Name:

Date:

P8 - Test 5
SPACE PHYSICS
Advanced

GCSE

PHYSICS

AQA - Triple Science

Mark

Grade

Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

Instructions

- Answer all questions
- Answer questions in the space provided
- All working must be shown

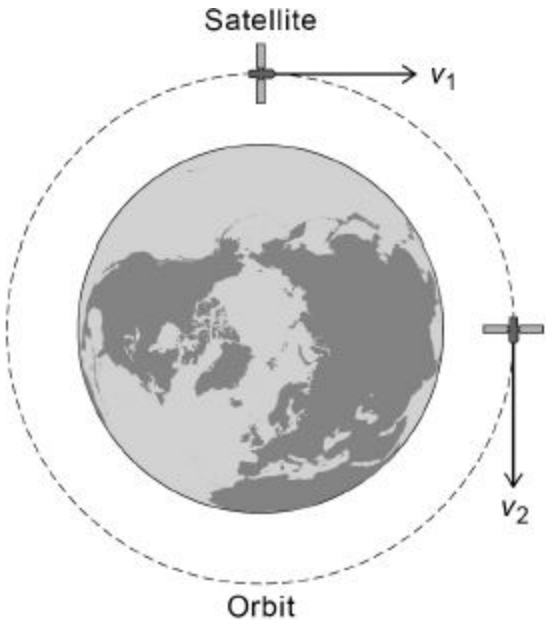
Information

- The marks for the questions are shown in brackets

1. 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

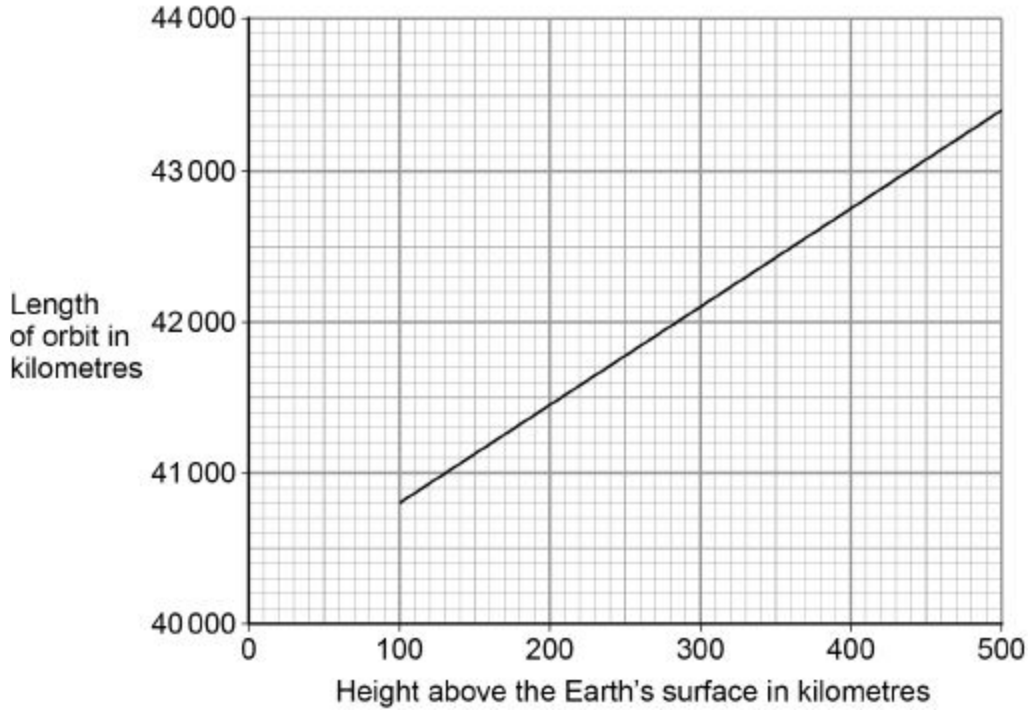


(a) Explain why the velocity of the satellite changes as it orbits the Earth.

(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.

Number of complete orbits = _____

(5)

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)

2. The ‘steady state’ theory was once a popular alternative to the ‘big bang’ theory.

The ‘steady state’ theory suggested that the universe, although expanding, had no origin and it has always existed. As the universe expands, a small amount of matter is created to keep the universe looking exactly the same all of the time.

