THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

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Thursday 12 January 2012 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE SCIENCE A

A141/02 Modules B1 C1 P1 (Higher Tier)

A135180112

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour

A141102

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- A list of physics equations is printed on page 2.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Useful relationships

The Earth in the Universe

distance = wave speed × time

wave speed = frequency × wavelength

Sustainable energy

energy transferred = power × time

power = voltage × current

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

Explaining motion

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

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight × vertical height difference

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

Electric circuits

power = voltage × current

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

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

Radioactive materials

energy = mass × [speed of light in a vacuum]^2

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Question 1 begins on page 4

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Answer **all** the questions.

1 Huntington's disease is a genetic disorder.

(a) Which of the following are symptoms of Huntington's disease?

Put ticks (✓) in the boxes next to each correct answer.

memory loss	☐
chest infections	☐
thick mucus	☐
sore throat	☐
clumsiness	☐
difficulty digesting food	☐

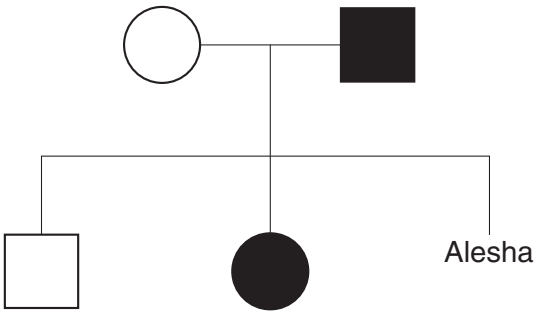
[2]

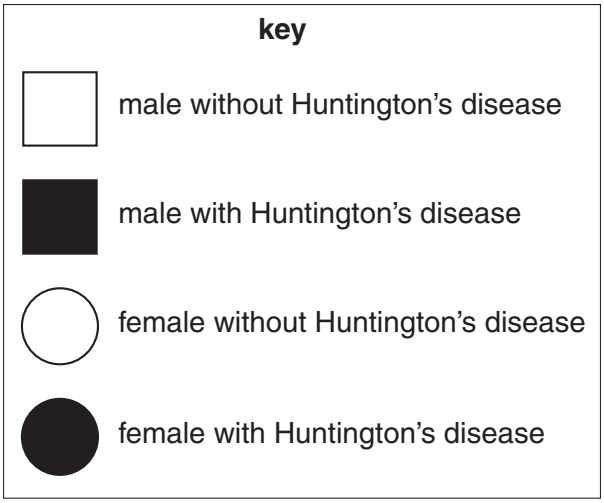
(b) Alesha's father has Huntington's disease.

The symptoms of Huntington's disease do not usually develop until middle age.

Alesha is 19 years old and she does not know if she has inherited Huntington's disease.

Look at Alesha's family tree.





Alesha's father has the genotype Hh.

H = dominant allele
h = recessive allele

(i) Write down the genotype of Alesha's brother.

..... **[1]**

(ii) Complete the Punnett square and use the space below it to calculate the probability of Alesha having Huntington's disease.

		Alesha's mother	
		.....	.....
Alesha's father	.....	.....	.....
	.....	.....	.....

probability = ... **[3]**

(c) Alesha can have a genetic screening test. The test will tell her if she has inherited Huntington's disease.

Alesha's doctor and employer have different reasons for wanting to know the results of the genetic screening test.

Suggest what these reasons might be.

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..... **[2]**

[Total: 8]

2 Simone found out about Mendel, a scientist who investigated inheritance.

Mendel could not use humans in his experiments so he used pea plants.

Pea plants are either tall or short. This is controlled by one gene with two alleles.

Mendel allowed **two tall** parent plants to reproduce sexually.

He counted the number of tall plants and the number of short plants produced.

Simone did Mendel's experiment and then repeated it.

Look at her results.

	number of plants counted	
	tall	**short**
experiment 1	6	4
experiment 2	152	48

(a) Calculate the ratio of tall to short plants produced in experiment 1.

Write your answer in its simplest form.

ratio of tall to short plants = ... **[1]**

(b) Both parent plants used in the experiments were heterozygous.

Simone uses this information to calculate the expected ratio of tall to short plants produced from these parent plants.

One of her experiments produces results which are closer to the expected ratio.

Which experiment is this? Use data from the table to justify your answer.

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..... **[2]**

(c) Simone plans to do the experiment a third time.

