Solar System, Stability of Orbital Motions, Satellites

These practice questions can be used by students and teachers and is

Suitable for GCSE AQA Physics Topic Question 8463

Level: GSCE AQA 8463

Subject: Physics

Exam Board: GCSE AQA

Topic: Solar System, Stability of Orbital Motions, Satellites

Q1.

(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)

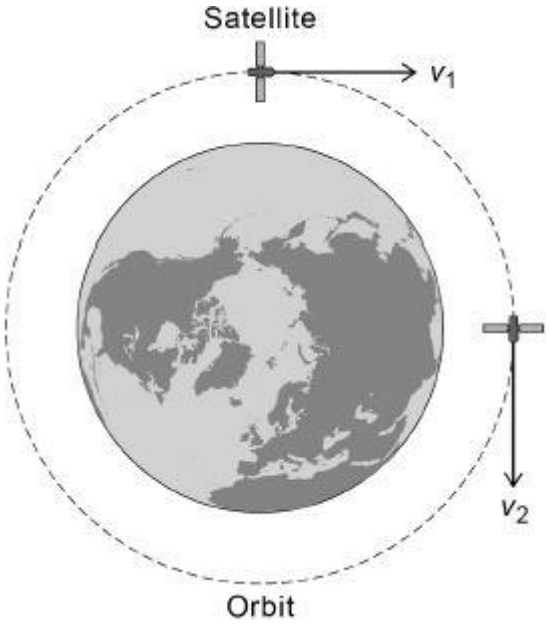
(Total 7 marks)

Q2.

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

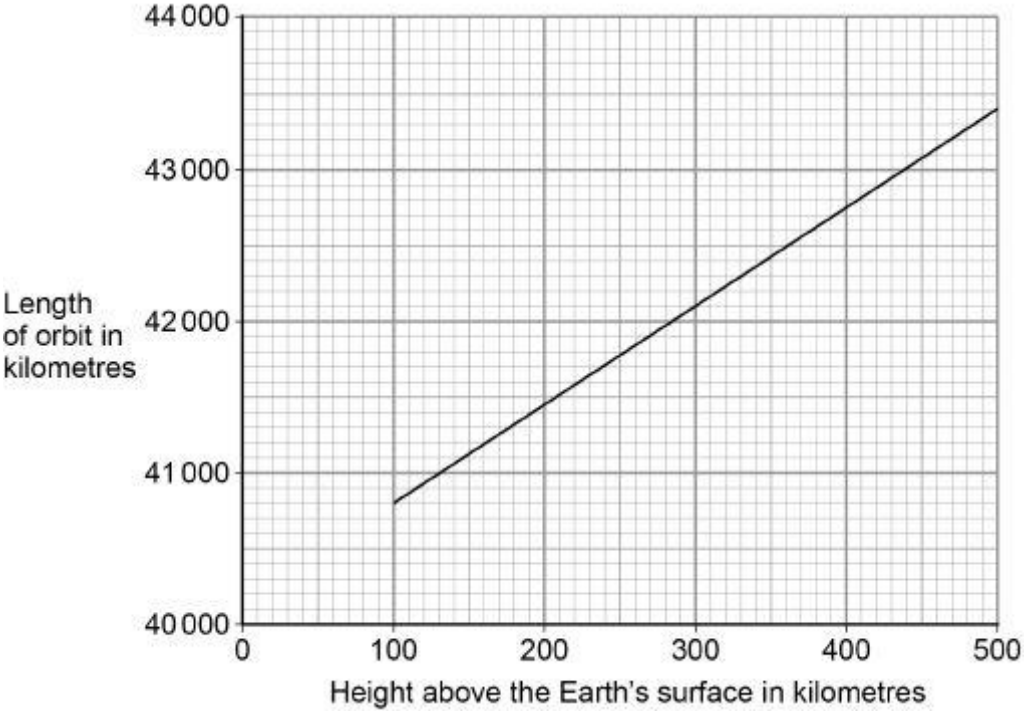


(a) Explain why the velocity of the satellite changes as it orbits the Earth.

(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)

Q3.

(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)

Q4.

(a) Which one of the following types of electromagnetic wave has the highest frequency?

Tick **one** box.

Gamma rays ☐

Infrared ☐

Microwaves ☐

Ultraviolet ☐

(1)

(b) What makes microwaves suitable for sending communications to a satellite in space?

_____

_____

(1)

(c) Scientists have detected short bursts of radio waves emitted from a distant galaxy.

The scientists think that the radio waves may have been emitted from a neutron star.

What event leads to a neutron star forming?

_____

_____

(1)

(d) Some of the radio waves from the distant galaxy have a frequency of 1.2 gigahertz (GHz).

Which of the following is the same as 1.2 GHz?

Tick **one** box.

1.2×10^3 Hz ☐

1.2×10^6 Hz ☐

1.2×10^9 Hz ☐

1.2×10^{12} Hz ☐

(1)

(e) Radio waves travel through space at a speed of 3.0×10^8 m/s

Calculate the wavelength of the 1.2 GHz radio waves emitted from the distant galaxy.

_____

_____

_____

_____

_____

Wavelength = _____ m

(3)

(f) When radio waves are absorbed by an aerial they may create an alternating current in an electrical circuit.

If an alternating current is created what frequency would it have?

