Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2022–2023

Single Award Science: Physics

Unit 3

Higher Tier

[GSA32]

GSA32

WEDNESDAY 23 NOVEMBER 2022, MORNING

TIME

1 hour.

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 60.
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 Question **4**.

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1 **(a)** The table below gives the results of an investigation to find the stopping distance of three different vehicles (**A**, **B** and **C**).

	A	**B**	**C**
Thinking distance/m	9	9	9
Braking distance/m	12		15
Stopping distance/m	21	23	24

(i) Calculate the braking distance for vehicle **B**.

_____ m [1]

(ii) In the event of having to avoid an accident, which vehicle (**A**, **B** or **C**) would stop in the least amount of **time**?

_____ [1]

(b) **(i)** What is meant by the term **thinking distance**?

_____

_____

_____ [2]

(ii) What effect, if any, would a shorter reaction time have on the thinking distance?

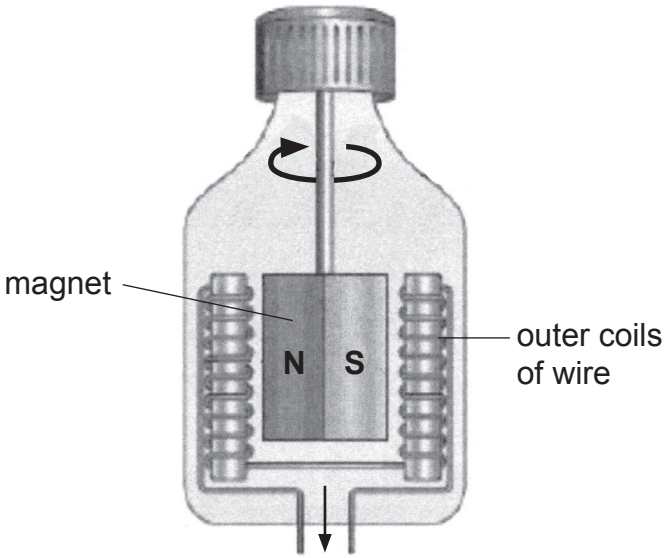
Circle your answer.

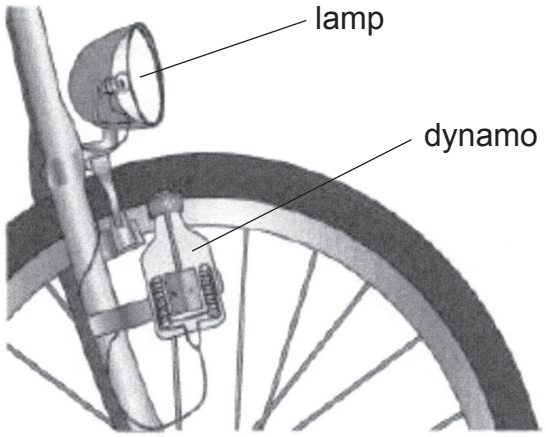
increased : **no effect** : **decreased**

[1]

[Turn over

2 The diagram below shows a dynamo and how it can be used to light a lamp on a bicycle. A dynamo is a small generator.





(a) Describe fully how the dynamo works to light the lamp on the bicycle.

_____

_____

_____ [3]

The table below gives the current output of the dynamo at different speeds.

Speed/ km/h	Current/ mA
0	0
5	200
10	300
15	400
20	500
25	510
30	520
35	520
40	520

