Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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11	
12	
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14	
15	
16	
TOTAL	

General Certificate of Secondary Education
Higher Tier
June 2014

Science A 2

SCA2HP

Unit 6

H

Thursday 12 June 2014 9.00 am to 10.30 am

For this paper you must have:
- a ruler
- the Chemistry Data Sheet and Physics Equations Sheet booklet (enclosed).

You may use a calculator.

Time allowed
- 1 hour 30 minutes

A

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 7 should be answered in continuous prose. In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

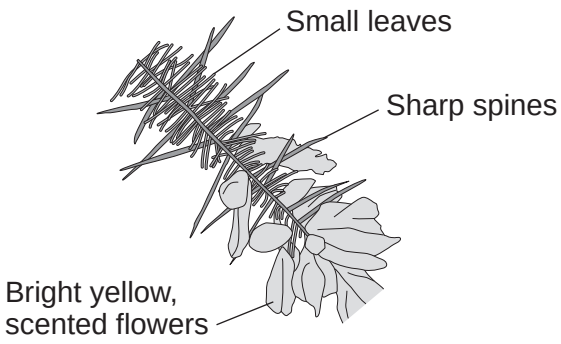
Answer **all** questions in the spaces provided.

Biology Questions

1 **Figure 1** shows part of a gorse plant.

Gorse is a plant that can grow in dry soils in areas where there are strong winds. Gorse plants have deep roots. The roots produce a chemical that stops the growth of seeds of other plants.

Figure 1



Suggest how **each** of the following adaptations helps the gorse plant to survive.

[3 marks]

Small leaves .....

.....

Deep roots .....

.....

Roots that produce a chemical that stops the growth of seeds of other plants .....

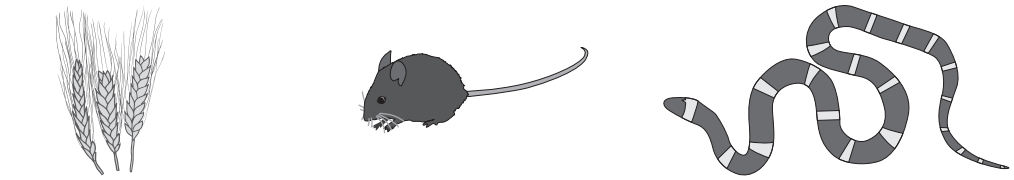
.....

.....

3

2 **Figure 2** shows a food chain and the total mass of organisms at each stage.

Figure 2



Barley
600 kg

Field mouse
80 kg

Snake
6 kg

Not to scale

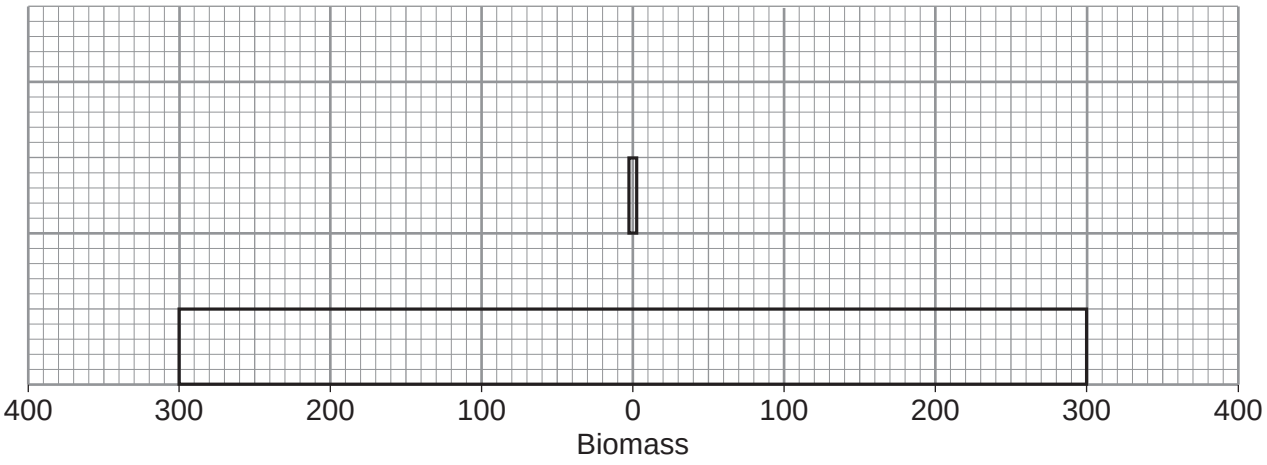
2 (a) (i) What is the source of energy for this food chain?

[1 mark]

.....

2 (a) (ii) **Figure 3** shows an incomplete pyramid of biomass for this food chain.

Figure 3



Complete **Figure 3**.

[3 marks]

Draw the missing bar to scale on the grid.

Label all the bars.

Question 2 continues on the next page

2 (b) The amounts of energy and biomass decrease along the food chain.

2 (b) (i) Why does energy decrease along a food chain?

Give **one** reason.

[1 mark]

.....

.....

2 (b) (ii) Why does biomass decrease along a food chain?

Give **one** different reason from your answer to **(b)(i)**.

[1 mark]

.....

.....

6

3 A group of students did a survey to find out where woodlice were found in a garden.

Their results are shown in **Table 1**.

Table 1

Habitat	Number of woodlice
On top of the soil	1
Under dead, dry leaves	6
Under dead, wet leaves	15

3 (a) (i) From these results, what **two** environmental conditions do woodlice prefer?

[2 marks]

1 .....

2 .....

3 (a) (ii) What piece of equipment could be used to measure **one** of the environmental conditions you gave in **(a)(i)**?

[1 mark]

.....

3 (a) (iii) Suggest why the students could **not** make a valid conclusion in this investigation.

[1 mark]

.....

.....

4

Turn over for the next question

Chemistry Questions

4 **Figure 4** shows a jar of mayonnaise.