_____

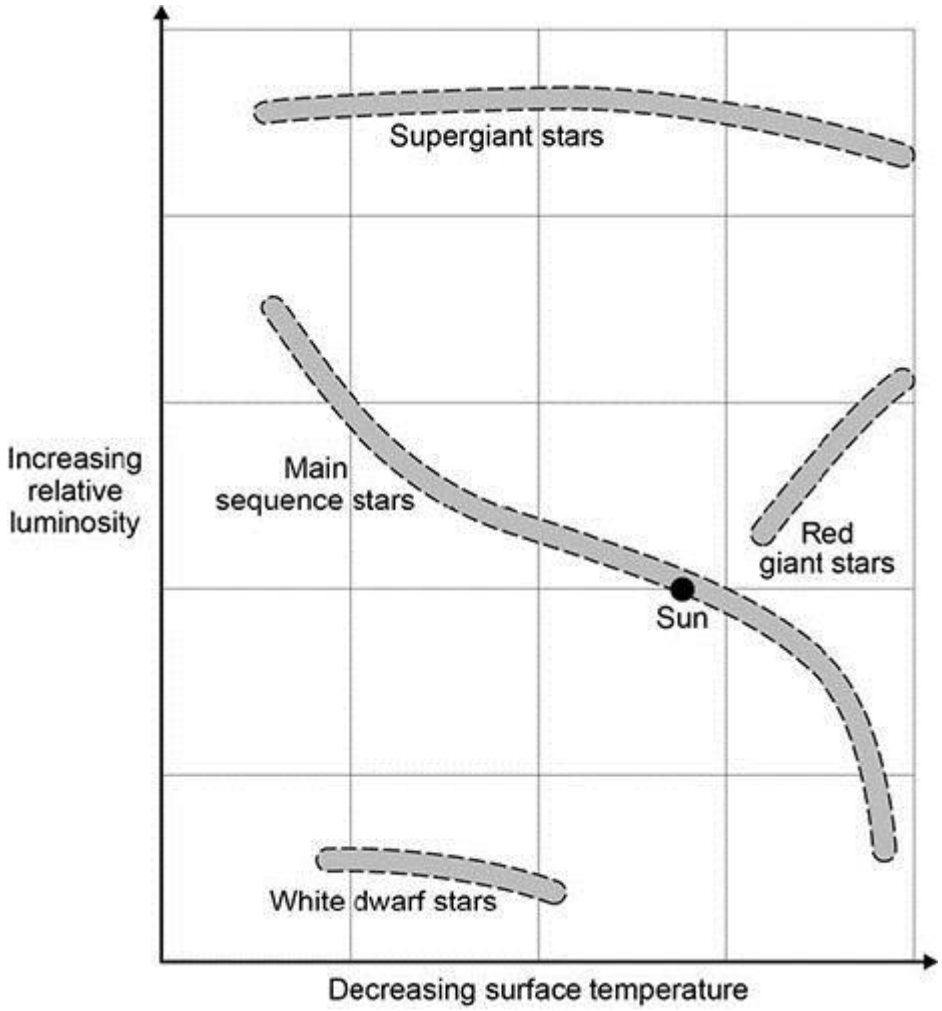
_____

(1)

The diagram 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.



(g) The Sun is in the group of main sequence stars. These stars are stable.

Explain why a star remains stable.

_____

(2)

(h) 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 the diagram.

(4)

(Total 8 marks)

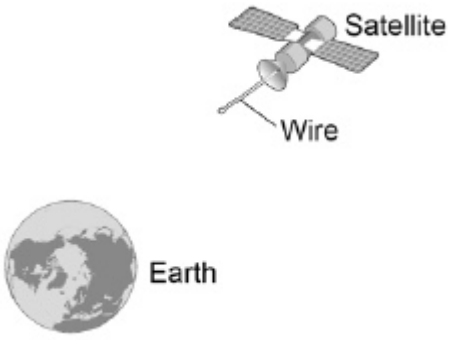
Q5.

Scientists have used a satellite system to investigate the idea of generating electricity in space.

As the system orbited the Earth a 20 km copper wire was reeled out.

Before the wire snapped a current of 1 amp was induced in the wire.

Figure 1



(a) What provides the force needed to keep a satellite in orbit around the Earth?

_____

(1)

(b) Explain how a current is induced in the wire.

_____

_____

_____

_____

_____

_____

_____

_____

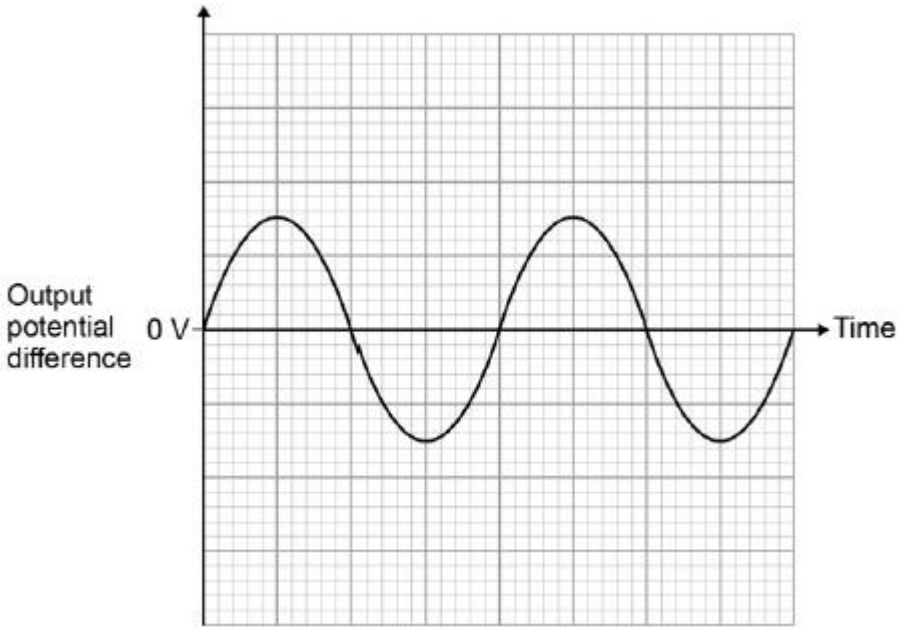
(3)

An alternator is connected to a data logger.

The data logger is connected to a computer.

Figure 2 shows how the output potential difference of the alternator varies with time.

Figure 2



(c) The coil inside the alternator now rotates at twice the frequency.

Draw on **Figure 2** to show how the output potential difference varies with time at this

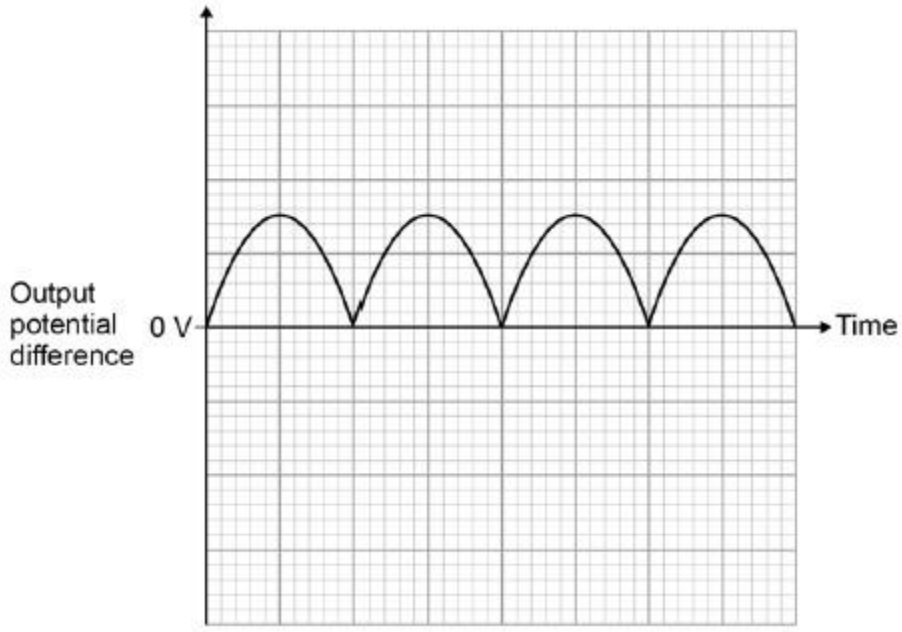
new frequency.

