GCSE Physics

Solar System

Question Paper

Time available: 60 minutes
Marks available: 53 marks

1. (a) The Sun is a star.

Which galaxy is the Sun in?

Tick **one** box.

Cartwheel ☐

Milky Way ☐

Starburst ☐

Tadpole ☐

(1)

(b) Light takes 500 seconds to travel from the Sun to the Earth.

Light travels at 300 000 kilometres per second.

Calculate the distance between the Sun and the Earth.

Use the equation:

distance = speed × time

_____

_____

_____

_____

Distance = _____ kilometres

(2)

The table below gives information about some of the planets in our solar system.

The planets are in order of increasing distance from the Sun.

Planet	Time to orbit the Sun in years
Mercury	0.2
Venus	0.6
Earth	1.0
Mars	
Jupiter	12.0

(c) There are some planets in our solar system missing from the table above.

How many planets are missing?

_____

(1)

(d) Estimate how many years it takes Mars to orbit the Sun.

_____ years

(1)

(e) Calculate how many times Venus will orbit the Sun in 9 years.

_____

_____

_____

_____

In 9 years, Venus will orbit the Sun _____ times.

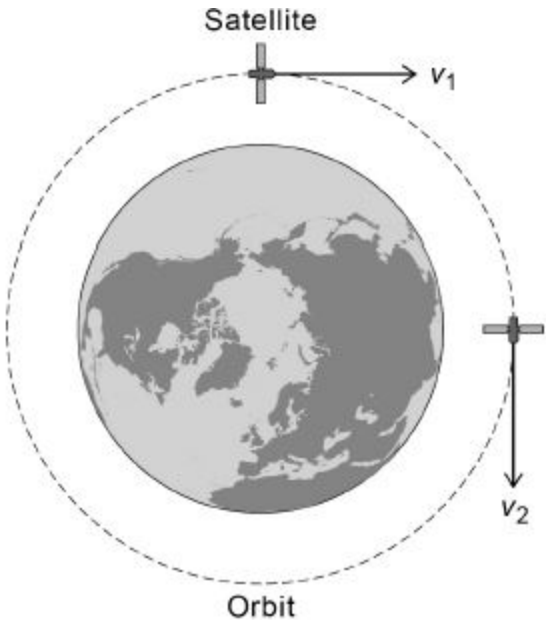
(2)

(Total 7 marks)

2. A satellite is in a circular orbit around the Earth.

Figure 1 shows the velocity of the satellite at two different positions in the orbit.

Figure 1

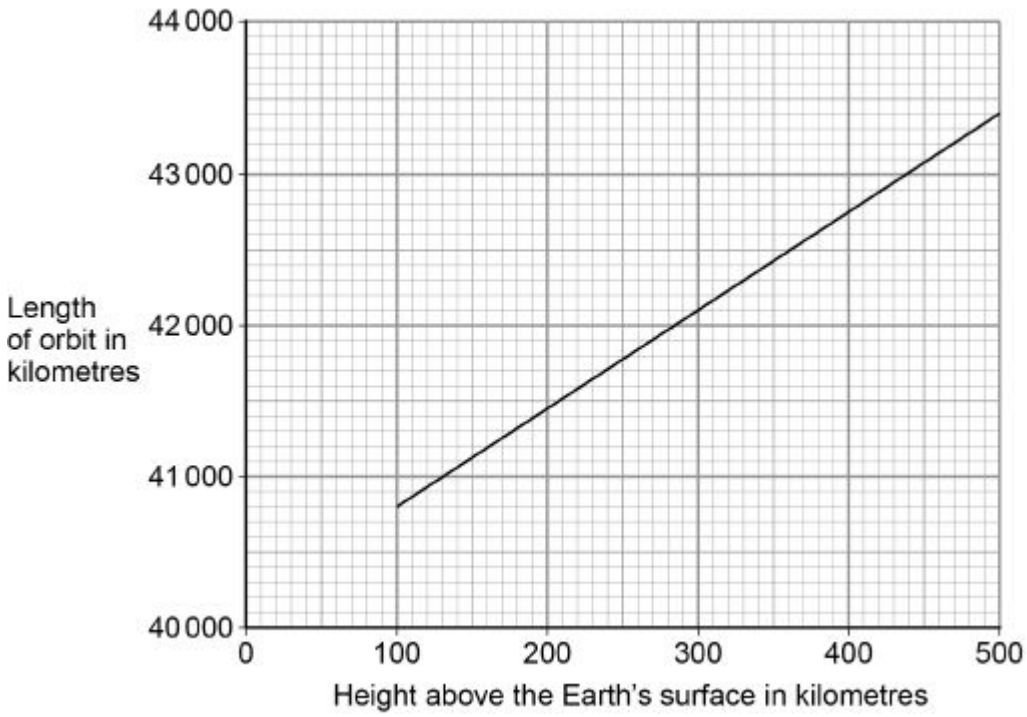


(a) Explain why the velocity of the satellite changes as it orbits the Earth.

