



Rewarding Learning

General Certificate of Secondary Education
2022–2023

Centre Number

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Candidate Number

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Single Award Science: Physics

Unit 3

Higher Tier



[GSA32]

GSA32

FRIDAY 24 FEBRUARY 2023, 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.

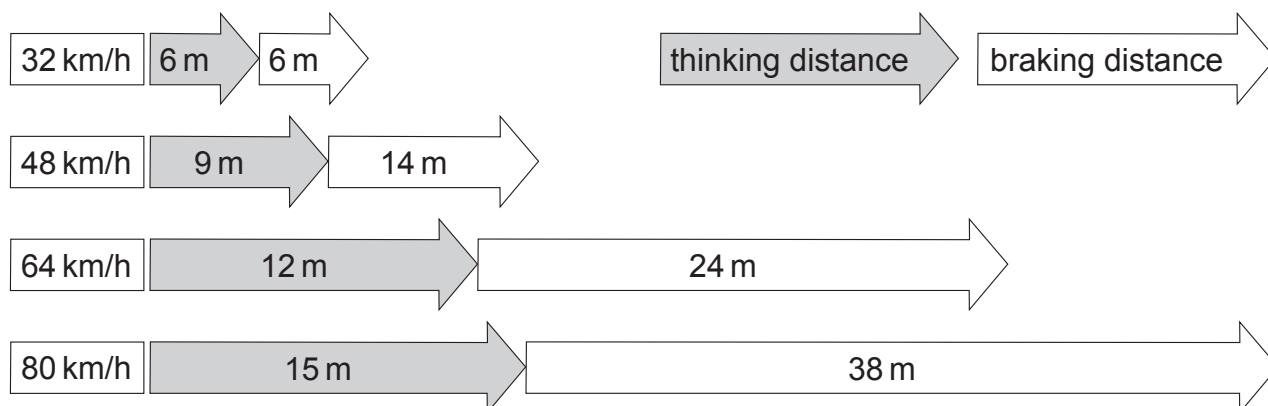
Quality of written communication will be assessed in Question 3.

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24GSA3201

- 1 (a) The diagram below shows the thinking and braking distances for a car being driven at different speeds.



- (i) Use the equation:

$$\text{stopping distance} = \text{thinking distance} + \text{braking distance}$$

to calculate the stopping distance for a car travelling at 64 km/h.

_____ m [1]

A driver must leave enough distance between their car and the car in front to avoid a collision in the event of an emergency stop.

This distance is judged in car lengths, **an average car length is 4 m.**

- (ii) Use your answer to part (i), to calculate how many car lengths it would take to stop at 64 km/h.

_____ [1]



Thinking distance, braking distance and stopping distance may be affected by worn tyres or a tired driver.

