Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Space physics

Time allowed: 1 hour 20 minutes

Subject code **0625**

Physics

Questions from Paper 3 and Paper 4

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 82

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 82 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 Fig. 11.1 represents the Solar System. The Sun and five of the eight planets are labelled.

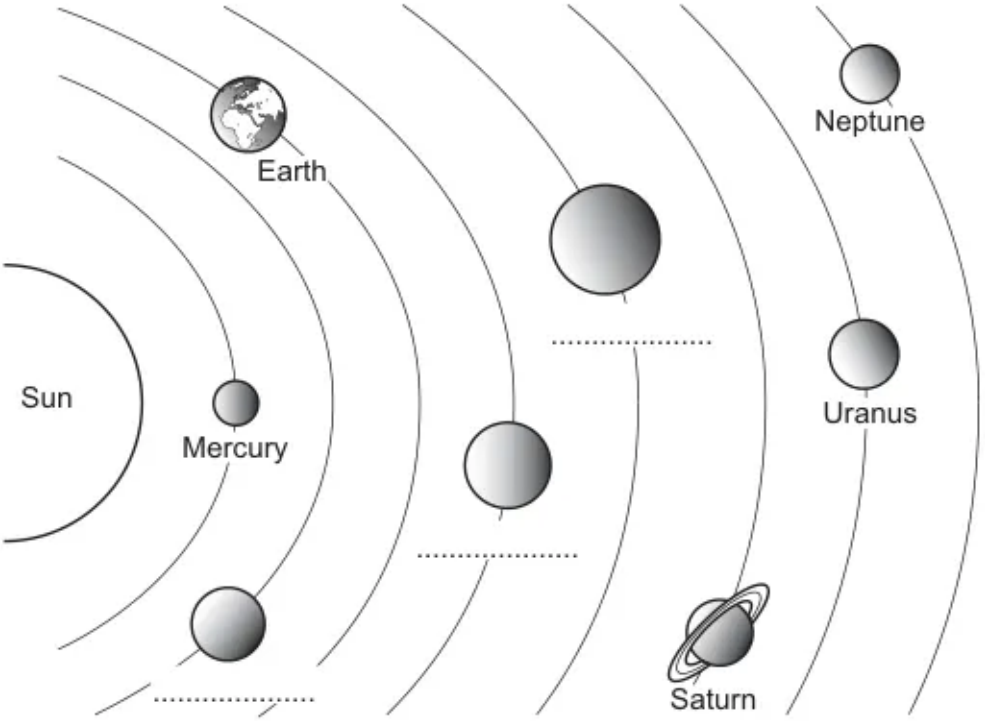


Fig. 11.1 (not to scale)

(a) Complete the **three** missing labels on Fig. 11.1 by writing the name of each planet on its dotted line. [2]

(b) **(i)** The Sun consists mainly of two elements.

Name the **two** elements.

..... and ..... [2]

(ii) The Sun radiates energy mainly in three regions of the electromagnetic spectrum. Ultraviolet is one of the three regions.

State the name of **one** of the other two regions.

..... [1]

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(c) **(i)** Scientists use the Big Bang Theory to explain the way the Universe began.

State **one** piece of evidence that supports the Big Bang Theory.

.....

..... [1]

(ii) Scientists use the accretion model to explain the formation of the Solar System.

Complete the following sentences about the accretion model.

In space, there are clouds of dust and ..... .

The material spins around and moves closer together due to the force of ..... .

This forms an accretion ..... .

[3]

[Total: 9]

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2 Fig. 10.1 represents part of the Solar System.