Suggest a change that Simone could make to her experiment to produce results that are even closer to the expected ratio.

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..... **[1]**

[Total: 4]

3 Thomas and James are identical twin boys.

Thomas **James**

(a) Explain why identical twins look very similar, but have some differences in their appearance.

You may use examples from the diagrams to support your answer.

The quality of written communication will be assessed in your answer.

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..... **[6]**

(b) Thomas and James are both boys.

Their sex depends on the sex chromosomes they inherited from their parents.

These statements are about the inheritance of sex chromosomes.

Put a tick (✓) in the box next to each **true** statement.

Each body cell in a human male contains XX sex chromosomes.	☐
A gene on the X chromosome determines the sex of the embryo.	☐
The sex-determining gene triggers the development of the ovaries.	☐
A gene on the Y chromosome determines the sex of the embryo.	☐
Each body cell in a human female contains XX sex chromosomes.	☐
The sex-determining gene triggers the development of testes.	☐

[2]

[Total: 8]

4 Read this information about hybrid cars.

> The Government is encouraging people to buy hybrid cars.
>
> Some of the power in hybrid cars comes from an engine that burns petrol.
> The rest of the power comes from an electric motor that runs off a battery.
>
> The battery is recharged when the brakes are used.
> The battery does not have to be recharged from mains electricity.
>
> Hybrid cars make less air pollution than cars that only have a petrol engine.

(a) Dave drives his car 16 000 km each year.

(i) At first Dave has an old car that only burns petrol.

He uses 1200 kg of petrol each year.

Each kilogram of petrol burns to make 2.1 kg of carbon dioxide.

Show that Dave's car puts 2520 kg of carbon dioxide into the air each year.

[1]

(ii) Dave changes his car for a hybrid model.

His new car makes 90 g of carbon dioxide per kilometre.

He still drives 16 000 km in one year.

How much **less** carbon dioxide is made in one year in Dave's new car compared with his old one?

..... kg **[2]**

(b) The Government is encouraging people to buy hybrid cars.

This should lower air pollution.

Suggest **one** measure the Government could introduce to encourage people to buy hybrid cars.

.....

..... **[1]**

(c) Some cars are powered only by electricity.

There are problems linked with electrically powered vehicles.

Describe **two** problems that may happen if all the cars sold were electric.

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..... **[2]**

[Total: 6]

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5 **(a)** Carbon can react with oxygen to make **carbon monoxide**.

Complete both sides of the diagram to show this reaction.

carbon oxygen carbon monoxide

[1]

(b) Since 1993 cars in the UK have been fitted with catalytic converters.

Catalytic converters lower the amounts of carbon monoxide and nitrogen monoxide reaching the air.

Use ideas about oxidation and reduction to explain how levels of carbon monoxide and nitrogen monoxide are lowered using a catalytic converter.

You may use word equations or diagrams of reactions in your answer.

The quality of written communication will be assessed in your answer.

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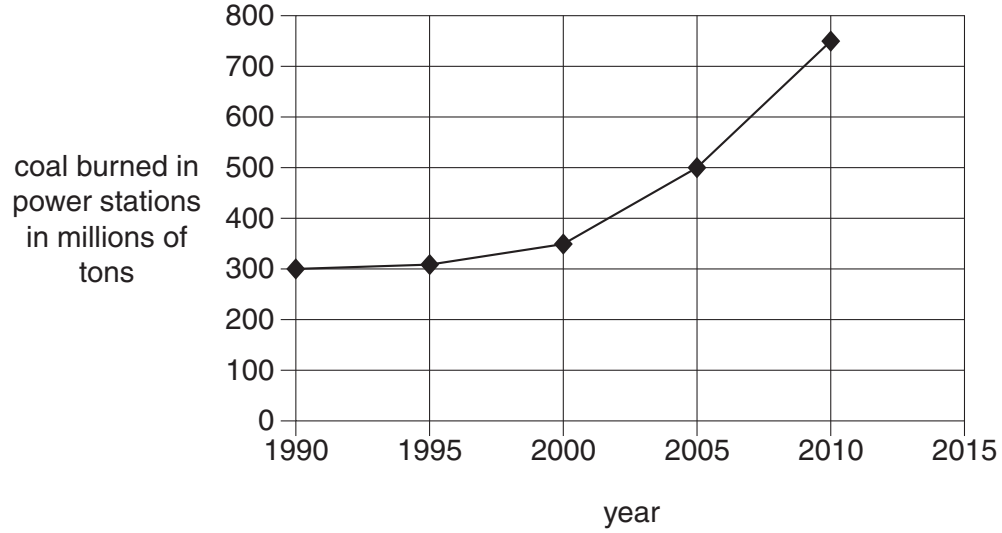
..... **[6]**

