Name: _____

Class: _____

Date: _____

Space Physics part 1 AQA Triple Physics

Time: **74 minutes**

Marks: **71 marks**

Comments:

1. Telescopes are used to observe distant objects.

(a) Complete the sentences.

Choose answers from the box.

galaxy	moon	nebula	star	universe

A natural satellite of a planet is called a _____.

A planet orbits a _____.

(2)

(b) What is the name of our galaxy?

Tick (✓) **one** box.

Andromeda ☐

Centaurus ☐

Milky Way ☐

Whirlpool ☐

(1)

(c) The Sun is our nearest star.

What will happen to the Sun at the end of its life cycle?

Tick (✓) **one** box.

It will become a black dwarf. ☐

It will become a black hole. ☐

It will become a neutron star. ☐

(1)

The James Webb Space Telescope is the most powerful telescope ever launched into space.

(d) Very distant galaxies can be observed using the James Webb Space Telescope.

How does the speed of a very distant galaxy compare to the speed of a much nearer galaxy?

Tick (✓) **one** box.

A very distant galaxy moves faster. ☐

The speeds are the same. ☐

A very distant galaxy moves slower. ☐

(1)

(e) There is an observed increase in the wavelength of light from most distant galaxies.

What name is given to this increase in the wavelength of light?

Tick (✓) **one** box.

Blue-shift ☐

Green-shift ☐

Red-shift ☐

(1)

(f) Observations from the James Webb Space Telescope support the Big Bang theory.

Complete the sentence.

Choose the answer from the box.

cold	**hot**	**large**

The Big Bang theory suggests that the universe began from a region that

was extremely _____.

(1)

(g) What does the Big Bang theory suggest is happening to the size of the universe?

Tick (✓) **one** box.

The universe is getting smaller. ☐

The size of the universe is constant. ☐

The universe is getting bigger. ☐

(1)

(Total 8 marks)

2. A group of stars is called a galaxy.

(a) What is the name of our galaxy?

Tick (✓) **one** box.

Black Eye ☐

Hockey Stick ☐

Milky Way ☐

Sculptor Dwarf ☐

(1)

(b) The Sun is one of the stars in our galaxy.

What was the Sun originally formed from?

Tick (✓) **one** box.

Dust and gas ☐

Heavy elements ☐

Oxygen ☐

(1)

(c) Which of the following forces was involved in the formation of the Sun?

Tick (✓) **one** box.

Electrostatic force ☐

Gravitational force ☐

Magnetic force ☐

(1)

(d) Stars produce light because they release energy.

Complete the sentence.

Choose the answer from the box.

combustion	**conduction**	**fusion**

The process which releases energy inside stars is _____

(1)

(e) Visible light and infrared radiation travel from the Sun to the Earth.

Which statement describes the time taken for visible light and infrared radiation to travel from the Sun to the Earth?

Tick (✓) **one** box.

Visible light takes less time than infrared radiation ☐

Visible light takes the same time as infrared radiation ☐

Visible light takes more time than infrared radiation ☐

(1)

(f) Infrared radiation has a longer wavelength than visible light.

Complete the sentence.

Choose the answer from the box.

smaller	**the same**	**greater**

Compared with the frequency of infrared radiation, the frequency of

visible light is _____ .

(1)

(g) The Sun and the Earth both emit infrared radiation.

How does the rate of infrared radiation emitted by the Sun compare with the rate of infrared radiation emitted by the Earth?

Give a reason for your answer.

Tick (✓) **one** box.

Lower rate than the Earth ☐

Same rate as the Earth ☐

Greater rate than the Earth ☐

Reason _____

_____

(2)

(Total 8 marks)

3. The Universe contains many stars.

(a) The Sun is the star at the centre of our solar system.

Give **three** other types of object that form our solar system.

1 _____

2 _____

3 _____

(3)

Some main sequence stars will eventually form black holes.

The table below gives the mass of four stars.

Star	**Mass in kg**
Arcturus	2.2×10^{30}
Betelgeuse	2.2×10^{31}
Cygni A	1.4×10^{30}
The Sun	2.0×10^{30}

(b) Which star in the table above is most likely to form a black hole?

_____

(1)

(c) The distance from Cygni A to the Earth is 1.1×10^{8} gigametres.

Which distance is the same as 1.1×10^{8} gigametres?