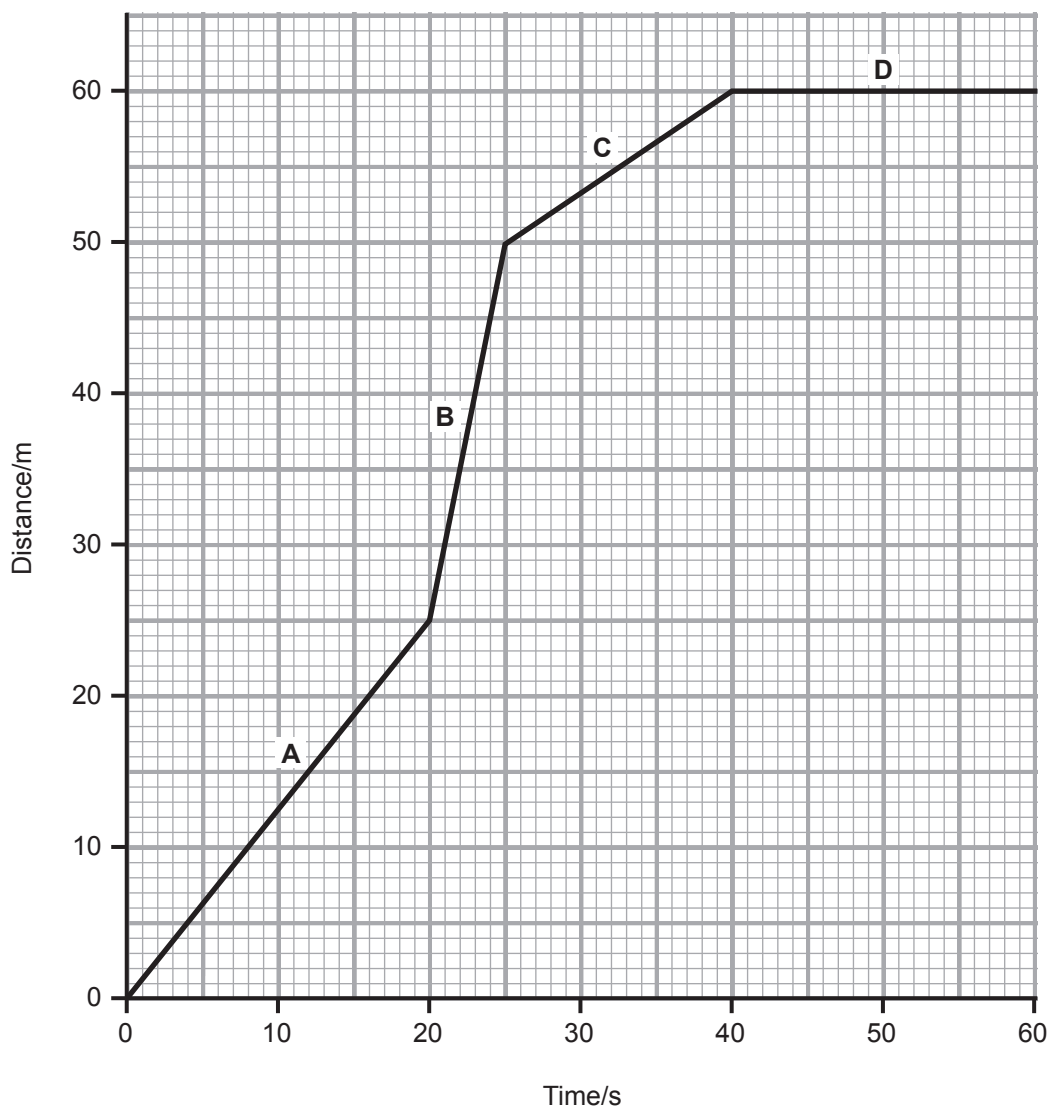
- (iii) Complete the table below, using ticks (✓), to show the distances that are affected by each condition.

Condition Distance	Worn tyres	A tired driver
thinking		
braking		
stopping		

[2]



- (b) Shown below is a distance–time graph for a person walking a short distance then stopping to take a rest.



(i) On which part of the journey (**A**, **B**, **C** or **D**) was the person walking fastest?

_____ [1]

(ii) How far did the person walk in the first 40 seconds?

_____ m [1]

(iii) Use the equation:

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

to calculate the average speed of the person when they were **walking**.

_____ m/s [1]

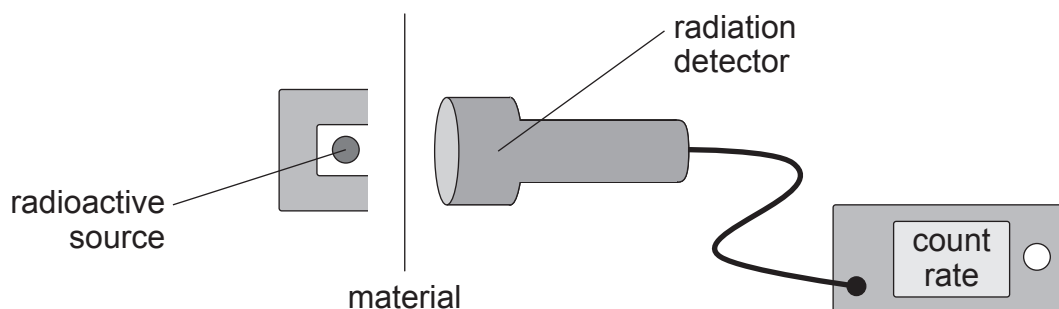
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24GSA3205

- 2 (a) The diagram below shows a radioactive source being used to investigate how effective a material is at stopping alpha, beta and gamma radiation.