(2)

Another type of generator is now connected to the data logger and computer.

Figure 3 shows how the output potential difference varies with time for this generator.

Figure 3



(d) What name is given to this second type of generator?

_____

(1)

(e) Look at **Figure 2** and **Figure 3**.

Give one difference between the outputs from the two types of generator.

_____

_____

_____

(1)

(f) The charger used to charge the battery inside a laptop computer contains a small transformer.

The charger plugs into the mains electricity supply.

mains electricity supply = 230 V

number of turns on the primary coil of the transformer = 690

number of turns on the secondary coil of the transformer = 57

Calculate the potential difference applied by the charger across the battery inside the computer.

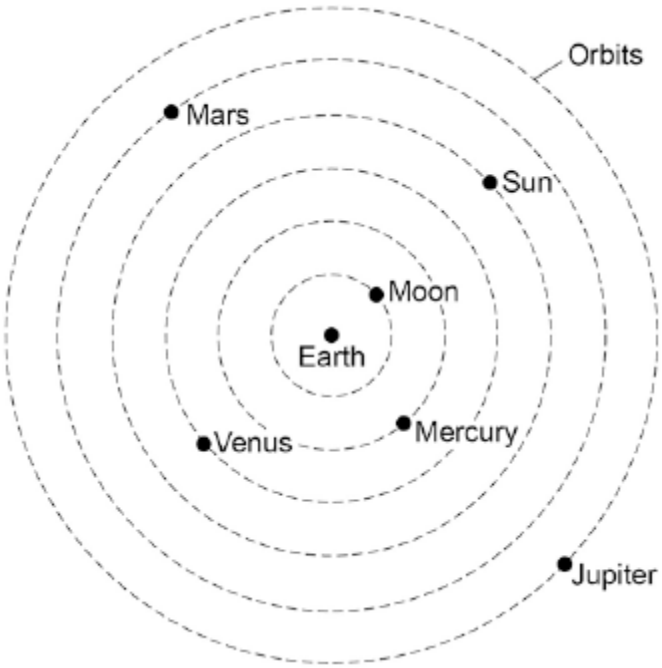
Potential difference = _____ V

(3)

(Total 11 marks)

Q6.

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?

_____

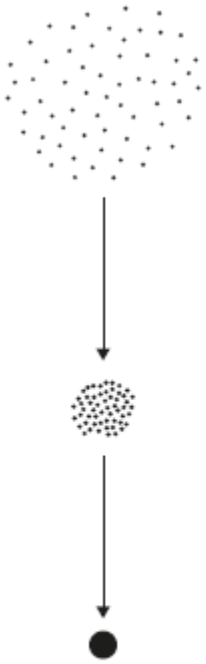
_____

(1)

(Total 5 marks)

Q7.

(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)

Q8.

(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)

Q9.

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)

Q10.

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

(a) Describe how stars are formed.

_____

_____

_____

_____

_____

_____

(3)

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

decay	**fission**	**fusion**

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.

_____

_____

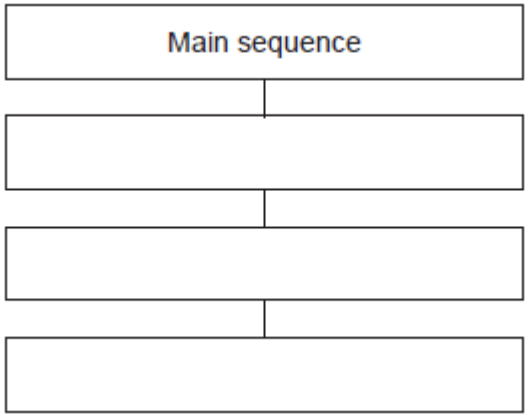
(1)

(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)

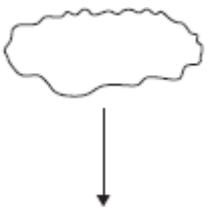
Q11.

(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**.

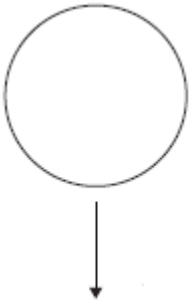
main sequence star	**neutron star**	**supernova**	**white dwarf**

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.

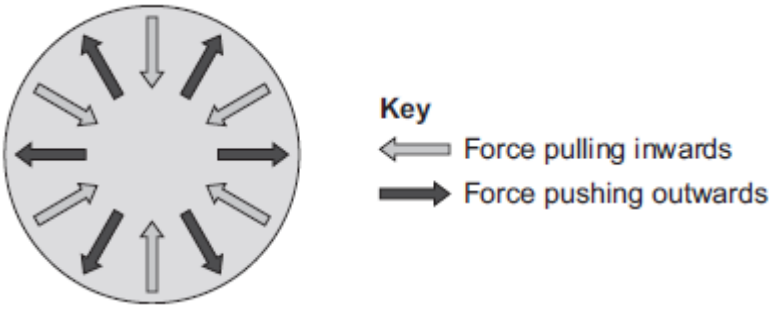
The outer layers of the star explode as a _____ .

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

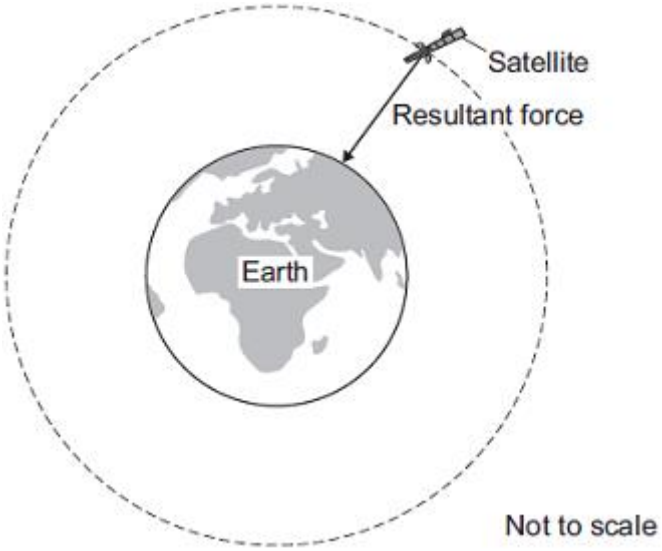
bigger than
smaller than
balanced by

the forces pulling inwards.