Tick (✓) **one** box.

1.1×10^{11} m ☐

1.1×10^{14} m ☐

1.1×10^{17} m ☐

1.1×10^{20} m ☐

(1)

(d) The light spectrum from every galaxy includes dark lines.

The lines have the same pattern.

The figure below shows the position of dark lines in the visible spectra of light from the Sun and from two distant galaxies.

Explain what these light spectra tell us about the velocities of galaxy **A** and galaxy **B**.

(3)

(e) The distance between Arcturus and the Earth is 3.6×10^{14} km.

speed of light = 3.0×10^{8} m/s

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

Use the Physics Equations Sheet.

Time taken = _____ s

(4)

(f) When stars are formed, they contain mostly hydrogen.

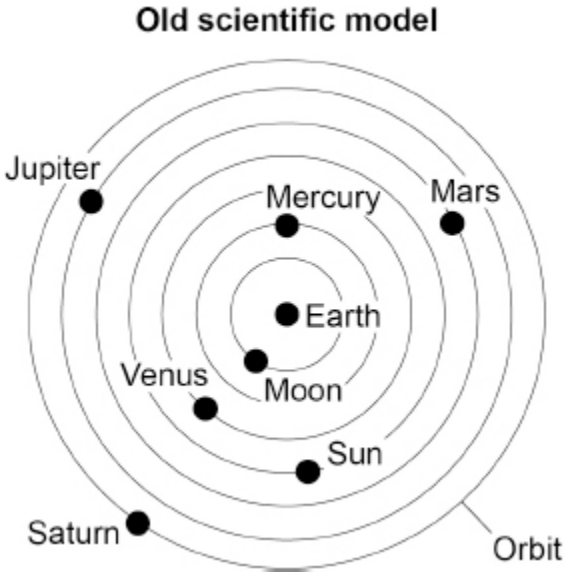
Describe how stars produce all other naturally occurring elements.

(4)

(Total 16 marks)

4. **Figure 1** shows an old scientific model of the solar system that has now been replaced.

Figure 1



(a) Which statement is a reason for replacing an old scientific model with a newer scientific model?

Tick (✓) **one** box.

The old model cannot explain new observations. ☐

The old model has been used by scientists for a long time. ☐

The old model is too simple. ☐

(1)

(b) Compare the model of the solar system used now with the old model of the solar system shown in **Figure 1**.

(4)

The table below shows data about four planets.

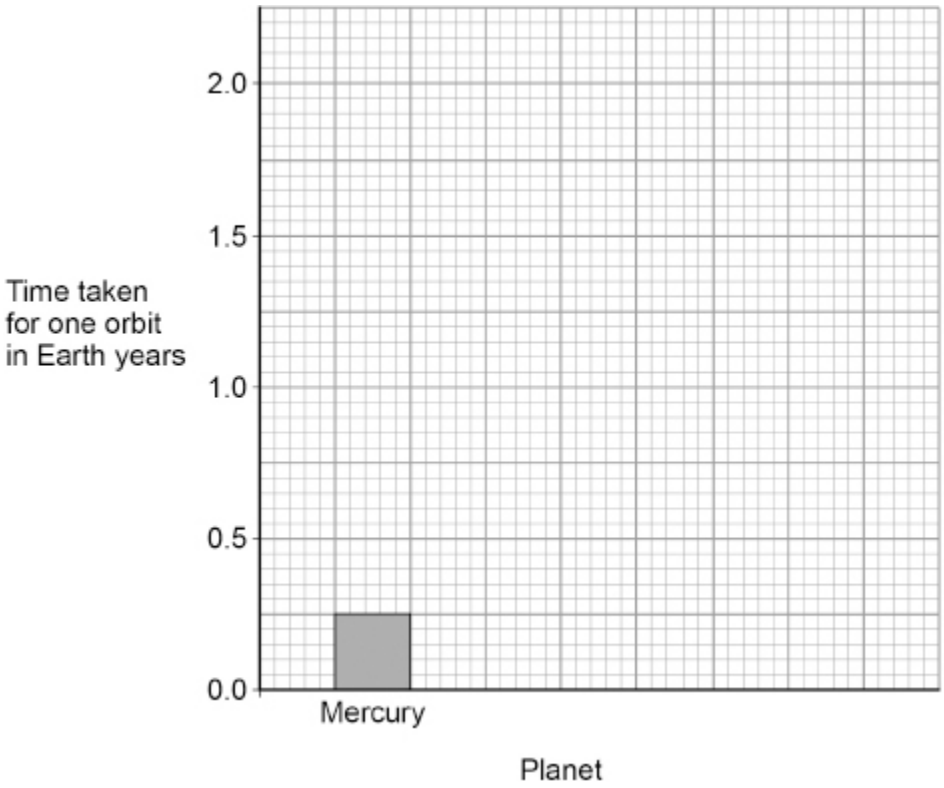
Planet	**Mean distance from the Sun in millions of kilometres**	**Time taken for one orbit in Earth years**
Mercury	58	0.25
Venus	108	0.60
Earth	150	1.00
Mars	228	1.90

