



Answer **all** the questions.

1 This question is about objects which orbit the Sun.

(a) The table has data on the orbits of three planets around the Sun.

Planet	Distance from the Sun (millions of km)	Speed (km/s)	Diameter of planet (thousands of km)
Mercury	60	50	4.88
Earth	150	30	12.8
Jupiter	780	13	143

(i) Which of the following statements correctly describes a correlation shown in the table? Put a tick (✓) in the box next to the correct statement.

Bigger planets have a greater speed.

Planets closer to the Sun have a greater speed.

Smaller planets are more distant from the Sun.

[1]

(ii) The planet Mars orbits at a distance of 230 million km from the Sun.

Use information from the table to **estimate** the speed of Mars in its orbit.

Explain your answer.

estimated speed = ..... km/s

.....  
 .....

[2]

(b) Planets are not the only objects which orbit our Sun.

Complete the sentences below, using words from the list.

**asteroids    comets    galaxy    moons    solar system    stars    Universe**

The Sun is at the centre of our .....

Many small objects orbit the Sun. Some of these are made of ice and dust, and often have orbits which are not circular. These are .....

Other small objects are stony. Most of these have orbits between Mars and Jupiter.

These are .....

[3]

[Total: 6]

Answer **all** the questions.

- 1 In 2000 some astronomers announced the discovery of a planet around the star Epsilon Eridani. Variations in the light from the star allowed the astronomers to detect the planet. The light took 10.5 years to reach the Earth.

The planet is about 380 times more massive than the Earth and takes 7 years to complete one orbit around Epsilon Eridani.

- (a) (i) How far away from us is the planet?

answer ..... [2]

- (ii) How could the distance to the star Epsilon Eridani have been measured?

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

- using parallax
- sending a space ship
- comparing its relative brightness
- asking people who live there
- using a laser

[2]

- (iii) Put these distances, **A**, **B**, **C**, **D** and **E**, in order from smallest to largest.

- A** – The diameter of the Earth’s orbit.
- B** – The diameter of the solar system.
- C** – The diameter of the Earth.
- D** – The distance from the Earth to Epsilon Eridani.
- E** – The diameter of the Sun.

One has been done for you.

smallest 

<b>C</b>				
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 largest

[2]

(b) The initial report by the astronomers was published in a peer-reviewed scientific journal.

Why is this process important for the acceptance of the astronomers' findings?

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

It allows other astronomers to try and repeat the finding.

The astronomers' friends will be able to see their results.

It shows the astronomers are scientists.

The findings can be evaluated by other astronomers.

Only astronomers are allowed to write articles for the journal.

[2]

(c) In 2010 astronomers discovered a new solar system with a large star and at least **three** large planets.

Paul works in a planetarium. His job is to draw a labelled diagram of the new solar system showing the planets' orbits.

He thinks that there are probably other smaller objects in the new solar system which the astronomers cannot detect at such an enormous distance.

These types of smaller objects are also found in our solar system. Paul adds these to his drawing.

Draw a labelled diagram of the new solar system, including some objects that Paul might have added to his diagram.



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

[6]

[Total: 14]

Turn over

**8** Five scientists are discussing the ages of the Universe and our solar system.

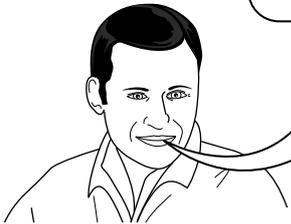
They are all referring to data from their research.

**Dr Adams**

I use a telescope to study the movement of galaxies. By analysing their distances and speeds, I found that the best estimate of the age of the Universe is 13.7 thousand million years old.

**Dr Baker**

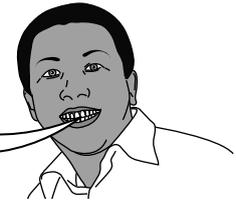
I study rocks. The age of the oldest rocks on the surface of the Earth is about 3.8 thousand million years old.

**Dr Curtis**

I study the light from nearby stars. This shows me they are approximately 12 thousand million years old.

**Dr Das**

I study meteorites – bits of asteroid that get through our atmosphere. The oldest of these is around 5 thousand million years old.

**Professor Eddington**

I use satellite observations to study images from the Sun at different wavelengths. The Sun is less than 8 thousand million years old.

(a) Which three scientists study objects inside our solar system?

Put ticks (✓) in the boxes next to the **three** correct answers.

- |                     |                          |
|---------------------|--------------------------|
| Dr Adams            | <input type="checkbox"/> |
| Dr Baker            | <input type="checkbox"/> |
| Dr Curtis           | <input type="checkbox"/> |
| Dr Das              | <input type="checkbox"/> |
| Professor Eddington | <input type="checkbox"/> |

[2]

(b) Which three scientists study the radiation emitted from stars?

Put ticks (✓) in the boxes next to the **three** correct answers.

- |                     |                          |
|---------------------|--------------------------|
| Dr Adams            | <input type="checkbox"/> |
| Dr Baker            | <input type="checkbox"/> |
| Dr Curtis           | <input type="checkbox"/> |
| Dr Das              | <input type="checkbox"/> |
| Professor Eddington | <input type="checkbox"/> |

[2]

(c) Use the data given by these scientists to choose the best estimate for the age of our **solar system**.