Figure 4

Mayonnaise is an emulsion made from vegetable oil and vinegar.
Egg yolk can be used as an emulsifier.

A student added egg yolk to some vegetable oil and vinegar.

The student shook the mixture and timed how long the mixture took to separate.

The student repeated the experiment using different volumes of egg yolk, as shown in **Table 2**.

Table 2

Volume of egg yolk in cm^3	Time for mixture to separate in seconds			
	1	**2**	**3**	**mean**
0	40	43	39	41
2	157	149	156	154
4	256	259	271	262
6	372	376	356	368
8	472	467	471	

4 (a) (i) Calculate the mean value for the time taken for the mixture to separate when 8 cm^3 of egg yolk was added.

[1 mark]

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4 (a) (ii) Give a conclusion for this investigation.

[1 mark]

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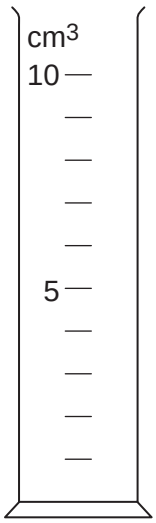
4 (b) The student used a 10 cm^3 measuring cylinder as shown in **Figure 5** to measure the egg yolk.

Figure 5



What is the resolution of the measuring cylinder?

[1 mark]

.....

4 (c) In mayonnaise, oil and vinegar are used as an emulsion and not as two separate liquids.

Give **two** reasons why.

[2 marks]

1 .....

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2 .....

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5

5 In 1785, Henry Cavendish investigated gases in the air. Cavendish found a very small amount of an unknown gas. Cavendish predicted that the unknown gas was a new element.

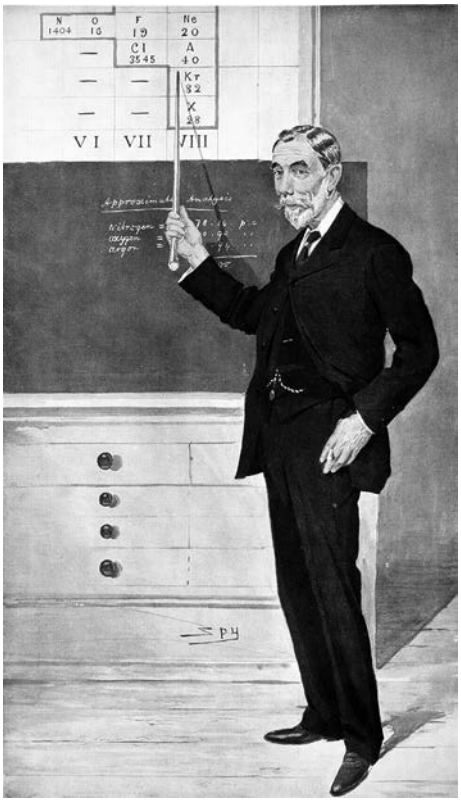
Figure 6 shows William Ramsay.

In 1894, William Ramsay:

- removed oxygen and carbon dioxide from dry air
- passed the remaining gases over hot magnesium.

The nitrogen reacted with magnesium to produce magnesium nitride. A very small amount of unreactive gas was left, which Ramsay named as a new element.

Figure 6



5 (a) Write a word equation for the chemical reaction that Ramsay used to remove nitrogen from the remaining gases.

[2 marks]

.....

5 (b) Name the type of gas that Ramsay discovered in the air.

[1 mark]

.....

5 (c) Suggest why Cavendish did not publish the discovery of a new element.

[1 mark]

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4

Turn over for the next question

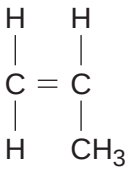
6 **Figure 7** shows some Australian bank notes. In Australia, bank notes are made of poly(propene) not paper.

Figure 7

6 (a) Poly(propene) is made from propene.
Figure 8 shows the structure of propene.

Figure 8

Propene



6 (a) (i) How does the structure of propene show that it is an unsaturated molecule?

[1 mark]

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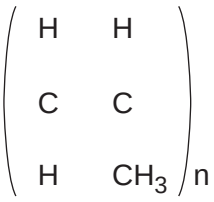
6 (a) (ii) Complete **Figure 9** to show the structure of poly(propene).

[2 marks]

Figure 9

Poly(propene)



6 (b) Propene is an alkene.
Describe a test that can be done to show that an alkene is present.

[2 marks]

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5

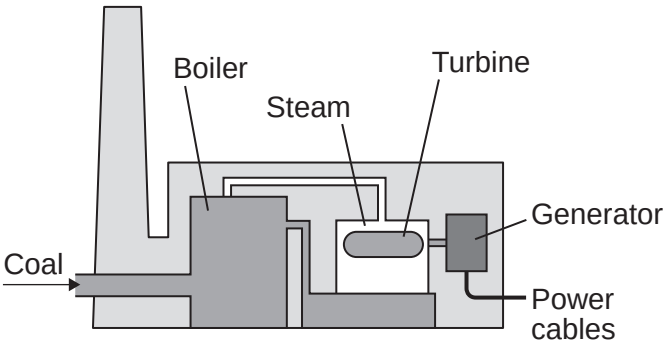
Turn over for the next question

Physics Questions

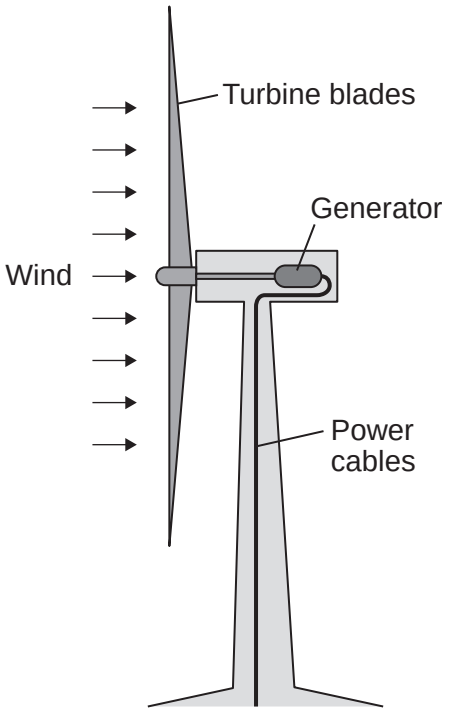
7 Electricity can be generated using different methods. Two methods of generating electricity are shown in **Figure 10**.

