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EDEXCEL GCSE PHYSICS: QUESTIONS BY TOPIC

Astronomy (7)

GCSE Physics (Higher) Topic 7

8 questions · 85 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Physics 1PH0, Higher Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

QUESTION	SOURCE	MARKS	PAGE
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QUESTIONS

8 questions · 85 marks · lowest tariff first



8-MARK QUESTIONS

1 question in this booklet



- 1 (a) Nuclear fusion is a process that releases energy.

Which of these statements applies to a nuclear fusion reaction?

(1)

- ☐ **A** it emits daughter nuclei
- ☐ **B** it is a controlled chain reaction
- ☐ **C** it produces radioactive waste
- ☐ **D** it requires high temperature and pressure

- (b) In the Sun, four protons start the process of nuclear fusion.

These protons combine and finally produce a helium nucleus.

The helium nucleus has a smaller mass than the four protons.

This difference in mass is converted to energy.

Four protons have a total mass of 6.69×10^{-27} kg.

A helium nucleus has a mass of 6.64×10^{-27} kg.

Calculate the percentage of the original mass that has been converted to energy.

(3)

percentage of mass converted to energy %



- (c) Figure 1 shows the spectrum of an element detected in the light from a distant galaxy, from a nearby galaxy and from a source on Earth.

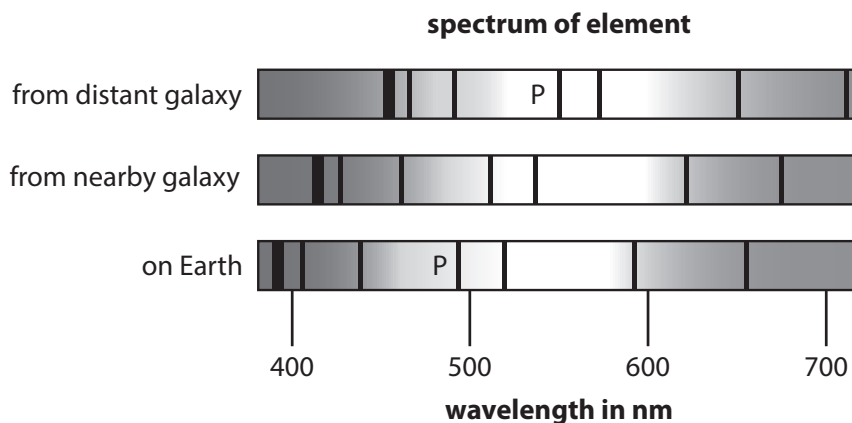


Figure 1

- (i) Estimate the difference between the wavelength of line P in the spectrum from the distant galaxy and the wavelength of line P in the spectrum on Earth.

(1)

difference in wavelength = ... nm

- (ii) Scientists have discovered that light from almost all distant galaxies has spectral lines shifted towards the red end of the spectrum.

Explain how red shift in light, received from galaxies at different distances from the Earth, supports the idea that the Universe is expanding.

(3)

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(Total for Question 1 = 8 marks)

9-MARK QUESTIONS

1 question in this booklet



- 6 (a) The Big Bang and Steady State are two theories of the origin of the Universe.

Red shift and cosmic microwave background (CMB) radiation have been discovered by observing the Universe.

Which line of the table links the evidence to the theory it supports?

(1)

		evidence	
		theory	
		red shift	CMB
☐ A	Big Bang	Yes	No
☐ B	Steady State	Yes	Yes
☐ C	Big Bang	Yes	Yes
☐ D	Steady State	No	Yes



(b) Figure 7 shows two hydrogen spectra.

One spectrum is taken from a source on Earth.

The other spectrum is taken from a source on a distant galaxy.

The spectral lines in the spectrum from the distant galaxy are shifted towards the red end of the spectrum.