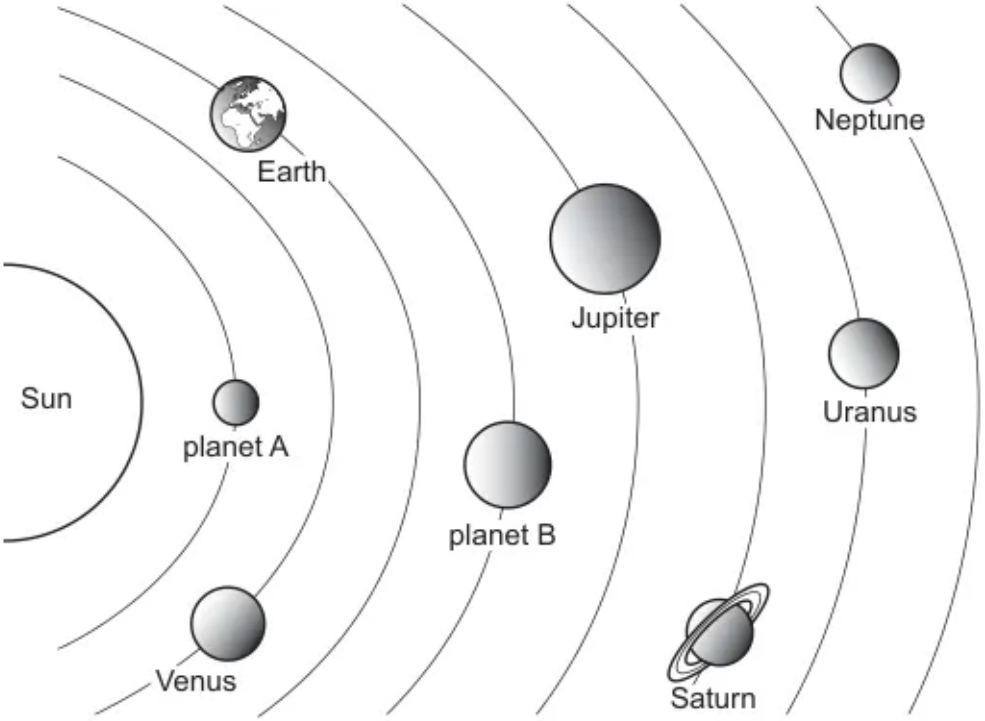


Fig. 10.1 (not to scale)

(a) (i) State the name of planet A and the name of planet B.

planet A .....

planet B .....
[2]

(ii) On Fig. 10.1, draw an X to represent a moon of Jupiter. Draw a line to show how this moon moves. [1]

(iii) State **two** ways in which the four planets nearest to the Sun are different from the four planets furthest away from the Sun.

1 .....

2 .....
[2]

(iv) Complete the following sentences:

The galaxy that includes the Solar System is called the ..... .

The ..... includes billions of galaxies.
[2]

(b) The distance between the Sun and the Earth is 1.5×10^{11} m.
The speed of an electromagnetic wave is 3.0×10^{8} m/s.

Calculate the time taken for an electromagnetic wave to travel from the Sun to the Earth.

time taken = ... s [3]

[Total: 10]

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3 Table 11.1 shows some information about two of the planets in the Solar System.

Table 11.1

name of planet	mass of planet / kg	distance from the Sun / km	time for one rotation on its axis / hours
Venus	4.87×10^{24}	108.2×10^{6}	5832
Earth	5.97×10^{24}	149.6×10^{6}	24

(a) (i) Venus is a similar size to the Earth.

State why the gravitational field strength at the surface of the Earth is greater than the gravitational field strength at the surface of Venus.

..... [1]

(ii) Calculate the time, in Earth days, for **one** day on Venus.

time = ... Earth days [3]

(iii) Calculate the time taken for light to travel from the Sun to Venus. The speed of light is 3.0×10^{8} m / s.

time taken = ... s [4]

(b) The star nearest to the Sun is about 4.25 light-years from the Sun.

Explain what is meant by one light-year.

.....

..... [2]

[Total: 10]

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4 Table 9.1 gives information about three planets in the Solar System.

Table 9.1

planet	mass / 10^{24} kg	average distance from Sun / 10^{6} km	orbital period / days	gravitational field strength at surface / N/kg
Earth	5.97	149.6	365.2	9.8
Jupiter	1898	778.6	4331	23.1
X	4.87	108.2	224.7	8.9

(a) State the name of planet X.

..... [1]

(b) Describe the relationship shown in Table 9.1 between the mass of a planet and the gravitational field strength at its surface.

.....

..... [1]

(c) Explain why 'distance from Sun' in Table 9.1 is an average value.

.....

..... [1]

(d) Show that the average orbital speed of the Earth is approximately 30 km/s.

[3]

[Total: 6]

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5 **(a)** Sketch a diagram to show the orbital path of a comet around the Sun.

Mark the position of the Sun on your diagram using an S.

[2]

(b) Draw a cross on your diagram to show where the comet is travelling with the slowest speed. Label the cross **L**. [1]

(c) Explain why the speed of a comet changes as it travels around its orbit.

Use the conservation of energy in your explanation.

.....

.....

.....

..... [3]

[Total: 6]

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6 **(a)** **(i)** **1.** State what is represented in space physics by the symbol H_0.

..... [1]

2. Write down the equation that defines H_0 in terms of the speed that a far galaxy is moving away from the Earth and its distance from the Earth.

..... [1]

(ii) The numerical value of H_0 is 2.2×10^{-18}. State the unit of H_0.

..... [1]

(iii) Use this value of H_0 to determine an estimate for the age of the Universe in seconds.

age of the Universe = ... s [2]

(b) State when cosmic microwave background radiation (CMBR) was formed and where we detect it coming from.

.....

.....

.....

..... [2]

[Total: 7]

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7 The Milky Way is the galaxy in which the Solar System is located.

(a) State what a galaxy is.

.....

..... [1]

(b) The Milky Way has a diameter that is approximately equal to 100 000 light-years.

Determine this distance in kilometres (km).

distance = ... km [2]

(c) Astronomers determine the speed and distance from the Earth of a far galaxy that is moving away from the Earth.

(i) State **one** observation that allows the speed at which a galaxy is moving away to be determined.