Figure 10

Coal-fired power station



Wind turbine



The diagrams are not drawn to scale.

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Use the information in **Figure 10** and your knowledge to:

- describe the differences in these two methods used to generate electricity
- describe the possible environmental effects of the two methods.

[6 marks]

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Extra space .....

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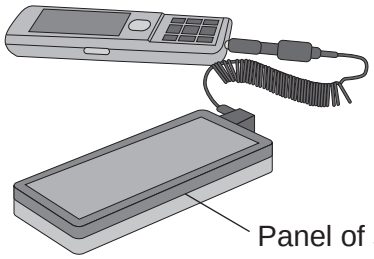
6

8 A student goes camping and uses a panel of solar cells to charge his mobile phone, as shown in **Figure 11**.

Figure 11



8 (a) Give **one** disadvantage of using a panel of solar cells to generate electricity to charge a mobile phone.

[1 mark]

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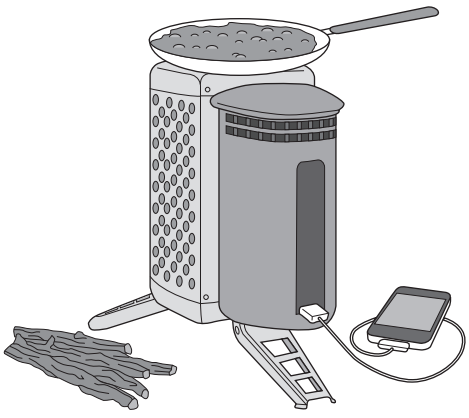
.....

8 (b) A new camping stove has been invented that uses burning wood to cook food and to generate electricity.

Figure 12 shows the new camping stove and a fossil fuel gas camping stove.

Figure 12

New camping stove



Fossil fuel gas camping stove

The new camping stove has a USB connection to charge portable devices such as mobile phones.

Suggest **two** other advantages of using the new camping stove instead of a fossil fuel gas camping stove.

[2 marks]

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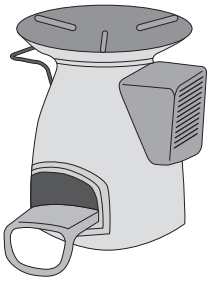
Question 8 continues on the next page

8 (c) Another version of the new camping stove, called a home-stove, has been designed for use in Africa and is shown in **Figure 13**.

Figure 13

Home-stove

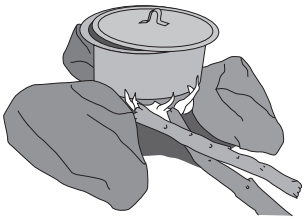


It can be used to cook food and generate electricity. The total power output of the stove is 5 kW. The maximum electrical power output is 20 W.

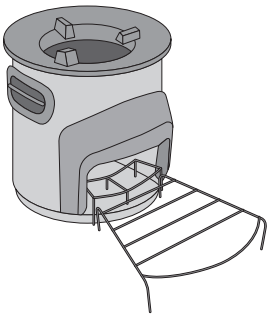
In African villages, there are three methods that can be used to heat food, a traditional three-stone fire, a basic stove and the home-stove as shown in **Figure 14**.

Figure 14

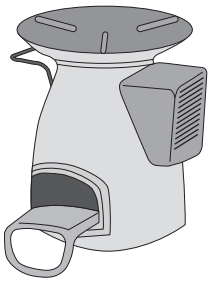
Three-stone fire



Basic stove



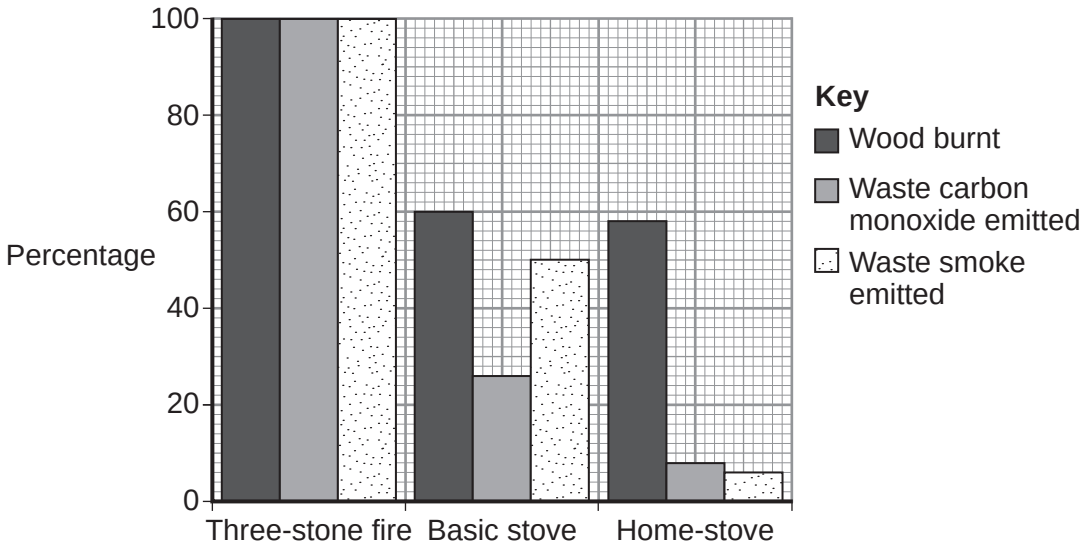
Home-stove



A scientist investigated the wood burnt and the carbon dioxide and smoke emitted when each method was used to boil the same volume of water.

