



## Space Questions 1

35 Questions

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

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Time:

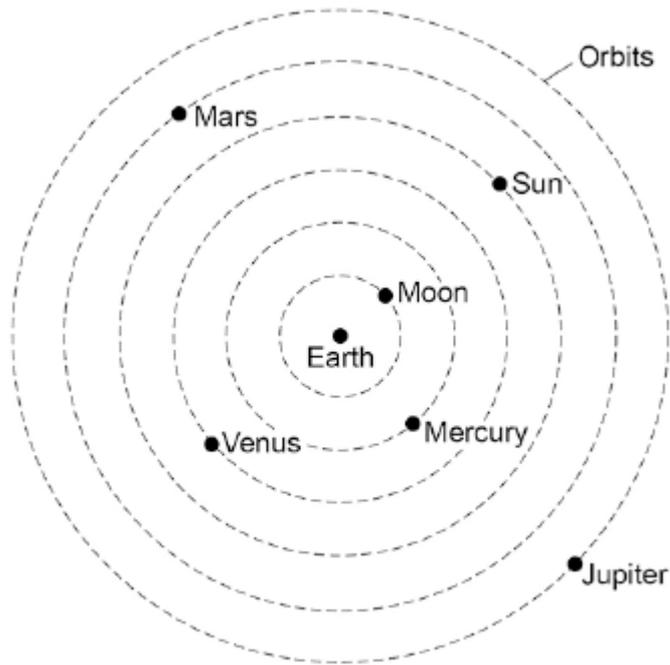
Marks:

Comments:

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**Q1.**

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.

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(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.

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(1)

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

Describe the orbit of an artificial satellite.

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(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?

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(1)

(Total 5 marks)

## Q2.

In 1929, the astronomer Edwin Hubble observed that the light from galaxies moving away from the Earth had longer wavelengths than expected.

- (a) What name is given to this effect?

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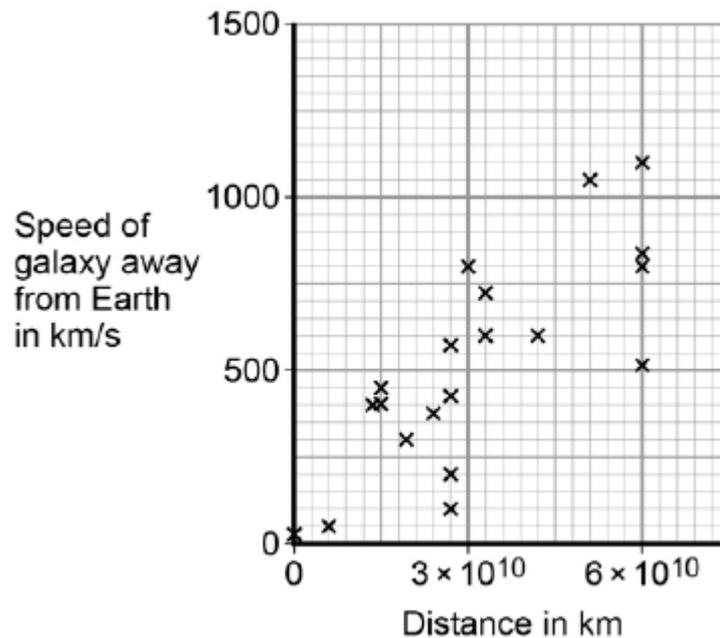
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(1)

- (b) From his observations, Hubble was able to calculate the speed of a galaxy and the distance of the galaxy from the Earth.

**Figure 1** shows the results of Hubble's calculations.

**Figure 1**



What relationship between the speed of a galaxy and the distance is suggested by Hubble's results?

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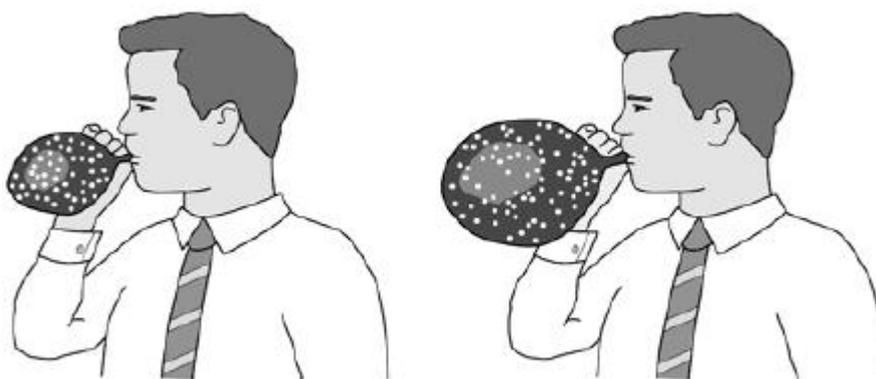
(1)

The observations made by Hubble support the idea that the Universe is expanding. This means that galaxies are continually moving away from each other and from the Earth.

**Figure 2** shows a student using a balloon to model the idea of an expanding Universe.

Some dots, which represent galaxies, were marked on the balloon. The balloon was then inflated.

**Figure 2**



- (c) Give **one** strength and **one** weakness of this model in representing the idea of an expanding Universe.

Strength \_\_\_\_\_

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Weakness \_\_\_\_\_

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(2)

In the 1950s there were two main theories to explain how the Universe began.

**Theory 1**

The Universe has always existed, it is continually expanding. New galaxies are formed as older galaxies die out.

**Theory 2**

The Universe began from a very small region that was extremely hot and dense. The Universe has been expanding ever since.

- (d) In what way do the observations made by Hubble support both Theory 1 and Theory 2?

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(1)

- (e) Most scientists now believe that Theory 2 is correct.  
Suggest what is likely to have caused scientists to start thinking Theory 1 is wrong.

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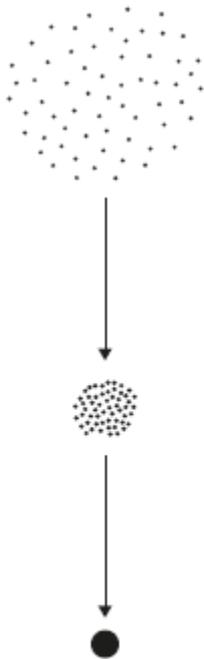
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(1)

(Total 6 marks)

**Q3.**

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



gas	rock	water
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A star starts as a huge cloud of dust and \_\_\_\_\_ particles in space.

friction	fusion	gravity
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The force of \_\_\_\_\_ pulls the particles in the cloud closer together.

protostar	red giant	white dwarf
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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)

#### Q4.

- (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.

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(2)

- (ii) Describe the process of nuclear fusion.

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(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.

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(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?

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(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?

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(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?

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(1)

(Total 7 marks)

### Q5.

The early Universe contained only the lightest element.

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

hydrogen	iron	uranium
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The early Universe contained only \_\_\_\_\_.

(1)

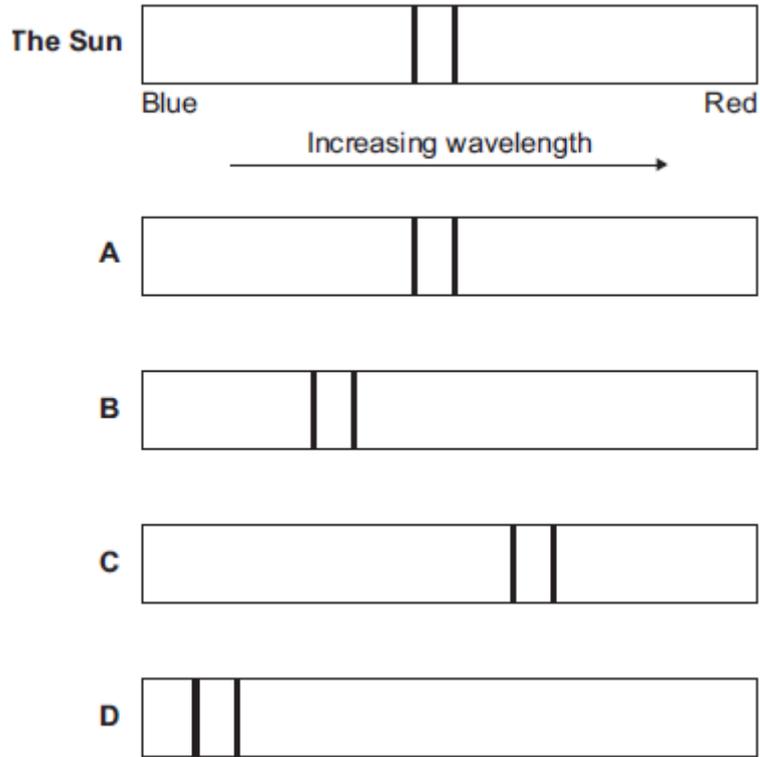
(b) Use the correct answer from the box to complete the sentence.

main sequence star	protostar	supernova
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The heaviest elements are formed only in a \_\_\_\_\_.

(1)





(i) Which star, **A**, **B**, **C** or **D**, is moving away from the Earth?

(1)

(ii) How does the speed of star **B** compare with the speed of star **D**?

Tick (✓) **one** box.

	Tick (✓)
The speed of star <b>B</b> is greater than the speed of star <b>D</b> .	<input type="checkbox"/>
The speed of star <b>B</b> is less than the speed of star <b>D</b> .	<input type="checkbox"/>
The speed of star <b>B</b> is the same as the speed of star <b>D</b> .	<input type="checkbox"/>

(1)

(b) A radio wave is emitted by a star.  
The radio wave has a wavelength of 1500 m and a frequency of 200 000 Hz.

Calculate the speed of this radio wave.

Choose the correct unit from the list below.

**m      m / s      m / s<sup>2</sup>**

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Speed = \_\_\_\_\_ unit \_\_\_\_\_

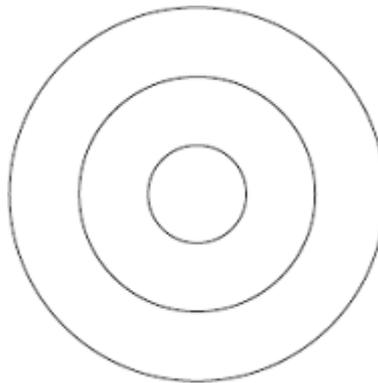
(3)  
(Total 5 marks)

**Q7.**

A teacher demonstrates the production of circular waves in a ripple tank.