(a) When considering the origin of the universe, what is the difference between the ‘big bang’ theory and the ‘steady state’ theory?

_____

_____

_____

_____

(2)

(b) The light from distant galaxies shows a *red-shift*.

(i) What is *red-shift*?

_____

_____

(1)

(ii) Why does red-shift provide evidence to support both the ‘big-bang’ theory and the ‘steady state’ theory?

_____

_____

_____

_____

(2)

(c) The ‘steady state’ theory was important in encouraging new research into the universe.

Suggest a reason why scientists were keen to carry out new research.

_____

_____

(1)

(d) Scientists can answer many questions about the universe, but not the question:

'Why was the universe created?'

Suggest a reason why this question cannot be answered by scientists.

_____

_____

(1)

(Total 7 marks)

3. The Big Bang theory attempts to explain the origin of the Universe.

(i) What is the Universe?

_____

_____

(1)

(i) What are the main ideas of the Big Bang theory?

_____

_____

_____

(2)

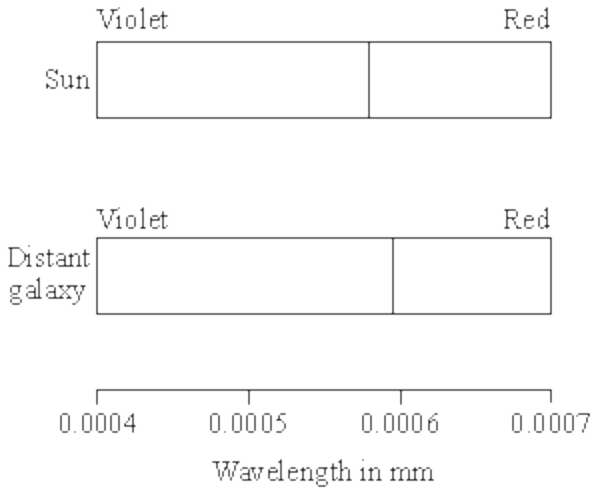
(iii) What is thought to be happening to the size of the Universe?

_____

(1)

(Total 4 marks)

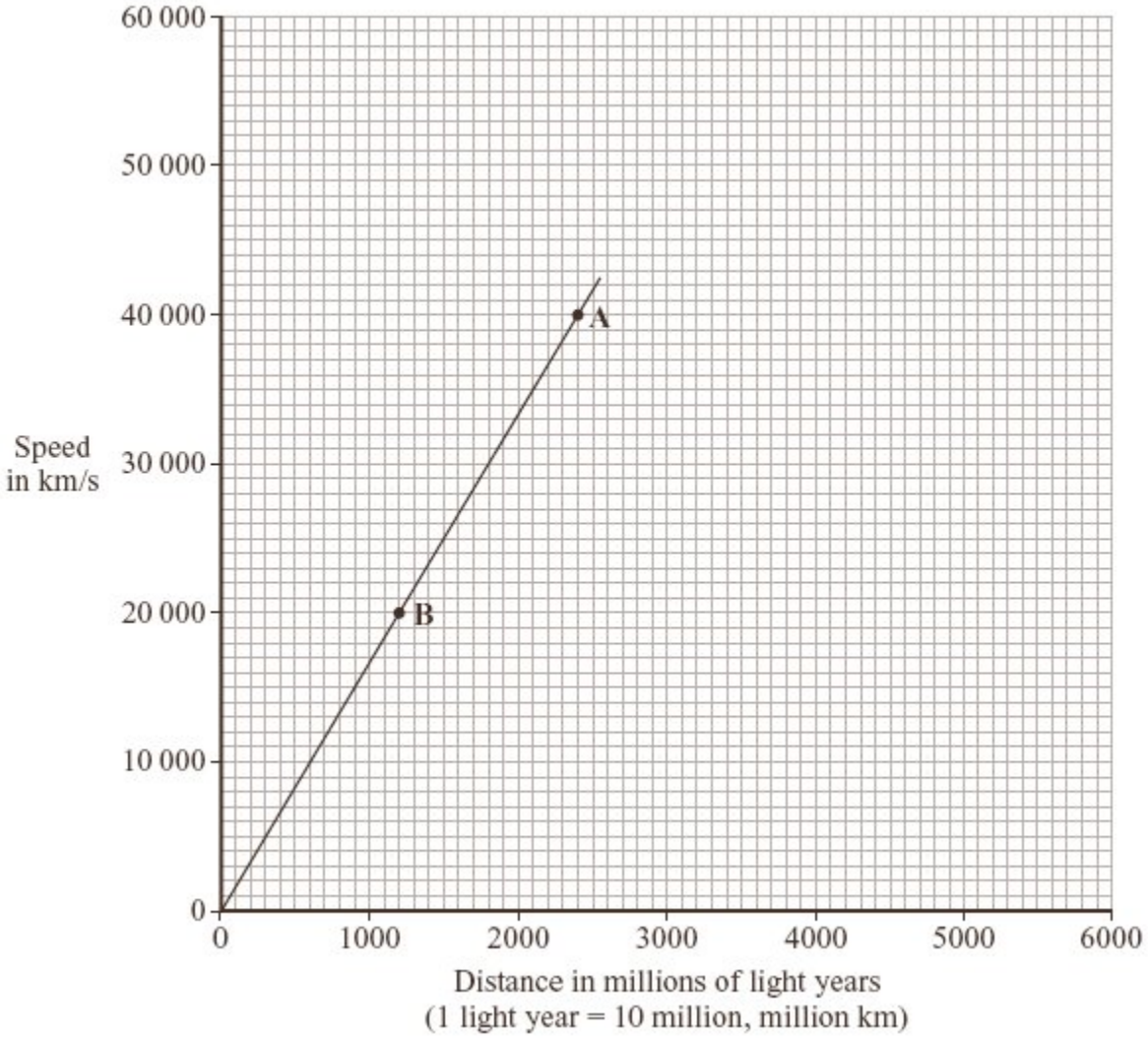
4. The visible part of the electromagnetic spectrum from a star includes a dark line. This line is at a specific wavelength. The diagram shows the position of the dark line in the spectrum from the Sun and in the spectrum from a distant galaxy.