Figure 15 shows the results of the investigation. The results for the basic stove and home-stove are relative to the three-stone fire.

Figure 15



8 (c) (i) Give **two** advantages of using the home-stove compared to the other two methods.

You must use information in **Figure 15**.

[2 marks]

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8 (c) (ii) The home-stove is a reliable method of generating electricity.

Suggest **two** reasons why home-stoves are unlikely to be connected to a national grid in Africa.

[2 marks]

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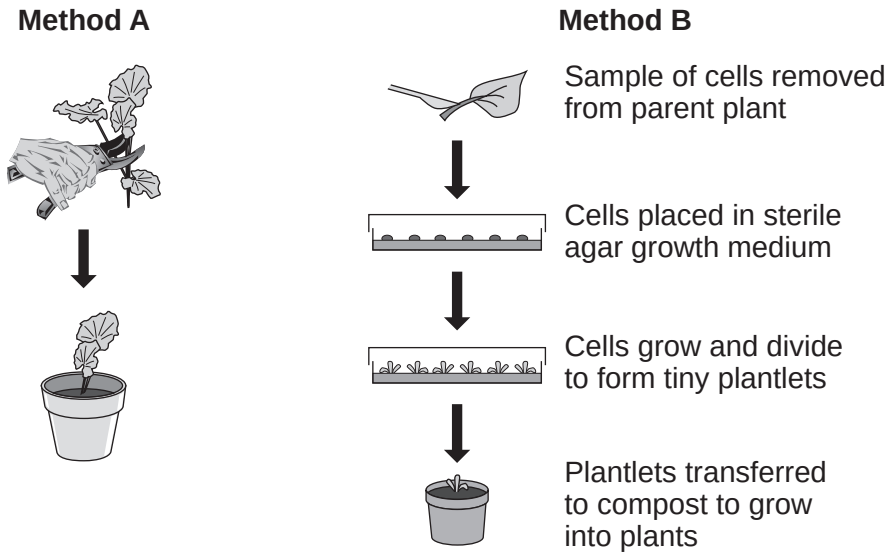
7

Biology Questions

9 Clones of plants are produced by the two methods shown in **Figure 16**.

Figure 16



9 (a) What are clones?

[1 mark]

.....

.....

9 (b) (i) Name the **two** methods of cloning shown in the diagrams.

[2 marks]

Method A: ..... **Method B**: .....

9 (b) (ii) **Method A** is widely used by gardeners to produce clones of common plants. **Method B** is usually only used to produce clones of plants which are rare or endangered.

Suggest reasons why **Method A** and **Method B** are used in these ways.

[3 marks]

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10 In a stable community, the processes that remove carbon are balanced by processes that return carbon.

Figure 17 shows a woodland community.

Figure 17

Describe how carbon is recycled in a woodland community.

[6 marks]

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11 Researchers carried out a survey to find out about the variation in eye colour in different European countries.

Table 3 shows the number of people with blue, brown, green or other eye colours and the total number of people surveyed in each country.

Table 3

Eye colour	Number of people			
	Britain	**Germany**	**Ireland**	**Italy**
Blue	711	539	185	22
Brown	661	462	145	145
Green	335	222	86	19
Other	391	269	79	45
Total	2098	1492	495	231

Table 4 shows the percentage of the people surveyed in each country who had each different eye colour.

Table 4

Eye colour	Percentage (%) of people surveyed			
	Britain	**Germany**	**Ireland**	**Italy**
Blue	33.89	36.13	37.37	9.52
Brown	31.51	30.97	29.29	
Green	15.96	14.88	17.37	8.23
Other	18.64	18.03	15.96	19.48

11 (a) To compare results, it is better to use the percentage of people with each eye colour instead of the number of people with each eye colour.

Suggest why.

[1 mark]

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11 (b) (i) In **Table 4** there is no data for the percentage of people in Italy with brown eyes.

Use information from **Table 3** to calculate the percentage of people surveyed in Italy who had brown eyes.

[2 marks]

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.....

Percentage of people surveyed in Italy with brown eyes ..... %

11 (b) (ii) Use the data in **Table 4** to give **one** conclusion about the variation in eye colour between different countries.

[1 mark]

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11 (b) (iii) Suggest how the survey could be improved so that the results would be more accurate.

[1 mark]