**Diagram 1** shows the waves at an instant in time.

**Diagram 1**



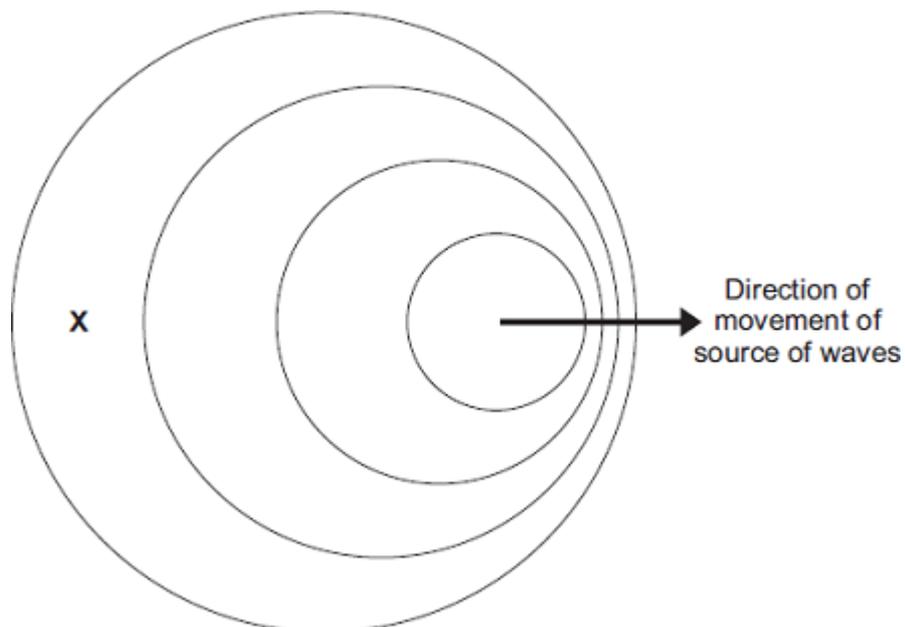
(a) Show on **Diagram 1** the wavelength of the waves.

(1)

(b) The teacher moves the source of the waves across the ripple tank.

**Diagram 2** shows the waves at an instant in time.

**Diagram 2**  
(Actual size)



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

decreased	increased	stayed the same
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In **Diagram 2**, the observed wavelength of the waves at **X** has \_\_\_\_\_ .

In **Diagram 2**, the frequency of the waves at **X** has \_\_\_\_\_ .

(2)

(ii) Take measurements from **Diagram 2** to determine the wavelength of the waves received at **X**.

Give the unit.

\_\_\_\_\_  
\_\_\_\_\_

Wavelength = \_\_\_\_\_

(3)

(c) The teacher uses the waves in the ripple tank to model the changes in the wavelengths of light observed from distant galaxies.

When observed from the Earth, there is an increase in the wavelength of light from distant galaxies.

(i) State the name of this effect.

\_\_\_\_\_

(1)

(ii) What does this increase in wavelength tell us about the movement of most galaxies?

\_\_\_\_\_  
\_\_\_\_\_

(1)

(iii) Explain how this observation supports the Big Bang theory of the formation of the Universe.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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(4)

(iv) State **one** other piece of evidence that supports the Big Bang theory of the formation of the Universe.

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(1)

(Total 13 marks)

**Q8.**

Astronomers claim that there are about 300 billion stars in the Milky Way.

(a) Describe how stars are formed.

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(3)

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

<b>decay</b>	<b>fission</b>	<b>fusion</b>
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Energy is released in stars by the process of nuclear \_\_\_\_\_ .

(1)

(c) State why a star is stable during the 'main sequence' period of its life cycle.

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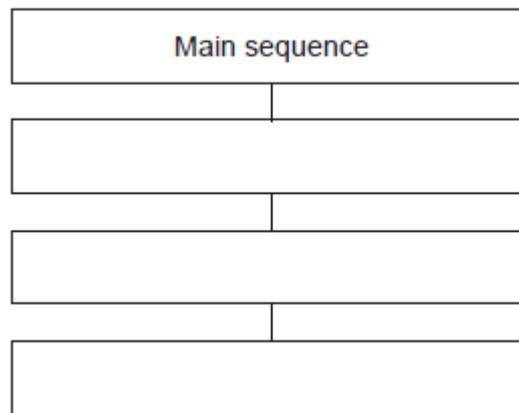
(1)

(d) The life cycle of a star after the 'main sequence' period depends on the size of the star.

A particular star is the same size as the Sun.

What are the stages, after the main sequence, in the life cycle of this star?

State them in order by writing in the boxes.



(3)  
(Total 8 marks)

**Q9.**

(a) **Figure 1** shows the life cycle of a very large star.

Use the correct answers from the box to complete the sentences in **Figure 1**.

main sequence star	neutron star	supernova	white dwarf
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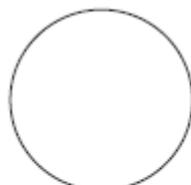
**Figure 1**



Gas and dust join together to become a protostar.

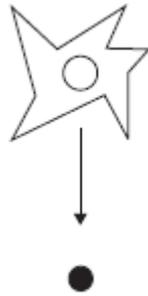


The star is stable as a \_\_\_\_\_.



The star expands to become a red super giant.





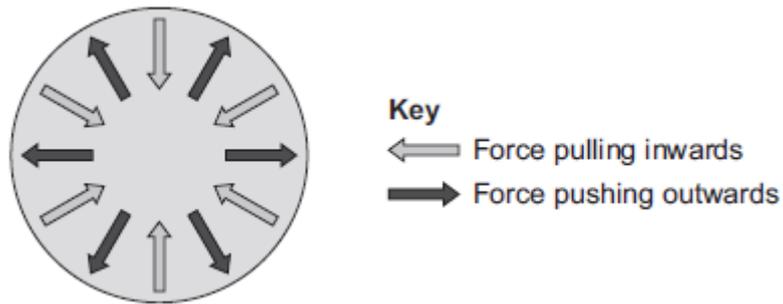
The outer layers of the star explode as a \_\_\_\_\_ .

The core of the star shrinks and a black hole is formed.

(2)

(b) **Figure 2** shows the forces acting on a star when the star is stable.

**Figure 2**



Draw a ring around the correct answer to complete the sentence.

When a star is stable, the forces pushing outwards are  
the forces pulling inwards.

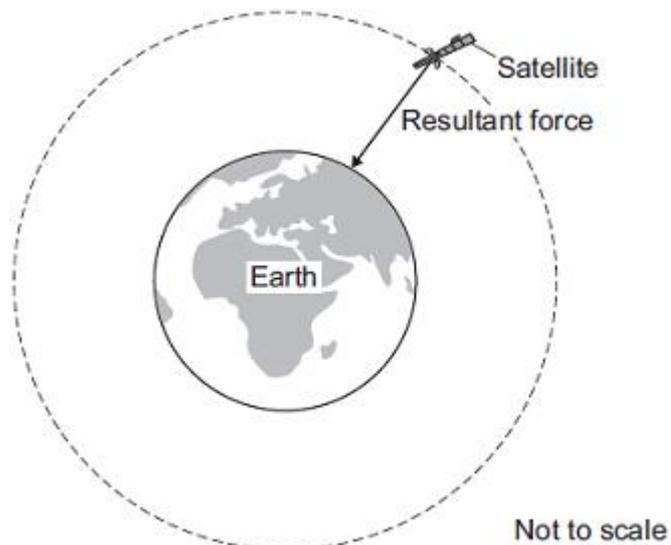
bigger than
smaller than
balanced by

(1)

(Total 3 marks)

**Q10.**

Man-made satellites can orbit the Earth, as shown in the figure below.



The satellite experiences a resultant force directed towards the centre of the orbit.

The resultant force is called the centripetal force

- (a) What provides the centripetal force on the satellite?

\_\_\_\_\_ (1)

- (b) State **two** factors that determine the size of the centripetal force on the satellite.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2)

- (c) The table below gives data for five different satellites orbiting the Earth.

Satellite	Average height above Earth's surface in kilometres	Time taken to orbit Earth once in minutes	Mass of satellite in kilograms
A	370	93	419 000
B	697	99	280
C	827	103	630
D	5 900	228	400
E	35 800	1440	2 030

- (i) State the relationship, if any, between the height of the satellite above the Earth's surface and the time taken for the satellite to orbit the Earth once.

\_\_\_\_\_  
\_\_\_\_\_

(1)

- (ii) State the relationship, if any, between the time taken for the satellite to orbit the Earth once and the satellite's mass.

\_\_\_\_\_  
\_\_\_\_\_

(1)

- (d) Over 300 years ago, the famous scientist Isaac Newton proposed, with a 'thought experiment', the idea of satellites.

Newton suggested that if an object was fired at the right speed from the top of a high mountain, it would circle the Earth.

Why did many people accept Isaac Newton's idea as being possible?

Tick (✓) **one** box.

Isaac Newton was a respected scientist who had made new discoveries before.

Isaac Newton went to university.

It was a new idea that nobody else had thought of before.

(1)

(Total 6 marks)

**Q11.**

(a) Observation of the spectra from distant galaxies provides evidence to support the 'Big Bang' theory.

(i) Complete the following sentence.

Many scientists think that the 'Big Bang' theory describes the \_\_\_\_\_

\_\_\_\_\_

(1)

(ii) Tick (✓) **one** box to complete the sentence.

The discovery of cosmic microwave background radiation was important because it ...

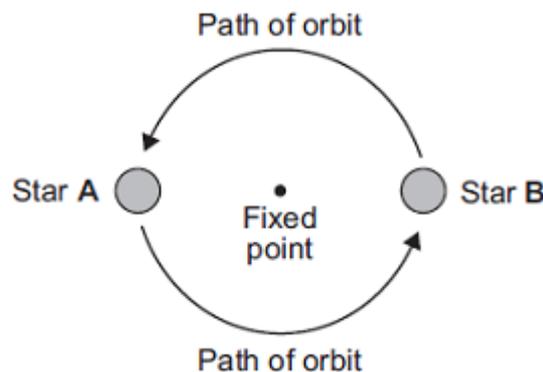
proved the 'Big Bang' theory to be correct.

provided more evidence to support the 'Big Bang' theory.

proved the Universe will continue to expand forever.

(1)

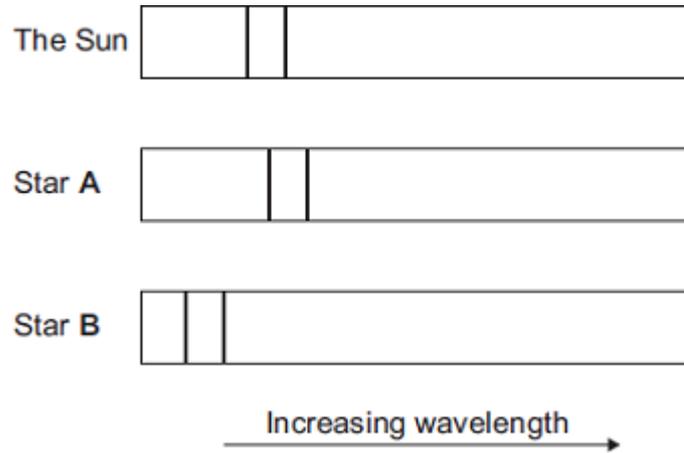
(b) Many stars are part of a binary star system. Binary star systems have two stars.



The visible spectrum from stars includes dark lines. These lines are at specific

wavelengths.

The diagram shows the position of two dark lines in the spectrum from the Sun. It also shows the same lines in the spectra from two stars **A** and **B** in a binary star system at the same point in time.



- (i) What name is given to the effect shown in the spectrum from star **A**?