Different materials were placed, one at a time, between the source and the detector and the count rate measured.

The initial count rate of the source, when there was **no** material, was 2543 cps.

The results are shown below.

Material	Count rate/cps
paper	2543
aluminium	328
lead	26

- (i) Name the type of radiation that is **not** emitted by this source.
Use information from the table to explain your answer.

_____ [2]

- (ii) What is the value for background radiation in this experiment?

_____ cps [1]



(b) Explain why the nuclei of some materials are described as radioactive.

[2]

(c) State **one** use of radioactivity in medicine.

[1]

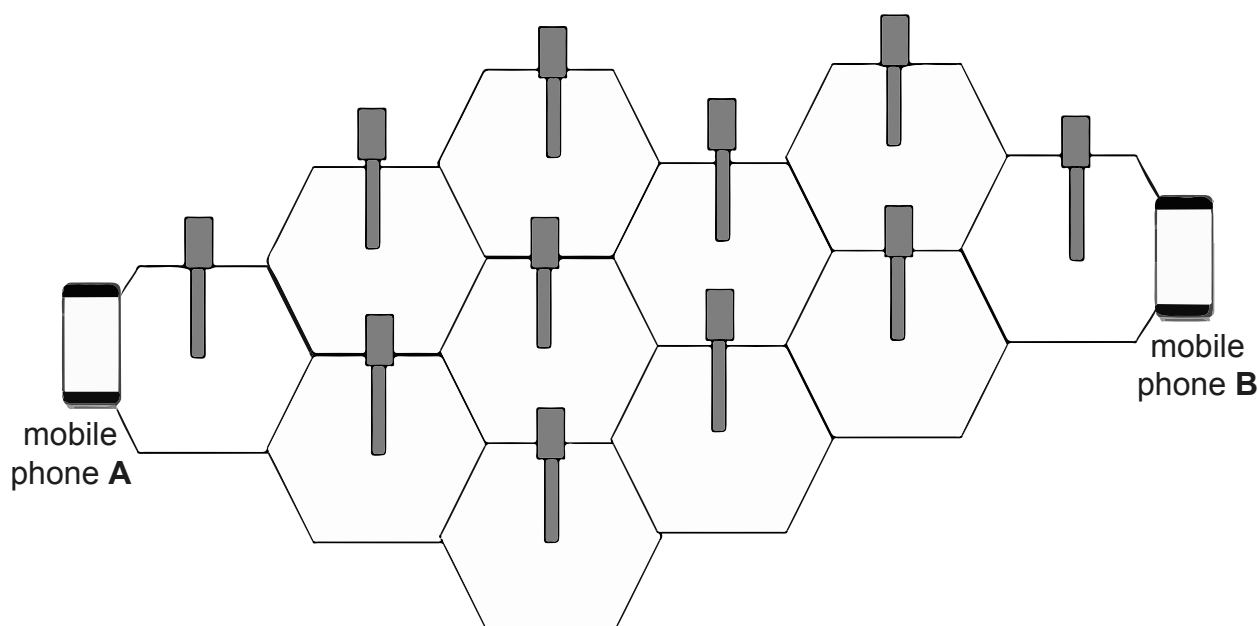
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24GSA3207

3 The diagram below shows a mobile phone network.



Describe fully how mobile phone **A** sends a signal to mobile phone **B**.

Your answer should include:

- the type of electromagnetic wave used;
- how the signal is transmitted through the network;
- the possible health risks of mobile phone use; and
- **two** ways these risks can be reduced.