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5

Chemistry Questions

12 Scientists have predicted what will happen to continents in 250 million years.

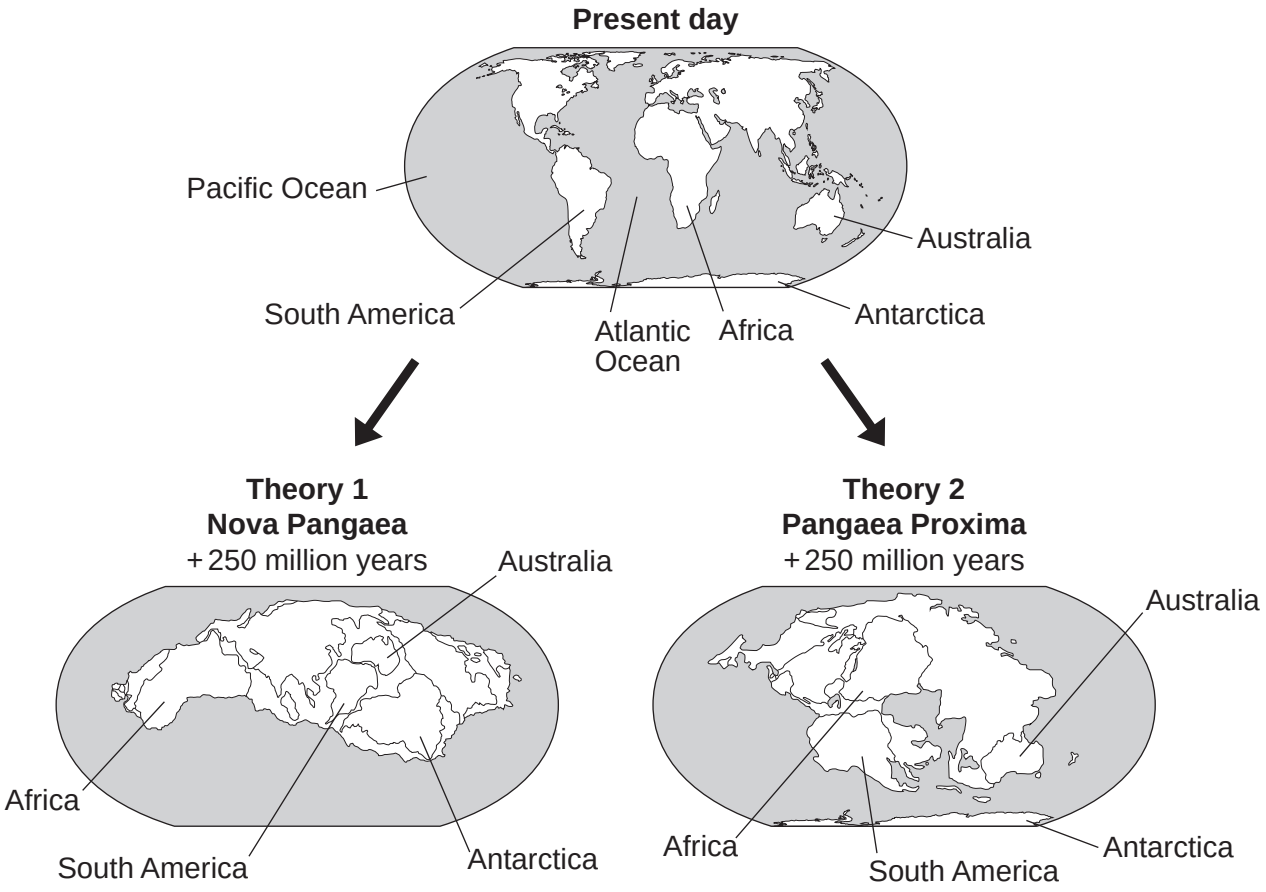
They have predicted that a new supercontinent will be formed.

Figure 18 shows the present-day continents and two theories that have been proposed.

Theory 1 calls the new supercontinent 'Nova Pangaea' and is based on what is happening now.

Theory 2 calls the new supercontinent 'Pangaea Proxima' and is based on where the continents used to be.

Figure 18



12 (a) Use the information to describe **three** differences between the theories.

[3 marks]

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12 (b) (i) The proposed changes will happen because tectonic plates move.

Name **two** other changes which can happen at plate boundaries.

[2 marks]

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12 (b) (ii) Describe how natural radioactive processes cause the Earth's tectonic plates to move.

[3 marks]

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12 (b) (iii) How far do the tectonic plates move each year?

[1 mark]

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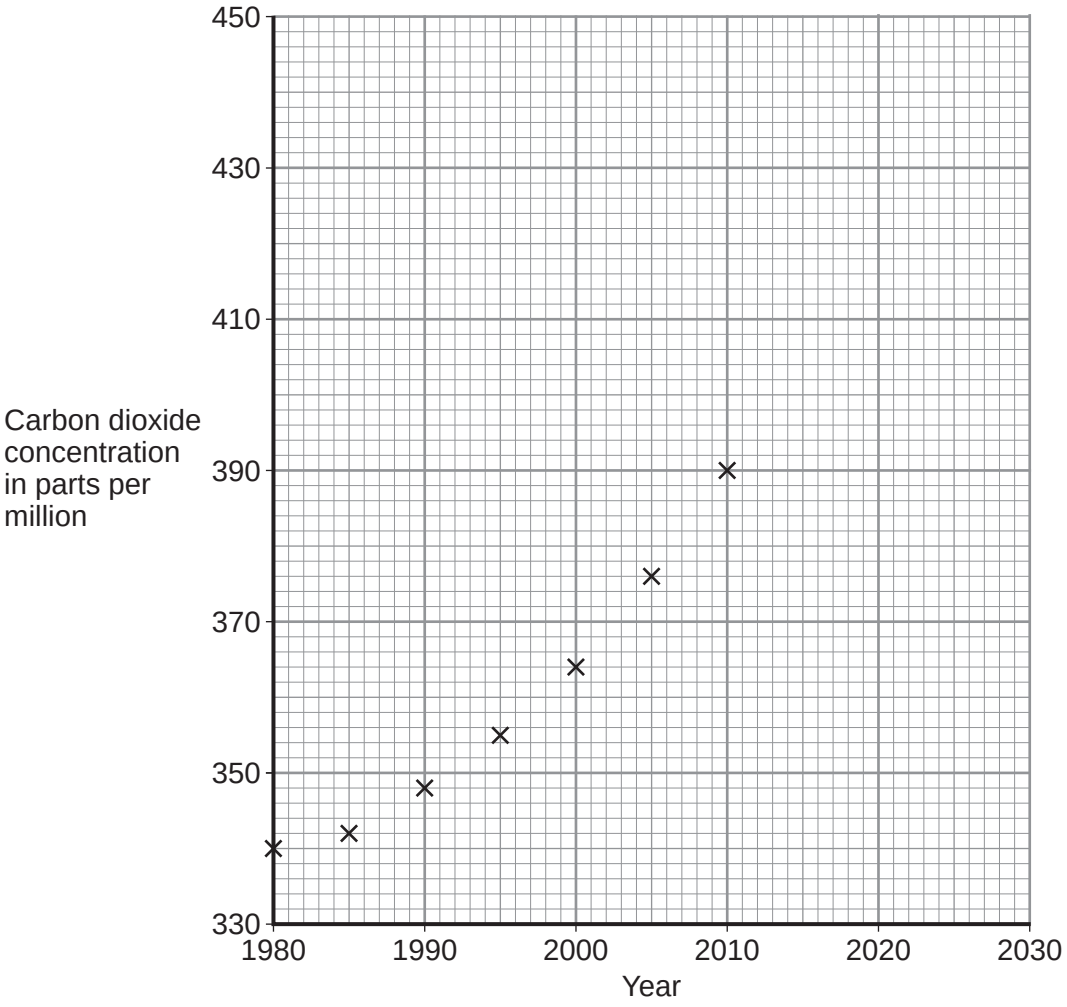
9

13 **Figure 19** shows the concentration of carbon dioxide in the air from 1980 to 2010.