(3)

(b) **Figure 2** shows how the length of a satellite orbit depends on the height of the satellite above the Earth's surface.

Figure 2



A satellite orbits 300 km above the Earth's surface at a speed of 7.73 km/s.

Calculate how many complete orbits of the Earth the satellite will make in 24 hours.

(5)

Number of complete orbits = _____

In 1772, an astronomer called J Bode developed an equation to predict the orbital radii of the planets around the Sun.

The table shows Bode's predicted orbital radii and the actual orbital radii for the planets that were known in 1772.

Planet	**Predicted orbital radius in millions of kilometres**	**Actual orbital radius in millions of kilometres**
Mercury	60	58
Venus	105	108
Earth	150	150
Mars	240	228
Jupiter	780	778
Saturn	1500	1430

(c) The predicted data can be considered to be accurate.

Give the reason why.

_____

_____

(1)

(d) J Bode used his equation to predict the existence of a planet with an orbital radius of 2940 million kilometres.

The planet Uranus was discovered in 1781.

Uranus has an orbital radius of 2875 million kilometres.

Explain why the discovery of Uranus was important.

_____

_____

_____

_____

(2)

(Total 11 marks)

3. (a) There are eight planets in orbit around the Sun.

Which other type of object orbits the Sun?

Tick **one** box.

Dwarf planet ☐

Galaxy ☐

Moon ☐

Star ☐

(1)

(b) Complete the sentences.

Choose the answers from the box.

black hole	**gravity**	**friction**
nebula	**protostar**	**upthrust**

The Sun was formed when a _____ in space was pulled together by _____ .

(2)

(c) The Sun has reached the Main Sequence stage in its lifecycle.

What stage in the lifecycle of the Sun will follow the Main Sequence stage?

_____

(1)

The table shows some data about the eight planets that orbit the Sun.

Planet	**Distance from the Sun compared to the Earth**	**Time to orbit the Sun in years**	**Mean surface temperature in °C**
Mercury	0.4	0.2	+125
Venus	0.7	0.6	+465
Earth	1.0	1.0	+22
Mars	1.5	1.9	–48
Jupiter	**X**	12	–108
Saturn	9.6	30	–180
Uranus	19.3	84	–216
Neptune	30.0	165	–201

(d) What pattern links the distance a planet is from the Sun and the time taken by the planet to orbit the Sun?

_____

_____

_____

(1)

(e) Estimate the value of **X** in the table.

Distance = _____

(1)

(f) A student looked at the data in the table and wrote the following conclusion:

'The mean surface temperature of a planet decreases the further the planet is from the Sun.'

Explain why this conclusion is **not** totally correct.

_____

_____

_____

_____

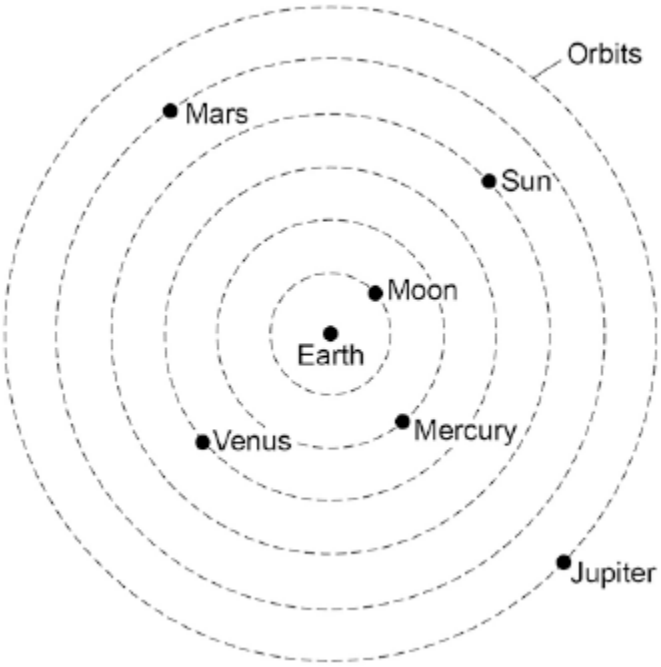
_____

_____

(3)

(Total 9 marks)

4. The figure below shows what scientists over 1000 years ago thought the solar system was like.



(a) Give **one** way that the historical model of the solar system shown in the figure above is different from what we now know about the solar system.