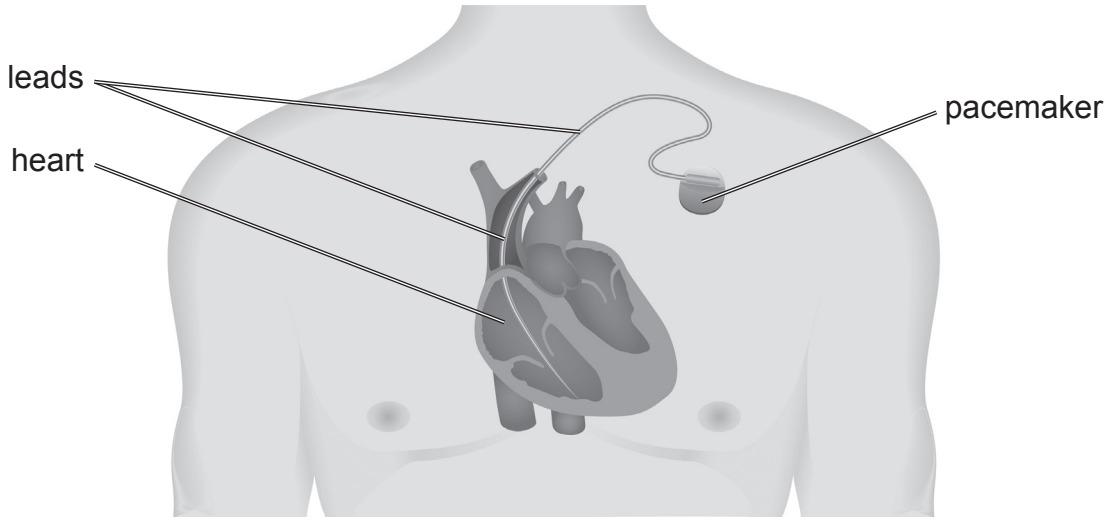
(b) Describe fully the trend shown by this information.

_____

_____

_____ [2]

3 **(a)** The diagram below shows a pacemaker attached to a person's heart to regulate their heart rate. To fit the pacemaker, an operation is needed.



This pacemaker is powered by a radioactive source and has a metal and plastic casing. The radioactive source must be long-lasting and emit alpha radiation.

(i) Explain fully why an alpha source is used in this pacemaker rather than a beta or gamma source.

_____

_____

_____ [2]

(ii) Suggest **one** reason why it is important, to the person, that the radioactive source is long-lasting.

_____

_____ [1]

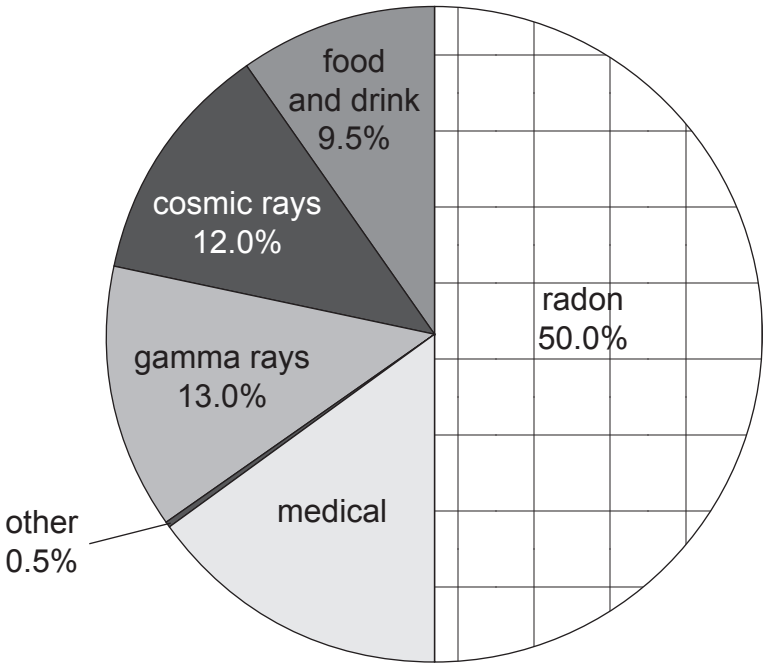
(b) Many different radioactive sources contribute to background radiation.

(i) What is meant by the term **background radiation**?

_____

_____ [1]

The pie chart below shows the percentage that different sources contribute to background radiation.



(ii) Calculate the percentage that medical sources contribute to background radiation.

(Show your working out.)

_____ % [2]

[Turn over

4 Given below are the names of five waves that are in the electromagnetic spectrum. The letters **A** and **B** show the positions of two other waves.

gamma rays	**X-rays**	**A**	**visible light**	**B**	**micro waves**	**radio waves**

Compare the different waves that make up the electromagnetic spectrum.