(1)
(Total 3 marks)

Q12.

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)

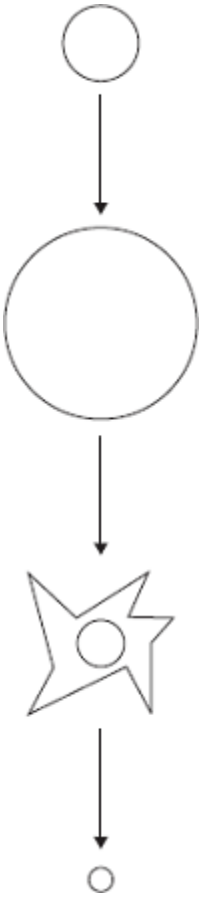
(Total 6 marks)

Q13.

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.

black hole	**red supergiant**	**supernova**	**white dwarf**



The star is stable.

The star expands forming a _____ .

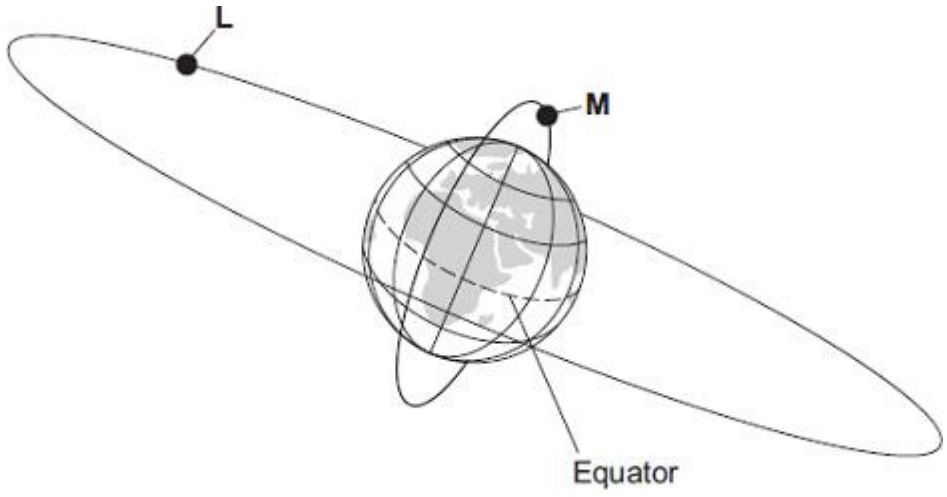
The star collapses, the outer layers explode as a _____ .

The centre collapses further and further until it finally forms a _____ .

(Total 3 marks)

Q14.

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.

_____

_____

(1)

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

_____

_____

(1)

(Total 5 marks)

Q15.

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

Universe **Earth** **Milky Way** **Sun**

Smallest _____

_____

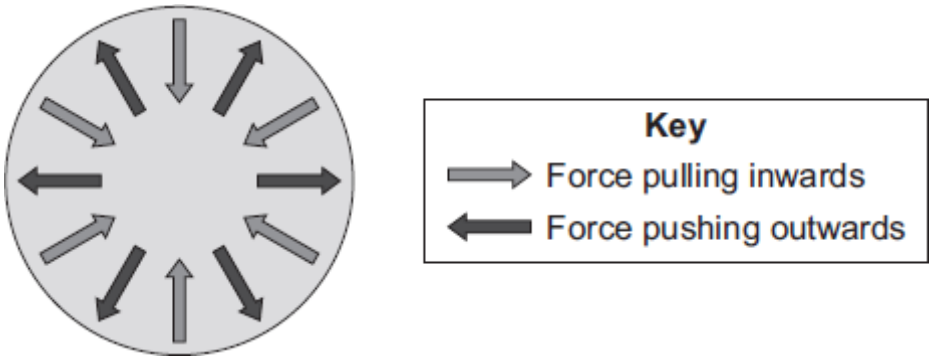
_____

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?*

_____

(1)

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

_____

_____

_____

_____

(2)

(Total 6 marks)

Q16.

(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.

_____

_____

_____

_____

(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.

_____

_____

_____

_____

_____

_____

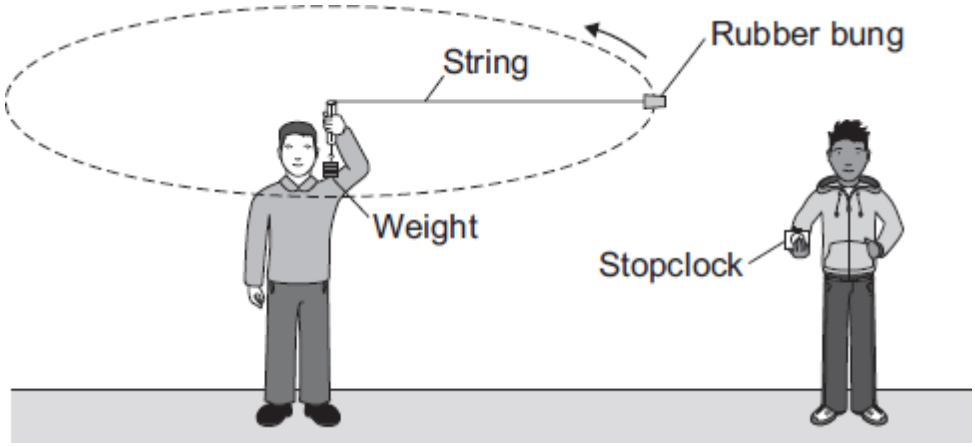
(3)

(Total 5 marks)

Q17.

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?

_____

_____

(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.

_____

_____

_____

_____

(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.

