All questions are for separate science students only

1. The Sun is the closest star to the Earth.

(a) A 2.5 kg mass would have a weight of 750 N at the surface of the Sun.

Calculate the gravitational field strength at the surface of the Sun.

Use the equation:

$$\text{gravitational field strength} = \frac{\text{weight}}{\text{mass}}$$

____

____

____

____

Gravitational field strength = ____________ N/kg

(2)

(b) Gravity is a non-contact force.

Which of the following is also a non-contact force?

Tick (✓) **one** box.

Air resistance	☐
Electrostatic	☐
Friction	☐
Tension	☐

(1)

(c) All stars have a life cycle.

The figure below shows part of the life cycle of a star that becomes a black dwarf.

Complete the figure below.

Choose answers from the box.

	Black hole	Neutron star
Red giant	Supernova	White dwarf

Main sequence star

↓

____

↓

____

↓

Black dwarf

(2)

The table below gives the mass of three stars compared to the mass of the Sun.

Sta	Mass compared to the mass of the Sun
r X	× 25.0
Y Z	× 15.0
	× 0.9

(d) Which letter represents the star most likely to become a black dwarf?

Give a reason for your answer.

Tick (✓) **one** box.

X ☐ Y ☐ Z ☐

Reason ____

____

____

(2)

(e) In which stage of the life cycle of a star are elements heavier than iron produced?

Tick (✓) **one** box.

Nebula	☐
Protostar	☐
Supernova	☐

(1)

(Total 8 marks)

2. Most galaxies are moving away from the Earth. Scientists can determine the speed of a galaxy by observing the light from the galaxy.

(a) Complete the sentence.

Choose the answer from the box.

frequency	speed	wavelength

When scientists observe the light from distant galaxies, they observe an increase in the ______________________ of light from those galaxies.

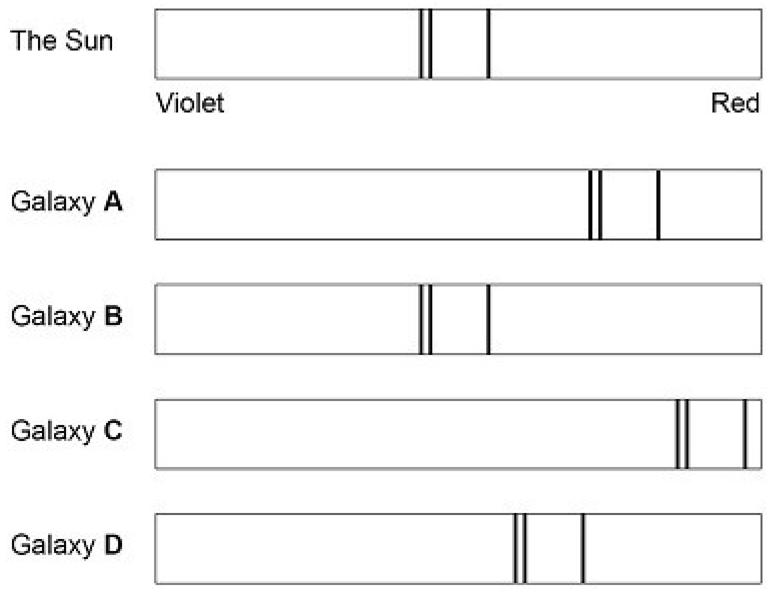
(1)

The light spectra from stars and galaxies include dark lines.

The lines have the same pattern.

Figure 1 shows the light spectrum from the Sun and from four galaxies.

Figure 1



(b) Which galaxy is moving the fastest away from the Earth?

Tick (✓) **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

(c) Which galaxy is the furthest away from the Earth?

Tick (✓) **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

(d) The Big Bang theory is one way to explain the origin of the universe.

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

Tick (✓) **one** box.

Very big and very dense ☐

Very big and extremely hot ☐

Very dense and extremely hot ☐

Very small and extremely cold ☐

(1)

(e) Which statement about the Big Bang theory is correct?

Tick (✓) **one** box.