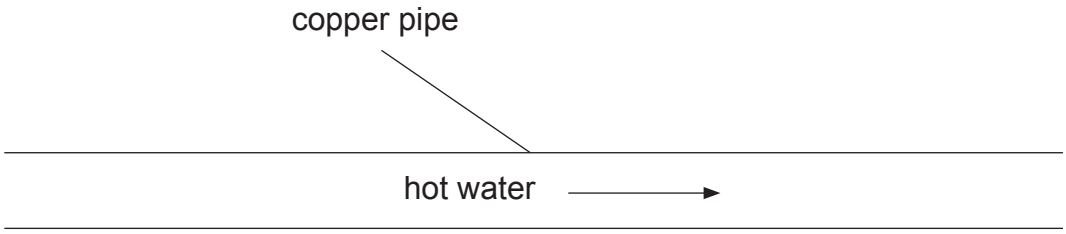
Your answer should include:

- the names of the **two** waves (**A** and **B**);
- **two** features all these waves have in common;
- **two** differences between these waves; and
- **one** use and **one** danger of gamma rays.

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

[6]

5 **(a)** The diagram below shows hot water flowing through a copper pipe.



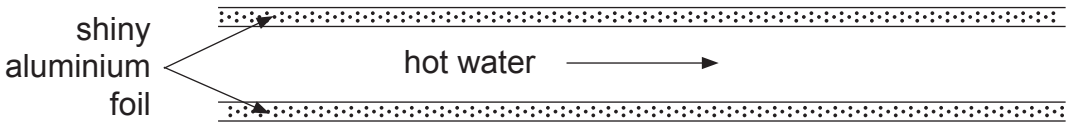
(i) Explain fully how the hot water will lose heat through the **copper** pipe.

_____

_____

_____ [2]

Wrapping shiny aluminium foil around the copper pipe, as shown in the diagram below, will reduce heat loss from the hot water.



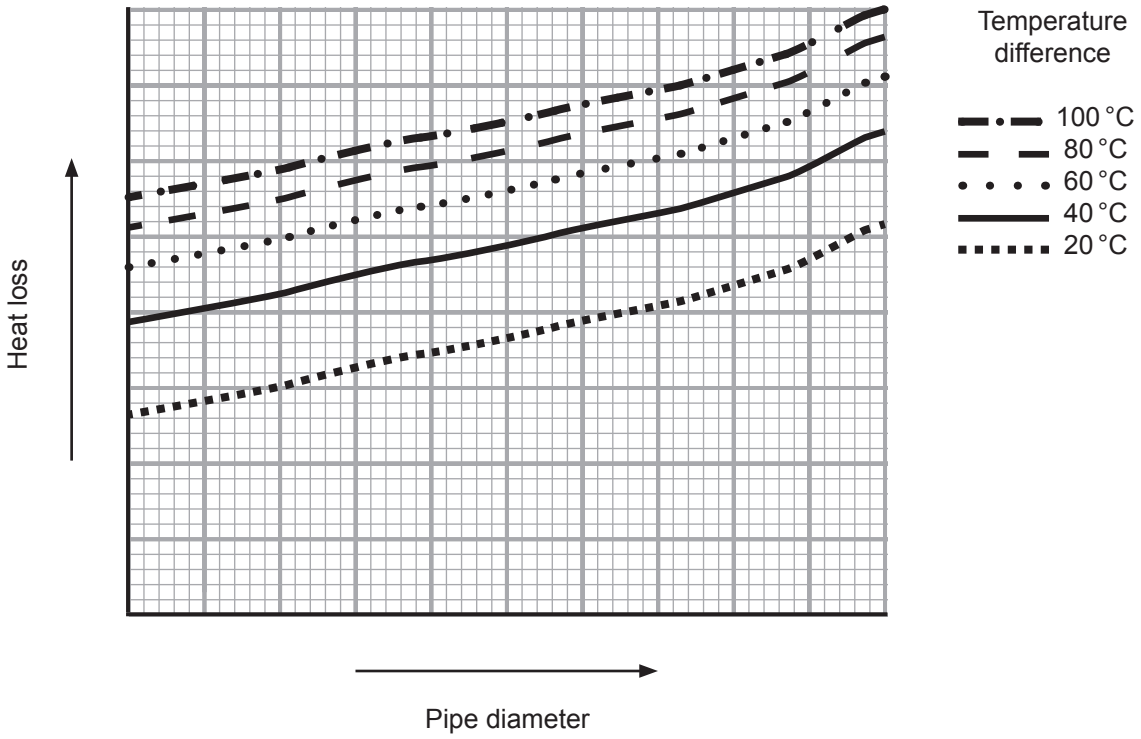
(ii) Explain how the aluminium foil will reduce heat loss.