Figure 19



13 (a) What is the main cause of the change in carbon dioxide concentration shown in **Figure 19**?

[1 mark]

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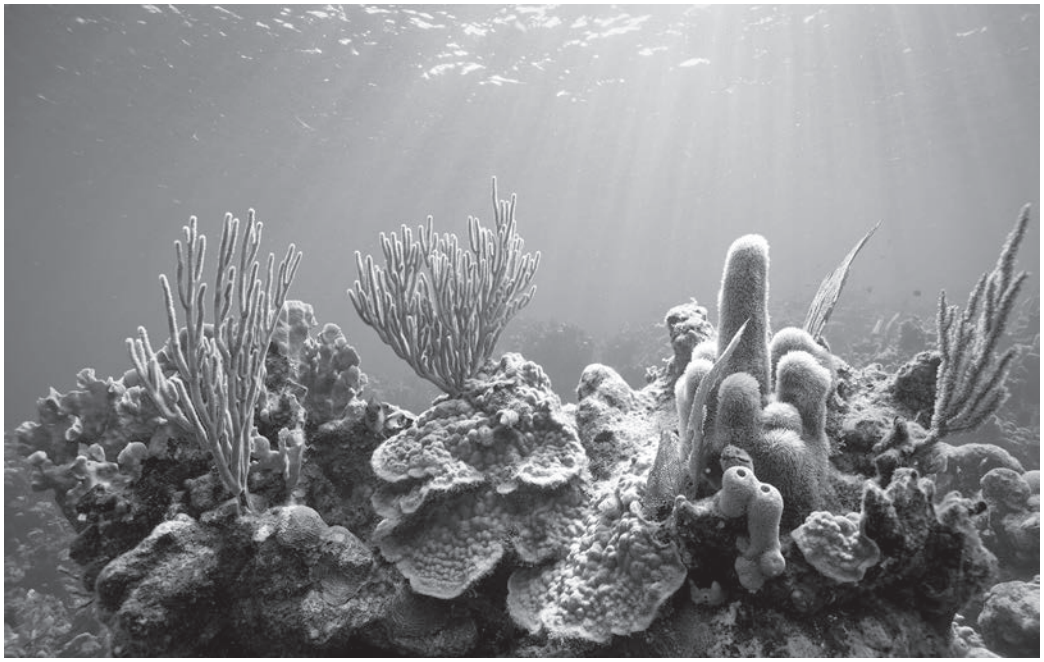
13 (b) **Figure 20** shows part of the Great Barrier Reef.
The Great Barrier Reef is in an ocean and is made of coral.

Coral is made by tiny living organisms.

Figure 20



Scientists measured the amount of coral on the reef from 1980 to 2010.

By 2010 half (50 %) of the coral present in 1980 had disappeared from the reef.

Suggest why a change in carbon dioxide concentration in the air can affect coral in the marine environment.

[2 marks]

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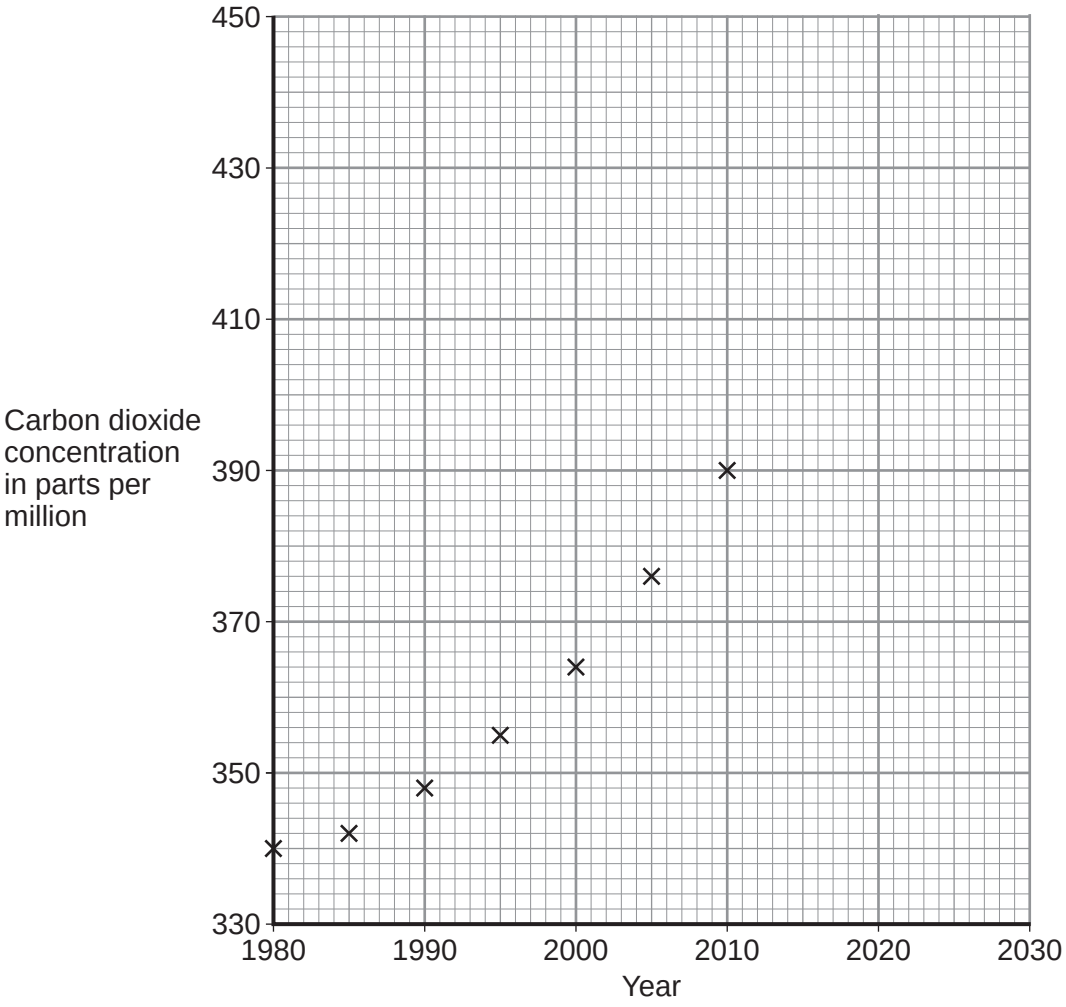
Question 13 continues on the next page