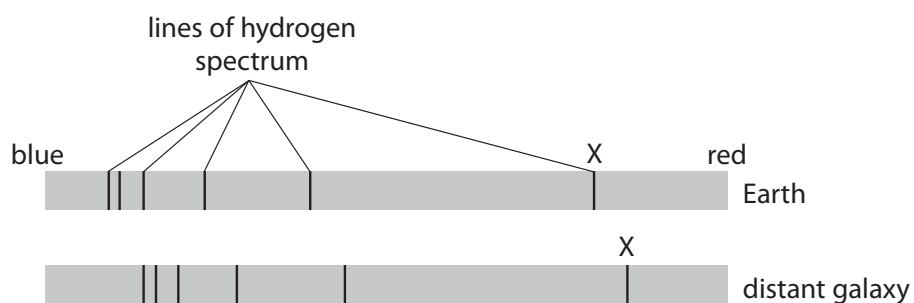


Figure 7

The wavelength of line X on Earth, $\lambda_o = 6.56 \times 10^{-7} \text{ m}$

The wavelength of line X from the distant galaxy, $\lambda_g = 6.72 \times 10^{-7} \text{ m}$

The red shift (z) is given by the equation

$$z = \frac{(\lambda_g - \lambda_o)}{\lambda_o}$$

(i) Show that the red shift for the light from the distant galaxy is about 0.025

(2)

- (ii) The galaxy is moving away from the Earth at velocity, v (recession velocity).

The velocity of light, $c = 3.00 \times 10^8 \text{ m/s}$

The recession velocity is given by the equation.

$$v = z \times c$$

Calculate the recession velocity of the distant galaxy.

(2)

recession velocity = ... m/s

- (iii) The wavelength of the spectral line X measured for a more distant galaxy was $6.92 \times 10^{-7} \text{ m}$.

Explain how this provides evidence that the Universe is expanding.

(2)

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(c) Observations of the Universe can be made using telescopes on Earth.

Explain why some telescopes are located on satellites that orbit the Earth.

(2)

(Total for Question 6 = 9 marks)



11-MARK QUESTIONS

4 questions in this booklet



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

- 4 (a) Which row of the table is correct for both force and velocity?

(1)

	force	velocity
☒ A	scalar	scalar
☒ B	scalar	vector
☒ C	vector	scalar
☒ D	vector	vector

- (b) Figure 6 shows a satellite orbiting the Earth.

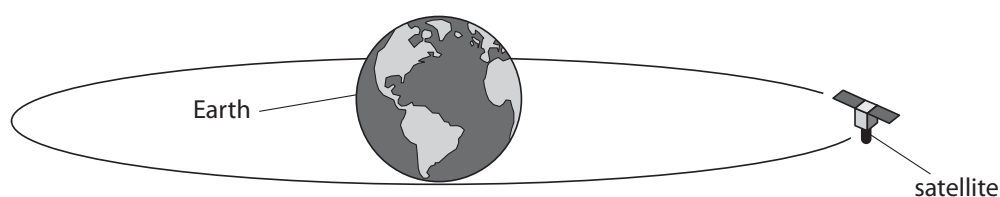


Figure 6

- (i) State the name of the force that keeps the satellite in orbit around the Earth.

(1)

- (ii) Draw an arrow on Figure 6 to show the direction of the force acting on the satellite, that keeps the satellite in orbit around the Earth.

Label this arrow 'F'.

(1)

11



(c) Satellites are used to gather data about the origin of the Universe.

The Big Bang theory is a theory about the origin of the Universe.

Evidence for the Big Bang theory is provided by red-shift and CMB radiation.

(i) Describe what is meant by red-shift.

(2)

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(ii) Explain how red-shift provides evidence for the Big Bang theory.

(2)

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(iii) The Cosmic Background Explorer (COBE) satellite observed CMB radiation from 1989 to 1993.

State what the 'M' in CMB radiation stands for.

(1)

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(iv) State what is meant by 'cosmic background radiation'.

(1)

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DO NOT WRITE IN THIS AREA

- (v) Explain how the presence of CMB radiation provides evidence for the Big Bang theory.

(2)

(Total for Question 4 = 11 marks)



- 4 (a) The Sun has a mass of 2.0×10^{30} kg.
A white dwarf has a mass of 3.4×10^{29} kg.

Calculate the value of

$$\frac{\text{mass of this white dwarf}}{\text{mass of the Sun}}$$

(2)

value = ...

- (b) Figure 4 is a diagram giving some information about main sequence stars.
Luminosity is a measure of how bright something is.
An increase in luminosity means an increase in brightness.