_____

_____ [1]

[Turn over

The graph below shows how the amount of heat lost through a pipe depends on the diameter of the pipe and the temperature difference between the inside and outside of the pipe.



(b) Give **two** trends shown by this information.

1. _____

_____

2. _____

_____ [2]

(c) The photograph below shows a person warming their hands in front of a coal fire.

(i) Name the heat transfer method that carries heat straight out from the fire to the person's hands.

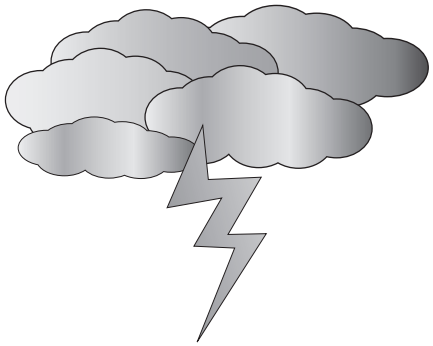
_____ [1]

(ii) Name the heat transfer method that carries heat up the chimney.

_____ [1]

[Turn over

6 Thunder and lightning during a storm is an example of nature producing a flash-bang.



(a) The distance from the storm can be calculated when the time between the lightning and thunder is known.

Use the equation:

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

to calculate the distance (**in kilometres**) from the storm when the time between seeing the lightning and hearing the thunder is 5 s.
The speed of sound is 330 m/s.

(Show your working out.)

_____ km [3]

Thunder is a longitudinal wave and lightning produces a transverse wave.

(b) In terms of particle movement, describe the difference between longitudinal and transverse waves.

_____

_____

_____ [3]

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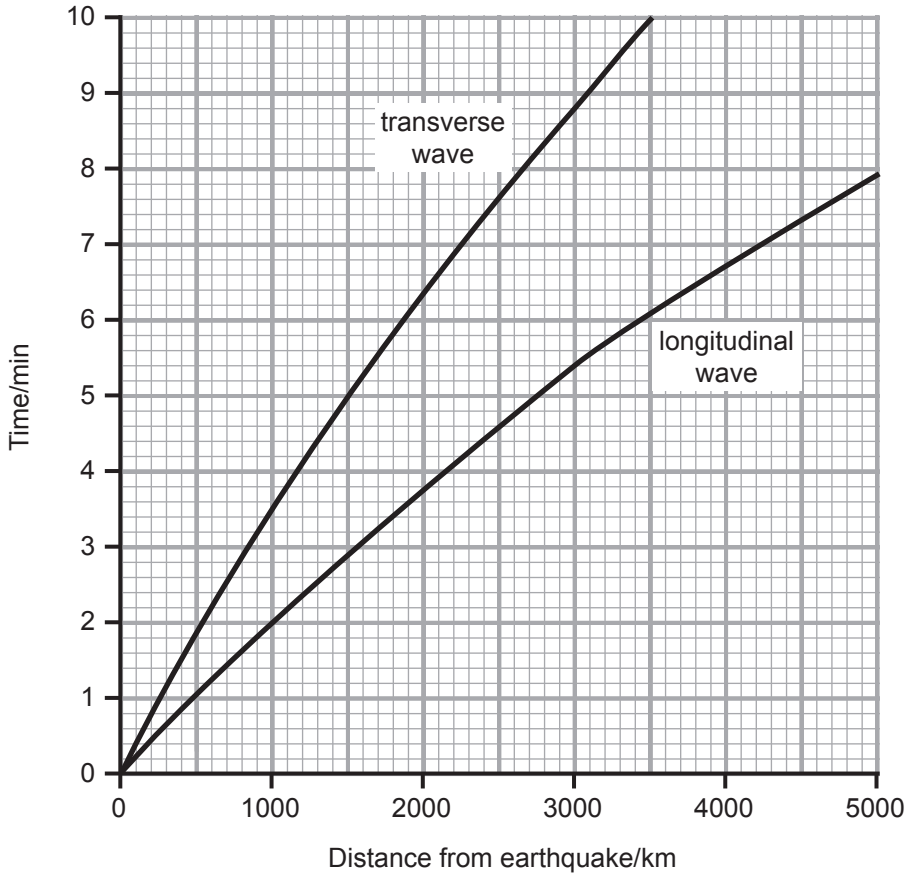
Transverse and longitudinal waves are also produced during an earthquake.
The graph below shows the time it takes these waves to travel through the Earth.



