



Rewarding Learning

General Certificate of Secondary Education
2017–2018

Centre Number

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Candidate Number

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Science: Single Award

Unit 3 (Physics)

Higher Tier

ML

[GSS32]

WEDNESDAY 23 MAY 2018, AFTERNOON

TIME

1 hour 15 minutes, plus your additional time allowance.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages.

Complete in black ink only. **Do not write with a gel pen.**

Answer **all nine** questions.

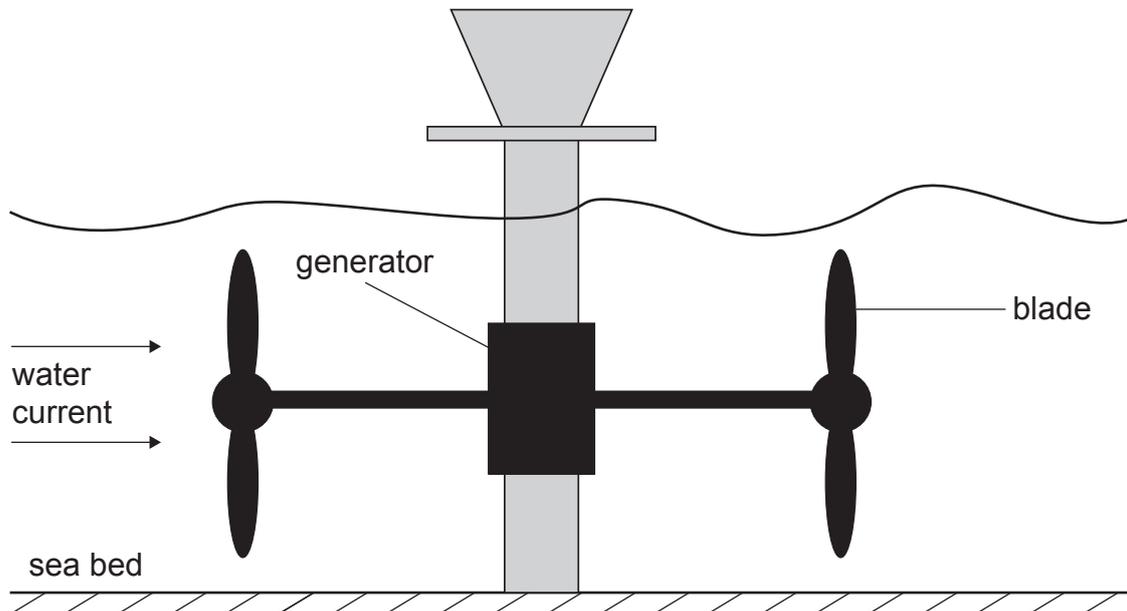
INFORMATION FOR CANDIDATES

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 **2(a)** and **7(a)**.

- 1 (a) Look at the diagram below. It shows a tidal turbine which uses water currents to generate electricity.



- (i) Tidal energy is a form of renewable energy. What is meant by **renewable energy**?

_____ [1]

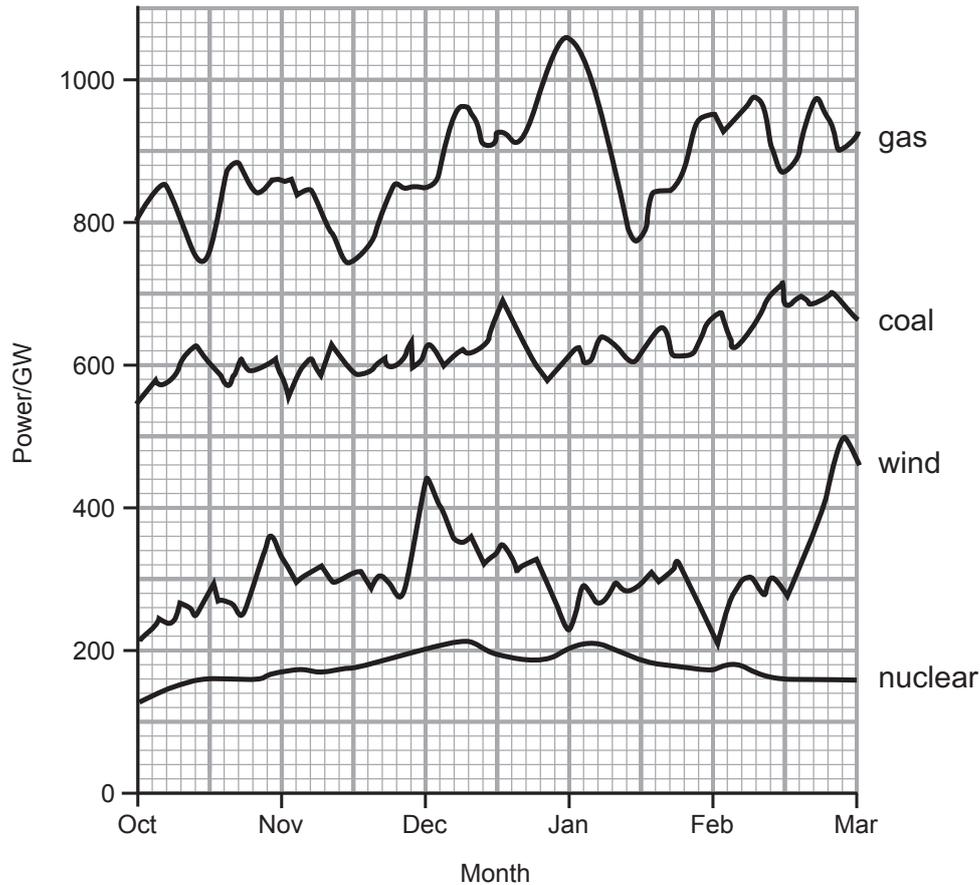
- (ii) Use the diagram and your knowledge to explain fully how water currents produce electricity in the generator.