(a) Explain how the spectrum 'shift' of the dark line supports the theory that the Universe began from a very small point.

(3)

(b) From data collected, a graph can be drawn that links the speed of a galaxy with the distance of the galaxy from the Earth.



(i) How does the visible light spectrum from galaxy **A** look different from the visible light spectrum from galaxy **B**?

_____

_____

(1)

(ii) A third galaxy, **C**, seems to be travelling away from the Earth at about 60 000 km/s.

Estimate how far galaxy **C** might be from the Earth, showing how you use the graph to do this.

_____

_____

Distance between galaxy **C** and the Earth = _____ million light years

(2)

(Total 6 marks)

5. Stars do not stay the same forever.

(a) Over billions of years the amount of hydrogen in a star decreases. Why?

_____

_____

(1)

(b) Describe how a massive star (at least five times bigger than the Sun) will change at the end of the main stable period.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) The inner planets of the solar system contain atoms of the heaviest elements.

(i) Where did these atoms come from?

_____

_____

(1)

(ii) What does this tell us about the age of the solar system compared with many of the stars in the Universe?

_____

(1)

(Total 7 marks)

6. (a) Satellites fitted with various telescopes orbit the Earth. These telescopes detect different types of electromagnetic radiation.

Why are telescopes that detect different types of electromagnetic waves used to observe the Universe?

_____

_____

(1)

(b) In 2005 a space telescope detected a star that exploded 13 billion years ago. The light from the star shows the biggest *red-shift* ever measured.

(i) What is *red-shift*?

_____

_____

(1)

(ii) What does the measurement of its red-shift tell scientists about this star?

_____

_____

(1)

(c) Red-shift provides evidence for the 'big bang' theory.

(i) Describe the 'big bang' theory.

_____

_____

_____

_____

(2)

(ii) Suggest what scientists should do if new evidence were found that did not support the 'big bang' theory.

_____

_____

_____

(1)

(Total 6 marks)

7. Read the passage.

> In the SolarSystem, the inner planets, such as the Earth, contain elements which are eavierthan the elements hydrogen and helium.
>
> Our star,the Sun, is a medium sized star. If a star is much more massive than the Sunit will eventually swell into a red giant, start to contract, continue tocontract and finally explode.

(a) What is the explosion called?