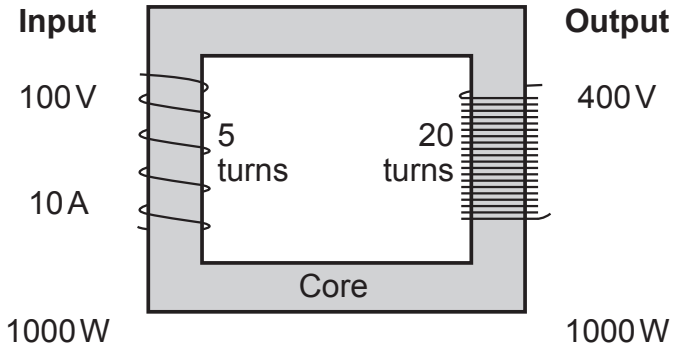
(c) Calculate how much longer the transverse wave takes to travel 3000 km compared to the longitudinal wave.

(Show your working out.)

_____ min [2]

[Turn over

7 **(a)** The diagram below gives information about a step-up transformer.



(i) Give **one** piece of information from the diagram that shows that this is a step-up transformer.

_____

_____ [1]

(ii) Give **one** piece of information from the diagram that shows this transformer is 100% efficient.

_____

_____ [1]

(iii) Use the equation:

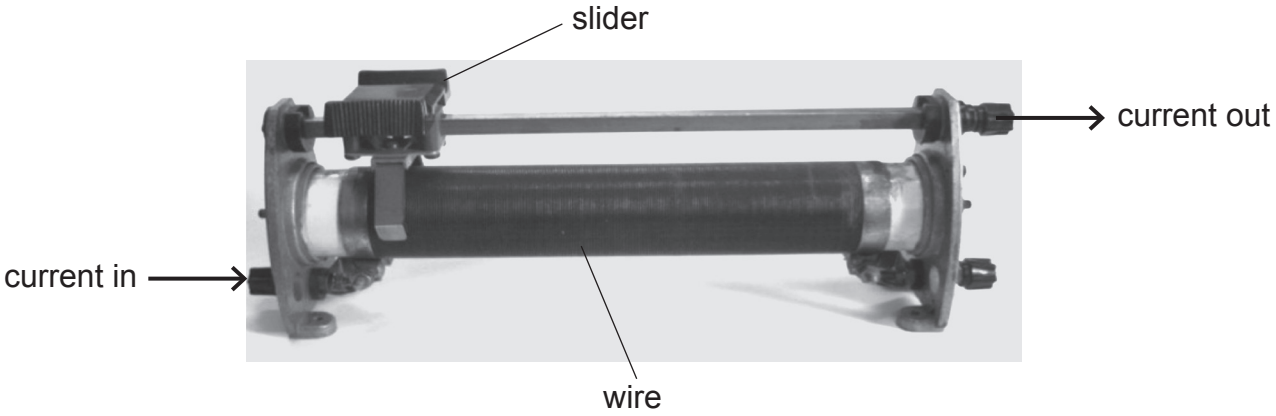
power = voltage × current

to calculate the **output** current for this step-up transformer.