 _____ [3]

- (iii) Write down **one** disadvantage of tidal turbines.

 _____ [1]

- (b) Look at the graph below. It shows the power produced per day by different energy sources from October to March for part of the United Kingdom.



- (i) Name the **two** fossil fuels shown in this graph.

_____ and _____ [1]

- (ii) Calculate the difference between the maximum and minimum power produced by **wind**.

Show your working out.

Answer _____ GW [2]

- (iii) Write down **one** reason why the power produced by wind varies so much.

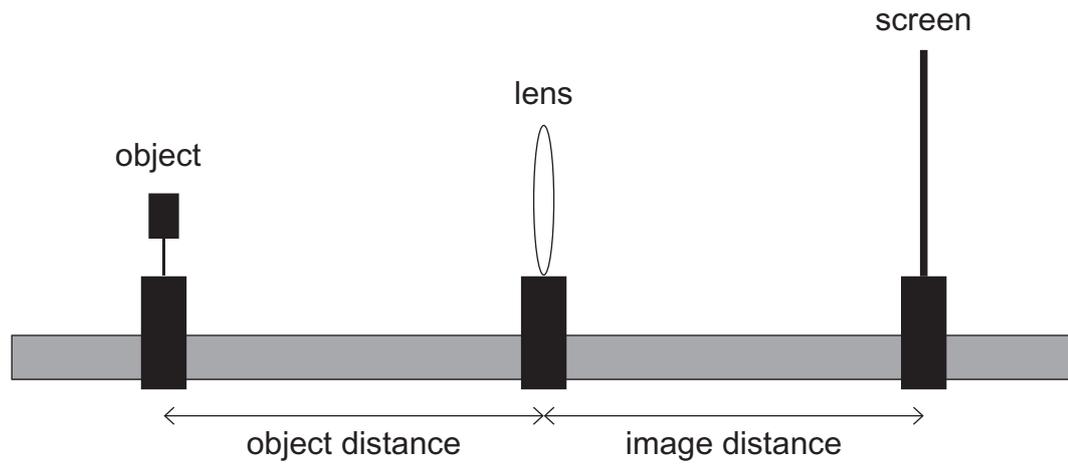
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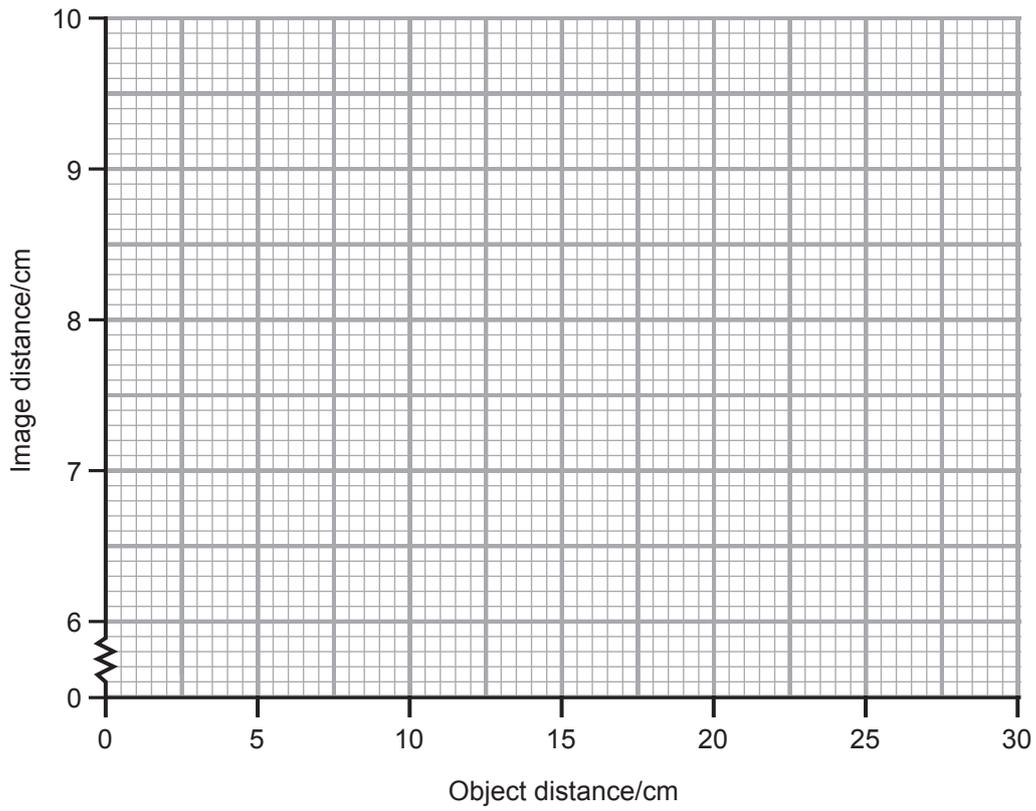
(b) A student used the apparatus below to investigate a lens.



