Mark schemes

1.

(a) gravitational force inwards and forces as a result of fusion reactions outwards

allow fusion energy for fusion reactions outwards

allow radiation pressure for fusion reactions outwards

1

are in equilibrium / balanced

dependant on scoring 1st mark point

*allow for **1** mark forces are in equilibrium*

1

(b) (the star will) expand to become a red giant

*the answers must be in the correct sequence to score all **3** marks*

1

(the star will) collapse to become a white dwarf

allowed outer layers ejected for collapsed

1

(the star will) cool to become a black dwarf

*if no other marks score, allow red giant, white dwarf, black dwarf in the correct order for **1** mark*

1

(c) **A**

1

it is (moving away from Earth) the slowest
or
it is the closest (to the Earth)

reason only scores if A is chosen

1

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2.

(a) wavelength

this answer only

1

(b) (extremely) hot and dense

ignore very small

1

(c) (directly) proportional

allow a correct description of direct proportionality
ignore positive correlation

1

(d) 6×10^{24}

1

(e) the furthest galaxies are moving the fastest

1

(this suggests) the universe is expanding (from a very small region)

1

(f) expanding at (an ever) greater rate
allow expanding faster

1

(g) any **one** from:

- detects false claims
  allow provides credibility
- detects inaccurate data
  allow detects mistakes
- detects bias
  allow removes bias
- verifies new data
  allow checks validity
- provides a consensus (of opinion)
  ignore shows data is accurate
  ignore proves a theory

1

(h) wavelength (seems to have) decreased

1

frequency (seems to have) increased

1

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3. (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

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

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)

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

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

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4. (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 × 109 Hz

1

(e) 3.0 × 108 = 1.2 × 109 × λ

*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

λ = 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. **No relevant content**	1-2
Indicative content	0
• 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	

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5.

(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**

Vs = 19 (V) **1**

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

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