(Show your working out.)

_____ A [2]

(b) The photograph below shows a variable resistor.



(i) In the space below, draw the electrical symbol for a variable resistor.

[1]

As the slider moves from left to right it increases the length of wire in the variable resistor.

(ii) How does increasing the length of wire change the resistance of, and current through the variable resistor?

_____

_____

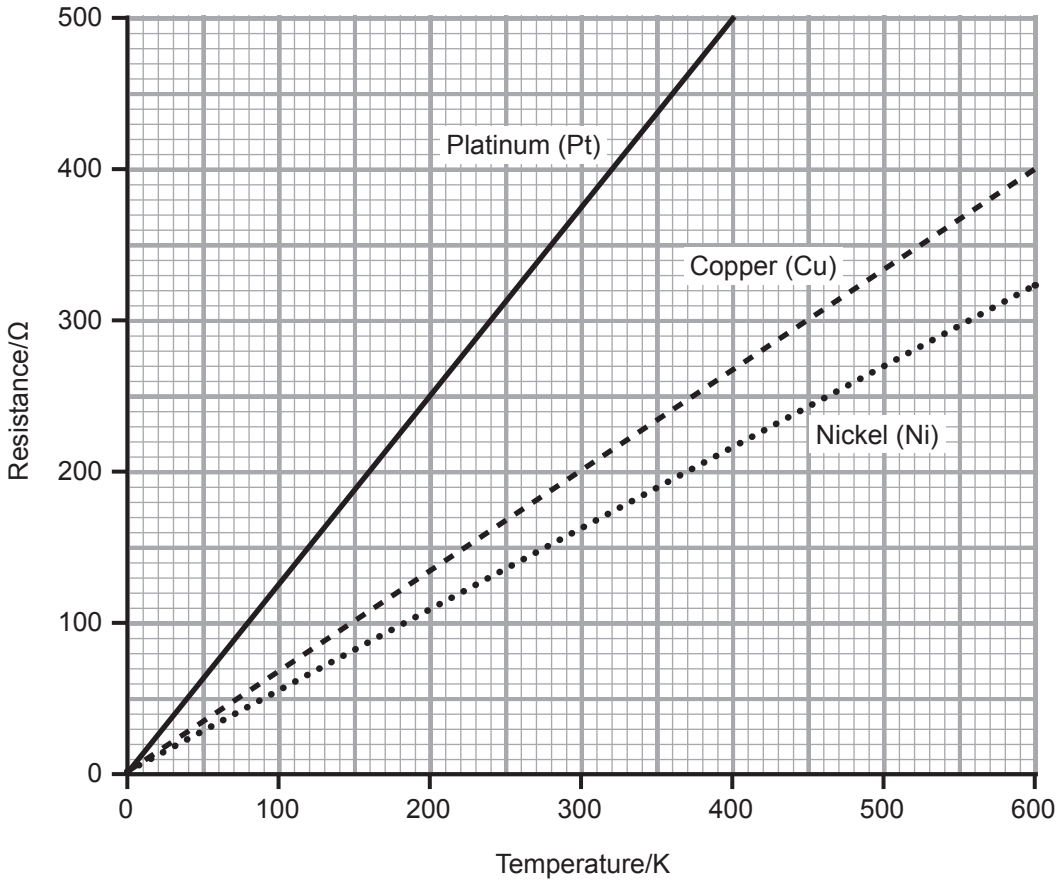
_____ [2]

(iii) Give **one** use of variable resistors in the home.

_____ [1]

[Turn over

The graph below shows how resistance changes, with temperature, for three different metals.



(c) Which of these metals would be the best electrical conductor when used at 400K ? Explain your answer.

_____

_____ [1]

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(Questions continue overleaf)

8 Car manufacturers have been trying to minimise reliance on fossil fuels using substitutes, extenders, and hybrid systems.