She set the object distance at 10 cm from the lens and moved the screen until it showed a clear image. She repeated this with different object distances. Her results are shown below.

Object distance/cm	Image distance/cm
10	10.0
15	7.5
20	6.7
25	6.2
30	6.0

(i) Plot and draw a line graph of these results on the grid below.



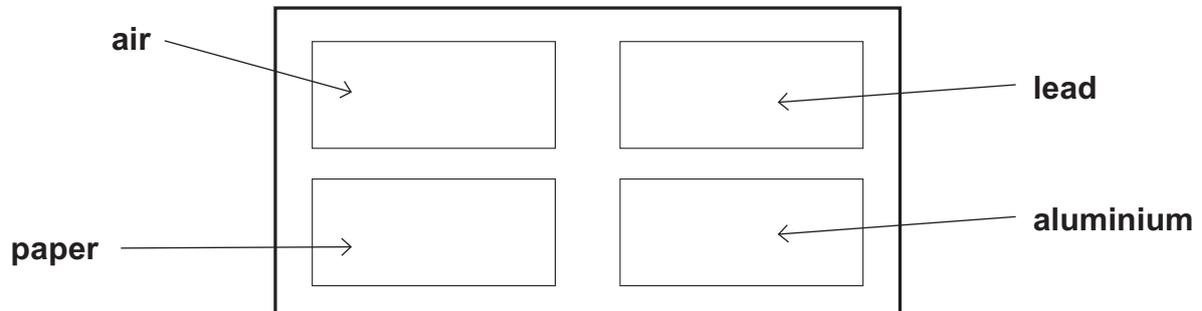
[3]

(ii) What is the trend shown by these results?

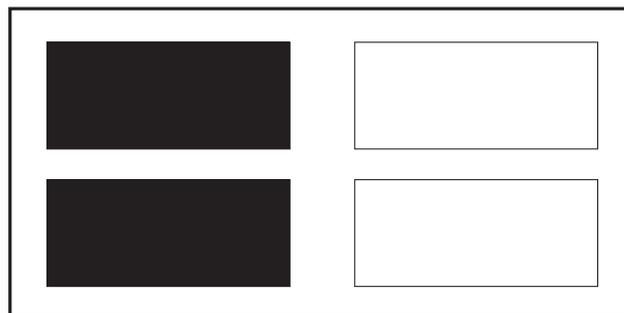
[1]

[Turn over

- 3 (a) Scientists who work in nuclear power stations must wear a special badge. The badge consists of a radiation sensitive film covered by four different materials, as shown in the diagram. These materials may or may not stop the different types of radiation passing to the film.



The film turns black if any radiation reaches it by passing through the material. Shown below is the badge worn by one of the scientists.



- (i) Use the information given to identify **one** type of radiation (**alpha**, **beta** or **gamma**) that was present. Explain your answer fully.

[3]

- (ii) Some of the radiation present is background radiation.
What is meant by **background radiation**?

_____ [1]

- (iii) Radon gas is a source of background radiation. Give one other source of **natural** background radiation.

_____ [1]

The table below shows the effect of radon gas on both smokers and non-smokers.