\_\_\_\_\_

(1)

- (ii) Scientists have concluded that the two stars in a binary star system orbit around a fixed point between the two stars.

A comparison of the spectra from the two stars in a binary star system provides evidence to support this conclusion.

Explain how.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(3)

(Total 6 marks)

### Q12.

- (a) Scientists have observed that the wavelengths of the light from galaxies moving away from the Earth are longer than expected.

- (i) What name is given to this observation?

\_\_\_\_\_

(1)

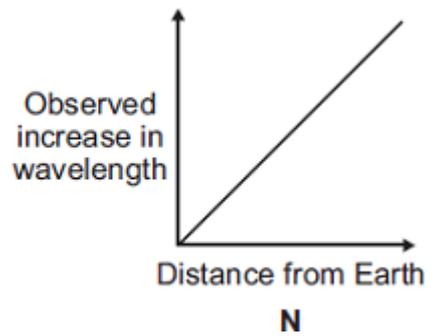
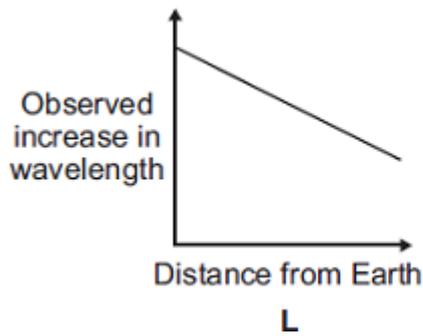
(ii) Draw a ring around the correct answer to complete each sentence.

This observation gives scientists evidence that

- |  |
|--|
| light can be stretched.<br>galaxies are changing colour.<br>the Universe is expanding. |
|--|

(1)

(iii) There is a pattern linking the size of the observed increase in the wavelengths of light from a galaxy and the distance the galaxy is from the Earth.



Which **one** of the graphs, **L**, **M** or **N**, shows the correct pattern?

Write the correct answer in the box.

(1)

(b) Observations help scientists answer questions about the Universe.

Scientists **cannot** answer every question.

Which **one** of the following questions **cannot** be answered by scientists?

Tick (✓) **one** box.

How old is the Universe?

Why was the Universe created?

How fast does light travel through the Universe?

(1)

(Total 4 marks)

**Q13.**

Galaxies emit all types of electromagnetic wave.

- (a) (i) Which type of electromagnetic wave has the shortest wavelength?

\_\_\_\_\_ (1)

- (ii) State **one** difference between an ultraviolet wave and a visible light wave.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (1)

- (b) Electromagnetic waves travel through space at a speed of  $3.0 \times 10^8$  m/s.

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Frequency = \_\_\_\_\_ (3)

- (c) Scientists use a radio telescope to measure the wavelength of the radio waves emitted from the galaxy in part (b) as the waves reach the Earth. The scientists measure the wavelength as 25.2 metres. The effect causing this observed increase in wavelength is called red-shift.

- (i) The waves emitted from most galaxies show red-shift.

What does red-shift tell scientists about the direction most galaxies are moving?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (1)

- (ii) The size of the red-shift is **not** the same for all galaxies.

What information can scientists find out about a galaxy when they measure the size of the red-shift the galaxy produces?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2)

- (iii) What does the observation of red-shift suggest is happening to the Universe?

\_\_\_\_\_

**Q14.**

Stars go through a life cycle. About 90 % of all stars are in the 'main sequence' period of the life cycle.

- (a) Stars are stable during the 'main sequence' period of the life cycle.

Why?

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(1)

- (b) The table gives an estimated time for the number of years that three stars, **X**, **Y** and **Z**, will be in the 'main sequence' period of their life cycle.

Star	Relative mass of the star compared to the Sun	Estimated 'main sequence' period in millions of years
X	0.1	4 000 000
Y	1.0	9 000
Z	40.0	200

- (i) This data suggests that there is a pattern linking the mass of a star and the number of years the star is in the 'main sequence' period of its life cycle.

What is the pattern suggested by the data?

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(1)

- (ii) Scientists cannot give the exact number of years a star will be in the 'main sequence' period.

Suggest why.

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(1)

- (iii) Nuclear fusion is the process by which energy is released in stars.

Which **one** of the following can be concluded from the data in the table?

Draw a ring around the correct answer in the box to complete the sentence.

The rate of nuclear fusion in a large star is

faster than
the same as
slower than

in a small star.

Explain the reason for your answer.

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(3)

- (c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Describe what happens to a star **much bigger** than the Sun, once the star reaches the end of the 'main sequence' period of its life cycle.

Your answer should include the names of the stages the star passes through.

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(6)

(Total 12 marks)

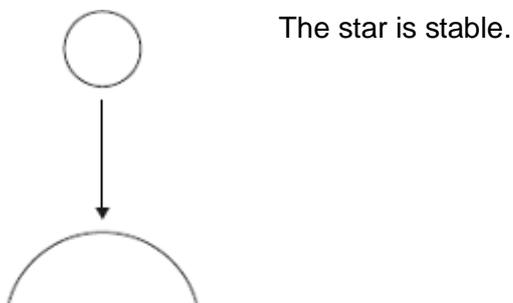
### Q15.

The diagram shows part of the lifecycle of a very large star.

Use words or phrases from the box to complete the sentences contained in the diagram.

<b>black hole</b>	<b>red supergiant</b>	<b>supernova</b>	<b>white dwarf</b>
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(3)



The star expands forming

a \_\_\_\_\_ .

The star collapses, the outer layers explode

as a \_\_\_\_\_ .

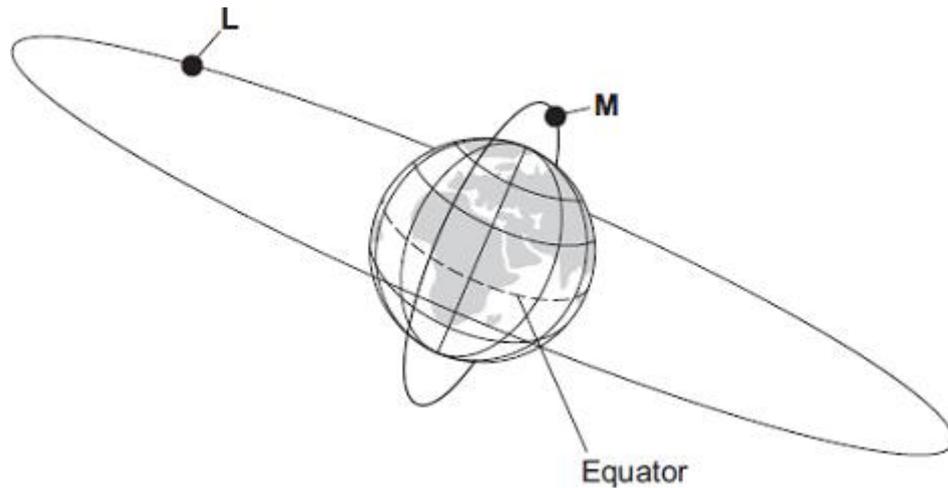
The centre collapses further and further until

it finally forms a \_\_\_\_\_ .

(Total 3 marks)

**Q16.**

The diagram, which is not to scale, shows two satellites, **L** and **M**, orbiting the Earth.



(a) Complete the following table.

Each letter, **L** or **M**, may be used once, more than once, or not at all.

Statement about the satellite	Letter for the satellite
It is used as a monitoring satellite.	
It is a geostationary satellite.	
It takes 24 hours to complete its orbit.	

(2)

(b) Complete the following sentence.

To stay in its present orbit around the Earth, each satellite must move at

a particular \_\_\_\_\_ .

(1)

- (c) Thousands of satellites are now in orbit around the Earth. A student used the internet to collect information about some of them.

Name of satellite	Average distance from the centre of the Earth in kilometres	Speed in kilometres per second	Time taken to orbit the Earth
The Moon	391 400	1.01	28 days
GEO	42 200	3.07	1 day
Navstar	26 600	3.87	12 hours
Lageos	12 300	5.70	3.8 hours
HST	7 000	7.56	97 mins
ISS	6 700	7.68	92 mins

- (i) The Moon takes a longer time than any of the other satellites to orbit the Earth.

Give **one** other way in which the Moon is different from the other satellites in the table.

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(1)

- (ii) What conclusion on the relationship between the *average distance* and *speed* can the student come to on the basis of this data?

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(1)

(Total 5 marks)

### Q17.

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 there are over one hundred elements. Scientists think that all the elements on Earth are also present throughout the Universe.

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

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(2)

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

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(2)

(c) Scientists have only examined a tiny fraction of the Universe.

What is the basis for scientists thinking that the elements found on Earth are present throughout the Universe?

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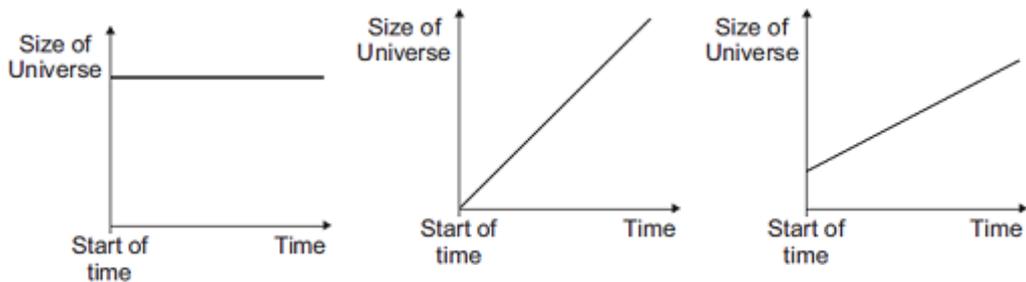
(1)

(Total 5 marks)

**Q18.**

The 'big bang' theory is one theory explaining the origin of the Universe.

(a) The graphs **X**, **Y** and **Z**, show how the size of the Universe may have changed with time.



Which graph would the 'big bang' theory suggest is correct?

Write your answer, **X**, **Y** or **Z**, in the box.

Explain the reason for your answer.

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(3)

(b) In 1948, an alternative to the 'big bang' theory, called the 'steady state' theory, was developed.  
The 'steady state' theory suggested that the Universe, although expanding, has always existed without a beginning in time.

(i) Complete the following sentence by drawing a ring around the correct line in the box.

The measurement of red-shift in the light from distant galaxies provides evidence

to support

only the 'big bang' theory.
only the 'steady state' theory.
both the 'big bang' and 'steady state' theories.

(1)

(ii) In 1965, scientists rejected the 'steady state' theory in favour of the 'big bang' theory.

Suggest what might cause scientists to stop supporting one theory and to start supporting an alternative theory.

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(1)

(Total 5 marks)

**Q19.**

(a) Starting with the smallest, list the following in order of increasing size.