_____

_____

(1)

(b) Give **one** way that the solar system shown in the figure above is the same as what we now know about the solar system.

_____

_____

(1)

(c) The first artificial satellite to orbit the Earth was launched into space in 1957.

Describe the orbit of an artificial satellite.

_____

_____

(1)

(d) What provides the force needed to keep a satellite in its orbit?

Tick **one** box.

friction ☐

gravity ☐

tension ☐

(1)

(e) All stars go through a lifecycle.

The star Mira will go through a supernova stage in its lifecycle but the Sun will not.

How is the star Mira different to the Sun?

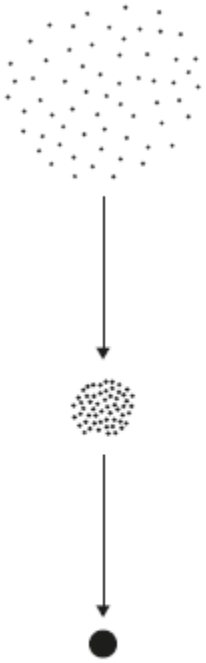
_____

_____

(1)

(Total 5 marks)

5. (a) The figure below shows how a star is formed.
Use **one** answer from each box to complete the sentences.



gas	rock	water

A star starts as a huge cloud of dust and _____ particles in space.

friction	fusion	gravity

The force of _____ pulls the particles in the cloud closer together.

protostar	red giant	white dwarf

The compressed mass of particles

forms a _____ .

(3)

(b) Elements heavier than iron are formed in a supernova.
What is a supernova?

Tick (✓) **one** box.

the explosion of a massive star ☐

a very bright, hot young star ☐

a very cool super giant star ☐

(1)

(c) Brown dwarf stars are small stars too cool to give out visible light. They were first discovered in 1995. Scientists think that there are millions of these stars spread throughout the Universe.

Which **one** of the following is the most likely reason why brown dwarf stars were not discovered before 1995?

Tick (✓) **one** box.

Brown dwarf stars did not exist before 1995. ☐

Scientists were looking in the wrong part of the Universe. ☐

The telescopes and measuring instruments were not sensitive enough. ☐

☐

(1)

(Total 5 marks)

6. (a) Brown dwarf stars are thought to have been formed in the same way as other stars.
They are too small for nuclear fusion reactions to take place in them.
Brown dwarf stars emit infrared radiation but are not hot enough to emit visible light.

(i) Describe how a star is formed.

_____

_____

_____

_____

(2)

(ii) Describe the process of nuclear fusion.

_____

_____

_____

(1)

(iii) Scientists predicted that brown dwarf stars existed before the first one was discovered in 1995.

Suggest **one** reason why scientists are now able to observe and identify brown dwarf stars.

_____

_____

_____

(1)

(b) In the 18th century some scientists suggested a theory about how the planets formed in the Solar System. The theory was that after the Sun formed, there were cool discs of matter rotating around the Sun. These cool discs of matter formed the planets. The scientists thought this must have happened around other stars too.

(i) Thinking about this theory, what would the scientists have predicted to have been formed in other parts of the Universe?

_____

_____

(1)

(ii) Since the 1980s scientists studying young stars have shown the stars to be surrounded by cool discs of rotating matter.

What was the importance of these observations to the theory the scientists suggested in the 18th century?

_____

_____

(1)

(c) The Earth contains elements heavier than iron.

Why is the presence of elements heavier than iron in the Earth evidence that the Solar System was formed from material produced after a massive star exploded?

_____

_____

(1)

(Total 7 marks)

7. The early Universe contained only the lightest element.

(a) Use the correct answer from the box to complete the sentence.

hydrogen	**iron**	**uranium**

The early Universe contained only _____ .

(1)

(b) Use the correct answer from the box to complete the sentence.

main sequence star	**protostar**	**supernova**

The heaviest elements are formed only in a _____ .

(1)

(c) Use the correct answer from the box to complete the sentence.

red giant	**red super giant**	**white dwarf**

Only a star much bigger than the Sun can become a _____ .

(1)

(d) The Universe now contains a large variety of different elements.

Describe how this happened.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 7 marks)