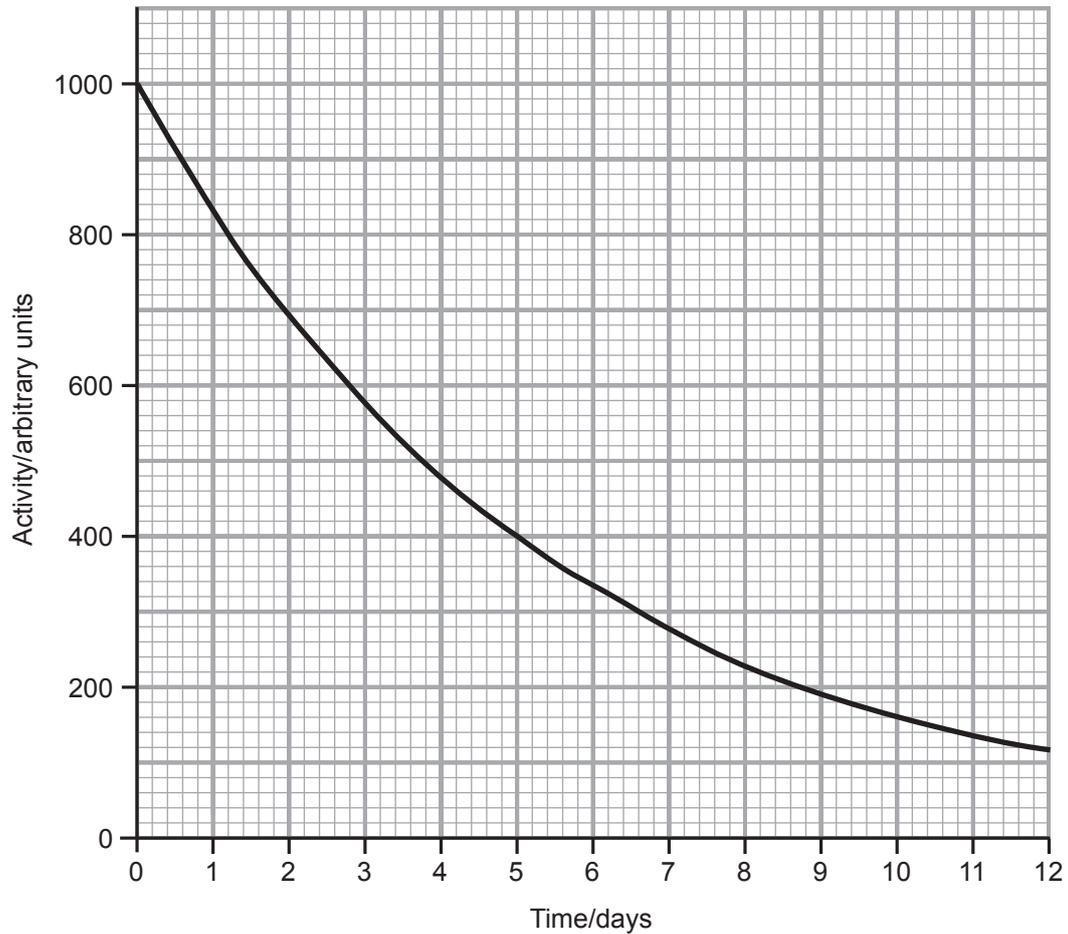
Indoor radon level Bq/m ³	Chance of lung cancer/%	
	Non-smoker	Smoker
20	0.50	14.00
200	0.55	20.00
800	1.00	34.00

- (b) Write down **one** conclusion that can be made from this information.

_____ [1]

[Turn over

Look at the graph below. It shows how the radioactivity of radon-222 changes with time.



(c) Use the graph to find the half-life of radon-222.

Answer _____ days [1]

(d) Another radon source has a half-life of 1 minute. What fraction, if any, will be left after 2 minutes?

Circle the correct answer.

$\frac{1}{2}$

$\frac{1}{4}$

$\frac{1}{8}$

0

[1]



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- 4 (a) The table below shows the **increased risk of crashing** as **blood alcohol content** rises.

Blood alcohol content/ mg/100ml	Increased risk of crashing
80	$\times 4$
120	$\times 15$
160	$\times 30$

The legal limit for a driver's blood alcohol content is 80 mg/100 ml of blood.

- (i) Use evidence from the table to suggest why some people think this legal limit should be lower than 80 mg/100 ml.

_____ [1]

- (ii) Explain fully how alcohol increases the driver's risk of crashing.

_____ [2]

Look at the table below. It shows the number of people caught driving while over the legal limit for alcohol at different times during the night and early morning.

Time	Day of the week						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Midnight	28	15	21	27	30	83	96
1 am	21	12	13	16	30	78	87
2 am	20	11	11	15	23	62	70
3 am	14	6	7	10	17	51	65
4 am	9	8	7	10	16	45	58
5 am	9	7	2	6	8	27	38

(b) Give **two** conclusions that can be made from this data.