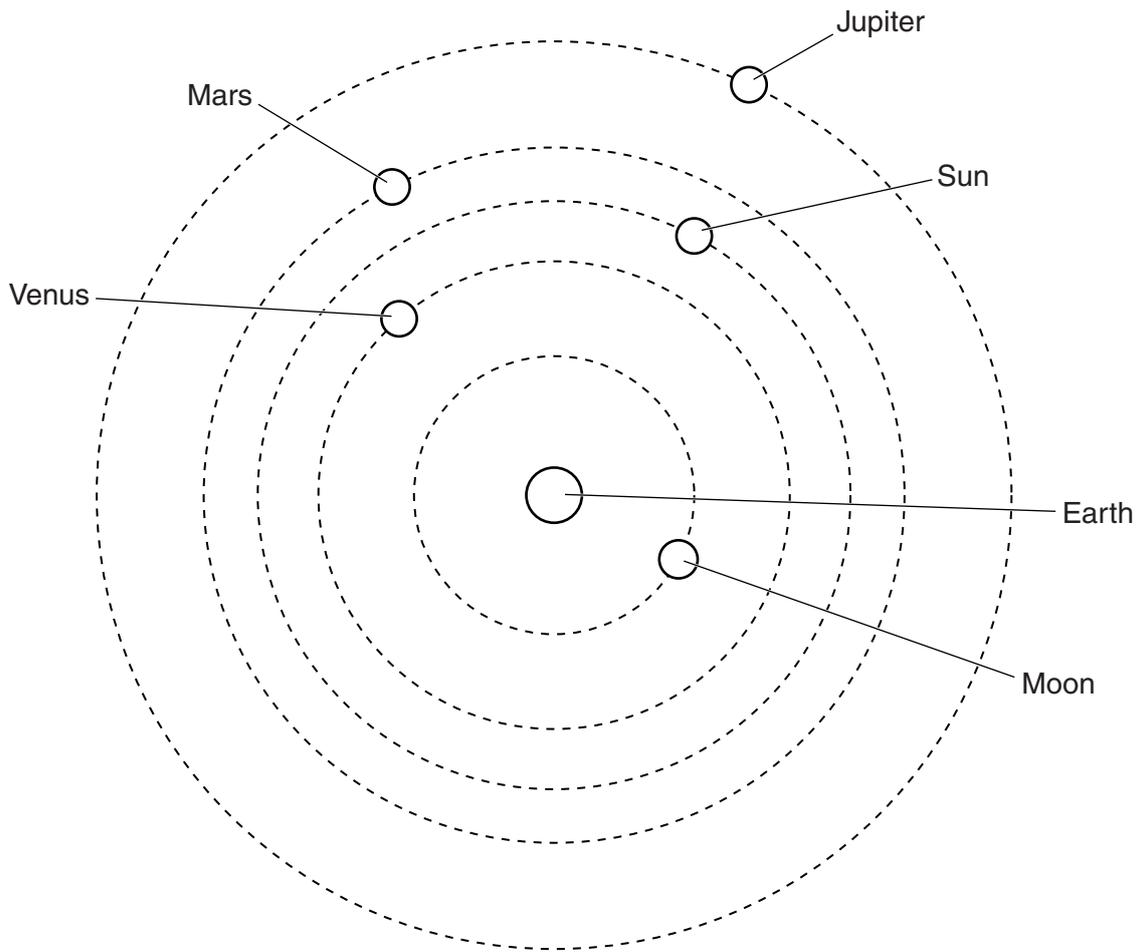
Put a tick (✓) in the box next to the correct answer.

- |  |                          |
|--|--------------------------|
| less than 3.8 thousand million years old       | <input type="checkbox"/> |
| between 3.8 and 5 thousand million years old   | <input type="checkbox"/> |
| between 5 and 8 thousand million years old     | <input type="checkbox"/> |
| between 8 and 12 thousand million years old    | <input type="checkbox"/> |
| between 12 and 13.7 thousand million years old | <input type="checkbox"/> |

[1]

[Total: 5]

9 At one time, most people thought that the Earth was the centre of the solar system.



**Old view of the solar system (not all planets shown)**



- 8 The table shows the distances to four different galaxies, **A**, **B**, **C** and **D**, and the speed with which these galaxies are moving.

Galaxy	A	B	C	D
Distance (millions of light years)	300	800	1000	3000
Speed (km/s)	6500	18000	21 000	67 000

- (a) Describe the correlation shown by the data in this table.

.....

.....

..... [1]

- (b) Another galaxy, **E**, is at a distance of 900 million light years.

Use the information in the table to estimate the speed of Galaxy **E**.

Show how you found your answer.

speed = ..... km/s [2]

(c) Here are some statements about galaxies.

Only **two** of them are true.

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

The Milky Way is a galaxy.

The Universe contains 300 000 galaxies.

Some galaxies are bigger than the Universe.

Distant galaxies are all moving away from us.

Spacecraft have been sent to nearby galaxies.

[2]

(d) Which measurements of distant galaxies are needed to predict the fate of the Universe?

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

their motion

their shapes

their distances

their temperatures

the number of stars in them

[2]

[Total: 7]

Answer **all** the questions.

- 1 (a) Complete the sentences about galaxies.

Galaxies are made up of thousands of millions of .....

Thousands of millions of galaxies make up the .....

The Sun is in the ..... galaxy. [3]

- (b) Scientists have measured the distance to many galaxies and the speeds of the galaxies as they move away from the Earth.

The table shows the location, distance and speed of some galaxies.

Galaxy location	Distance in millions of light years	Speed in km/s
Corona Borealis	1440	21 600
Bootes	2740	39 300
Hydra	3960	61 200
Ursa Major	1000	15 000

Phil draws a conclusion from the data.



**Phil**  
There is no relationship between the distance to a galaxy and its speed.

Is Phil correct? Justify your answer using data from the table.

.....

.....

.....

.....

.....

.....

.....

[3]

- (c) How long did it take the light from the galaxy in Ursa Major to reach the Earth?

answer = ..... years [2]

[Total: 8]