Scientists have proved that the theory is correct. ☐

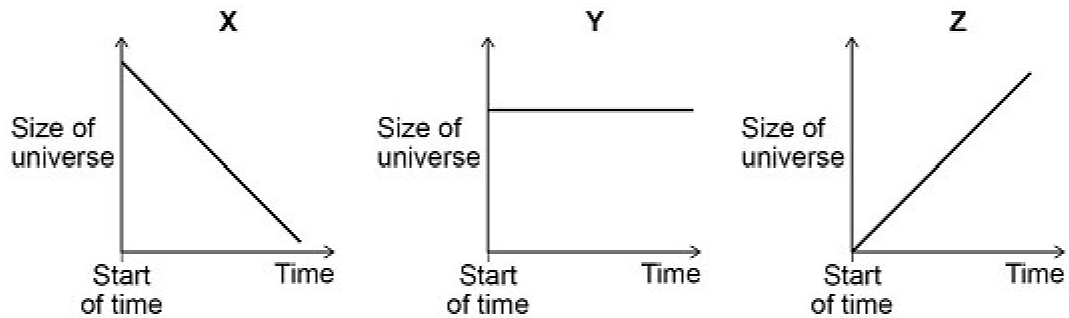
Scientific evidence supports the theory. ☐

There is no other way to explain the origin of the universe. ☐

(1)

(f) **Figure 2** shows three ways that the size of the universe may have changed with time.

Figure 2



Which graph would the Big Bang theory suggest is correct?

Tick (✓) **one** box.

X ☐ Y ☐ Z ☐

Give a reason for your answer.

____

____

(2)

(Total 7 marks)

3. (a) Complete the sentences.

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

by ______________ are in equilibrium with the forces pushing outwards caused by

the energy released by nuclear ______________.

(2)

(b) Write down the equation that links distance travelled (s), speed (v) and time (t).

____

(1)

(c) The mean distance between the Sun and the Earth is 1.5×10^{11} m.

Light travels at a speed of 3.0 × 108 m/s.

Calculate the time taken for light from the Sun to reach the Earth.

Time = ______________ s

(3)

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

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

(6)

(e) Stars emit radiation with a range of wavelengths.

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

Tick (✓) **one** box.

Density	☐
Mass	☐
Temperature	☐
Volume	☐

(1)

(Total 13 marks)

4. Our solar system includes the Sun, planets and moons.

(a) Complete the sentence.

Choose the answer from the box.

Andromeda	Milky Way	Pinwheel	Whirlpool

Our solar system is part of the ______________ galaxy.

(1)

(b) Planets orbit the Sun.

What force causes planets to orbit the Sun?

____

(1)

The table below shows data about five planets.

Planet	Mean distance from the Sun in millions of kilometres	Mean surface temperature in °C
Earth	150	+22
Mars	228	–48
Jupiter	778	X
Saturn	1430	–178
Uranus	2870	–200

(c) How does the mean surface temperature of the planets in the table change as the mean distance from the Sun increases?

____

____

(1)

(d) Predict the mean surface temperature of Jupiter (X) in the table above.

Mean surface temperature of Jupiter = __________ °C

(1)

(e) Five of the planets in the solar system are given in the table above.

How many other planets are there in the solar system?

Tick (✓) **one** box.

Two	☐
Three	☐
Four	☐
Five	☐

(1)

(f) Our Moon is a natural satellite.

Why is the Moon classified as a satellite?

Tick (✓) **one** box.

It has no atmosphere.	☐
It has no gravitational field.	☐
It is too small to be a planet.	☐
It orbits a planet.	☐

(1)

(g) How are planets and moons similar?

Tick (✓) **two** boxes.

Their mass is about the same.	☐
Their orbits are circular.	☐
Their surfaces are the same colour.	☐
They are similar in diameter.	☐
They do not emit visible light.	☐

(2)

(h) The diameter of the Earth is 13 000 km.

The diameter of the Sun is 110 times greater than the diameter of the Earth. Calculate the diameter of the Sun.

____

____

Diameter of the Sun = ____________ km

(2)

(Total 10 marks)

5. (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)

6. (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
Mercur	0.4	0.2	+125
y 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
Neptun	30.0	165	–201

e

(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.