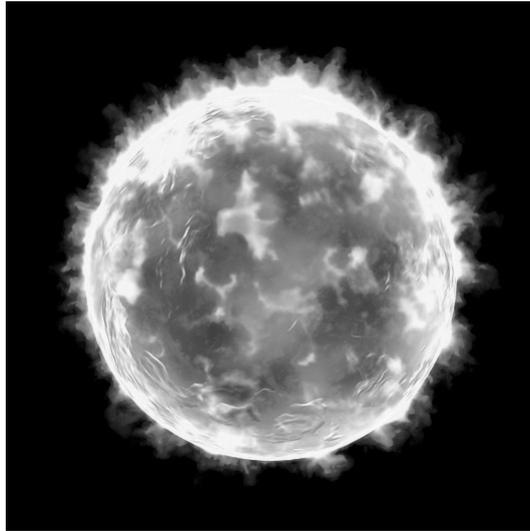
1. _____

2. _____

_____ [2]

[Turn over

- 5 The photograph below shows a star called Proxima Centauri.



© Kateryna Kon / Science Photo Library

A student wrote the following account of how a star is formed. It contains three mistakes.

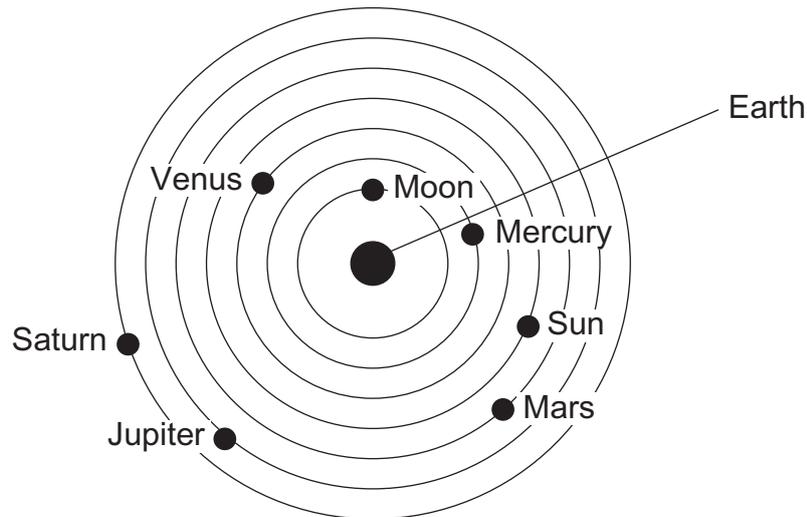
'A star forms from a cloud of gas which is mainly nitrogen. This gas is pushed together by the force of gravity. As the cloud collapses the centre heats up and becomes a Protostar. Eventually it starts producing heat and light through the process of nuclear fission.'

- (a) Complete the table below to identify and correct the mistakes in the student's account.

Mistake	Correction
nitrogen	

[3]

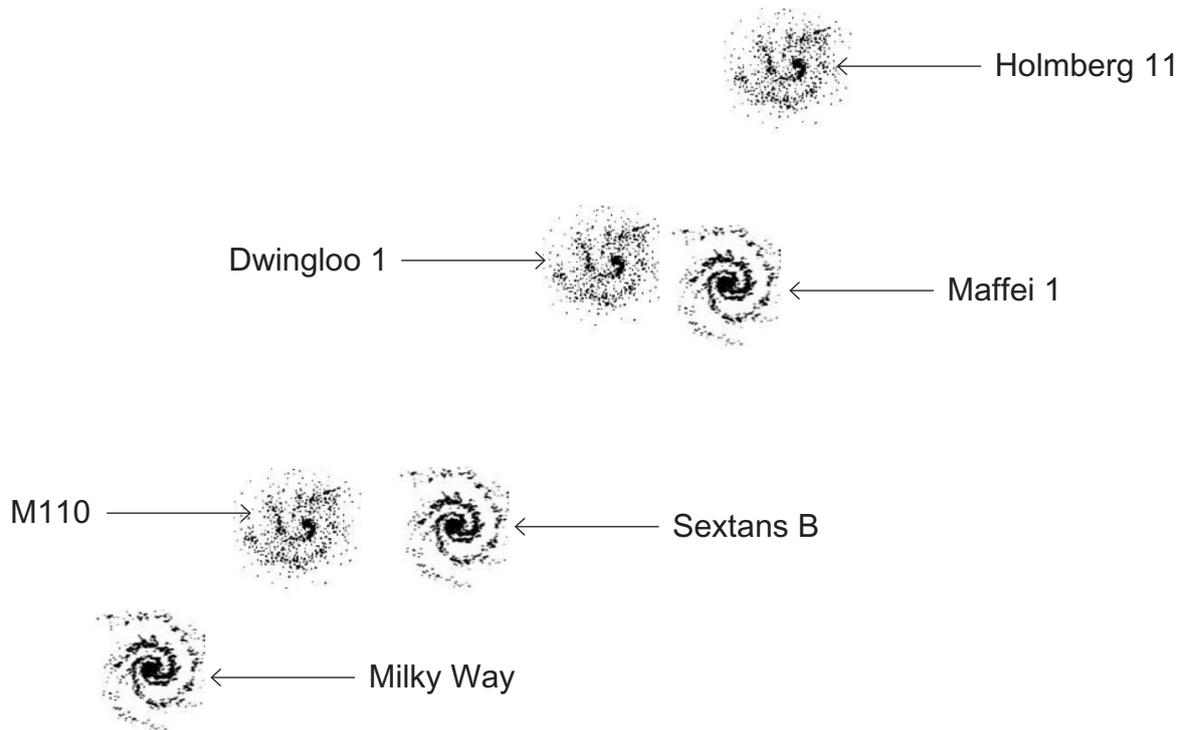
The diagram below shows the geocentric model of the Solar System.