_____

(1)

(b) Explain why scientists believe that the Solar System was formed from the material produced when earlier stars exploded.

_____

_____

_____

_____

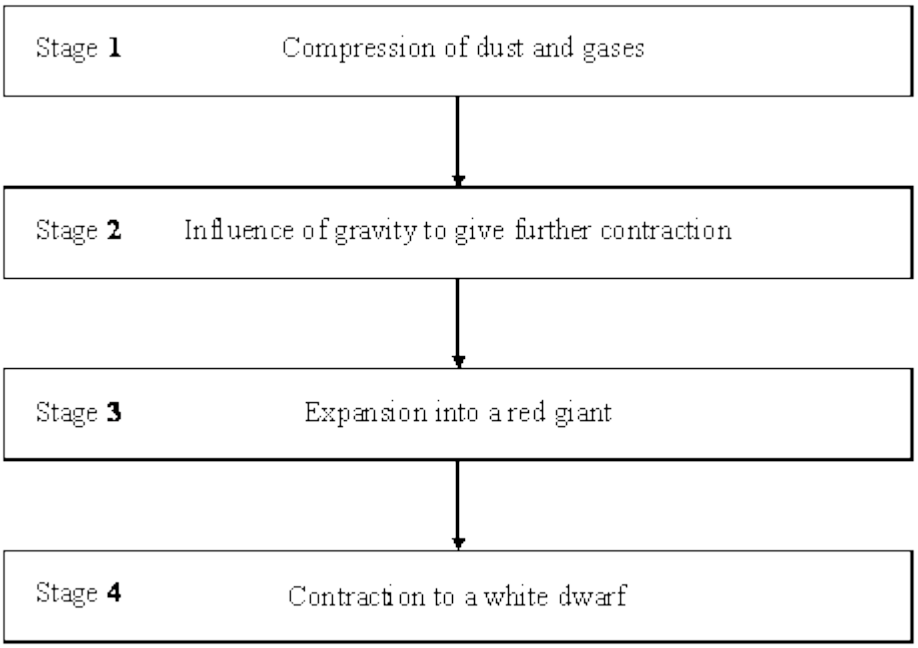
_____

_____

(3)

(Total 4 marks)

8. The flowchart shows four stages thought to occur in the evolution of a star such as our Sun.



At a particular time a star might have reached one of these stages or be between stages or be at a further stage. What period in its evolution has our star, the Sun, reached?

_____

(Total 1 mark)

9. (a) Our star, the Sun, is stable.

Explain what the conditions need to be for a star to remain stable.

_____

_____

_____

_____

_____

_____

(2)