(c) How does the time taken for one orbit change as the mean distance from the Sun increases?

(1)

(d) The bar chart in **Figure 2** shows some of the data from the table above.

Figure 2



Complete the bar chart.

Use data from the table above.

(2)

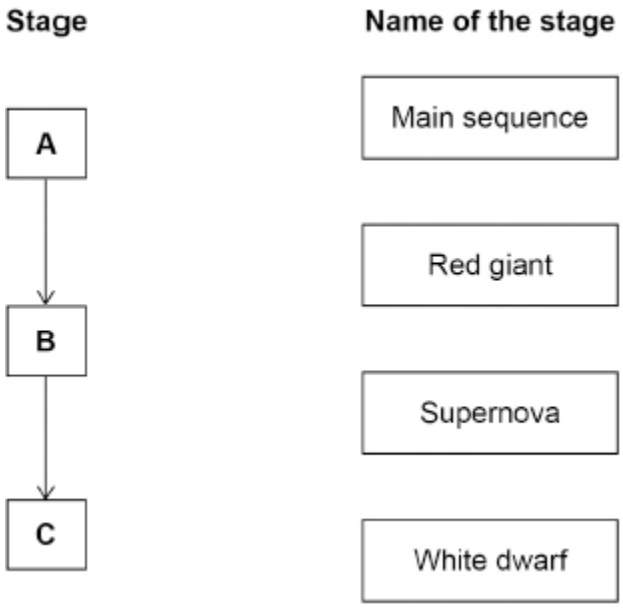
(e) All stars have a life cycle.

A, **B** and **C** in **Figure 3** represent three stages in the life cycle of the Sun.

The stages are in the correct order.

Draw **one** line from each stage to the name of the stage.

Figure 3



(2)

(f) Stars act like black bodies.

Which statement is true for perfect black bodies?

Tick (✓) **one** box.

They are good reflectors of radiation. ☐

They are the best emitters of radiation. ☐

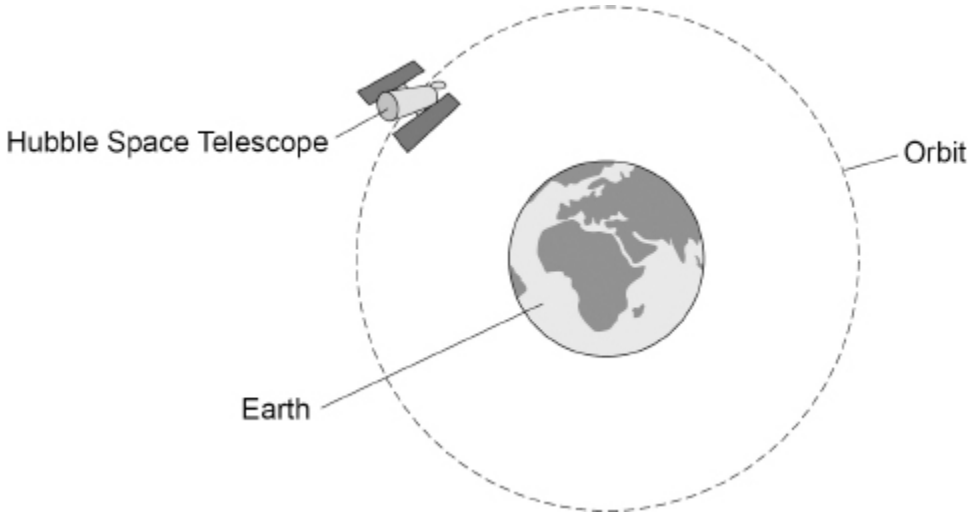
They easily transmit radiation. ☐

(1)

(Total 11 marks)

5. **Figure 1** shows the Hubble Space Telescope orbiting the Earth.