**Universe                      Earth                      Milky Way                      Sun**

Smallest \_\_\_\_\_

\_\_\_\_\_

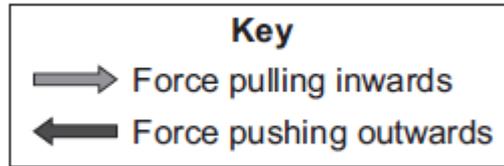
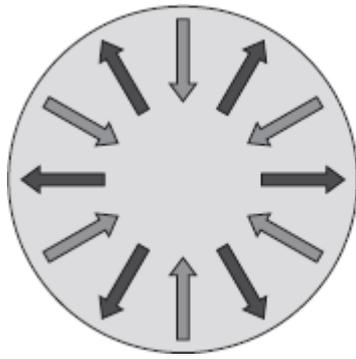
\_\_\_\_\_

Largest \_\_\_\_\_

(2)

(b) Stars pass through different stages during their life cycle.

The diagram shows the forces acting on the Sun during the stable stage of its life cycle.



Complete the following sentence by drawing a ring around the correct line in the box.

During the stable stage of the Sun's life cycle, the forces pulling inwards

are 

smaller than
equal to
bigger than

 the forces pushing outwards.

(1)

(c) During its life cycle, the Sun will never go through a *supernova* stage but the star Mira will.

(i) What is a *supernova*?

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(1)

(ii) Explain why the Sun will not go through the *supernova* stage but the star Mira will.

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(2)

(Total 6 marks)

**Q20.**

(a) The 'Big Bang' theory uses red-shift as evidence to explain the beginning of the Universe.

How does the red-shift from distant galaxies provide evidence for the beginning of the Universe?

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(3)

(b) Cosmic microwave background radiation (CMBR) is a type of electromagnetic radiation. CMBR fills the Universe. It was first discovered in 1965 by two astronomers called Penzias and Wilson.

(i) What do scientists believe is the origin of CMBR?

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(1)

(ii) Why was the discovery of CMBR so important to the scientists believing the 'Big Bang' theory to be correct?

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(1)

(iii) How is the wavelength of CMBR likely to change, if at all, over the next billion years?

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Give a reason for your answer.

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(2)

(Total 7 marks)

**Q21.**

(a) As part of its life cycle, a star changes from being a protostar to a main sequence star.

Explain the difference between a protostar and a main sequence star.

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(2)

(b) The early Universe contained only atoms of hydrogen. The Universe now contains atoms of over one hundred different elements.

Explain how the different elements now contained in the Universe were formed.

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(3)  
(Total 5 marks)

**Q22.**

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?

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(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.

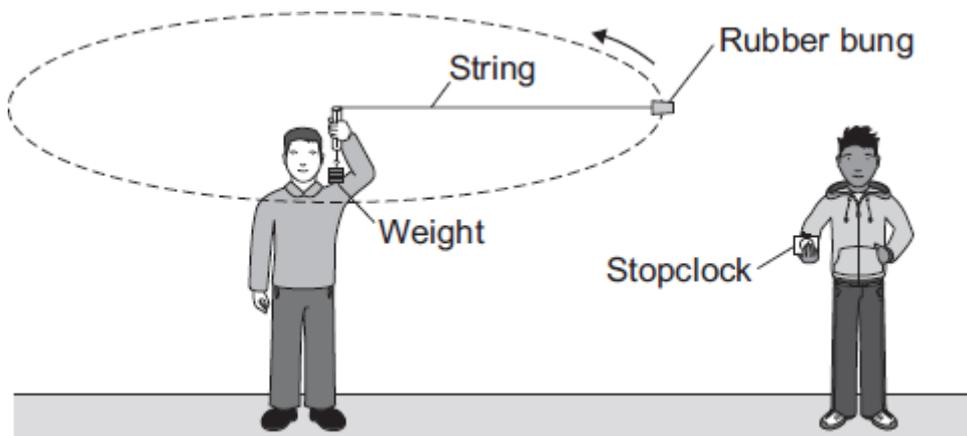
(1)

(Total 2 marks)

**Q23.**

Objects moving in a circle experience a force called **centripetal** force, which acts to the centre of the circle.

The diagram shows the apparatus used by two students to find out how the centripetal force acting on an object affects the speed of the object.



- (a) (i) In which direction does the centripetal force act on the rubber bung?

---

(1)

- (ii) In this investigation, what provides the centripetal force?

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(1)

- (b) One student swung the rubber bung around in a circle at constant speed. The second student timed how long it took the rubber bung to complete 10 rotations. The students then calculated the speed of the rubber bung, using the radius of the circle and the time to complete one rotation. The students repeated this for several different values of centripetal force.

- (i) During the investigation, the radius of the circle and the mass of the rubber bung were not changed.

Explain why.

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(2)

- (ii) One of the variables in this investigation was the time taken by the rubber bung to complete 10 rotations.

Which **two** words can be used to describe this variable?

Draw a ring around each of your **two** answers.

**continuous**

**control**

**dependent**

**independent**

(1)

- (iii) The students timed 10 rotations of the rubber bung, rather than just one rotation.

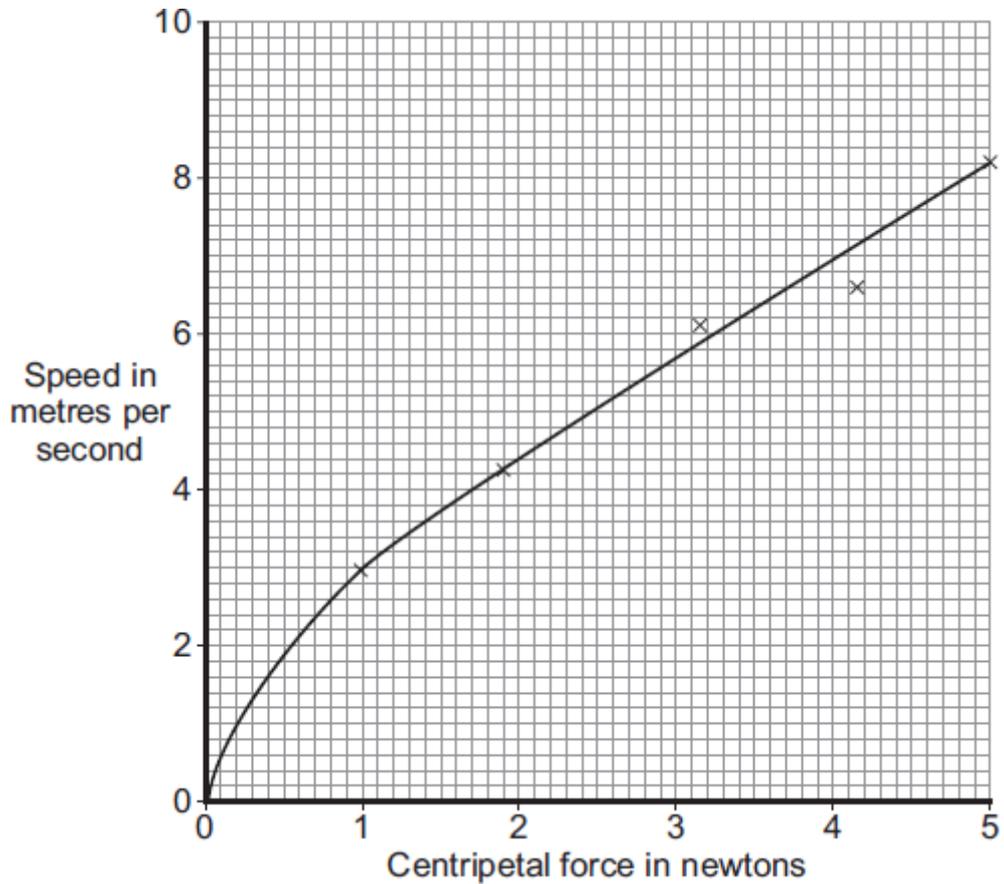
Suggest why.

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(1)

- (c) The graph shows the students' data.



There is a relationship between the speed of an object moving in a circle and the centripetal force acting on the object.

What conclusion about this relationship can the students make from their data?

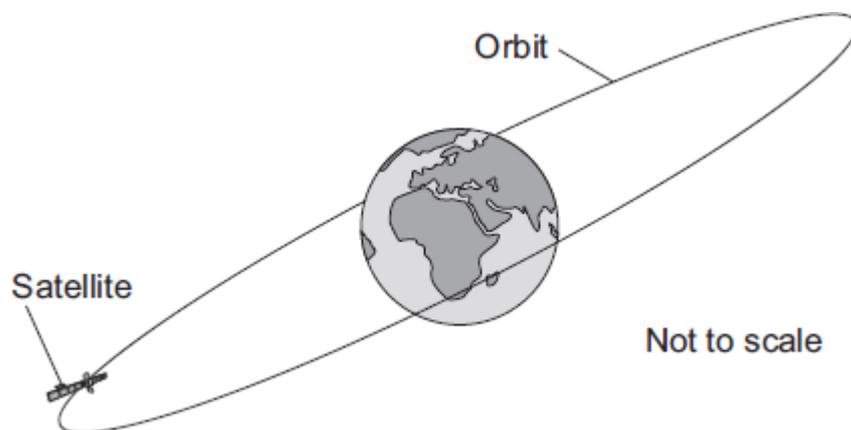
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(1)

- (d) The diagram shows a satellite in a circular orbit above the Earth. The satellite is part of the global positioning system (GPS). The satellite orbits the Earth **twice** every 24 hours.



- (i) What provides the centripetal force needed to keep the satellite in its orbit around the Earth?

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(1)

(ii) Is this satellite in a geostationary orbit?

Draw a ring around your answer.      **Yes**      **No**

Give a reason for your answer.