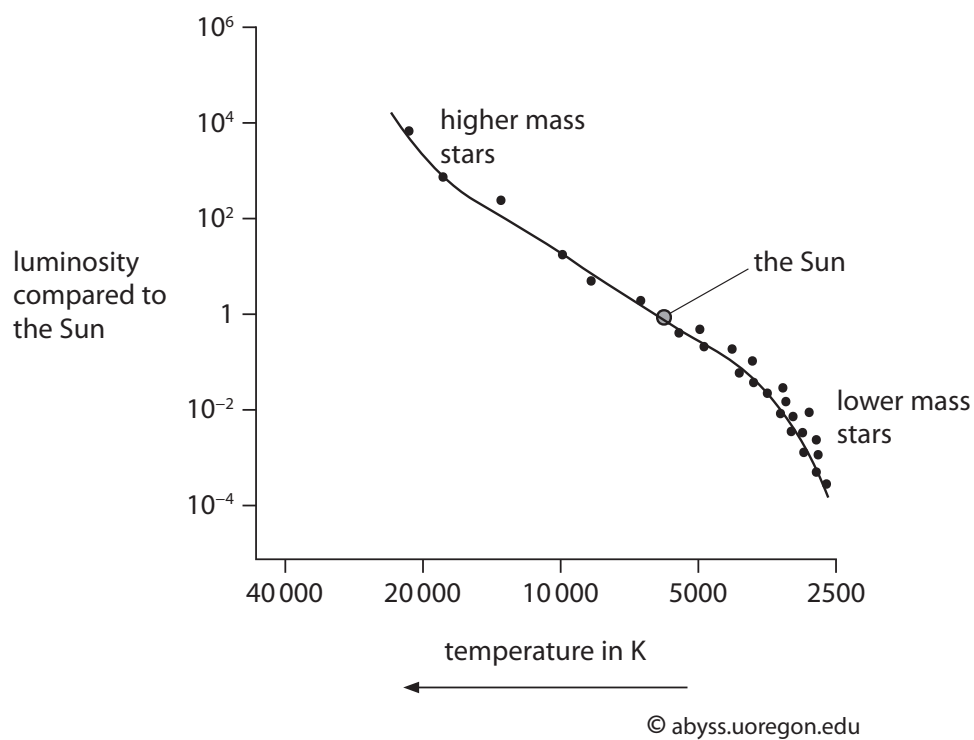


Figure 4

- (i) Estimate the temperature of the Sun.

(1)

temperature of the Sun = ... K

(ii) State how the brightness of a main sequence star changes with its temperature.

(1)

(iii) State how the brightness of a main sequence star changes with its mass.

(1)

(c) Nuclear fusion provides the energy source for stars including the Sun.

Describe what happens during nuclear fusion.

(3)

(d) A nebula may evolve into a main sequence star, such as the Sun.

Explain how a nebula may evolve into a main sequence star.

(3)

(Total for Question 4 = 11 marks)



4 The Big Bang theory is one theory for the origin of the Universe.

The Big Bang theory suggests:

- the Universe had a beginning
- the Universe is still expanding.

(a) Which of these provides evidence that the Universe had a beginning?

(1)

- ☐ A the discovery of other galaxies
- ☐ B the discovery of the moons of Jupiter
- ☐ C the discovery of planets orbiting distant stars
- ☐ D the discovery of cosmic microwave background (CMB) radiation

(b) Evidence that the Universe is still expanding comes from observations of light from distant galaxies.

Describe how light from distant galaxies shows that the Universe is still expanding.

(2)

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(c) The Steady State theory is also a theory about the origin of the Universe.

Give **one** similarity and **one** difference when comparing the Big Bang theory with the Steady State theory.

(2)

similarity.....

.....

difference.....

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- (d) Observations of the expanding Universe have shown that the further away a galaxy is from the Earth, the faster the galaxy is moving away from the Earth.

Figure 4 shows how the velocity of galaxies is related to their distance from the Earth.