Figure 1



(a) What name is given to an object that orbits a planet?

Tick (✓) **one** box.

A comet ☐

A satellite ☐

A star ☐

(1)

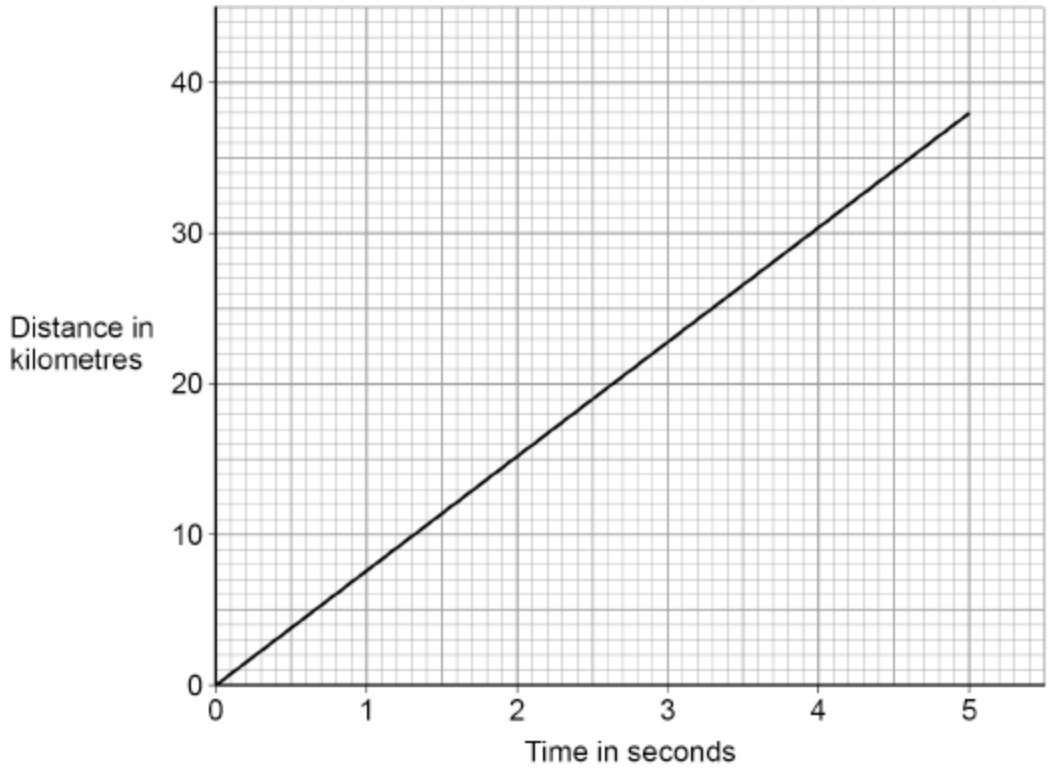
(b) The Earth exerts a gravitational force on the Hubble Space Telescope.

Draw an arrow on **Figure 1** to show the gravitational force.

(1)

(c) **Figure 2** shows how the distance travelled by the Hubble Space Telescope during its orbit changes with time.

Figure 2



The gradient of the line in **Figure 2** gives the speed of the Hubble Space Telescope.

Determine the speed of the Hubble Space Telescope.

Give your answer in km/s.

Speed = _____ km/s

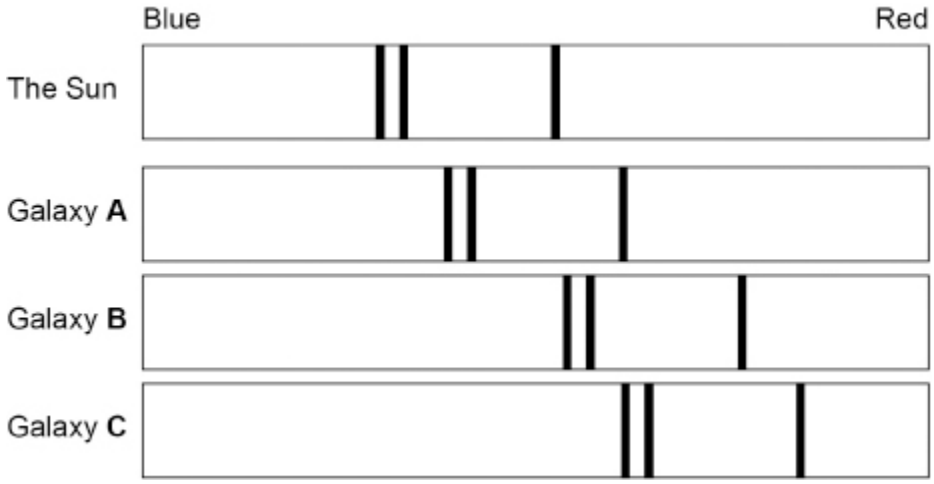
(3)