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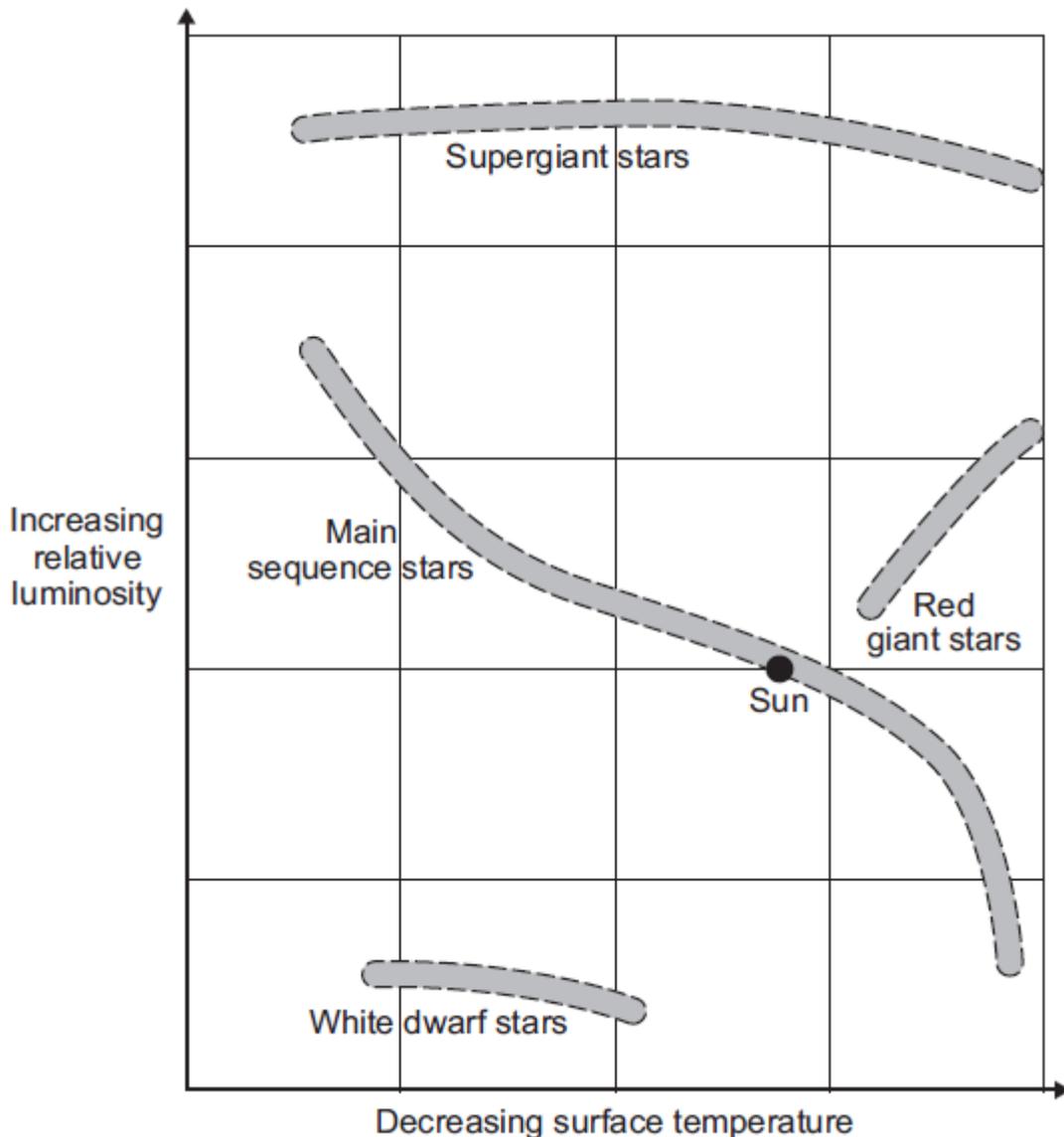
(1)  
(Total 9 marks)

**Q24.**

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?

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(1)

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

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(3)

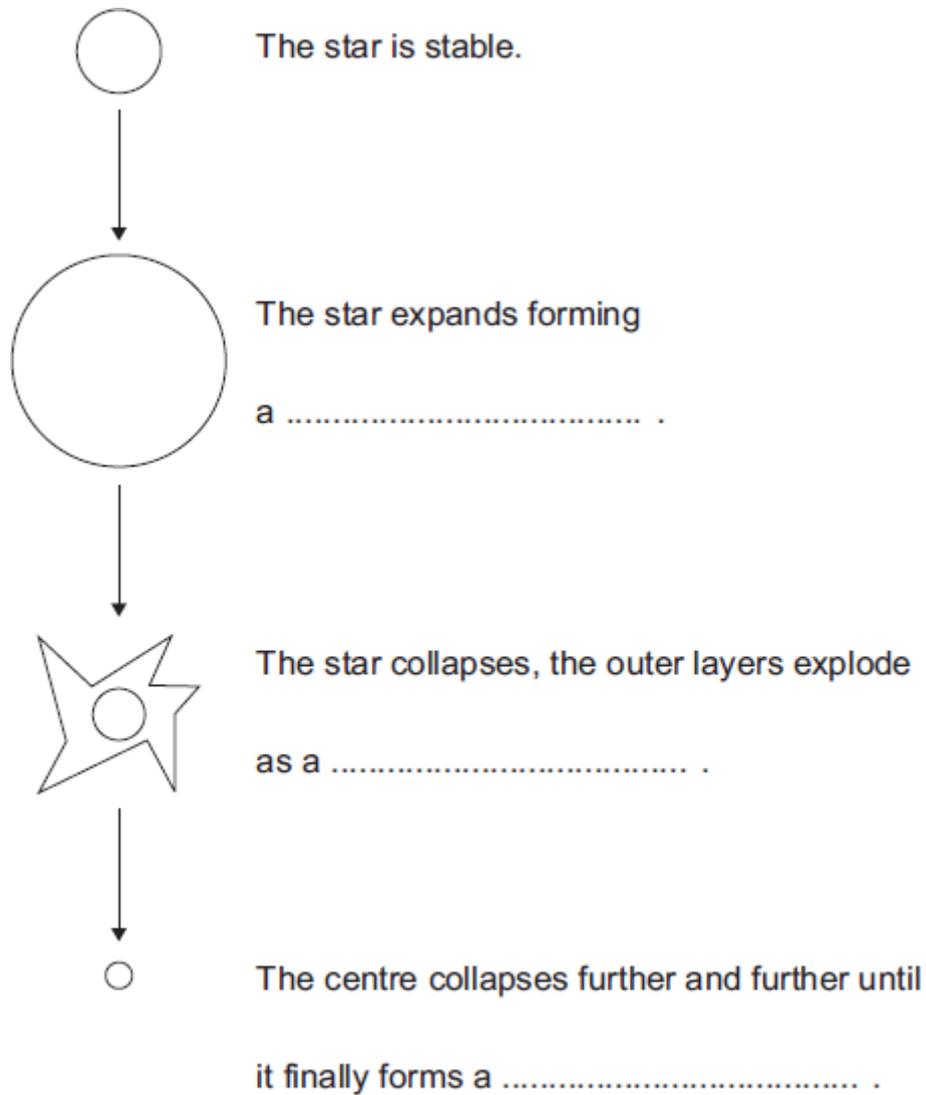
(Total 4 marks)

**Q25.**

The diagram shows part of the lifecycle of a very large star.

Use words or phrases from the box to complete the sentences contained in the diagram.

<b>black hole</b>	<b>red supergiant</b>	<b>supernova</b>	<b>white dwarf</b>
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(Total 3 marks)

**Q26.**

The 'Big Bang' theory is one theory of the origin of the Universe.

- (a) (i) Explain what is meant by the 'Big Bang' theory.

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(2)

- (ii) The light arriving from distant galaxies provides scientists with evidence to support the 'Big Bang' theory.

Explain how.

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(2)

- (b) At a meeting held in 2005, a group of scientists claimed that new data had been collected that showed the 'Big Bang' theory to be wrong. Other scientists said that there was no reason to doubt the 'Big Bang' theory.

What should scientists do when a theory does **not** appear to be supported by new data?

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(2)

- (c) 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.

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(1)

(Total 7 marks)

**Q27.**

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

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

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(2)

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

Explain how the other elements came to be formed.

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(3)  
(Total 5 marks)

**Q28.**

- (a) Scientists use telescopes to observe stars and galaxies.  
Some telescopes are on Earth, but some are on satellites in space.

Why do telescopes in space give better images than telescopes on the Earth?

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(1)

- (b) Scientists have observed that the wavelengths of the light given out from galaxies that are moving away from the Earth are longer than expected.

- (i) What name is given to this observation?

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

blue-shift

green-shift

red-shift

(1)

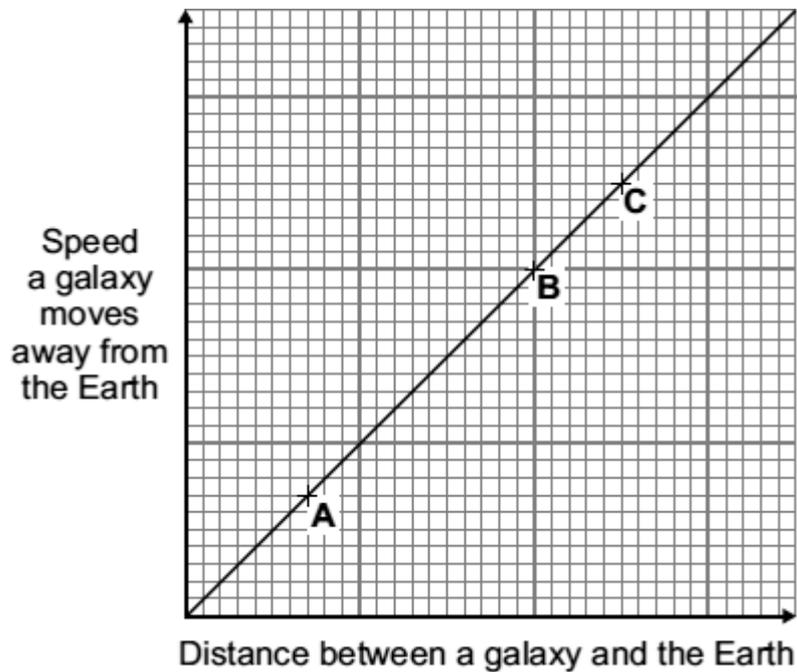
- (ii) Complete the following sentence by drawing a ring around the correct line in the box.

This observation gives evidence for the idea that the universe is

shrinking.
not changing.
expanding.

(1)

- (c) Use the graph to answer the following questions.



- (i) What is the link between the speed that a galaxy moves away from the Earth and the distance between the galaxy and the Earth?

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(1)

- (ii) The positions of three galaxies, **A**, **B** and **C**, are marked on the graph.

From which galaxy, **A**, **B** or **C**, would the wavelength of the light reaching the Earth seem to have changed the most?

Galaxy \_\_\_\_\_

Give a reason for your answer.

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(2)

(Total 6 marks)

**Q29.**

- (a) In 1929, the astronomer Edwin Hubble observed that the light from galaxies that are moving away from the Earth showed a *red-shift*.

What is *red-shift* ?