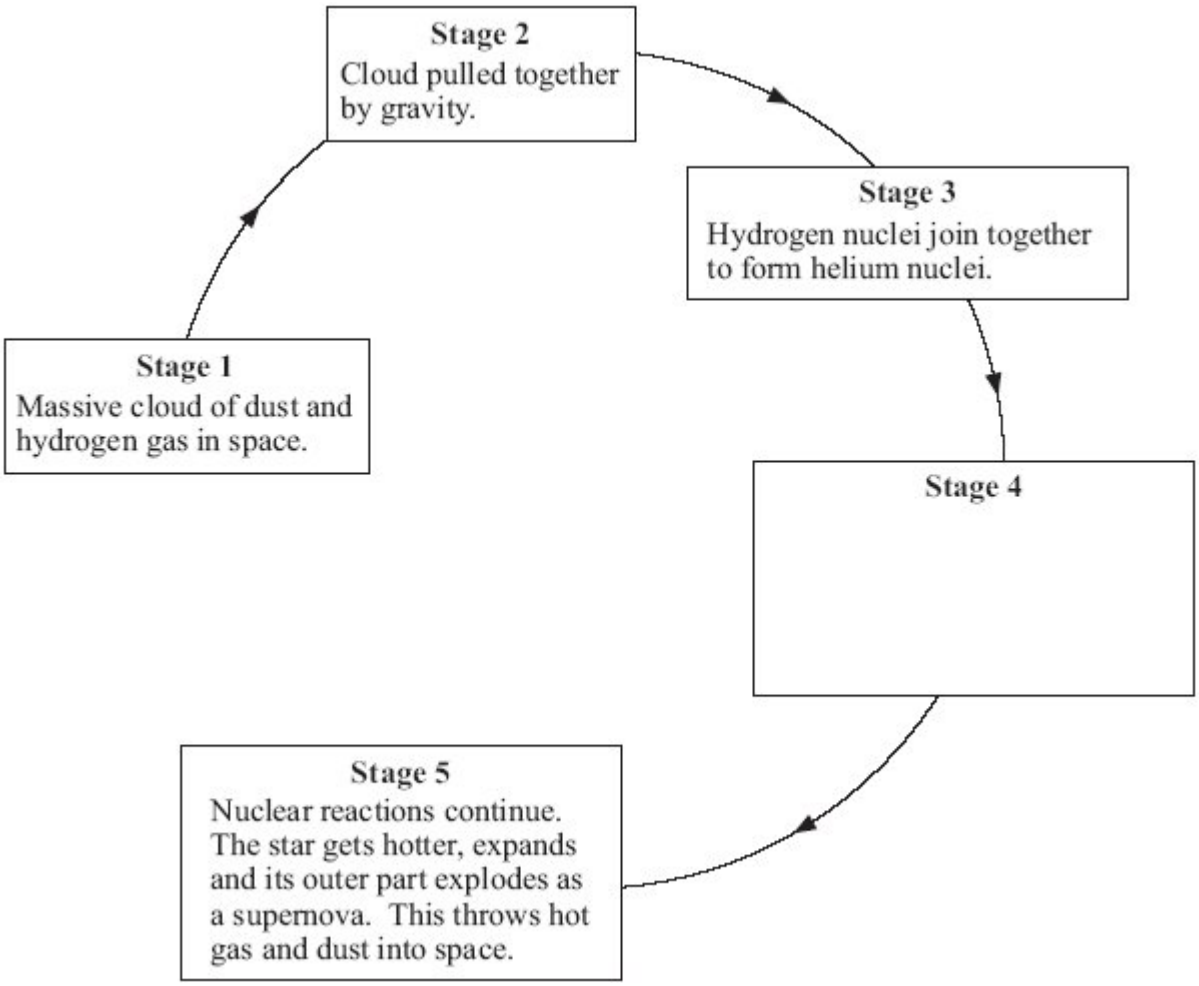
(b) Shortly after the 'big bang', hydrogen was the only element in the Universe.

Explain how the other elements came to be formed.

(3)

(Total 5 marks)

10. The diagram shows part of the life cycle of a star which is much bigger than the Sun.



(a) (i) What is the relationship between the masses of the dust and gas in the cloud in **Stage 2** and the force of gravity between them?

_____

_____

(1)

(ii) What is the relationship between the distance apart of the dust and gas in the cloud in **Stage 2** and the force of gravity between them?

_____

_____

(1)

(b) In **Stage 3** the star remains stable for millions of years.

Explain why.

_____

_____

_____

_____

_____

(2)

(c) What happens in **Stage 4**?

_____

_____

_____

_____

_____

(2)

(Total 6 marks)

11. Read this statement from a website.

> Immediately after the 'big bang', at the start of the Universe, there were only atoms of the element hydrogen (H).
>
> Now the Universe contains atoms of over one hundred elements.

(a) Explain how atoms of the element helium (He) are formed in a star.

_____

_____

_____

_____

(2)

(b) Explain how atoms of very heavy elements, such as gold (Au), were formed.

_____

_____

_____

_____

(2)

(c) Explain how, and when, atoms of different elements may be distributed throughout the Universe.