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___

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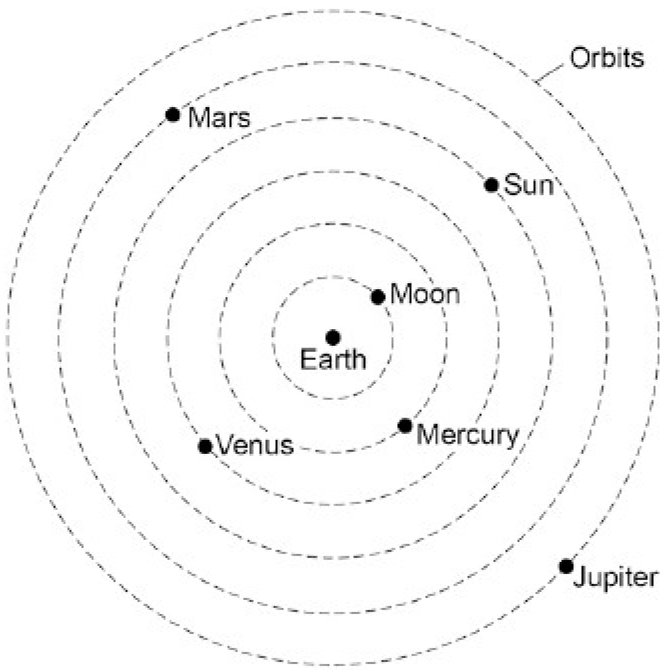
(3)

(Total 9 marks)

7. 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)

8. 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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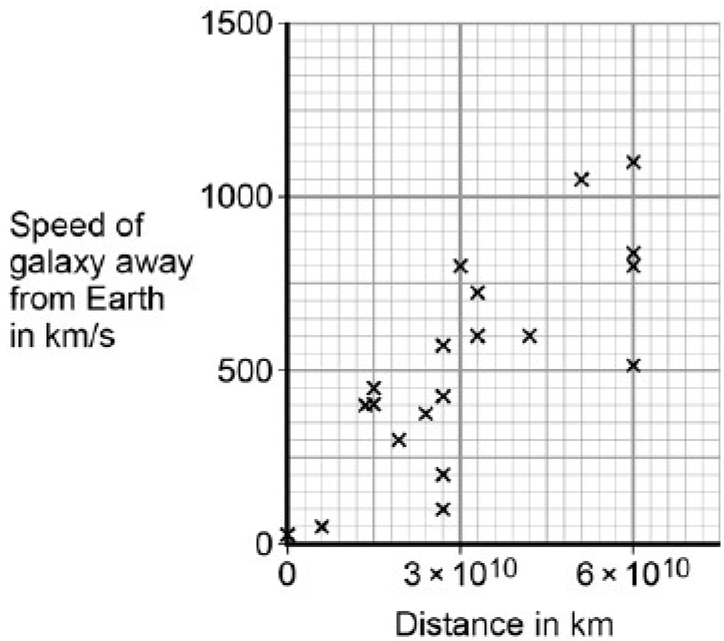
(1)

(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?

____

____

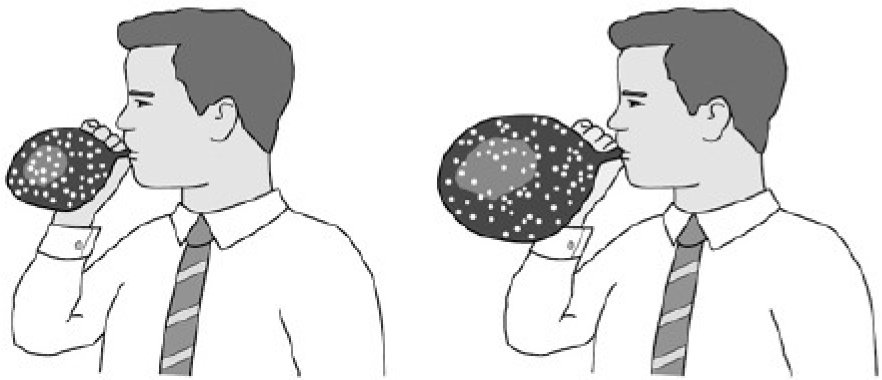
(1)

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 ____

____

Weakness ____

____

(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?

____

____

____

(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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(1)
(Total 6 marks)