Figure 19 has been repeated to help you answer the question.

Figure 19



13 (c) (i) Use **Figure 19** to estimate the carbon dioxide concentration in parts per million in 2020.
[1 mark]

Estimated carbon dioxide concentration in 2020 = ... parts per million.

13 (c) (ii) By 2010 half (50 %) of the coral present in 1980 had disappeared from the reef. Scientists predict that half of the coral remaining in 2010 could disappear by 2020.

Consider the change in the amounts of coral and the carbon dioxide concentration in 1980, 2010 and 2020.

Use the data to explain the scientists' prediction.
[3 marks]

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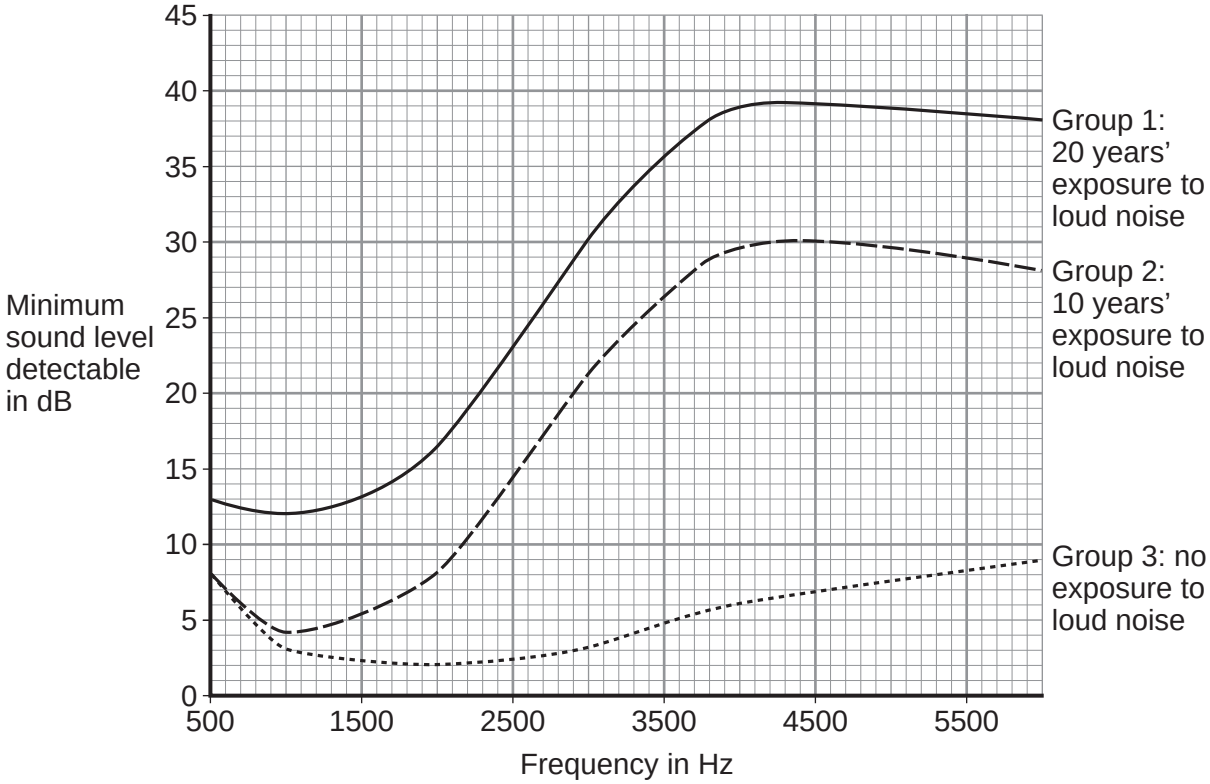
7

Turn over for the next question

Physics Questions

14 Exposure to a noisy environment can damage a person's hearing.
Figure 21 shows the minimum sound level that is needed to detect sounds of different frequencies for three different groups of people.
Sound level is measured in decibels, dB.

Figure 21



14 (a) Which group of people has the worst hearing?

Group: .....

Use the information from **Figure 21** to give a reason for your answer.

[1 mark]

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14 (b) Give **three** other conclusions that can be made from **Figure 21**.

[3 marks]

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4

Turn over for the next question

15 A Doppler probe emits high frequency sound waves.

15 (a) A doctor uses a Doppler probe to measure the pulse rate of an unborn baby in its mother's womb.

The sound waves have a frequency of 5.24×10^6 Hz.
The mean speed of sound through human body tissue is 1540 m/s.

Calculate the wavelength of the sound wave emitted by this Doppler probe as it travels through human body tissue.