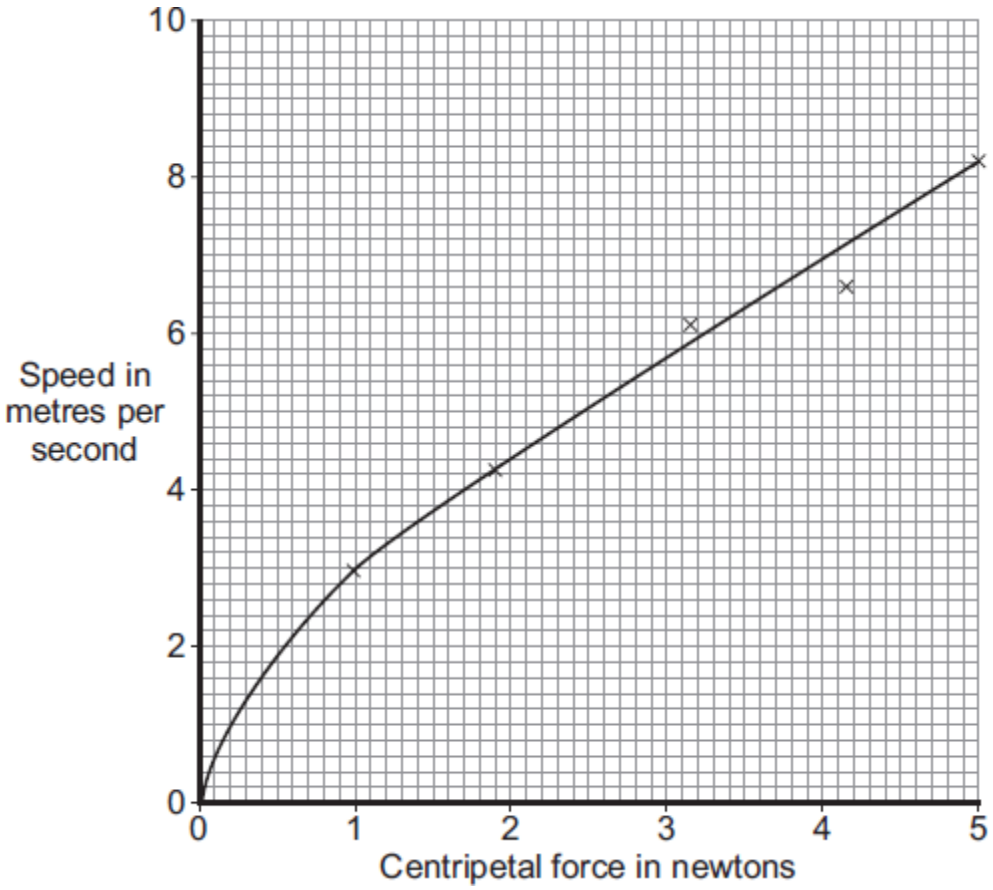
Suggest why.

_____

_____

(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?

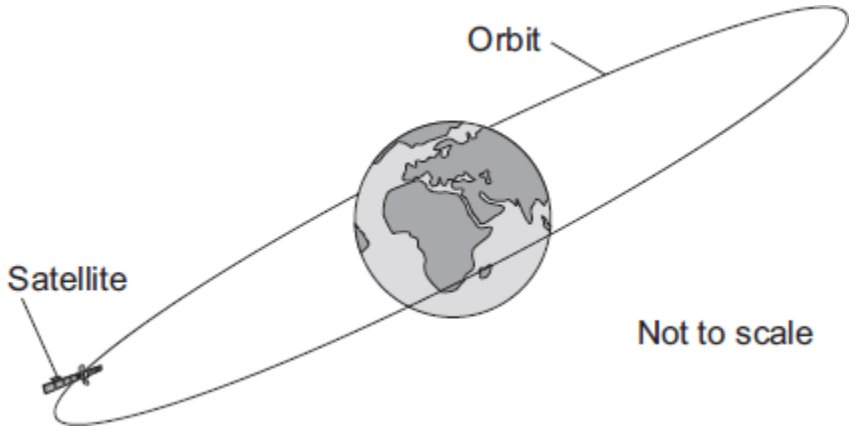
_____

_____

(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?

_____

(1)

(ii) Is this satellite in a geostationary orbit?

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

Give a reason for your answer.

