Show your working out.)

Answer _____ m/s [2]

(b) Explain fully, in terms of forces, why the bobsleigh increases speed as it moves downhill.

_____

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

8 **(a)** James blows a whistle and a short time later he hears the echo.

(i) Explain fully why he hears the sound of the whistle twice.

_____

_____

_____ [2]

(ii) James uses a stopwatch to measure the time between blowing the whistle and hearing the whistle for a second time. The stopwatch records a time of 1.2 s. The speed of sound in air is 330 m/s.

Use the equation:

$$\textbf{speed} = \frac{\textbf{distance}}{\textbf{time}}$$

to calculate James' distance from the wall.

(Show your working out.)

Answer _____ m [3]

(b) The flash-bang method can be used to measure the speed of sound in air.

Describe fully how the flash-bang method is used to measure the speed of sound accurately.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

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_____

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_____

_____

_____ [6]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

9 **(a)** The table below gives the distance to some galaxies and the speed they are moving away from Earth.

Name of Galaxy	Distance from Earth/light years ($\times 10^6$)	Speed away from Earth/ m/s ($\times 10^4$)
M110	2.8	6
Sextans B	4.8	10
Dwingloo 1	9.0	20
Maffei 1	9.8	21
Holmberg 11	11.2	23

(i) Describe the trend shown by this data.

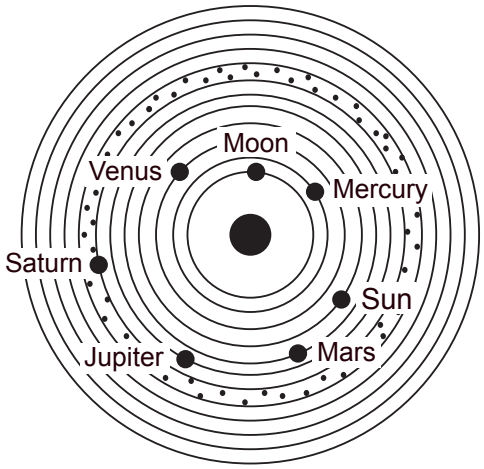
_____

_____ [1]

(ii) In what way would the red shift from Holmberg 11 differ from Sextans B?

_____ [1]

(b) The diagram below shows the Geocentric model of the Solar System.

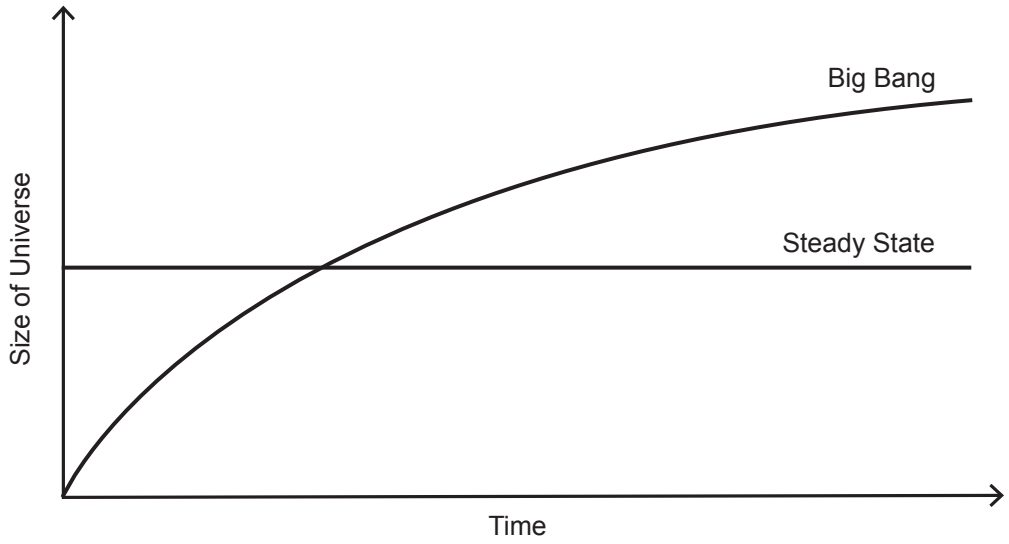


The planets Uranus and Neptune are missing from this model of the Solar System. Suggest **one** reason why they are not shown.

_____

_____ [1]

(c) The graph below represents two possible theories for the formation of the Universe.



Use the graph to give **two** main differences between the Big Bang theory and the Steady State theory.

_____

_____

_____ [2]

Examiner Only

Marks	Remark

10 The picture below shows a microwave oven.

© Lonely__/iStock/Thinkstock

(a) Explain fully how the rays in a microwave oven heat food.

_____

_____

_____

_____ [3]

(b) Thermal imaging cameras are often used to search for people (body temperature 37°C) trapped in buildings. The camera produces a colour picture; each colour represents a different temperature and infrared wavelength as shown below.

Image colour	Temperature of object/°C	Infrared wavelength/m
orange-yellow	38	9.34×10^{-6}
orange	36	9.40×10^{-6}
red-orange	34	9.46×10^{-6}
red	32	9.52×10^{-6}

Using the information provided, predict the wavelength emitted by a trapped person.

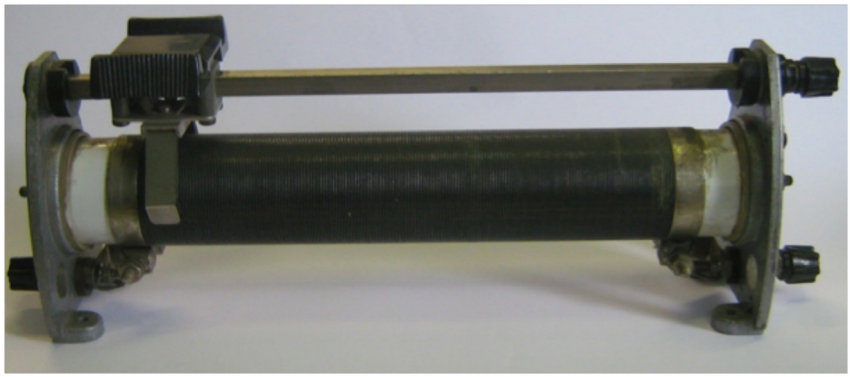
Answer _____ m [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

11 (a) The photograph below shows a rheostat (a variable resistor).



Describe fully how a variable resistor changes the current in a circuit.

_____

_____

_____

_____ [3]

(b) The table shows how diameter and wire type affect resistance.

Diameter of wire /mm	Resistance of wire/ ohms per metre	
	nichrome	copper
0.05	550	8.7
0.08	215	3.4
0.09	170	2.7
0.10	138	2.1
0.12	47.6	1.5

Give **two** conclusions provided by the data.

_____

_____

_____

_____ [2]

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