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





[6]

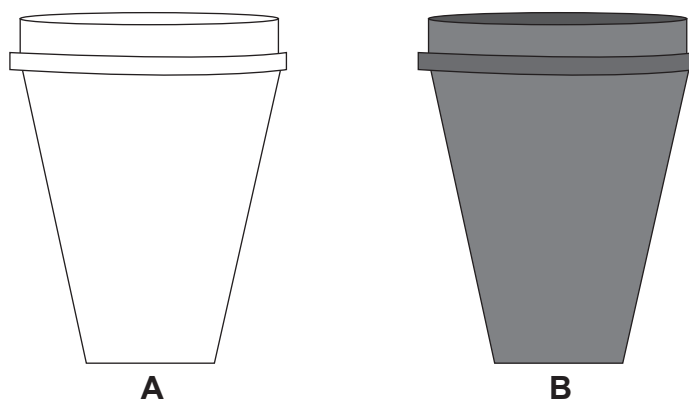
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24GSA3209

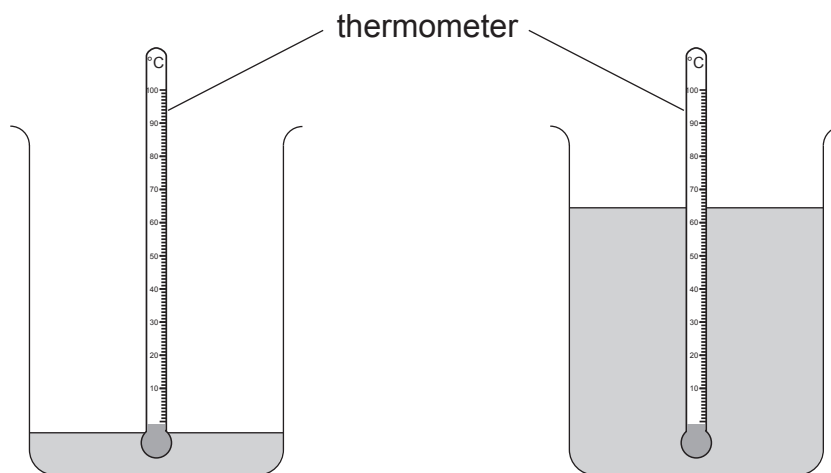
- 4 The diagram below shows two identical cups containing hot tea.



- (a) Why will the tea in cup **A** stay hotter for longer than the tea in cup **B**?

[1]

- (b) The temperature of different volumes of boiling water was measured over ten minutes.



One beaker contained 100 cm^3 of boiling water and the other contained 600 cm^3 of boiling water.



The temperature was recorded every minute and the results are shown below.

Time/minutes	Temperature/°C	
	100 cm ³ of boiling water	600 cm ³ of boiling water
0	100	100
1	82	92
2	77	88
3	74	84
4	71	81
5	68	78
6	66	76
7	64	74
8	62	72
9	60	70
10	59	68

(i) Give **two** conclusions that can be made from this information.

1. _____

2. _____
_____ [2]

The investigation continued until the temperature of the water in both beakers stayed at 20 °C.

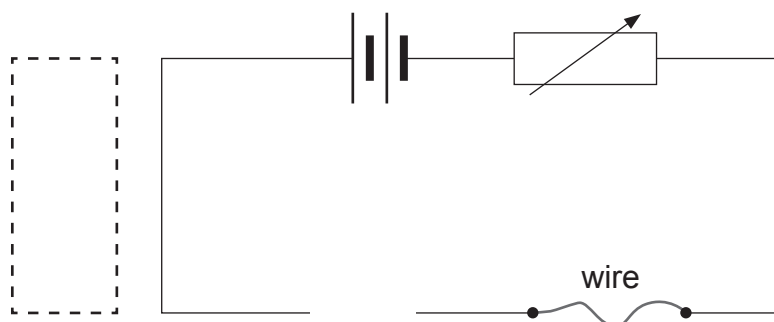
(ii) Suggest why the temperature of the water did **not** go below 20 °C.

_____ [1]

[Turn over



- 5 (a) Part of the circuit used to find the resistance of a piece of wire is shown below.



- (i) Using symbols, complete the circuit by adding a voltmeter and an ammeter. [2]

- (ii) Place an arrow in the dotted box above to show the direction of electron flow through the circuit. [1]

- (b) Measurements of current and voltage were taken and the results are shown below.

Current/A	Voltage/V
0.0	0.00
0.2	0.25
0.4	0.50
0.6	0.75
0.8	1.00



(i) Use the equation:

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

to calculate the resistance of the wire.

(Show your working out.)