(a) Explain the difference between an extender and a substitute naming **one** example of each.

_____

_____

_____

_____ [3]

(b) What is meant by the term **hybrid system**?

_____

_____ [1]

(c) The table below gives fuel economy figures in miles per gallon (mpg) for petrol, diesel and hybrid cars being driven at different speeds.

	Fuel economy/mpg		
Speed/mph	**Petrol**	**Diesel**	**Hybrid**
10	15	17	35
20	18	28	50
30	25	42	70
40	38	50	65
50	37	48	55
60	34	47	48
70	30	46	47

(i) Describe fully how the fuel economy changes, with speed, for cars that use petrol and diesel.

_____

_____

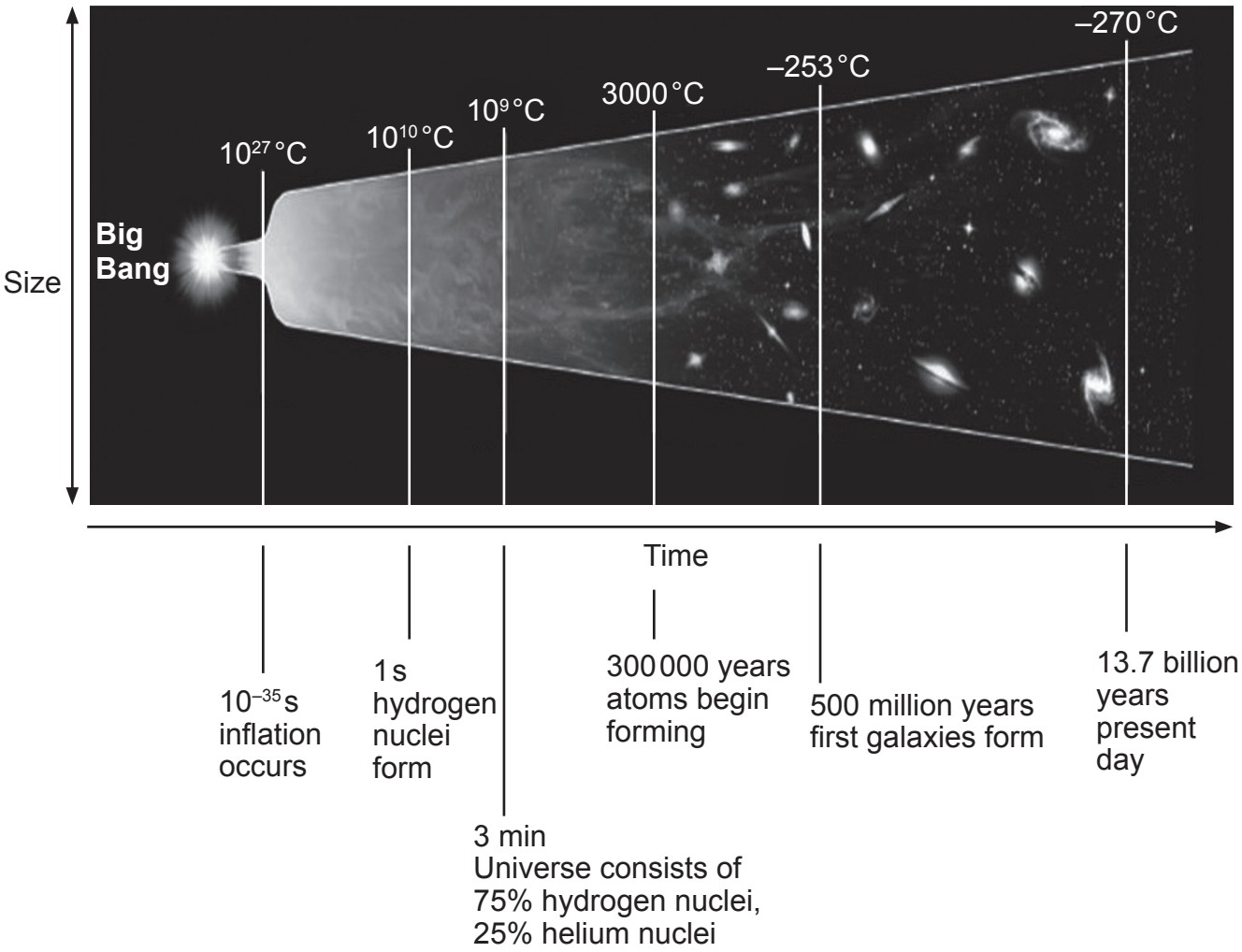
_____ [2]