The Hubble Space Telescope can detect the visible light spectra from distant galaxies.

The visible light spectra from stars and galaxies include dark lines at specific wavelengths.

Figure 3 shows the visible light spectra from the Sun and three galaxies.

Figure 3



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

Tick (✓) **one** box.

Galaxy **A** ☐

Galaxy **B** ☐

Galaxy **C** ☐

(1)

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

Tick (✓) **one** box.

Galaxy **A** ☐

Galaxy **B** ☐

Galaxy **C** ☐

(1)

(f) New scientific observations indicate that many galaxies rotate too quickly for the known mass of the stars they contain.

Why is it important that new scientific observations are peer reviewed?

Tick (✓) **one** box.

To check the observations are correct ☐

To identify control variables ☐

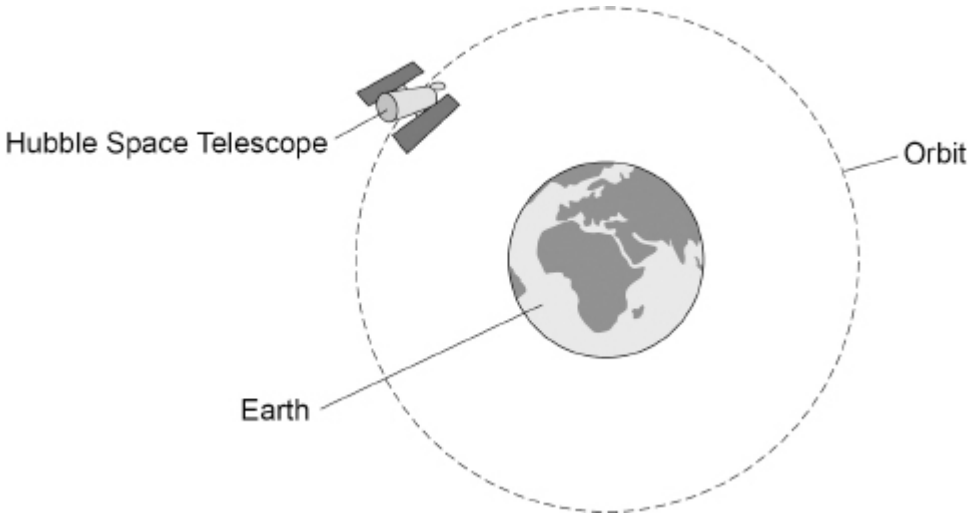
To provide more proof ☐

(1)

(Total 8 marks)

6. **Figure 1** shows the Hubble Space Telescope orbiting the Earth.

Figure 1



(a) What name is given to objects that orbit a planet?

_____

(1)

(b) A space telescope uses microwaves to communicate with the Earth.

A microwave has a wavelength of 12.5 cm.

The speed of microwaves through space is 3.0×10^8 m/s.

Calculate the frequency of the microwave.

Use the Physics Equations Sheet.

Give your answer in standard form.

Frequency (in standard form) = _____ Hz

(5)

(c) Explain the effect of the Earth's gravitational force on the motion of the Hubble Space Telescope.