_____

_____

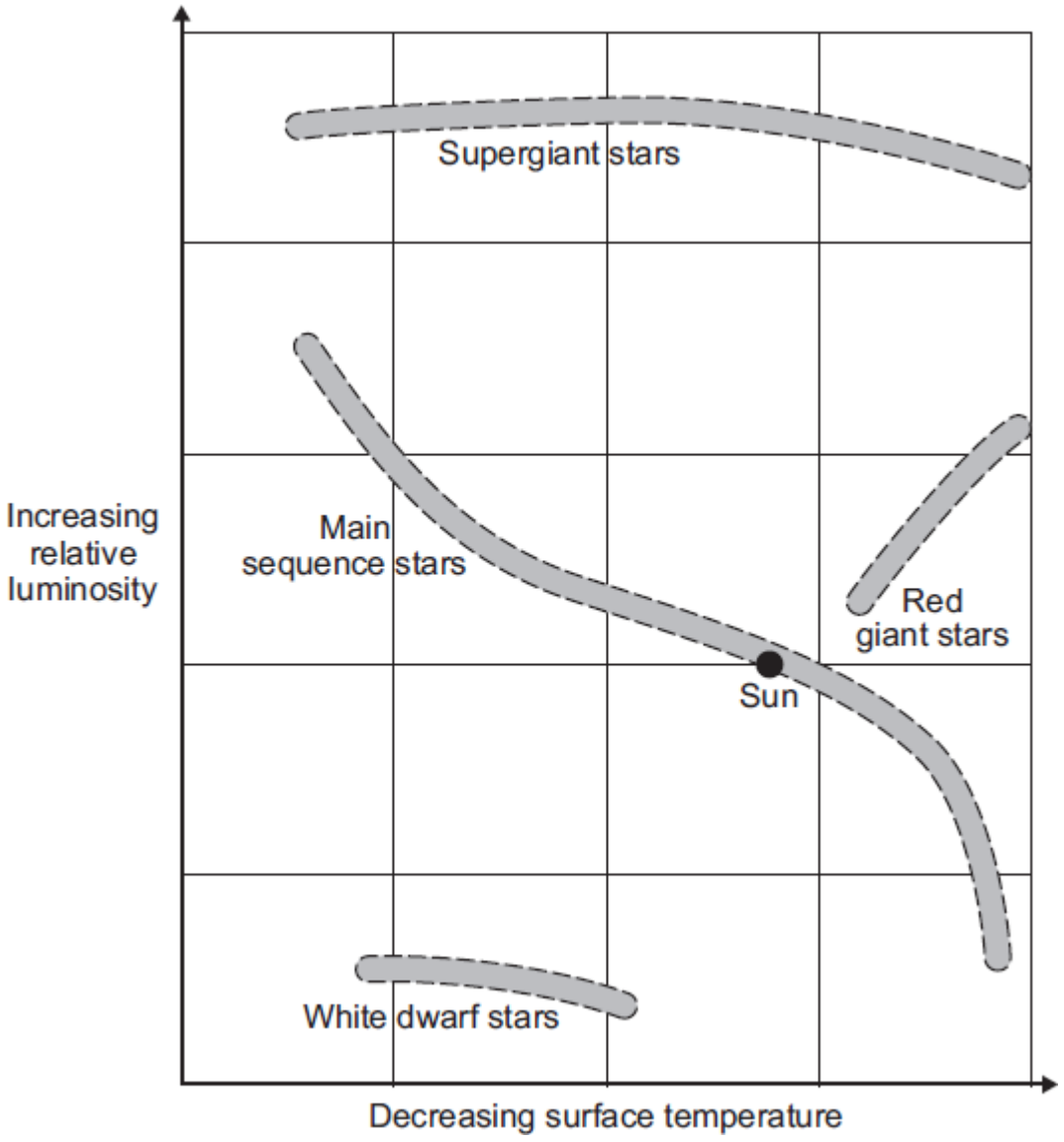
_____

_____

(2)

(Total 6 marks)

12. The diagram, drawn below, places stars in one of four groups.
Where a star is placed on the diagram is determined by the surface temperature and relative luminosity of the star.
A star with a relative luminosity of 1, emits the same amount of energy every second as the Sun.



(a) The Sun will spend most of its life cycle as a main sequence star. This is the stable period of the Sun's life cycle.

What happens to cause the stable period in the life cycle of a star to end?

_____

_____

(1)

(b) Use the information in the diagram to describe what will happen to the Sun after the stable period ends.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 4 marks)

13. Optical telescopes may be used to observe galaxies. Some optical telescopes are on the Earth and some are on satellites in space.

Scientists have observed that the wavelengths of the light from galaxies moving away from the Earth are longer than expected. This observation is called red-shift.

(i) What does the size of the red-shift tell the scientists about the distance a galaxy is from the Earth?

_____

_____

(1)

(ii) Complete the following passage.

Red-shift provides evidence to support the 'big bang' theory. The 'big bang' theory is

one of the ways of explaining the _____ of the Universe.

(1)

(Total 2 marks)