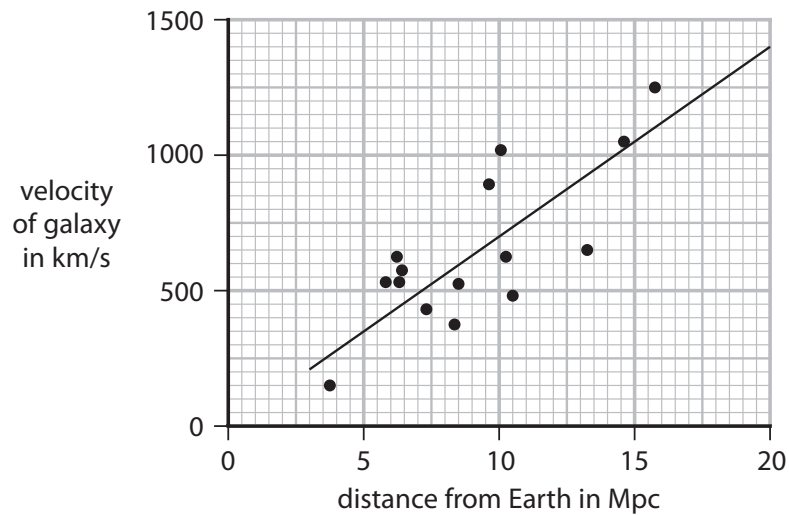


Figure 4

Mpc is a unit of distance used for large distances in space.

- (i) Use Figure 4 to estimate the velocity of a galaxy that is 15 Mpc away from the Earth.

(1)

velocity = ... km/s

- (ii) Calculate the gradient of the line shown in Figure 4.

State the unit.

(3)

gradient = ... unit

(iii) The gradient of the line in Figure 4 can be used to estimate the age of the Universe.

Explain why the gradient of the line in Figure 4 can only provide an **estimate** of the age of the Universe.

(2)

(Total for Question 4 = 11 marks)



- 4 (a) Figure 6 shows two objects, **E** and **D**.

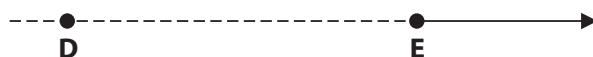


Figure 6

E emits a sound.

D detects the sound.

E is moving in the direction shown by the arrow, but **D** is not moving.

E emits a sound of wavelength 1.86 m.

D measures the wavelength of this sound as 1.98 m.

- (i) Calculate the difference between the wavelength that **E** emits and the wavelength that **D** detects.

(1)

difference in wavelength = ... m

- (ii) The velocity of sound is 330 m/s.

Calculate the velocity of **E**.

(2)

Use the equation

$$\text{velocity of E} = \frac{\text{velocity of sound} \times \text{difference in wavelength}}{\text{wavelength E emits}}$$

velocity of **E** = ... m/s

(b) The wavelength of light emitted from distant galaxies is different when the light is detected on Earth.

Explain how this difference in wavelength shows that the Universe is expanding. (2)

(c) CMB radiation provides evidence that the Universe had a definite beginning.

Use the table in Figure 7 to give a typical value for the wavelength of CMB radiation.

type of radiation	typical wavelength
gamma rays	$1.0 \times 10^{-12} \text{ m}$
X-rays	$3.0 \times 10^{-11} \text{ m}$
ultraviolet	200 nm
visible	600 nm
infrared	$4.0 \mu\text{m}$
microwaves	1.0 mm
radio waves	50 m

Figure 7 (2)

wavelength = ...

(d) During the evolution of a star, the nebula collapses and becomes a main sequence star.

(i) State what causes the nebula to collapse. (1)

(ii) Explain why the nebula stops collapsing as it becomes a main sequence star.

(3)

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(Total for Question 4 = 11 marks)

12-MARK QUESTIONS

2 questions in this booklet



8 The Asteroid Belt is part of our Solar System.

Vesta is an asteroid in the Asteroid Belt.

(a) Vesta orbits the Sun between the orbits of

(1)

- ☐ A Venus and Earth
- ☐ B Earth and Mars
- ☐ C Mars and Jupiter
- ☐ D Jupiter and Saturn

(b) Vesta has an orbital speed of 1.9×10^4 m/s.

Vesta travels a distance of 2.2×10^{12} m when it orbits the Sun once.

Calculate the time taken for Vesta to orbit the Sun once.

(2)

time = ... s

(c) Explain why Vesta is accelerating even when it is travelling at a constant speed.

(2)

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(d) Energy is transferred from the Sun to Vesta by radiation.

Explain why the temperature on Vesta does not continue to rise, even though it is absorbing energy from the Sun.

(3)

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(e) The distance between Vesta and the Sun is 2.4 AU.

1 AU is the distance between the Earth and the Sun.

The intensity of the Sun's radiation reaching the Earth is 1400 W/m^2 .