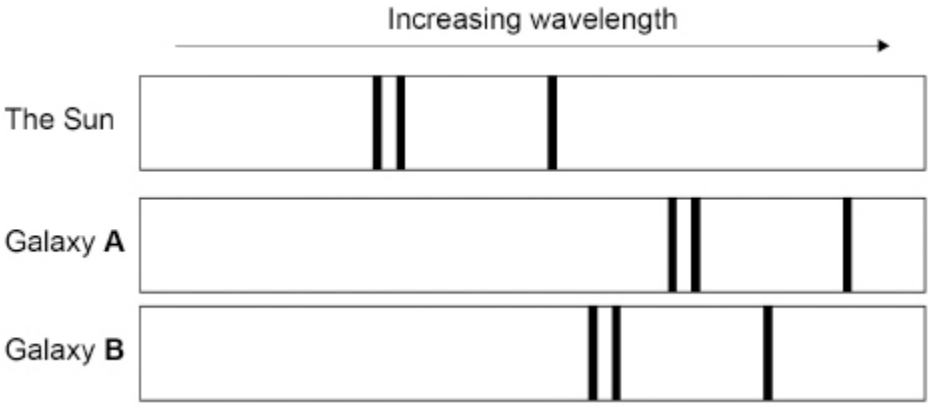
(3)

(d) The Hubble Space Telescope can detect visible light from distant galaxies.

The visible light spectra from stars and galaxies include dark lines at specific wavelengths.

Figure 2 shows the visible light spectra from the Sun and two galaxies.

Figure 2



Explain what conclusions can be made about galaxies **A** and **B**.

_____

_____

_____

_____

_____

_____

(3)

(Total 12 marks)

7. The Sun is at the centre of our solar system.

(a) What type of object is the Sun?

_____

(1)

(b) What is the name of the galaxy our solar system is part of?

Tick (✓) **one** box.

Andromeda ☐

Milky Way ☐

Sombrero ☐

Tadpole ☐

(1)

The table below gives information about some of the moons in our solar system.

Moon	**Radius in kilometres**
Ganymede	2630
Titan	2570
Europa	1560
Charon	606

(c) What is a moon?

_____

(1)

(d) A student researched the radius of some planets in the solar system.

radius of largest dwarf planet = 1190 km
radius of smallest planet = 2440 km

The student made the following conclusions:

1. dwarf planets are always smaller than moons
2. planets are always bigger than moons.

Give **one** reason why each of the student's conclusions is wrong.

Use the data given above and in the table above.

1. _____

_____

2. _____

_____

(2)

The Earth's Moon and the International Space Station both orbit the Earth.

(e) Give **one other** similarity and one difference between the orbit of the Earth's Moon and the orbit of the International Space Station.

Similarity _____

_____

Difference _____

_____

(2)

(f) Very few people have been to the International Space Station.

Suggest **one** reason why very few people have been to the International Space Station.

_____

_____

_____

(1)

(Total 8 marks)

1.

(a) moon

this order only

1

star

1

(b) Milky Way

1

(c) it will become a black dwarf

1

(d) a very distant galaxy moves faster

1

(e) red-shift

1

(f) hot

1

(g) the universe is getting bigger

1

[8]

2.

(a) Milky Way

1

(b) dust and gas

1

(c) gravitational force

1

(d) fusion

1

(e) visible light takes the same time as infrared radiation

1

(f) greater

1

(g) greater rate than the Earth

1

the Sun is at a higher temperature

allow the Sun has a greater surface area

MP2 is dependent on MP1

1

[8]

3. (a) planets

1

dwarf planets

1

moons
or
natural satellites

allow asteroids / meteors / meteoroids / meteorites

allow comets

1

(b) Betelgeuse

1

(c) 1.1×10^{17} m

1

(d) both show red-shift so both are moving away from us

or

the wavelength of the (absorption) lines has increased so both are moving away from us

1

A shows a greater red-shift (than B)

1

so A is travelling faster (than B)

1

(e) $s = 3.6 \times 10^{17}$ (m)

1

$3.6 \times 10^{17} = 3.0 \times 10^{8} \times t$

allow a correct substitution of an incorrectly / not converted value for s

1

$$\frac{3.6 \times 10^{17}}{3.0 \times 10^{8}} = t$$

allow a correct re-arrangement using an incorrectly / not converted value for s

1

$t = 1.2 \times 10^{9}$ (s)

or

$t = 1\ 200\ 000\ 000$ (s)

allow a correct calculation using an incorrectly / not converted value for s 1

1

(f) **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

- fusion occurs at high temperatures
- fusion produces new elements
- hydrogen nuclei fuse to form helium nuclei
- hydrogen (in the core) begins to run out
- helium nuclei fuse to make heavier elements
- up to iron
- some massive stars become supernovae
- creating elements heavier than iron

[16]

4.