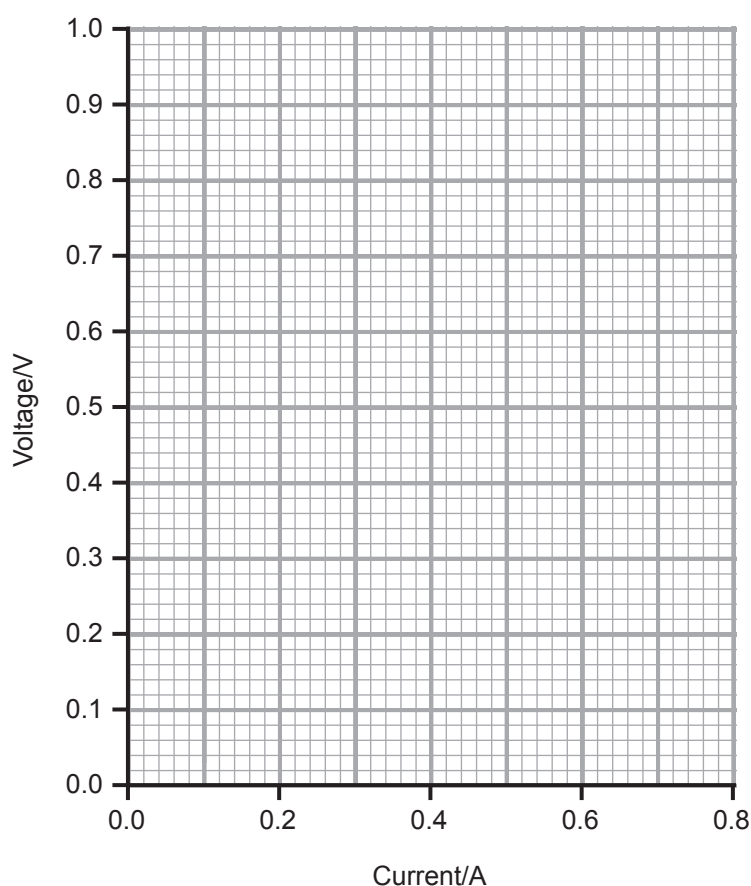
_____ Ω [2]

The experiment was repeated using a wire of the same material and length but with a larger cross-sectional area.

(ii) Suggest a value for the resistance of the thicker wire.

_____ Ω [1]

(iii) On the grid below, plot and draw a line graph for the results shown opposite.



[3]

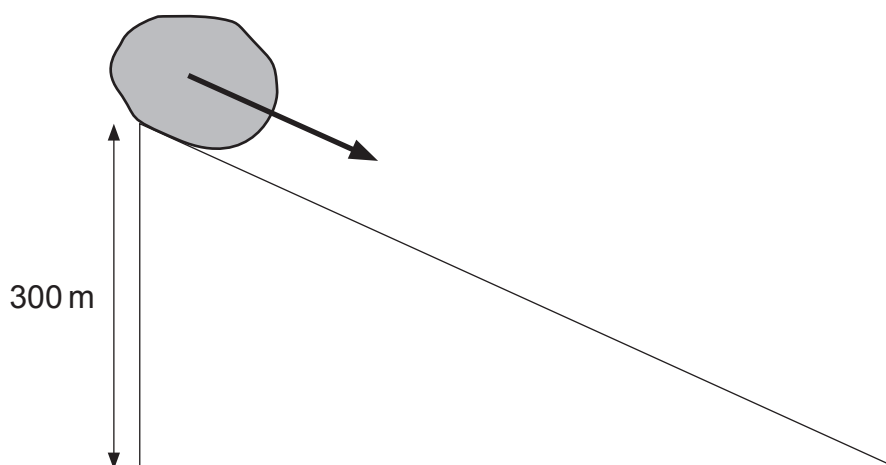
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24GSA3213

- 6 (a) The diagram below shows a 50 kg rock at the top of a slope with a vertical height of 300 m.



- (i) Use the equation:

$$\text{gravitational potential energy} = \text{mass} \times \text{gravity} \times \text{height}$$

to calculate the potential energy of the rock at the top of the slope.
Take gravity as 10 N/kg

(Show your working out.)