- (b) The planets Uranus and Neptune are missing from this model of the Solar System. Suggest **one** reason why they are not in this model.

[1]

The diagram below shows our galaxy (Milky Way) and some other galaxies.



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(c) Describe the movement of Holmberg 11 compared to the movement of Sextans B. Explain your answer.

[2]

(d) The 'Big Bang' theory can explain the origin of the Universe.

(i) How many years ago did the Big Bang happen?

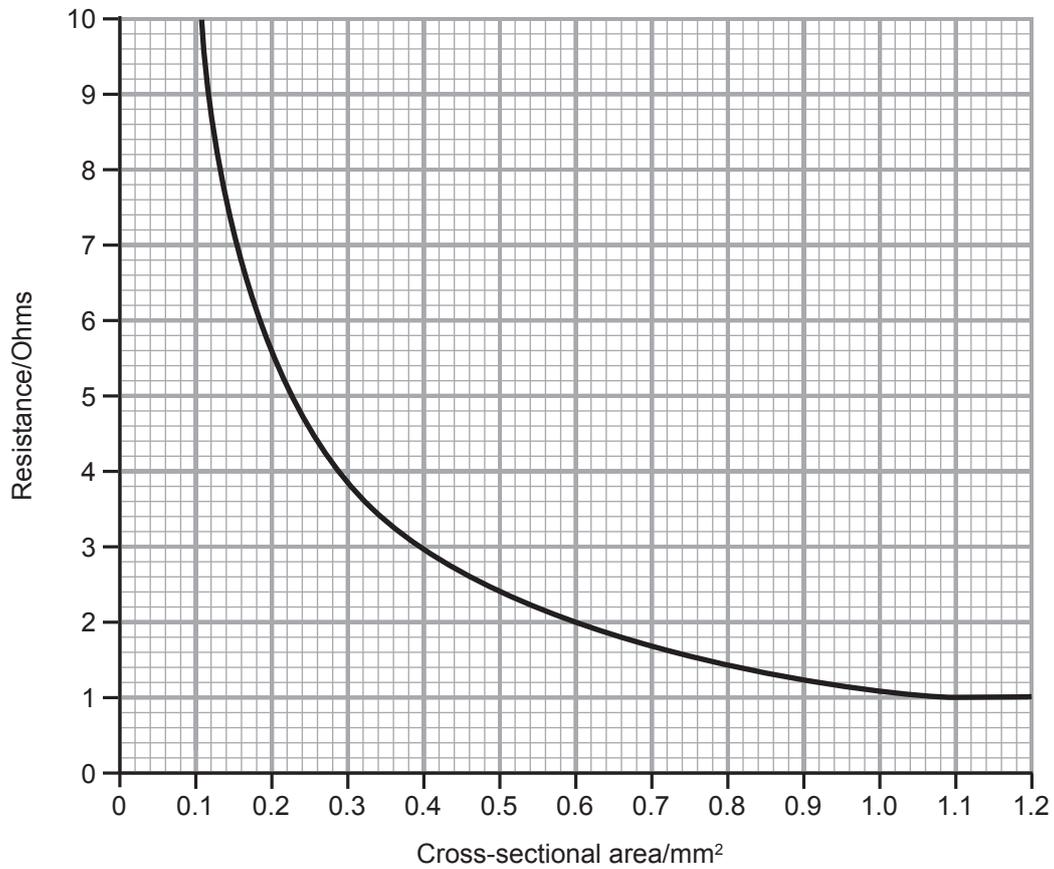
Answer _____ years [1]

(ii) Give **one** alternative scientific theory for the formation of the Universe.

_____ [1]

[Turn over

- 6 (a) The graph below shows how cross-sectional area affects the resistance of one metre of nichrome wire.



- (i) Describe fully the trend shown by this information.

[2]

- (ii) Use the graph to find the resistance of one metre of nichrome wire with a cross-sectional area of 0.66 mm².