(a) the old model cannot explain new observations

1

(b) **Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.

3-4

Level 1: Relevant features are identified and differences noted.

1-2

No relevant content.

0

Indicative content

Similarities

in both models:

- the orbits of the Moon and / or planets are circular / elliptical
- the Moon orbits the Earth
- there is one star / Sun

Differences

In the current model:

- the planets orbit the Sun, whereas in the old model the planets orbit the Earth
- there are (two) more planets
- there are also dwarf planets, whereas no dwarf planets are shown in the old model
- other planets have moons, whereas other planets have no moons shown in the old model

(c) it increases

1

(d) three bars drawn correctly

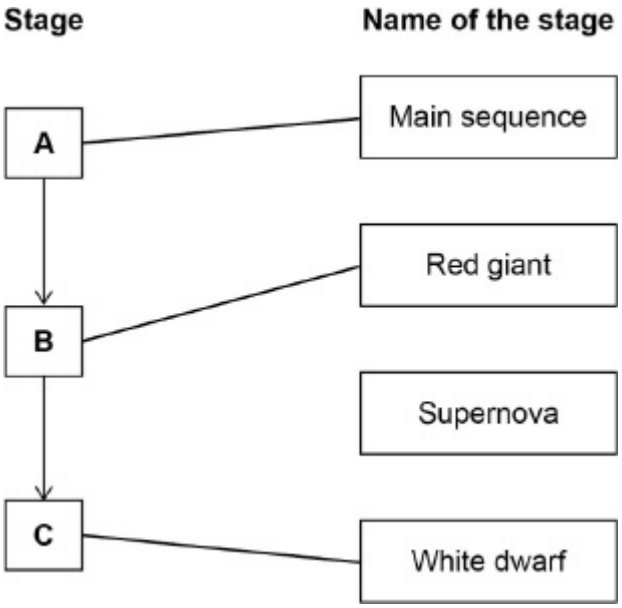
allow tolerance of half a small square

1

three bars correctly labelled

1

(e)



2 marks for all lines correct
1 mark for 2 lines correct

additional line from a box on the left negates the mark for that box

2

(f) they are the best emitters of radiation

1

[11]

5. (a) a satellite

1

(b) arrow drawn towards the centre of the Earth from the Hubble Space Telescope

1

(c) any correct change in distance with the correct change in time

e.g. 38 (km) and 5 (s)

1

a correct substitution of a correct pair of values

e.g. $v = \frac{38}{5}$

1

a correctly calculated answer

e.g. v = 7.6 (km/s)

1

(d) galaxy **C**

1

(e) galaxy **C**

1

(f) to check the observations are correct

1

[8]

6. (a) satellite

allow moon

1

(b) 12.5 cm = 0.125 m

1

$3 \times 10^8 = f \times 0.125$

this mark may be awarded for an incorrectly / not converted value for wavelength

1

$f = \frac{3 \times 10^8}{0.125}$

this mark may be awarded for an incorrectly / not converted value for wavelength

1

f = 2 400 000 000 (Hz)

this mark may be awarded for an incorrectly / not converted value for wavelength

1

$f = 2.4 \times 10^9$ (Hz)

this mark may be awarded for an incorrectly calculated value for frequency in standard form using the given data

1

(c) gravitational force causes the Hubble Space Telescope to accelerate towards the Earth

1

this changes the direction of motion (but not the speed)

1

so changes the velocity of the Hubble Space Telescope

if no other marks awarded, allow 1 mark for gravitational force maintains circular orbit

1

(d) galaxy A has the greater red shift

1

(so) A is travelling (away from us) faster (than B)

1

(because) A is further away (from us than B)

if no other marks awarded, allow 1 mark for galaxy A and galaxy B are moving away from us

1

[12]

7. (a) a star

1

(b) Milky Way

1

(c) natural satellite (that orbits a planet)

1

(d) Charon is smaller than the (largest) dwarf planet

1

Ganymede / Titan is larger than the (smallest) planet

*allow **1** mark for some are bigger than the smallest planet **or** some are smaller than dwarf planets*

1

(e) similarity: circular orbit

1

difference: (orbital) period
or
(orbital) height

allow (orbital) speed

1

(e) expensive

or

dangerous

allow difficult to get to

allow few opportunities

allow only trained astronauts can go

1

[8]