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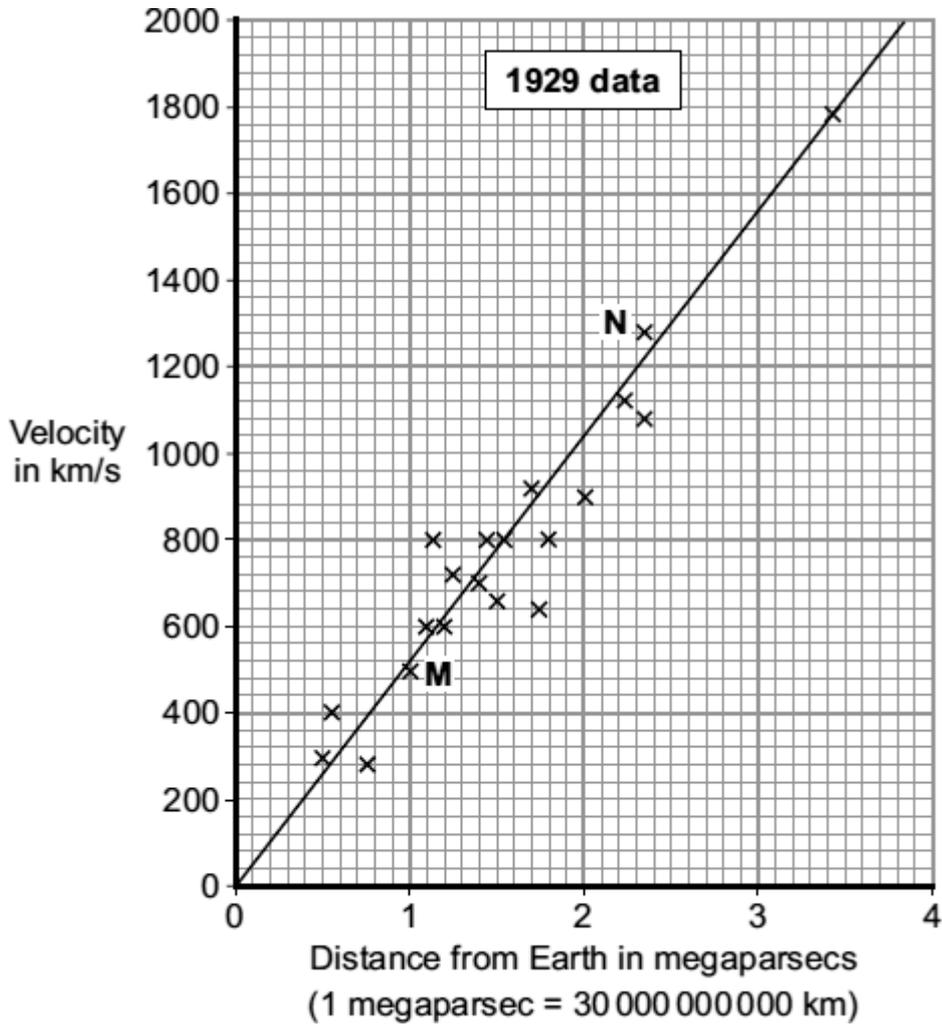


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(1)

- (b) By measuring the *red-shift*, Hubble was able to calculate the speed at which the galaxies are moving away from the Earth. He was also able to calculate the distance of these galaxies from the Earth.

The graph shows some of the data calculated by Hubble.



- (i) The data from two galaxies, **M** and **N**, has been included in the graph. The light from galaxy **M** has a smaller *red-shift* than the light from galaxy **N**.

What does the difference in *red-shift* tell scientists about the two galaxies, **M** and **N**?

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(2)

- (ii) The gradient of the line drawn on the graph gives a number known as the Hubble constant. The Hubble constant can be used to estimate when the universe began.

Use the graph to calculate the value of the Hubble constant.

Show clearly how you obtained your answer.

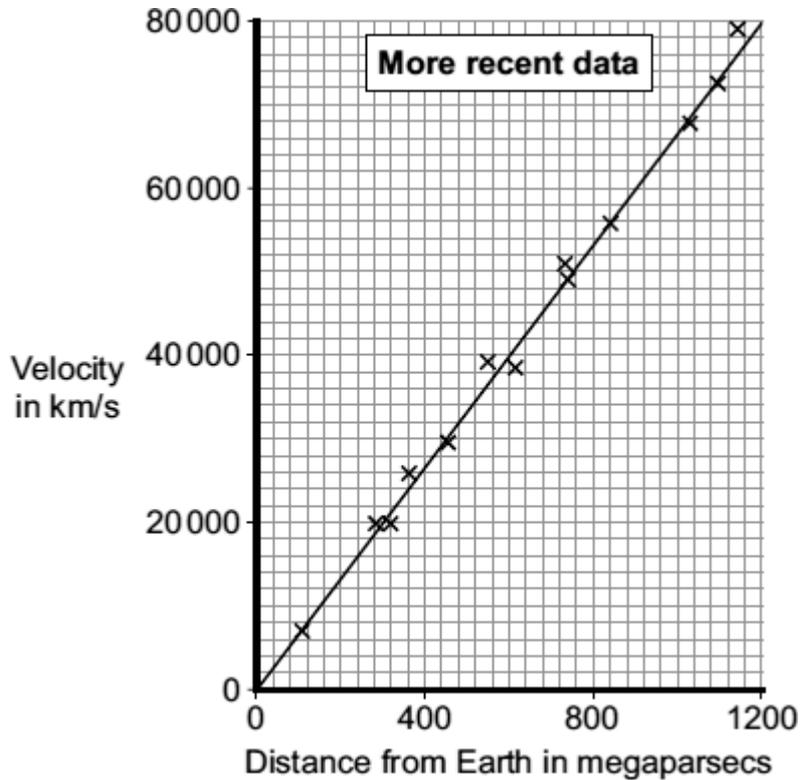
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Hubble constant = \_\_\_\_\_ km/s per megaparsec

(2)

(iii) More recently, data has been obtained from more distant galaxies.



The results from the more recent data give a totally different value for the Hubble constant to the one calculated from the 1929 data.

Which set of data, the 1929 or the more recent, is most likely to give the value closest to the true value for the Hubble constant?

Draw a ring around your answer.

**1929**

**more recent**

Give a reason for your answer.

---

---

(1)

(c) The Andromeda galaxy is not moving away from the Earth. It is actually moving towards the Earth. This means that the light from Andromeda shows a blue-shift.

How do the wavelength and frequency of the light from Andromeda seem to have changed when viewed from the Earth?

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(2)  
(Total 8 marks)

**Q30.**

Every star goes through a 'life cycle'.

- (a) Describe how a star forms.

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(2)

- (b) During a long period of its life, a star remains in a stable state.

Explain why a star remains stable.

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(2)

- (c) Some stars are much more massive than the Sun.

Describe what will happen to a star, originally much more massive than the Sun, after it reaches its red giant stage.

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(2)  
(Total 6 marks)

**Q31.**

- (a) Choose the best words from the box to complete the following sentences.

billions	fission	friction	fusion	gases
----------	---------	----------	--------	-------

gravity	liquids	millions	thousands
---------	---------	----------	-----------

(i) Stars form when enough dust and \_\_\_\_\_ from space are pulled together by \_\_\_\_\_ . (2)

(ii) Stars are able to give out energy for millions of years by the process of \_\_\_\_\_ (1)

(iii) The Sun is one of many \_\_\_\_\_ of stars in our galaxy. (1)

(b) What is the name of our galaxy?  
\_\_\_\_\_ (1)

(1)  
(Total 5 marks)

**Q32.**

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)

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(2)  
(Total 6 marks)

**Q33.**

This passage is from a science magazine.

*A star forms when enough dust and gas are pulled together.  
Masses smaller than a star may also be formed when dust and gas are pulled together.*

(a) What is the force which pulls the dust and gas together?

---

(1)

(b) Complete the sentences.

(i) The smaller masses may be attracted by the star and become

---

(1)

(ii) Our nearest star, the Sun, is stable because the gravitational forces and the radiation pressure are \_\_\_\_\_.

(1)

(iii) The Sun is one of billions of stars in the galaxy called the

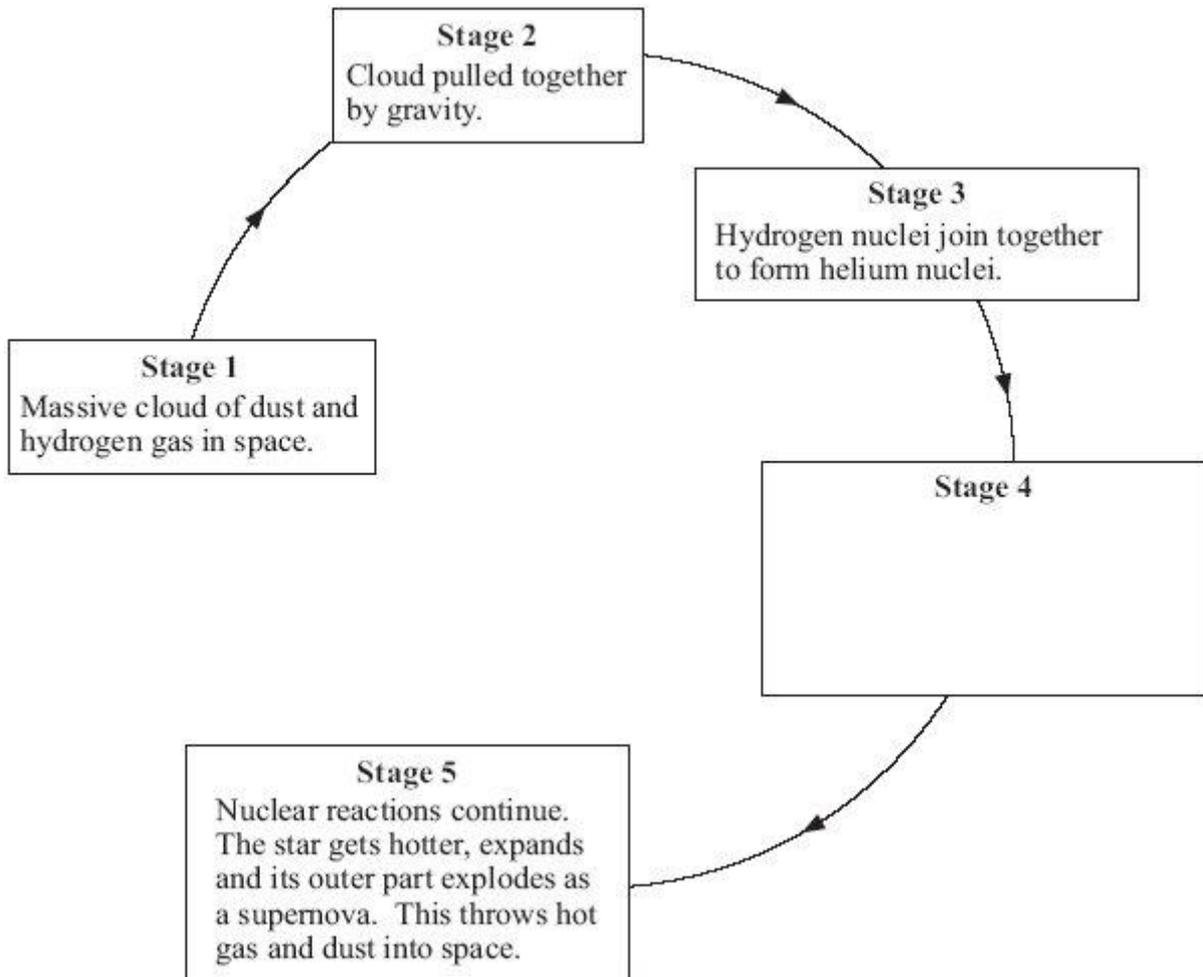
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(1)

(Total 4 marks)

**Q34.**

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?

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(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?

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(1)

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

Explain why.

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(2)

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

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(2)

(Total 6 marks)

**Q35.**

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?

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(2)

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

(i) What is *red-shift*?

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(1)

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

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(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.