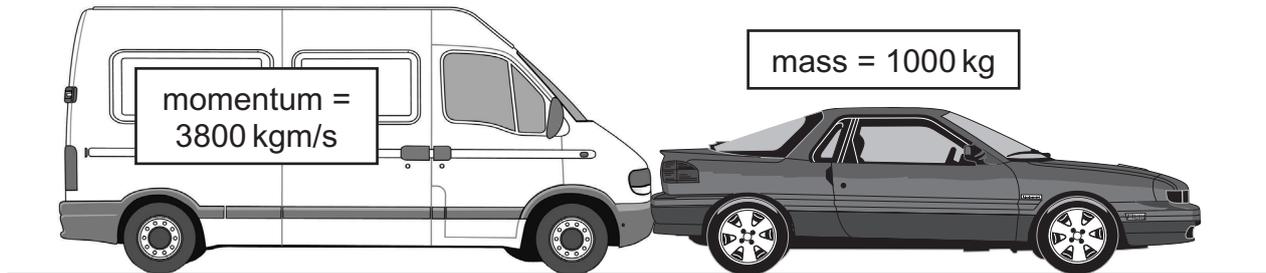
Answer _____ Ohms [1]

(iii) A new metal has been discovered called Gihonium. Gihonium has a higher resistance than nichrome. On the grid opposite draw a line to suggest how the resistance of one metre of Gihonium will change as cross-sectional area changes. [2]

(b) Apart from cross-sectional area, give **one** other factor which affects the resistance of nichrome wire.

_____ [1]

(b) The diagram below shows a collision between a van and a stationary car.



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- (i) When they collide, the van stops instantly and all the momentum is transferred to the car which starts to move.

Use the equation:

$$\text{momentum} = \text{mass} \times \text{velocity}$$

to calculate the maximum velocity the car may move with.

Show your working out.

Answer _____ m/s [2]

In the collision the car absorbed some of the energy.

- (ii) Name the part of the car designed to absorb energy in a collision.

_____ [1]

[Turn over

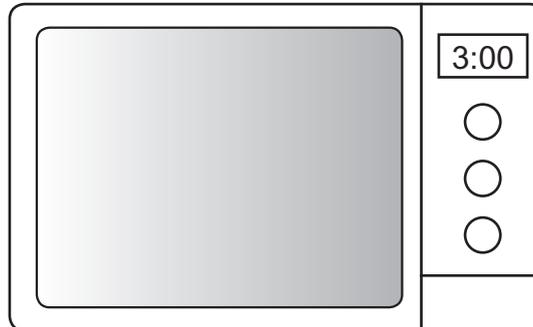
- 8 The table below gives the range of wavelengths of different types of waves in the electromagnetic spectrum.

Wave	Wavelength range/m
radio waves	1×10^6 to 1×10^{-1}
microwaves	1×10^{-1} to 1×10^{-3}
infrared	1×10^{-3} to 7×10^{-7}
visible light	7×10^{-7} to 4×10^{-7}
ultraviolet	4×10^{-7} to 1×10^{-8}
X - rays	1×10^{-8} to 1×10^{-13}
gamma rays	1×10^{-10} to 1×10^{-16}

- (a) Name the wave that has the **smallest** range of wavelengths.

_____ [1]

- (b) The diagram below shows a microwave oven.



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

 _____ [3]

The table below shows the frequency of three different bands of 4G mobile phone signals.

Band	Frequency/Hz	Wavelength/m
A	8.0×10^8	0.375
B	1.8×10^9	0.167
C	2.6×10^9	0.115

(c) Which band (**A**, **B** or **C**) may cause the most harm to humans? Explain your answer fully.

[3]

(d) A microwave oven has a power of 1100 W and is used for 3 minutes.

Use the equation:

$$\text{units used} = \text{power} \times \text{time}$$

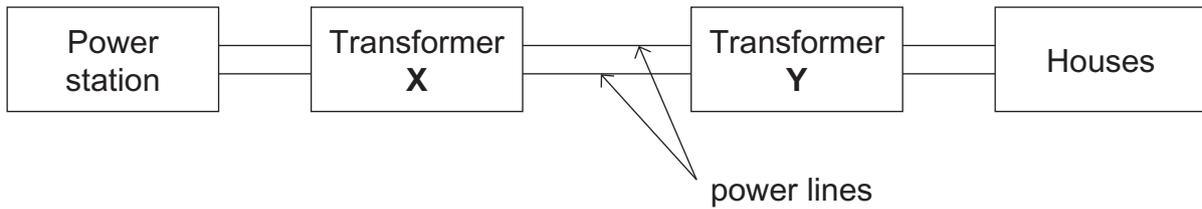
to calculate the number of electrical units used.

Show your working out.

Answer _____ kWh [3]

[Turn over

- (e) The diagram below shows how electricity produced at a power station is transmitted to distant houses.



- (i) What name is given to the type of transformer used at Y?

_____ [1]

Transformers change the voltage across power lines and the current through them. These changes affect energy losses in the power line.

- (ii) Which row in the table below (A, B, C or D) is correct for transformer X?

