2021 ASSESSMENT MATERIALS

GCSE
PHYSICS

Physics Test 6: Space Physics (Higher)

Total number of marks: 36

0 5 . 1 The light from distant galaxies shows red-shift.

Complete the sentence.

[1 mark]

The term red-shift describes the observed increase

in the Wavelength of the light from a distant galaxy.

0 5 . 2 The Big Bang theory is one model used to explain the origin of the universe.

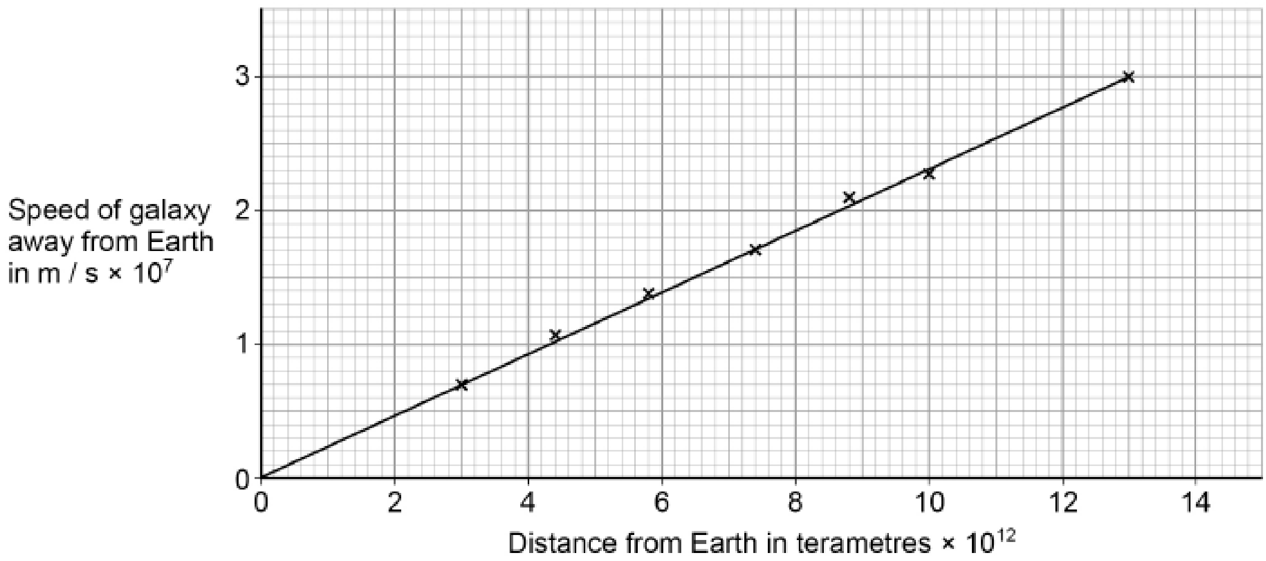
How does the Big Bang theory describe the universe when it began?

[1 mark]

It describes that the universe expanded from a very small, extremely hot and dense region.

Figure 9 shows data scientists have calculated from measurements of red-shift.

Figure 9



0 5 . 3 Describe the relationship between the speed of a galaxy and the distance the galaxy is from the Earth.

[1 mark]

They are directly proportional to each other.

0 5 . 4 Which of the following is the same as 6×10^{12} terametres?

[1 mark]

Tick (✓) **one** box.

6×10^{15} m	
6×10^{18} m	
6×10^{21} m	
6×10^{24} m	✓

0 5 . 5 Explain how the data in **Figure 9** supports the suggestion that the universe began from a very small region.

[2 marks]

Data describe that galaxies further away, move faster away from the Earth. This is also seen in explosions as they have faster moving particles furthest away from the source.

0 5 . 6 The Big Bang theory suggested that gravity would slow the rate at which galaxies move away from the Earth.

New observations suggest that distant galaxies are moving away from the Earth at an increasingly fast rate.

What do the new observations suggest is happening to the universe?

[1 mark]

The expansion of the universe is accelerating currently.

0 5 . 7 New observations and data that do not fit existing theories should undergo peer review.

Give **one** reason why peer review is an important process.

[1 mark]

There can be errors in the procedure followed that will not be realized.

0 5 . 8 The Andromeda galaxy is moving towards the Earth.

Describe how the wavelength and frequency of the light from Andromeda seem to have changed when viewed from the Earth.

[2 marks]

The wavelength seems to have decreased and the frequency increased due to Doppler's effect.

0 2 . 1 Complete the sentences.

[2 marks]

The Sun is a stable star. This is because the forces pulling inwards caused by

gravity are in equilibrium with the forces pushing outwards caused

by the energy released by nuclear fusion.