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(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)**

## Mark schemes

### Q1.

- (a) any **one** from:
- Earth is at the centre (not the Sun)
  - there are fewer planets  
*accept there is no asteroid belt shown*  
*accept there are only 5 planets (and not 8)*  
*accept other planets have no moons shown*
- (b) Shows the moon in orbit around the Earth  
*accept the planets have circular orbits*
- (c) circular  
*accept elliptical*
- (d) gravity
- (e) Mira is much more massive

[5]

### Q2.

- (a) red-shift
- (b) the further away from the Earth, the faster a galaxy is moving
- (c) **strength**  
as the balloon expands the dots get further apart, representing the galaxies moving apart
- weakness**  
dots are only on the surface of the balloon, galaxies are throughout the universe  
**or**  
there is a limit to how far the balloon can expand
- (d) both theories suggest that the Universe is expanding
- (e) new evidence / observations that cannot be explained by Theory 1  
*accept specific example of new evidence ie CMBR*

[6]

### Q3.

- (a) gas

- correct order only*
- 1
- gravity 1
- protostar
- accept correct word circled in box provided no answer given  
in answer space*
- 1
- (b) the explosion of a massive star 1
- (c) The telescopes and measuring instruments were not sensitive enough. 1

[5]

**Q4.**

- (a) (i) (enough) dust and gas (from space) is pulled together
- accept nebula for dust and gas  
accept hydrogen for gas  
accept gas on its own  
dust on its own is insufficient  
mention of air negates this mark*
- 1
- by:
- gravitational attraction
- or**
- gravitational forces
- or**
- gravitaty
- ignore any (correct) stages beyond this*
- 1
- (ii) joining of two (atomic) nuclei (to form a larger one)
- do not accept atoms for nuclei*
- 1
- (iii) more sensitive astronomical instruments / telescopes
- or**
- infrared telescopes developed
- accept better technology  
more knowledge is insufficient*
- 1
- (b) (i) (other) planets / solar systems
- do not accept galaxy  
moons is insufficient*
- 1
- (ii) provided evidence to support theory
- accept proves the theory*
- 1
- (c) elements heavier than iron are formed only when a (massive) star explodes

*accept materials for elements*  
*accept supernova for star explodes*  
*accept stars can only fuse elements up to (and including)*  
*iron*

1  
[7]

**Q5.**

(a) hydrogen

1

(b) supernova

1

(c) red super giant

1

(d) any **four** from:

- fusion takes place within stars
- hydrogen formed into helium
- fusion continued and formed larger elements
- elements heavier than iron were formed in supernova
- (heavy) elements were scattered by the supernova explosion.

*accept light elements formed*

4

[7]

**Q6.**

(a) (i) C

1

(ii) The speed of star **B** is less than the speed of star **D**.

1

(b) 300 000 000

*allow 1 mark for correct substitution ie  $200\,000 \times 1500$   
provided no subsequent step shown*

2

m / s

*allow unit correctly indicated in list if not written in answer  
space*

1

[5]

**Q7.**

(a) wavelength correctly shown

1

(b) (i) increased

1

decreased

1

(ii) 17-18 inclusive

1

evidence of measurement divided by 3 or mean of 3 separate measurements

1

mm

*accept cm if consistent with answer*

1

(c) (i) red shift

1

(ii) moving away

1

(iii) the furthest galaxies show the biggest red shift

1

(meaning that) the furthest galaxies are moving fastest

1

(so the) Universe is expanding

1

(extrapolating backwards this suggests that) the Universe started from an initial point

1

(iv) cosmic microwave background radiation

*allow CMBR*

1

[13]

**Q8.**

(a) (enough) dust / gas (from space)

1

are pulled together

1

by gravitational attraction

1

(b) fusion

*accept fusion circled in box*

1

(c) forces within it are balanced

1

(d)



*correct order only*

1

*ignore reference to planetary nebula*

1  
1

[8]

**Q9.**

- (a) main sequence star  
*correct order only*

1

supernova

1

- (b) balanced by

1

[3]

**Q10.**

- (a) gravitational attraction (between the satellite and the Earth)  
*allow gravity*  
*allow weight of the satellite*

1

- (b) any **two** from:  
• mass of satellite  
• speed / velocity (of satellite)  
• radius of orbit / circle  
*allow height above the Earth*  
*radius / height alone is insufficient*

2

- (c) (i) increasing the height (above the Earth's surface) increases the time (for one orbit)  
*allow a positive correlation*  
*allow as one gets bigger, the other gets bigger, or vice versa*  
*ignore they are directly proportional*

1

- (ii) there is no relationship / correlation

1

- (d) Isaac Newton was a respected scientist who had made new discoveries before

1

[6]

**Q11.**

- (a) (i) origin of the Universe  
*accept (why) the Universe is expanding*  
*do **not** accept origin of the Earth*

1

- (ii) provided more evidence to support the 'Big Bang' theory

1

- (b) (i) red-shift

*accept Doppler (shift)*

1

- (ii) (at the point in time shown the observed spectrum from) star A (shows it) is moving away from the Earth

*accept star A is moving away*

*star A shows red-shift is insufficient*

1

light from star B shows a decrease in wavelength

*accept light from star B shows blue-shift*

*accept light from star B shows an increase in frequency*

1

so star B is moving towards Earth

1

[6]

### Q12.

- (a) (i) red-shift

*accept Doppler (effect)*

1

- (ii) the Universe is expanding

1

- (iii) N

1

- (b) Why was the Universe created?

1

[4]

### Q13.

- (a) (i) gamma

*accept correct symbol*

1

- (ii) any **one** from:

- (ultraviolet has a) higher frequency  
*ultraviolet cannot be seen is insufficient*
- (ultraviolet has a) greater energy
- (ultraviolet has a) shorter wavelength  
*ignore ultraviolet causes cancer etc*

1

- (b)  $1.2 \times 10^7 / 12\,000\,000$

*allow 1 mark for correct substitution, ie  $3 \times 10^8 = f \times 25$*

2

hertz / Hz / kHz / MHz

*do **not** accept hz **or** HZ*

*answers 12 000 kHz **or** 12 MHz gain 3 marks*

*for full credit the numerical answer and unit must be consistent*

1

- (c) (i) away (from each other)  
*accept away (from the Earth)*  
*accept receding*

1

- (ii) distance (from the Earth)  
*accept how far away (it is)*

1

speed galaxy is moving

1

- (iii) (Universe is) expanding

1

[9]

#### Q14.

- (a) forces (within the star) are balanced  
*if specific forces are mentioned they must be appropriate*

1

- (b) (i) bigger the mass (of the star) the shorter the 'main sequence' period  
*accept bigger the star the shorter the time*

1

- (ii) any **one** from:

- insufficient evidence
- do not know (exact) amount of hydrogen in star  
*accept do not know (exact) mass of star*
- time too long (to measure directly)
- may be other factors (not yet known) that determine length of 'main sequence' period
- values are based on theory / calculation

1

- (iii) faster than

1

larger stars have a shorter 'main sequence' period so they must have the faster (rate of) nuclear fusion

*there must be a link between shorter 'main sequence' and nuclear fusion, this may be implied from the first marking point*

1

the end of 'main sequence' happens as the hydrogen in (the core of) a star is used up

**or**

(since) they use up hydrogen at a faster (rate)

*accept more massive stars (are brighter so) release energy*

- (c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](#), and apply a 'best-fit' approach to the marking.

**0 marks**

No relevant content.

**Level 1 (1-2 marks)**

There is a basic description of what happens to a star much larger than the Sun after the 'main sequence' period.

**OR**

Two stages are correctly named and are in the correct sequence.

**Level 2 (3-4 marks)**

There is a clear description of what happens to a star much larger than the Sun after the 'main sequence' period.

**AND**

At least two stages are correctly named and are in the correct sequence.

**Level 3 (5-6 marks)**

There is a detailed description of what happens to a star much larger than the Sun after the 'main sequence' period.

**AND**

At least three stages are named, in the correct sequence. There are no additional incorrect stages given.

**Examples of the points made in the response:**

***extra information***

- (the core of the) star runs out of hydrogen
- (the star) expands (to form)
- (the star) cools (to form)
  - *the core shrinks*
  - *helium starts to fuse to form other elements*
- a red supergiant
  - accept super red giant*
  - do **not** accept red giant*
  - (outer layers) explode
    - *fusion of lighter elements to form heavier elements (up to iron)*
- as a supernova
  - elements heavier than iron are formed
    - accept heaviest elements are formed*
  - core shrinks
- becoming a neutron star
  - if mass large enough (core collapses)

- (to form) a black hole  
*if a correct description and sequence for a star the same size as the Sun and much bigger than the Sun given without clearly indicating which is which is limited to Level 2*

6  
 [12]

**Q15.**

red supergiant

*do not accept red giant*

1

supernova

1

black hole

1

[3]

**Q16.**

(a) all correct

**M**  
**L**  
**L**

*allow 1 mark for one correct*

2

(b) speed

*accept 'velocity'*

1

(c) (i) any **one** from:

- it's natural
- slowest
- furthest (from the centre of the Earth)  
*accept 'others are artificial / made by humans'*

1

(ii) as the (average) distance decreases the speed increases  
*accept 'there is a negative correlation (between them)'*  
*do not accept 'they are inversely proportional'*

1

[5]

**Q17.**

(a) fusion

*do not credit any response which looks like 'fission'*

1

of hydrogen / H (atoms)

*credit only if 1<sup>st</sup> mark point scores*

1

- (b) fusion of other / lighter atoms / elements  
*reference to big bang nullifies both marks* 1
- during supernova / explosion of star(s) 1
- (c) the (available) evidence: supports this idea  
**or**  
 does not contradict this idea  
**or**  
 can be extrapolated to this idea  
**or**  
 (electromagnetic) spectrum from other stars is similar to sun 1

[5]

**Q18.**

- (a) **Y**  
*accept cannot be X as size is increasing* 1
- shows Universe expanding  
*this scores if Y or Z is chosen*  
*accept exploding outwards* 1
- from a (very small) point  
*this only scores if Y is chosen*  
*accept from zero (size)*  
*answers in terms of planets*  
*negate the last two mark points* 1
- (b) (i) both the 'big bang' and 'steady state' theories 1
- (ii) (new) evidence that supports / disproves a theory  
*accept proves for supports*  
**or**  
 (new) evidence not supported by current theory  
*accept there may be more evidence supporting one (theory)*  
*than the other (theory)*  
*accept new evidence specific to this question eg*  
*measurement of CBR*  
**or**  
*some types of star only found in distant parts of Universe*  
*(steady state suggests should be same throughout Universe)* 1

[5]

**Q19.**

- (a) Earth  
 Sun

Milky Way

Universe

*all four in correct order*

*allow 1 mark for Earth and Universe in correct places*

2

(b) equal to

1

(c) (i) explosion (of a star)

*ignore implosion*

1

(ii) only very massive stars become supernova

1

Mira large enough but sun too small

*allow 1 mark for each statement*

*Sun too small to give a supernova*

**or**

*Mira large enough to give a supernova*

1

[6]

### Q20.

(a) any **three** from:

- red-shift shows galaxies are moving away (from each other / the Earth)
- more distant galaxies show bigger red-shift