	Voltage across the power lines	Current through the power lines	Energy losses
A	increased	decreased	decreased
B	decreased	increased	increased
C	increased	decreased	increased
D	decreased	increased	increased

Answer _____ [1]



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- 9 The table below shows the average speed of a car at different stages (A, B, C and D) of a journey. The speed limit in this area, A to D, is 13.4 m/s.

Stage of journey	Time of day	Distance travelled/ m	Average speed/ m/s
A	1.00 – 1.20	15 600	13
B	1.20 – 1.30	7 800	13
C	1.30 – 1.35	4 230	14.1
D	1.35 – 1.50	6 930	

- (a) Use the equation:

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

to calculate the average speed for stage D of this journey.

Show your working out.

Answer _____ m/s [2]

(b) There are two types of speed cameras. One measures average speed and the other measures instantaneous speed.

(i) Explain fully the difference between average speed and instantaneous speed.

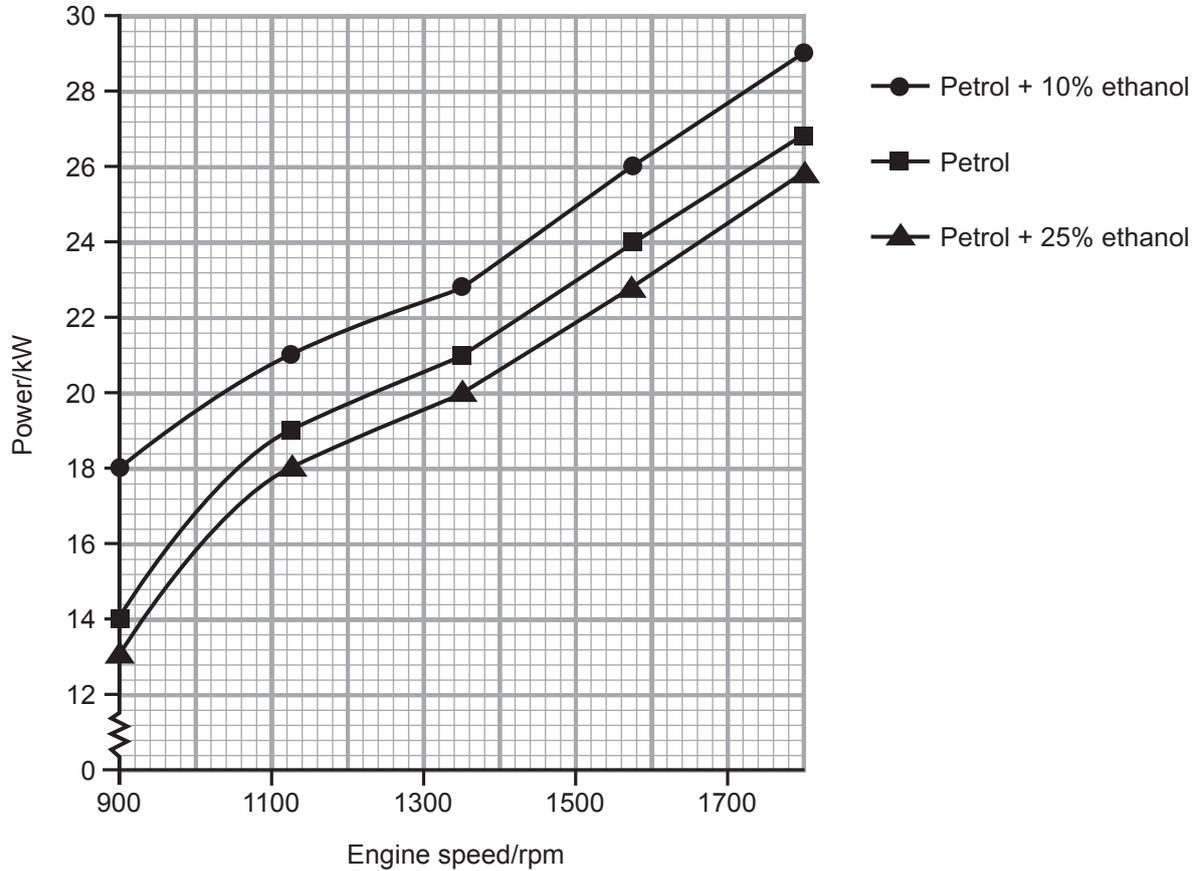
[2]

(ii) Which type of speed camera would catch this driver speeding?
Explain your answer.

[1]

- (c) To save fossil fuels manufacturers are designing cars to use petrol which contains an extender.

The graph below shows how different proportions of extenders added to petrol can affect the power produced by an engine.



- (i) Use the graph to fully describe the effects of adding this extender to petrol when the engine speed is 1500 rpm.

[2]

(ii) What name is given to fuels such as biodiesel and hydrogen which are being used instead of petrol and diesel?

_____ [1]

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