0 2 . 4 Some stars are much more massive than the Sun.

Describe the life cycle of stars much more massive than the Sun, including the formation of new elements.

[6 marks]

0 2 . 5 Stars emit radiation with a range of wavelengths.

Which property of a star does the range of wavelengths depend on?

[1 mark]

Tick (✓) **one** box.

Density	☐
Mass	☐
Temperature	☑
Volume	☐

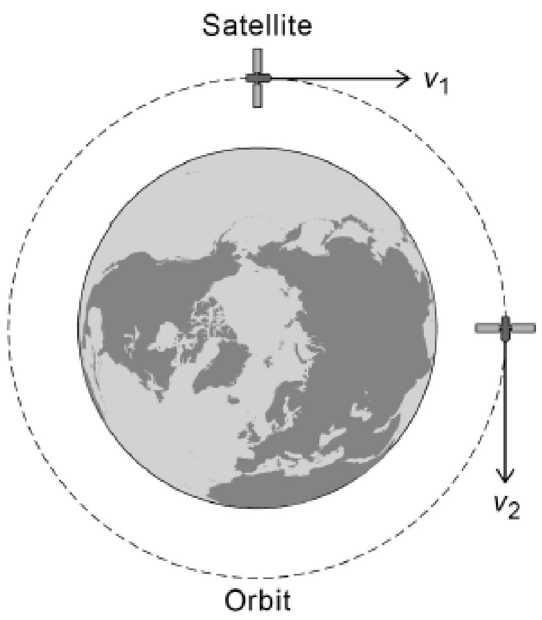
2.4 Answer

The star is formed from a cloud of dust and gas (nebula) which mainly consists of hydrogen. Gravity pulls the dust and gas together and when the mass is hot enough it becomes a protostar. The hydrogen nuclei fuse together to make helium and this keeps the core hot. The next stage is the main sequence star which is the stable phase in star's life as the gravity holding the star together is balanced by the high pressure due to the high temperature. When all the hydrogen is used up, larger nuclei form (up to iron) and the star expands to become a red super giant. The star keeps expanding till it explodes in a supernova. Depending on the mass, the supernova leaves behind a black hole or a neutron star.

0 8 A satellite is in a circular orbit around the Earth.

Figure 14 shows the velocity of the satellite at two different positions in the orbit.

Figure 14



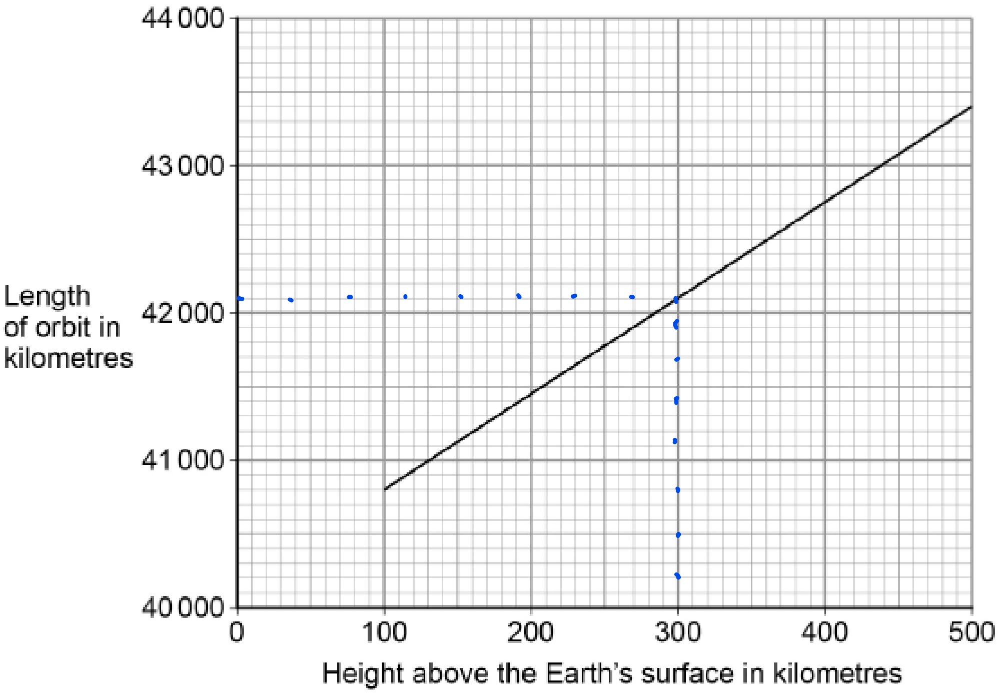
0 8 . 1 Explain why the velocity of the satellite changes as it orbits the Earth.