**or**

more distant galaxies show a greater increase in wavelength

*accept correct reference to frequency in place of wavelength*

- (in all directions) more distant galaxies are moving away faster  
*accept (suggests) universe is expanding*
- suggests single point of origin (of the universe)

3

(b) (i) (radiation produced shortly after) 'Big Bang'

*accept beginning of time / beginning of the universe for 'Big Bang'*

1

(ii) any **one** from:

- can only be explained by 'Big Bang'
- existence predicted by 'Big Bang'
- provides (further) evidence for 'Big Bang'  
*ignore proves 'Big Bang' (theory)*  
*ignore reference to red-shift*

- (iii) increase  
*accept becomes radio waves*
- 1
- universe continues to accelerate outwards  
*accept as universe continues to expand*
- 1
- or**
- greater red-shift
- 1

[7]

**Q21.**

- (a) a protostar is at a lower temperature  
**or**  
 a protostar does not emit radiation /energy
- 1
- as (nuclear) fusion reactions have not started  
*accept heat or light for energy*
- 1
- (b) by (nuclear) fusion  
*accept nuclei fuse (together)*  
*nuclear fusion and fission negates this mark*
- 1
- of hydrogen to helium
- 1
- elements heavier than iron are formed in a supernova  
*accept a specific example e.g. heavier elements such as gold are formed in a supernova*  
*accept heavier elements (up to iron) formed in red giant/red super giant*  
*reference to burning (hydrogen) negates the first 2 marks*
- 1

[5]

**Q22.**

- (i) bigger the red-shift, further the galaxy is from the Earth  
*accept red-shift and distance are directly proportional*  
*accept there is a positive correlation*
- 1
- (ii) origin / start / beginning / creation  
*accept expansion*
- 1

[2]

**Q23.**

- (a) (i) towards the centre of the circle

- accept inwards*  
*accept a correct description*  
*'along the string' is insufficient*
- 1
- (ii) tension (in the string)  
*accept pull of the string*  
*'the string' is insufficient*  
**or**  
weight (on the end of the string)  
*'the student' is insufficient*  
*'turning action' is insufficient*
- 1
- (b) (i) each may (also) affect the speed  
*accept results for speed*
- 1
- so only one independent variable  
*accept only one variable affects dependent variable*  
*'fair test' is insufficient*  
*'they are control variables' is insufficient*
- 1
- (ii) continuous  
*both required*
- dependent
- 1
- (iii) reduces (absolute) timing error (for one rotation)  
*accept too fast to time one*  
**or**  
increases / improves reliability / accuracy (for one rotation)  
*ignore checking for anomalous results*  
*to work out an average is insufficient*
- 1
- (c) speed increases with centripetal force  
*accept positive correlation*  
*do **not** accept proportional*
- 1
- (d) (i) gravitational pull (of the Earth)  
*accept gravity*
- 1
- (ii) **No**  
*both parts required – however this may have been*  
*subsumed within the reason*
- geostationary orbits once every 24 hours  
*accept a correct comparative description*
- 1

**Q24.**

- (a) runs out of hydrogen (in its core)  
*accept nuclear fusion slows down*  
*do **not** accept fuel for hydrogen*  
*do **not** accept nuclear fusion stops*  
*ignore reference to radiation pressure / unbalanced forces*

1

- (b) temperature decreases / (relative) luminosity increases as it changes to a red giant  
*if both temperature and luminosity are given both must be correct*

1

temperature increases / (relative) luminosity decreases as it changes to a white dwarf  
*if both temperature and luminosity are given both must be correct*

1

correct change in temperature **and** (relative) luminosity as Sun changes to a red giant and then to a white dwarf  
*an answer changes to a red giant and then white dwarf with no mention or an incorrect mention of temperature or (relative) luminosity change gains 1 mark only if no other marks awarded*  
*ignore correct or incorrect stages given beyond white dwarf*

1

[4]

**Q25.**

red supergiant

1

supernova

1

black hole

1

[3]

**Q26.**

- (a) (i) Universe began at a (very) small (initial) point  
*'it' refers to Universe*

1

*'explosion' sent matter outwards*

**or**

*'explosion' causing Universe to expand*

*accept gas / dust for matter*

*accept rapid expansion for explosion*

1

- (ii) light shows a red shift  
*owtte*

*the term red shift on its own does not score a mark*

1

galaxies moving away (from the Earth)

*'it' refers to light*

*'they' refers to galaxies*

*accept star for galaxy*

*do **not** accept planet for galaxy*

1

(b) check reliability / validity of data

*accept check data*

*accept collect more data*

1

amend theory

**or**

discount the data

*accept replace old theory with new theory*

1

(c) answer involves (religious) belief

**or**

no / insufficient evidence

*accept it cannot be tested*

1

[7]

### Q27.

(a) gravitational force(s) (1)

*accept 'gravity'*

balanced by (force(s) due to) radiation pressure (1)

*accept equal*

2

(b) by (nuclear) fusion (1)

of hydrogen to helium (other light elements) (1)

*allow 'low density' for light*

*accept hydrogen nuclei / atoms form helium*

*response must clearly link one element(s) producing others*

*fusion to produce helium (2)*

heavy element / elements heavier than iron are only produced (by fusion) in a supernova (1)

*allow dense for heavy*

*ignore any reference to elements undergoing radioactive decay (to form other elements)*

3

[5]

### Q28.

(a) any **one** from:

- above the atmosphere  
*accept no atmospheric pollution*
  - no clouds in the way
  - no light pollution  
*answers in terms of being closer to space negate*  
*answers in terms of looking at the Earth negate*
- 1
- (b) (i) red-shift
- 1
- (ii) expanding
- 1
- (c) (i) as one gets bigger the other gets bigger  
*accept (directly) proportional*  
*accept positive correlation*
- 1
- (ii) **C**
- 1
- it is furthest from the Earth  
*only scores if C is chosen*
- or**  
it is furthest away
- or**  
has the largest red-shift
- it is moving (away) the fastest
- 1

[6]

**Q29.**

- (a) wavelength (of light appears to) increase  
*accept frequency (appears to) decrease*  
*accept light moves to the red end of the spectrum*  
*do not accept it moves to the red end of the spectrum*  
*do not accept light becomes redder*
- 1
- (b) (i) **M** is closer (to the Earth) than **N**
- 1
- M** is moving (away from the Earth) slower than **N**
- 1
- (ii) 520  
*an answer between 510 and 530 inclusive gains 1 mark*
- 2
- (iii) more recent  
*no mark for this but must be given to gain reason mark*
- data more reliable  
*accept data is more accurate*

**or**  
improved equipment / techniques  
*more technology is insufficient*  
**or**  
data obtained from more (distant) galaxies  
*accept a wider range of data*  
*accept data closer to the line of best fit*  
**or** *data less scattered*  
*accept no anomalous result(s)*  
*accept all data fits the pattern*

1

(c) wavelength is decreased

1

frequency is increased

1

[8]

**Q30.**

(a) (enough) dust and gas (from space)  
*accept nebula for dust and gas*  
*accept hydrogen for gas*  
*mention of air negates this mark*

1

pulled together by:

- gravitational attraction
- or**
- gravitational forces
- or**
- gravity

1

(b) forces (in the star) are balanced  
*accept equal and opposite for balanced*  
*accept in equilibrium for balanced*

1

forces identified as gravity and radiation pressure  
*both forces are required*  
*gravitational forces inwards balance / equal radiation*  
*pressure outwards for 2 marks*  
*accept for 2 marks an answer in terms of sufficient hydrogen*  
*to keep the fusion reactions going*  
*accept for 1 mark an answer in terms of sufficient fuel to*  
*keep the fusion reactions going*

1

(c) (explodes as) a supernova

1

any **one** from:

- outer layer(s) thrown into space

do **not** accept just 'thrown into space'

- scatters dust and gas into space (for the formation of new stars)  
do **not** accept just 'dust and gas'
- elements distributed throughout space  
do **not** accept just 'distributed'
- matter left behind / core may form a neutron star  
do **not** accept just 'neutron star'
- a black hole will form if the gravitational forces are enormous / sufficient mass is left behind  
do **not** accept just 'black hole'  
do **not** accept any references to 'dark bodies' or 'black dwarfs'  
black hole forms if star is large enough is insufficient

1

[6]

**Q31.**

- (a) (i) gases (1)  
gravity (1)  
correct order essential for credit

2

- (ii) fusion

1

- (iii) billions

1

- (b) Milky Way  
u.c. initials not essential

1

[5]

**Q32.**

- (a) fusion (1)  
of hydrogen/H (atoms)(1)  
do **not** credit any response which looks like 'fission' **or** the 'word' 'fussion'  
credit only if a nuclear reaction

2

- (b) fusion of other/lighter atoms/elements (1)  
reference to big bang nullifies both marks

during super nova/explosion of star(s) (1)

2

- (c) explosion of star(s)/super nova (1)  
reference to big bang nullifies both marks reference to the star running out of energy/material nullifies both marks

at the end of the 'life' of star(s) / when they 'die' (1)

2

[6]

**Q33.**

(a) gravitational

*accept gravity*

*do **not** accept weight*

1

(b) (i) planet(s)

*accept comet(s)*

*accept asteroid(s)*

*do **not** accept moon(s)*

1

(ii) balanced

*accept equal / the same / are in equilibrium*

1

(iii) Milky Way

*accept milky way*

1

[4]

**Q34.**

(a) (i) the bigger the masses (of the dust and gases then) the bigger the force / gravity (between them)

*accept the converse*

1

(ii) the greater the distance (between the dust and gases then) the smaller the force / gravity (between them)

*accept the converse*

1

(b) radiation 'pressure' and gravity / gravitational attraction

these are balanced / in equilibrium

1

*must be in correct context*

*do **not** accept are equal*

**or** there is sufficient / a lot of hydrogen / fuel to last a very long time

*second mark consequent on first*

1

(c) any **two** from:

• hydrogen runs out / is used up

• nuclei larger than helium nuclei formed

*accept bigger atoms are formed however do **not** accept any specific mention of an atom with a mass greater than that of iron*

- (star expands to) / become(s) a red giant

2

[6]

**Q35.**

- (a) big bang theory – universe started at one point (then expanded)

1

steady state theory – universe has no origin / has always existed

*accept an answer in terms of mass*

*eg steady state theory mass is created*

1

- (b) (i) wavelength (of light) increases

*accept answers in terms of frequency decrease*

*accept wavelength stretched but **not** wave stretched*

**or** wavelength / light moves to red end of spectrum

*do **not** accept galaxy moves to the red end of the spectrum*

*do **not** accept light becomes red / redder*

1

- (ii) red-shift is evidence / supports idea of expanding universe

*accept prove for support*

1

both theories use the idea / accept / explain why the universe is expanding

1

- (c) to find evidence to support one or both theories

*accept prove for support*

*accept to gain more knowledge about the universe*

**or** to find evidence to disprove one or both theories

1

- (d) answer involves (religious) belief

*accept it cannot be tested*

**or** no / insufficient evidence

1

[7]