.....

..... [1]

(ii) State **one** different observation that is used to determine the distance to a far galaxy.

.....

..... [1]

(iii) State how the speeds of galaxies and their distances from the Earth are related.

.....

..... [1]

(iv) The best estimate for the Hubble constant H_0 is 2.2×10^{-18} per second.

Use this value to calculate an estimate for the age of the Universe.

age of the Universe = ... s [2]

[Total: 8]

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8 **(a)** State the equation that defines the average orbital speed v of a planet. State the meaning of any symbols you use.

.....

..... [2]

(b) Suggest why countries that are a significant distance from the Equator experience significant temperature variation throughout the year.

.....

.....

..... [1]

(c) Fill in the gaps in the paragraph about a star much more massive than the Sun.

The stage that follows the stable state in the life cycle of the star is the

..... stage.

It then explodes as a supernova to form a ..... , this leaves behind a

..... or a ..... .

[4]

(d) A galaxy is moving away from the Earth with a speed of 33 000 km / s.
The value of the Hubble constant is 2.2×10^{-18} per second.

Calculate the distance from the galaxy to the Earth. Give your answer in light-years.

distance = ... light-years [2]

[Total: 9]

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9 **(a)** **(i)** State the name of **one** planet that has an orbit further away from the Sun than Venus.

..... [1]

(ii) State the name of **one** planet that has an orbit closer to the Sun than Venus.

..... [1]

(b) Venus has an average radius of orbit of 1.1×10^{11} m and an orbital period of 220 Earth days. Calculate the average orbital speed of Venus. Give your answer in m/s.

average orbital speed = ... m/s [3]

(c) State the relationship between the orbital speeds of the planets and their distances from the Sun.

.....

..... [1]

(d) Comets are balls of ice and dust. Some comets orbit the Sun.

State how the speed of a comet changes as it orbits the Sun.
Explain your answer using ideas about the conservation of energy.

You may include a labelled diagram in your answer.

.....

.....

..... [3]

[Total: 9]

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10 **(a)** Define a light-year in words.

..... [1]

(b) It takes light 490 s to travel from the Sun to the Earth.

Calculate the distance from the Sun to the Earth.

distance = ... [2]

(c) Fig. 10.1 is a scatter graph showing how the speed of galaxies moving away from the Earth varies with their distances from the Earth.

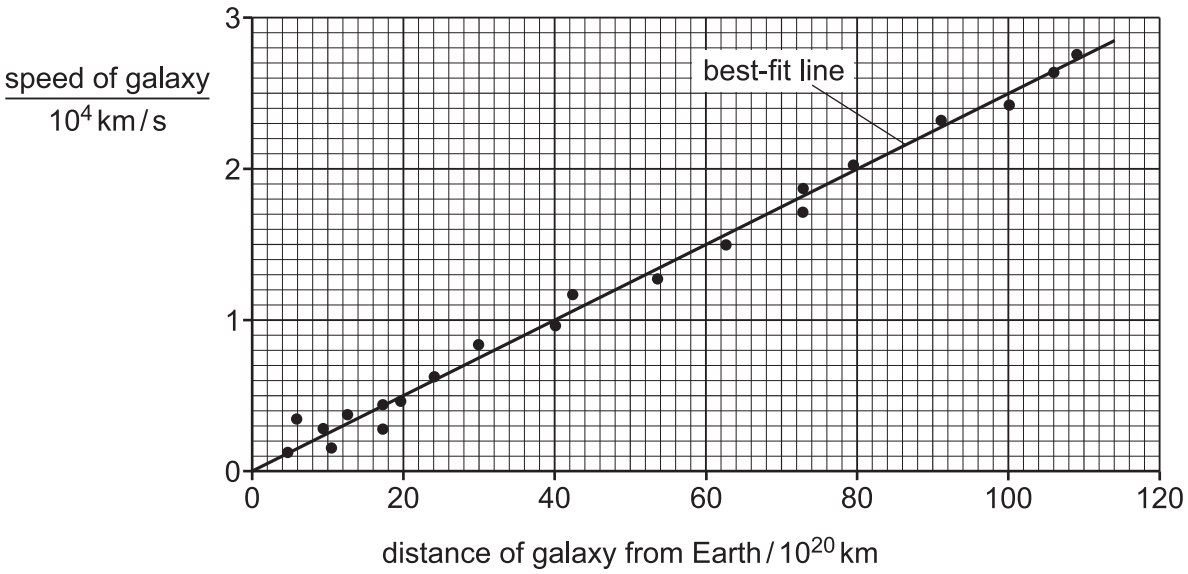


Fig. 10.1

A scientist draws a best-fit line on the scatter graph.

Use this best-fit line to determine a value for the Hubble constant.

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Hubble constant = ... [3]

(d) The speed of a receding galaxy can be estimated using redshift.

Describe what is meant by redshift.

.....

.....

.....

..... [2]

[Total: 8]

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