[3 marks]

Gravity causes the satellite to accelerate towards the Earth which causes a change in direction. Velocity is a vector and depends on the magnitude and direction. Hence, the velocity changes as the direction of the satellite changes.

0 8 . 2 **Figure 15** shows how the length of a satellite orbit depends on the height of the satellite above the Earth's surface.

Figure 15



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 marks]

$s = \frac{d}{t}$

$7.73 = \frac{42100}{t}$

$t \approx 5446\,s$

$\frac{24 \times 3600}{5446} \approx 15.9$

Number of complete orbits = 16

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

Table 3 shows Bode's predicted orbital radii and the actual orbital radii for the planets that were known in 1772.

Table 3

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

0 8 . 3 The predicted data can be considered to be accurate.

Give the reason why.

[1 mark]

They are acceptably close to the actual value.

0 8 . 4 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 marks]

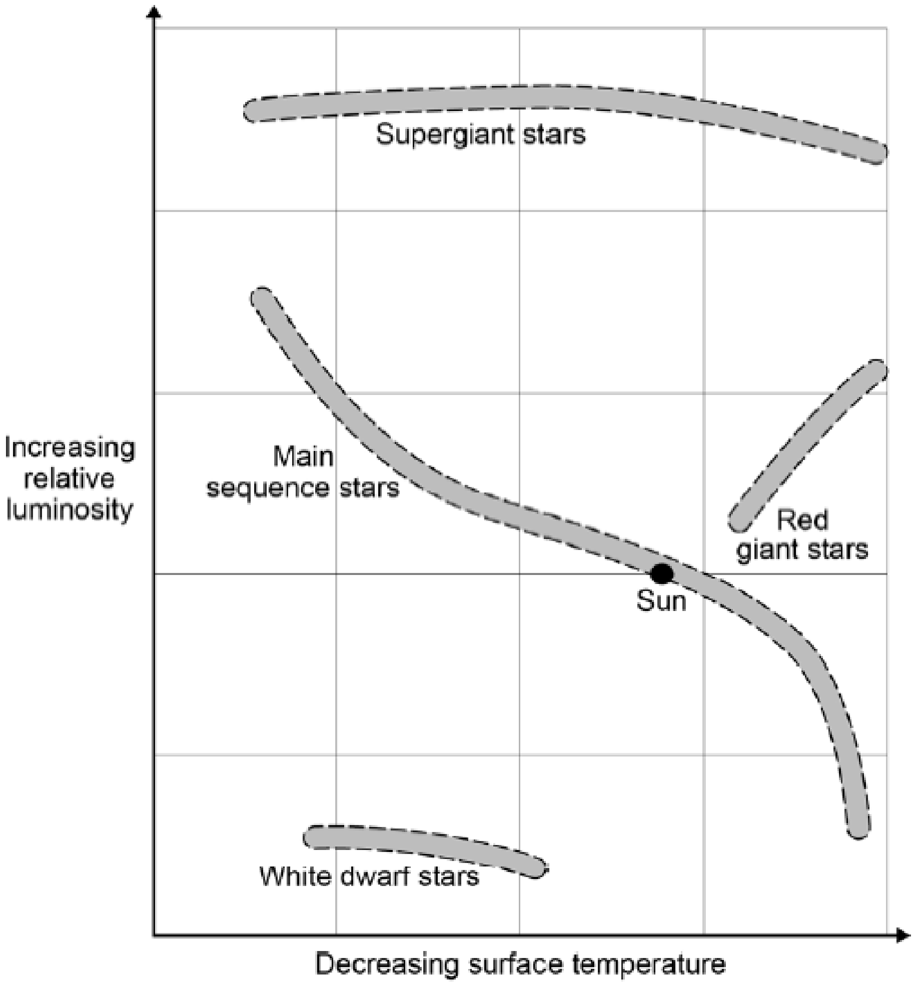
It supported J Bodes's prediction and provided more evidence that his equation works.

Figure 7 shows four groups of stars.

The surface temperature and relative luminosity determine which group a star is in.

A star with a relative luminosity of 1 emits the same amount of energy every second as the Sun.

Figure 7



0 4 . 7 The Sun is in the group of main sequence stars. These stars are stable.

Explain why a star remains stable.

[2 marks]

As the inward force due to gravity is balanced by the outward force due to nuclear fusion.

0 4 . 8 At different points in their lifecycle stars change from one group to another.

Describe what will happen to the Sun between it leaving the main sequence group and becoming a white dwarf.

Use information from **Figure 7**.

[4 marks]

The surface temperature decreases and luminosity increases as the sun changes to a red giant and then the surface temperature increases and luminosity decreases as the sun changes to a white dwarf.