_____

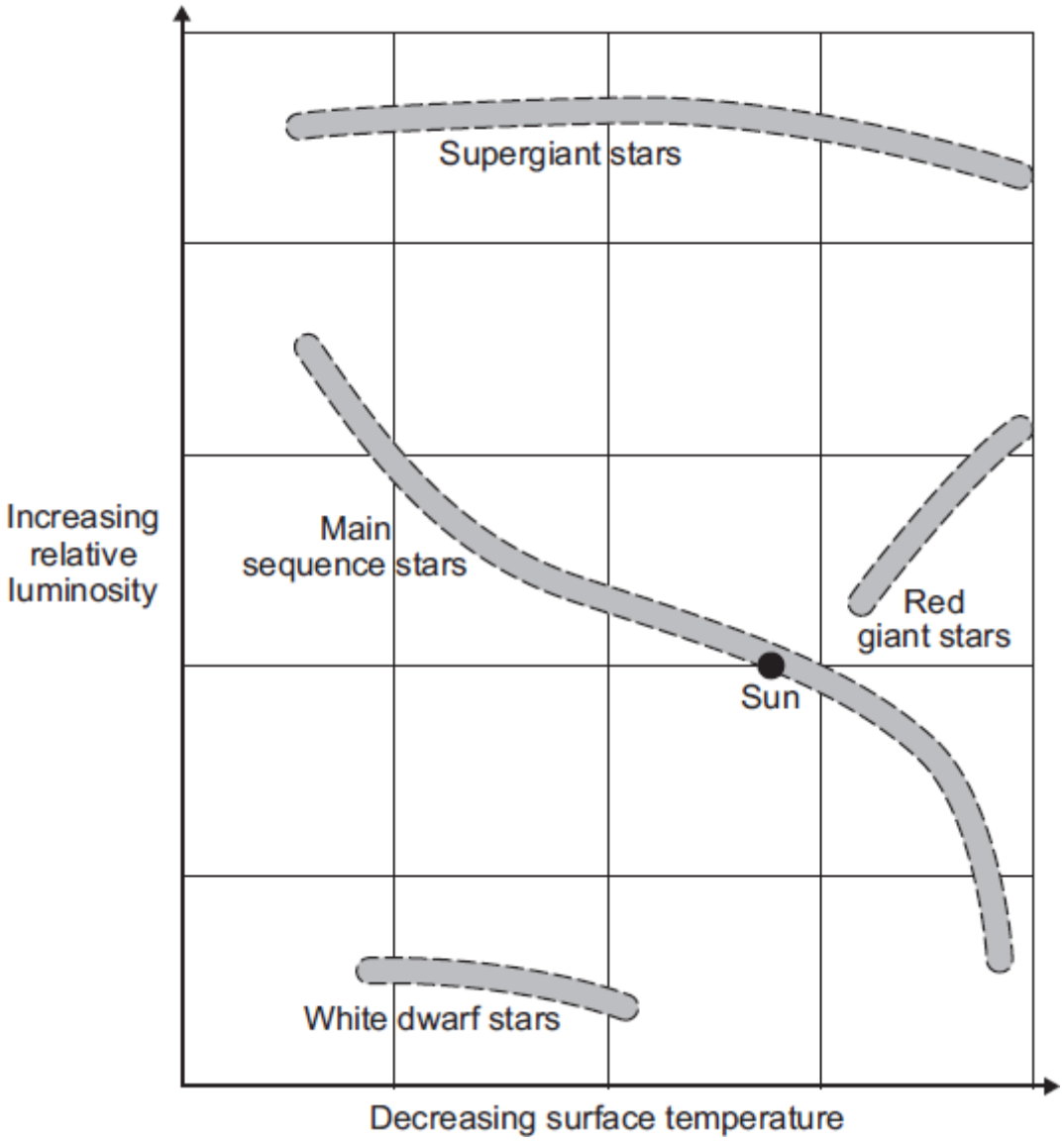
_____

(1)

(Total 9 marks)

Q18.

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)

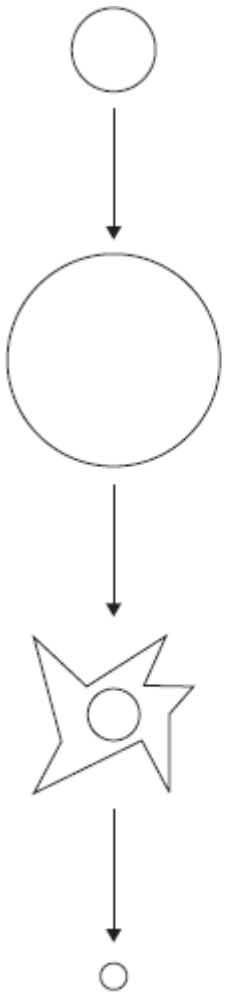
(Total 4 marks)

Q19.

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.

black hole	**red supergiant**	**supernova**	**white dwarf**



The star is stable.

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)

Q20.

(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)

Q21.

Every star goes through a 'life cycle'.

(a) Describe how a star forms.

(2)

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

Explain why a star remains stable.

_____

_____

_____

_____

_____

(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.

_____

_____

_____

_____

_____

(2)

(Total 6 marks)

Q22.

(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)

(Total 5 marks)

Q23.

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)

Q24.

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

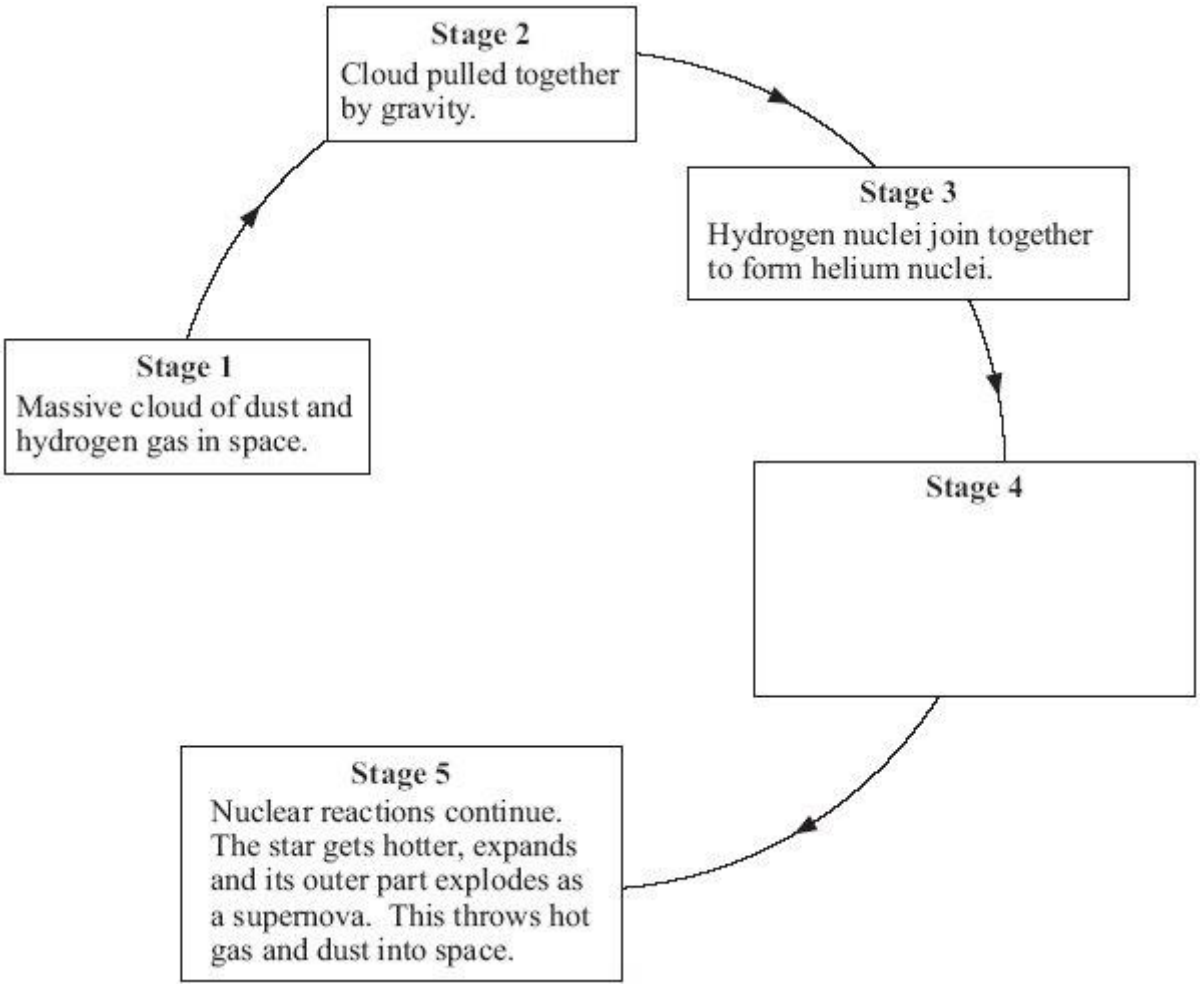
_____ .