Give your answer to **three** significant figures.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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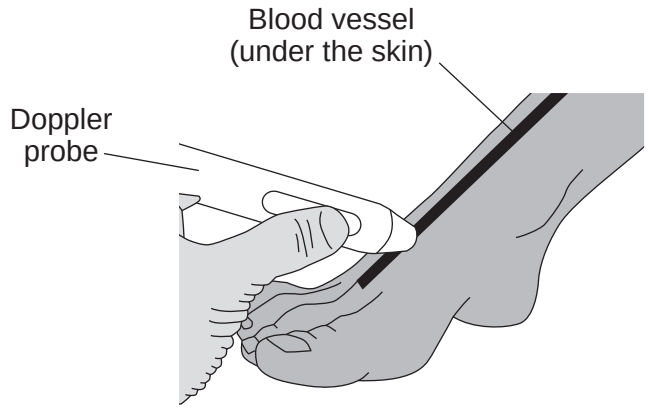
Wavelength = ... m

15 (b) Doctors use a different Doppler probe to measure blood flow in patients' bodies as shown in **Figure 22**.

Figure 22



The high frequency sound waves enter the patient's blood vessels and are reflected by the blood.

A doctor needs to choose the most appropriate Doppler probe for the task.
Table 5 shows the probes available.

Table 5

Doppler Probe	Wavelength in mm
A	1.14
B	0.970
C	0.0770

The blood vessels the doctor is examining are 1 mm in diameter.

The doctor wants the blood flowing in the blood vessel to reflect the high frequency sound waves. If she chooses the wrong Doppler probe the sound waves will be diffracted, not reflected.

15 (b) (i) Which Doppler probe should she choose?

Explain your answer.

[3 marks]

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15 (b) (ii) When the Doppler probe is in the position shown in **Figure 22**, the flow of blood is towards the Doppler probe.

How does the frequency of the reflected sound waves compare with the frequency of the sound waves emitted by the Doppler probe?

Draw a ring around the correct answer.

[1 mark]

higher frequency **lower frequency** **the same frequency**

7

16 In 1929, an astronomer called Edwin Hubble measured the distances of 24 galaxies from the Earth and the red shift of light from these galaxies. He used the red shift of light to calculate the speeds the galaxies were moving away from the Earth.

16 (a) Explain how the size of the red shift of light depends on the distance of the galaxy from the Earth.

[2 marks]

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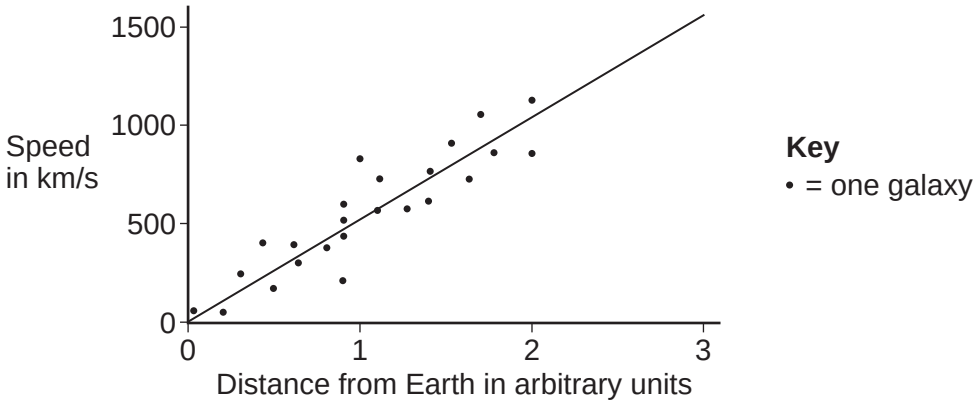
Figure 23 shows Hubble's results.

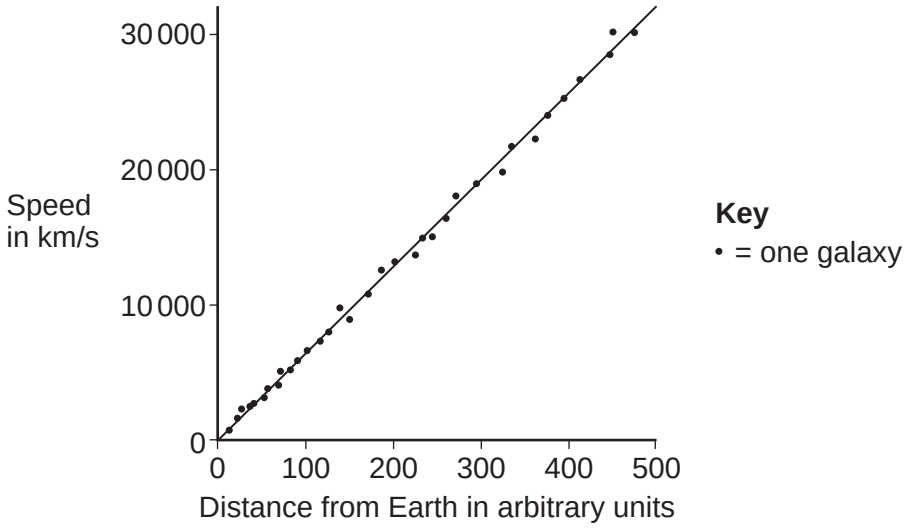
Figure 23



16 (b) Since Hubble made his original observations, more recent data has been collected about the speeds galaxies are moving away from the Earth.

The more recent data is shown in **Figure 24**.

Figure 24



Give **two** ways in which the more recent data provides more valid evidence for a conclusion to be made about the speeds the galaxies are moving away from Earth.

[2 marks]

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16 (c) Hubble's data supports the 'Big Bang' theory about the origin of the Universe. Another piece of evidence that supports the 'Big Bang' theory is Cosmic Microwave Background Radiation (CMBR).

What is **Cosmic Microwave Background Radiation**?

[2 marks]

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6

END OF QUESTIONS

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