_____ J [2]

- (ii) State the Principle of Conservation of Energy and describe how it applies to the rock as it rolls down the slope.

[3]



(b) Explain fully, in terms of forces, the motion of the rock as it rolls down the slope.

[3]

[Turn over

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24GSA3215

- 7 The table below shows information about the energy sources used to generate electricity in the UK in January and July 2021.

Energy source	January 2021 Electricity generation/ TWh	July 2021 Electricity generation/ TWh
nuclear	4.4	3.3
gas	10.9	8.8
coal	1.3	0.5
wind	5.0	2.0
solar	0.4	1.5
hydroelectric	0.5	0.1
biomass	1.9	1.8
Total	24.4	18.0

- (a) Calculate the percentage electricity generated from **fossil fuels** in January.

(Show your working out.)

_____ % [2]

- (b) Suggest **one** reason why the amount of electricity generated using solar and wind sources changed from January to July.

 _____ [1]



- (c) How many energy sources named in the table need to be burned to generate electricity?

_____ [1]

- (d) Complete the sentences below about nuclear energy.

Electricity generated from nuclear fuel involves the process of

nuclear _____ .

The fuel used in this process is called _____ and

is non-renewable. [2]

[Turn over

13898.07R



24GSA3217

8 The photograph below shows an electric vehicle (EV).



EVs can be either partly or fully powered by a battery.

(a) What name is given to EVs which are powered by both energy from a battery and a petrol engine?

_____ [1]



- (b) The table below shows information about four EVs (**A**, **B**, **C** and **D**) that are fully powered by energy stored in a battery.

EV	Battery output/ kWh	Driving range between charges/ miles	Charging time/ hours
A	13.8	24	2
B	75.0	238	11
C	40.0	143	6
D	90.0	275	13

- (i) Describe fully how the driving range and charging time depend on the battery output.

_____ [1]

- (ii) Suggest **one** environmental advantage of using a battery powered EV.

_____ [1]

- (iii) A driver is planning a 550 mile journey.
Give **one** disadvantage of using car **D** for this journey. Explain your answer fully.

_____ [1]

[Turn over



- 9 (a) The table below shows the distance, in metres, from the Earth to three different objects in the Universe.

Object	Average distance from Earth/m
Moon	3.84×10^8
Jupiter	6.0×10^{11}
Alpha Centauri (a star)	4×10^{16}

Instead of metres, astronomers use different units of length because the distances in space are so vast.

The units of distance that are often used are shown below.

Unit of distance	Symbol of unit	Distance/m
kilometre	km	1×10^3
astronomical unit	AU	1.5×10^{11}
light-year	ly	9.4×10^{15}

- (i) Calculate the distance, in kilometres, from the Earth to the Moon.

_____ km [1]

- (ii) Use the information in the table to complete the following sentence.

Jupiter is 6.0×10^{11} m from Earth, this is equal

to 4 _____ units. [1]

- (iii) The unit used for distances to other stars, such as Alpha Centauri, is the light-year.

What is meant by the term **light-year**?

_____ [2]



- (iv) The distance from Earth to the Sun is 1.5×10^{11} m
The speed of light is 3×10^8 m/s.

Use the equation:

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

to calculate the time, in seconds, it takes for light to travel from the Sun to Earth.

(Show your working out.)

_____ s [2]

- (b) The astronomer Edwin Hubble stated that all the galaxies are moving away from Earth and the Universe is expanding.

- (i) What evidence, from the light observed from distant galaxies, did he use that led to this conclusion?

_____ [1]

- (ii) What is meant by the term **galaxy**?

_____ [1]

- (c) (i) According to the Big Bang theory, how old is the Universe?

_____ [1]

- (ii) Name **one** other scientific theory about the origin of the Universe.

_____ [1]

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Sources:

- Question 1(a) . . . Principal Examiner
- Question 2(a) . . . Principal Examiner
- Question 3 Principal Examiner
- Question 4(a) . . . Principal Examiner
- Question 4(b) . . . Principal Examiner
- Question 5(a) . . . Principal Examiner
- Question 6(a) . . . Principal Examiner
- Question 8 Principal Examiner

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For Examiner's use only	
Question Number	Marks
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Examiner Number

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