(1)

(Total 4 marks)

Q25.

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)

Q26.

(a) Explain how stars produce energy.

(2)

(b) What evidence is there to suggest that the Sun was formed from the material produced when an earlier star exploded?

(1)

(c) It is thought that gases from the massive star Cygnus X-1 are spiralling into a black hole.

(i) Explain what is meant by the term *black hole*.

_____

_____

(2)

(ii) What is produced as the gases from a star spiral into a black hole?

_____

(1)

(Total 6 marks)

Q27.

Complete the following sentences by choosing the correct words from the box. Each word may be used once or not at all.

dwarf	**giant**	**neutron**	**proton**	**supernova**

If a red _____star is large enough, it may eventually blow up in an explosion called a _____, leaving behind a very dense _____ star.

(Total 3 marks)

Q28.

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)

Q29.

(i) Explain how stars like the Sun were formed.

_____

_____

_____

(2)

(ii) The Sun is made mostly of hydrogen. Eventually the hydrogen will be used up and the Sun will "die".

Describe what will happen to the Sun from the time the hydrogen is used up until the Sun "dies".

_____

_____

_____

_____

_____

(3)

(Total 5 marks)

Q30.

(a) Most of the Sun is hydrogen. Inside the core of the sun, hydrogen is being converted to helium. What name is given to this process and why is the process so important?

(2)

(b) Describe what will happen to the Sun as the core runs out of hydrogen.

(3)

(Total 5 marks)

Q31.

Stars are formed from massive clouds of dust and gases in space.

(a) What force pulls the clouds of dust and gas together to form stars?

(1)

(b) Once formed a star can have a stable life for billions of years. Describe the **two** main forces at work in the star during this period of stability.

(2)

(c) What happens to this star once this stable period is over?

(4)

(d) Suggest what might then happen to a planet close to this star.

_____

_____

(1)

(Total 8 marks)

Q32.

Describe briefly how stars such as the Sun are formed.

_____

_____

_____

(Total 2 marks)

Q33.

Nuclear fusion in the Sun releases large amounts of energy.

(i) Explain what is meant by nuclear fusion.

_____

_____

_____

_____

_____

(3)

(ii) Why is energy released by such nuclear fusion reactions?

_____

_____

_____

_____

(2)

(Total 5 marks)

Q34.

(a) The Sun is at the stable stage of its life.

Explain, in terms of the forces acting on the Sun, what this means.

(3)

(b) At the end of the stable stage of its life a star will change.

Describe and explain the changes that could take place.

(6)

(Total 9 marks)

Q35.

Our Sun is just one of many millions of stars in a galaxy called the Milky Way.

Our Sun is in the main stable period of a star's lifetime. The massive force of gravity draws its matter together. This force is balanced by the very high temperatures, from the fusion of hydrogen atoms, which tend to make the Sun expand. Describe and explain what will happen to the Sun as the hydrogen is eventually used up.

(Total 3 marks)

Mark schemes

Q1.

(a) Milky Way

1

(b) distance = 300 000 × 500

1

d = 150 000 000 (km)

1

*an answer of 150 000 000 scores **2** marks*

(c) 3

1

(d) accept any number greater than 1.0 and less than 12.0

1

(e) $\frac{9}{0.6}$

1

15

1

*an answer of 15 scores **2** marks*

[7]

Q2.

(a) (force of) gravity causes the satellite to accelerate (towards the Earth)

allow satellite is (constantly) accelerating

1

the acceleration causes a change in direction

acceleration causes a change in speed negates this mark point

1

velocity changes because direction changes

1

(b) length of orbit taken from graph = 42 100 (km)

1

42 100 = 7.73 × time

or

$\text{time} = \frac{42100}{7.73}$

allow
their distance = 7.73 × time

1

time (1 orbit) = 5446(s)

allow a value consistent with their distance

1

$$\text{number of orbits} = \left(\frac{24 \times 3600}{5446}\right)$$

= 15.86

allow $\left(\frac{24}{1.51}\right) = 15.86$

allow a value consistent with their distance

1

number of orbits = 15

allow a value consistent with their distance

*an answer of 16 scores **4** marks*

1

or

length of orbit taken from graph = 42 100 (km) (1)

$$7.73 = \frac{\text{distance}}{24 \times 3600} \text{ (1)}$$

distance = 667 872 (km) (1)

$$\text{number of orbits} = \left(\frac{667872}{42100}\right)$$

= 15.86 (1)

allow a value consistent with their two distances

number of orbits = 15 (1)

allow a value consistent with their two distances
up to full marks can be awarded for a method
calculating velocity in km/h and time in hours

*an answer of 15 scores **5** marks*

(c) the predicted data is very close to the actual data

1

(d) supported the prediction (made by Bode)

allow predicted and actual values are very close

1

so provides evidence that the equation is true / correct / works / accurate

allow proves for provides evidence

1

[11]

Q3.

(a) dwarf planet

1

(b) nebula

correct order only

1

gravity

1

(c) (becomes a) red giant

1

(d) the greater the distance (from the Sun) the greater the time taken to orbit the Sun

1

(e) any value between 3 and 7 inclusive

1

(f) because some planets do not fit the pattern

1

named planet that does not fit pattern

eg Venus

1

reason why named planet does not fit pattern

its temperature is higher than expected

or

Uranus: its temperature is lower than expected

or

Neptune: its temperature is higher than expected

or

Mercury: its temperature is lower than expected

1

[9]

Q4.

(a) gamma rays

1

(b) can travel through the atmosphere

1

(c) explosion of a red super giant

or

a supernova

1

(d) 1.2×10^9 Hz

1

(e) $3.0 \times 10^8 = 1.2 \times 10^9 \times \lambda$

*an answer of 0.25 (m) scores **3** marks*

*allow ecf from **(d)***

1

$$\lambda = \frac{3.0 \times 10^8}{1.2 \times 10^9}$$

1

$\lambda = 0.25$ (m)

1

(g) same as the radio wave

1

(f) expansion due to fusion energy

1

in equilibrium with gravitational collapse

*forces acting inwards equal forces acting outwards gains **1** mark*

1

(h)

Level 2: Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3-4
Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1-2
No relevant content	0
Indicative content • Sun goes from main sequence to red giant • then from red giant to white dwarf • when the Sun changes to a red giant the surface temperature will decrease • and the relative luminosity will increase • when changing from a red giant to a white dwarf the surface temperature increases • and the relative luminosity decreases	

4

[14]

Q5.