(ii) Use this information and your knowledge to explain how driving a hybrid car will save fossil fuels.

_____

_____ [1]

9 **(a)** The diagram below is a representation of the Big Bang theory for the formation of the Universe.



(i) State **two** trends that can be deduced from this diagram.

1. _____

_____

2. _____

_____ [2]

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(ii) At what time after the Big Bang could nuclear fusion begin?

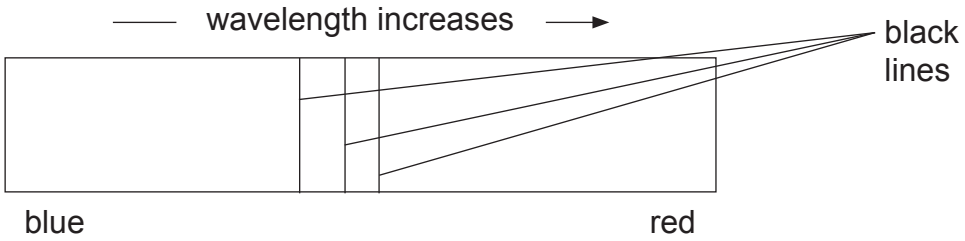
_____ [1]

(b) Name an alternative scientific theory for the formation of the Universe.

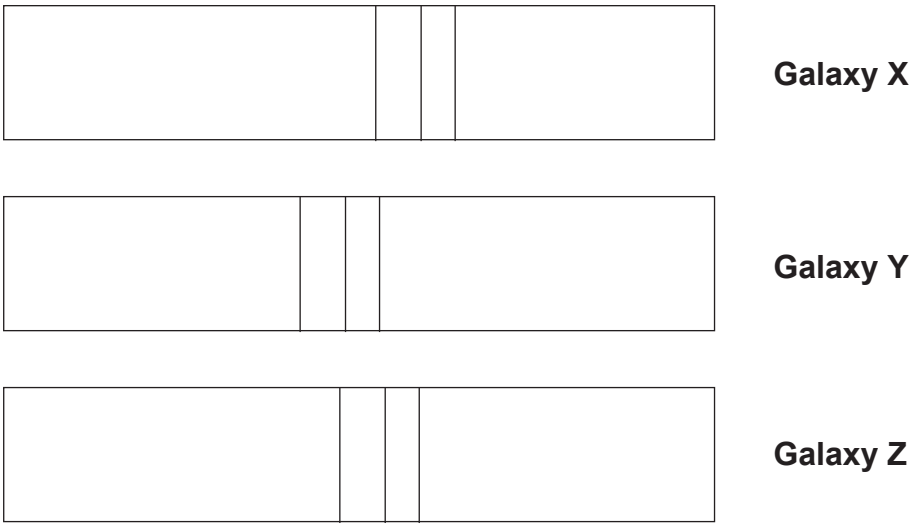
_____ [1]

[Turn over

When scientists analyse the spectrum of light from our galaxy they see the following black lines.



The spectra from three **different** galaxies (**X**, **Y** and **Z**) are shown below.



(c) Which galaxy **X**, **Y** or **Z** is furthest away from our galaxy?
Explain your answer.

_____

_____

_____ [2]

Space is so vast that measurements are made in light years rather than kilometres.

(d) What is meant by the term **light year**?

_____

_____ [1]

THIS IS THE END OF THE QUESTION PAPER

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Question 7(b). . Principal Examiner
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2	
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Examiner Number

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