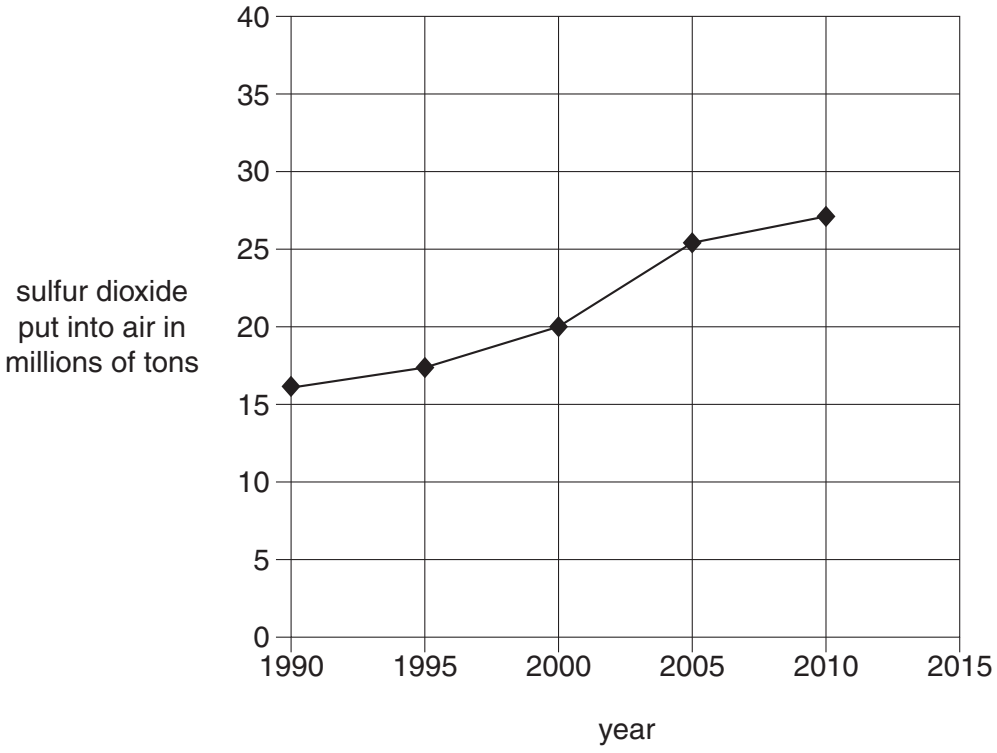
[Total: 7]

6 China makes electricity from coal-burning power stations.

(a) This graph shows the amount of coal burned in power stations in China each year.



This graph shows the amount of sulfur dioxide put into the air by China each year.



(i) Look at the graph that shows the amount of coal burned in power stations in China each year.

Describe **in detail** the trend shown by this graph.

.....

..... **[1]**

(ii) What is the correlation shown by the data between 1990 and 2005?

Put a tick (✓) in the box next to the correct answer.

As the amount of coal burned increases, the sulfur dioxide put into the air increases.	☐
Between 1990 and 2005, the amount of coal burned in China increases.	☐
More power stations are built in China every year.	☐
Burning coal has no effect on sulfur dioxide pollution.	☐
Modern power stations put less sulfur dioxide into the air than older ones.	☐

[1]

(iii) Estimate the amount of sulfur dioxide put into the air by coal-burning power stations in China in 2015.

..... million tons

Suggest reasons for this answer.

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..... **[2]**

(b) The average concentration of sulfur dioxide in the air near to a coal-burning power station changes from day to day.

The table shows concentrations of sulfur dioxide in the air on different days.

day	sulfur dioxide concentration in $\mu g/m^3$
Monday	66
Tuesday	72
Wednesday	38
Thursday	15
Friday	98

On Monday it was sunny and the power station was at normal power output.

On a different day it was raining and the power station was at normal power output.

On another day it was raining and the power station was at low power output.

(i) On which day was it raining and the power station at **normal** power output?

.....

On which day was it raining and the power station at **low** power output?