(a) gravity

1

(b) as the wire moves through the Earth's magnetic field

1

a potential difference is induced between the ends of the wire

1

the wire must be part of a complete circuit

1

(c) new trace shows:

twice the frequency

1

twice the amplitude

1

(d) dynamo

dc generator is insufficient

1

(e) the alternator pd changes polarity, the 2nd type of generator does not

1

(f) $\frac{230}{V_s} = \frac{690}{57}$

1

$V_s = \frac{230 \times 57}{690}$

1

V_s = 19 (V)

*an answer of 19 (V) scores **3** marks*

1

[11]

Q6.

(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

1

(b) Shows the moon in orbit around the Earth

accept the planets have circular orbits

1

(c) circular

accept elliptical

1

(d) gravity

1

(e) Mira is much more massive

1

[5]

Q7.

(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]

Q8.

(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]

Q9.

(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]

Q10.

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

1

are pulled together

1

by gravitational attraction

1

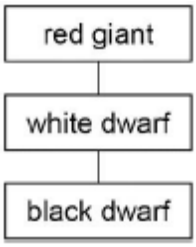
(b) fusion
accept fusion circled in box

1

(c) forces within it are balanced

1

(d)



correct order only

1

ignore reference to planetary nebula

1

1

1

[8]

Q11.

(a) main sequence star

correct order only

1

supernova

1

(b) balanced by

1

[3]

Q12.

(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]

Q13.

red supergiant

*do **not** accept red giant*

1

supernova

1

black hole

1

[3]

Q14.

(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]

Q15.

(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]

Q16.

(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]

Q17.

(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

[9]

Q18.

(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]

Q19.

red supergiant

1

supernova

1

black hole

1

[3]

Q20.

(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]

Q21.

(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]

Q22.

(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]

Q23.

(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]

Q24.

(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]

Q25.

(a) (i) the bigger the <u>masses</u> (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]

Q26.

(a) any **two** from:

- nuclei / atoms of light elements fuse

  accept hydrogen or helium for light elements
  accept join for fuse
  *accept for **1** mark, by nuclear fusion*
  answers about fission negates a mark

- each (fusion) reaction releases energy / heat / light
- lots of reactions occur

2

(b) presence of nuclei of the heaviest / heavy / heavier elements

accept atom for nuclei

1

(c) (i) (matter / mass) with such a high density / strong gravitational (field)

1

electromagnetic radiation / light is pulled in

accept nothing can escape
*do **not** accept answers in terms of an empty void*

1

(ii) X-rays

accept e-m radiation / e-m waves

1

[6]

Q27.

giant

1

supernova

1

neutron

1

[3]

Q28.

(a) converted into helium

accept helium created
accept converted into heavier elements
accept used up in nuclear fusion / to produce energy
*do **not** accept any reference to burning*

1

(b) turns / expands into a red giant

contradictions negate mark

1

contracts **and** explodes **or** becomes a supernova

1

may form a (dense) neutron star **or** (if enough mass shrinks to) form a black hole

accept forms a neutron star and (then) a black hole

1

Quality of written communication

correct points must be in sequence

1

(c) (i) supernova **or** remains of an earlier star

ignore super nebula

1

(ii) younger **or** not formed at the time of the Big Bang

1

[7]

Q29.

(i) from a (giant) cloud of gas or hydrogen

1

condensed **or** pulled into a smaller volume by gravity

1

(ii) any three from:

- fusion decreases or stops
- collapses rapidly causing the (core) temperature to rise
- (inward) gravitational forces no longer balance (outward) pressure
- expands
- and becomes a red giant
- it cools
- then becomes a white dwarf
- helium may fuse

*if the sequence is incorrect deduct [1] therefore maximum **2** marks*

3

[5]

Q30.

(a) fusion

accept fussion

1

energy producing process

accept heat and/or light for energy

accept fussion

1

(b) up to **2** points from:

***3** marks for 3 points in sequence with no contradiction*

- expands

***2** marks for 2 points in sequence with no contradiction*

- cools
- forms a red giant

***1** mark for a correct point which is not contradicted*

up to **2** points from:

*do **not** accept 'it turns red'*

- contracts
- increases in temperature
- forms a white dwarf

ignore further reference to black dwarfs, black holes, nebulae,

supernovae

3

[5]

Q31.

(a) gravitational attraction

for 1 mark

1

(b) gravitational (in);
high internal temperature generates force (out)

for 1 mark each

2

(c) star expands;
to form red giant;
then contracts/collapses;
to form white dwarf/neutron star/black hole/pulsar;
they may explode/become supernova

any four for 1 mark each

4

(d) engulfed by red giant/blown up by star/hit by debris from star; sucked into black hole

for 1 mark

1

[8]

Q32.

formed from dust or gas (unless in atmosphere) which is pulled together by gravitational forces high temperature inside

[2]

Q33.

(i) the nuclei
of hydrogen/smaller atoms
join to make helium/larger atoms

for 1 mark each

3

(ii) the mass of the large nucleus (atom) is less than the mass of the smaller nuclei (atoms)

for 1 mark

mass loss converted into energy or small mass loss given a large amount of energy

for 1 mark

2

[5]

Q34.

(a) the Sun is subject to two balancing forces / 2 forces in equilibrium
the forces are: gravity making it contract **or** inward force due to gravity
and a force due to temperature / heat / energy / radiation pressure making it expand **or** outward force due to temperature / heat / energy / radiation pressure

for 1 mark each

3

(b) Read all the answer first. Stop after 6 marks.

hydrogen / fuel used up owtte the star will expand and become a red giant
it will contract under gravity become a white dwarf
it may explode and become a supernova throwing dust and gas into space
leaving a dense neutron star / black hole

(no mark for contradiction)
any six for 1 mark each

6

[9]

Q35.

any **three** from

max 2 if stages but no explanation

- the star (Sun) expands because
(inward) gravitational forces no longer balance (outward) force

  accept the star collapses rapidly causing the core temperature to increase and the star to expand
  accept it expands because the forces are unbalanced

- to become a red giant

- when the fusion stops it contracts / cools

  accept (when hydrogen is used up) it collapses under gravity
  accept when fusion stops it contracts and explodes

- to become a white dwarf

  accept to become a supernova / pulsar / neutron star / black hole (only if red giant has exploded)

[3]