..... **[1]**

(ii) Explain your answers to part **(i)**.

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..... **[2]**

[Total: 7]

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Question 7 begins on page 18

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7 When earthquakes occur, S-waves and P-waves are produced which travel through the Earth.

(a) S-waves are transverse.

Explain what is meant by a transverse wave.

You may draw a diagram to help your answer.

.....

..... **[1]**

(b) S-waves travel from an earthquake to a detector 560 km away.

They take 150 seconds to make this journey.

(i) P-waves from the earthquake arrive 50 seconds before the S-waves.

Calculate the speed of the P-waves.

speed of the P-waves = ... km/s **[2]**

(ii) Without calculation, explain how you would expect the time between the arrival of the two types of wave to be different at a detector much further from the earthquake.

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..... **[1]**

(c) S-waves travel at 3.7 km / s.

In a time of 5 seconds, the ground oscillates 40 times.

Calculate the wavelength of the waves.

wavelength = ... km **[2]**

[Total: 6]

8 Earthquakes, volcanoes and mountain building take place at the edges of the Earth's tectonic plates.

Explain how tectonic plates cause earthquakes, volcanoes and mountain building.

The quality of written communication will be assessed in your answer.

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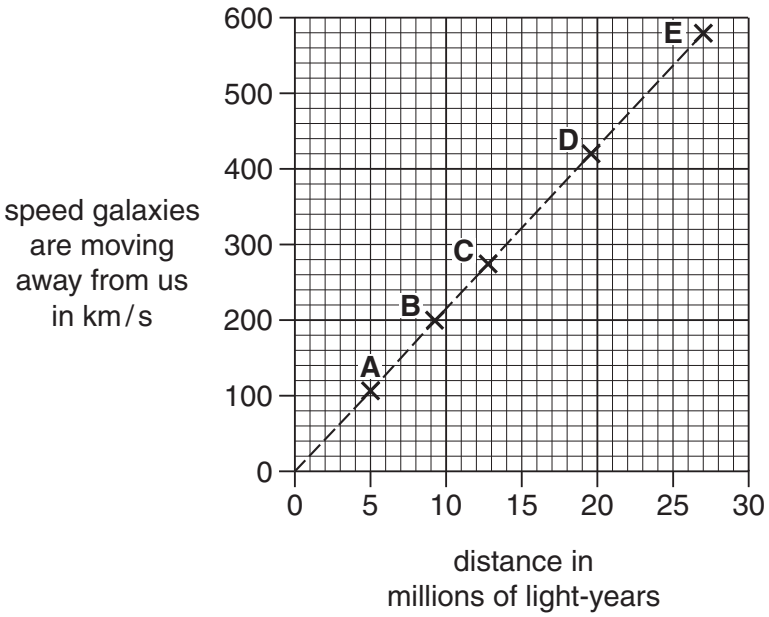
..... **[6]**

[Total: 6]

9 Look at the speed-distance graph for five galaxies, **A**, **B**, **C**, **D** and **E**.



(a) Describe what the graph shows about these galaxies.

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..... **[1]**

(b) The distance to galaxy **B** was actually a best estimate obtained from six galaxies in the same part of the sky all moving at 200 km/s.

The table shows the distances to these six galaxies.

distance in millions of light-years	9.3	9.0	9.2	9.4	9.1	6.6

The value for galaxy **B** shown on the graph was found from

$$\frac{9.3 + 9.0 + 9.2 + 9.4 + 9.1}{5} = 9.2$$

Is this a suitable method for calculating the best estimate of the distance to galaxy **B**?

Explain your answer.

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..... **[2]**

(c) If you continue the straight-line graph, it would predict that a galaxy which was 70 million light-years away would be moving away from us at a speed of 1500 km/s.

Which of the following are possible explanations for why this prediction may **not** be correct?

Put ticks (✓) in the boxes next to the **two** correct explanations.

1500 km/s is greater than the speed of light. ☐

The distance to the distant galaxies is difficult to measure. ☐

The relationship may not be a straight line beyond the data plotted. ☐

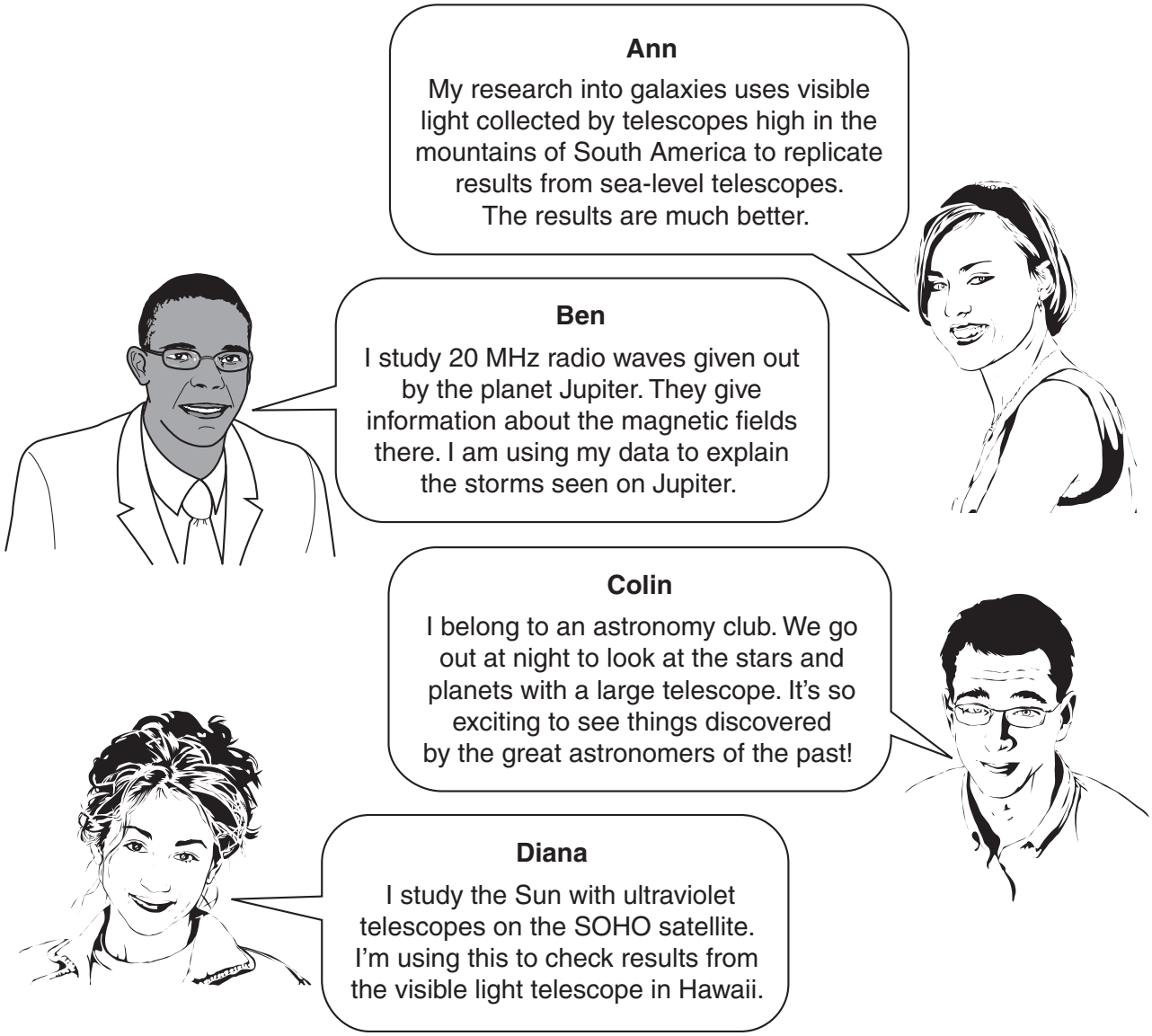
70 million years is greater than the age of the Universe. ☐

All galaxies show redshift. ☐

[2]

[Total: 5]

10 Read what these four astronomers have to say about their work.



(a) Who makes observations of objects outside our solar system?

Put ticks (✓) in the boxes next to the **two** correct people.

Ann ☐

Ben ☐

Colin ☐

Diana ☐

[1]

(b) Who is most likely to be affected by light pollution?

Put a tick (✓) in the box next to the correct person.

Ann ☐

Ben ☐

Colin ☐

Diana ☐

[1]

(c) Creativity is important in science.

Whose activity illustrates creativity?

Put a tick (✓) in the box next to the **best** answer.

Ann ☐

Ben ☐

Colin ☐

Diana ☐

[1]

[Total: 3]

END OF QUESTION PAPER

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