$1 \text{ W} = 1 \text{ J/s}$

The intensity of the Sun's radiation at a distance, d , from the Sun is given by the equation

$$\text{intensity} = \frac{K}{(d)^2}$$

where K always has the same value.

(i) State the unit of K .

(1)

.....



(ii) Calculate the intensity of the radiation from the Sun at Vesta.

(3)

intensity = ... W/m²

(Total for Question 8 = 12 marks)



10 (a) The table in Figure 16 shows some data about four stars.

star	mass in kg	age in years
Antares	2.6×10^{31}	1.5×10^7
Arcturus	2.2×10^{30}	7.1×10^9
Proxima Centauri	2.4×10^{29}	4.8×10^9
The Sun	2.0×10^{30}	4.6×10^9

Figure 16

(i) State which star in the table in Figure 16 is **most likely** to become a Black Hole. (1)

.....

(ii) Using data from the table in Figure 16, give a reason for your answer to part (i). (1)

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(b) In a nuclear fusion reaction, mass is converted into energy.

(i) Describe what is meant by nuclear fusion. (2)

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- (ii) The speed of light, c , is $3.0 \times 10^8 \text{ m/s}$.

The energy radiated by the Sun in 1 second is $3.9 \times 10^{26} \text{ J}$.

Calculate the decrease in the Sun's mass equivalent to this energy.

State the unit with your answer.

Use the equation

$$E = m \times c^2$$

(2)

decrease in mass = ...



*(c) There have been a number of theories about the origin and development of the Universe.

One theory about the origin and development of the Universe is The Big Bang Theory.

Discuss **two** pieces of evidence that support The Big Bang Theory.

(6)

(Total for Question 10 = 12 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question	Answer	Additional guidance	Mark
1 (c) (i)	50-70 (nm) inclusive		1 AO1.2

Question	Answer	Additional guidance	Mark
1 (c)(ii)	explanation linking (red shift means) <u>galaxies</u> must be moving away from Earth /us (1) more distant galaxies have bigger red shift (1) more distant galaxies moving faster (1)	<u>galaxies</u> getting further apart ORA	3 AO1.1

Total Question 1 = 8 marks

Question Number	Answer	Mark
Q6	C both Redshift and CMB can be explained by the Big Bang theory <i>A is not correct because CMB can be explained by the Big Bang</i> <i>B is not correct because the Steady State theory cannot explain CMB</i> <i>D is not correct because the Steady state theory can explain red shift</i>	(1) AO1

	Answer	Additional guidance	Mark
6(b)(i)	substitution (1) $(z=) \frac{6.72 \times 10^{-7} - 6.56 \times 10^{-7}}{6.56 \times 10^{-7}}$ OR $(z=) \frac{0.16 \times 10^{-7}}{6.56 \times 10^{-7}}$ evaluation (1) 0.024	allow $(z=) \frac{6.72 - 6.56}{6.56}$ OR $(z=) \frac{0.16}{6.56}$ do not accept 0.025 on its own accept 0.0243 / 0.02439 / 0.0244 award full marks for the correct answer without working	(2) AO2

	Answer	Additional guidance	Mark
6(b)(ii)	substitution (1) $(v) = 0.024 \times 3(.00) \times 10^8$ evaluation (1) $7.2 \times 10^6 \text{ (m/s)}$	accept $(v) = 0.025 \times 3 \times 10^8$ $(v) = 0.02 \times 3 \times 10^8$ accept answers which round to: $6.0 \times 10^6 \text{ (m/s)}$ $7.5 \times 10^6 \text{ (m/s)}$ $7.3 \times 10^6 \text{ (m/s)}$ $7.2 \times 10^6 \text{ (m/s)}$ award full marks for the correct answer without working	(2) AO2

	Answer	Additional guidance	Mark
6b(iii)	An explanation linking :- the redshift / z (value) will be larger (1) the galaxy is moving (away) at a <u>higher</u> velocity / recession velocity increased (1)	bigger (increase in) wavelength bigger difference in wavelength longer wavelength moving (away) faster	(2) AO1

	Answer	Additional guidance	Mark
6(c)	an explanation linking: telescopes are above Earth / in space / outside the Earth's atmosphere (1) less interference from dust / clouds (1) wavelengths that are absorbed by Earth's atmosphere (microwaves / IR / UV) (1) can view the whole sky (1)	allow any other sensible benefit allow atmospheric distortion/ (light/air) pollution accept named examples of satellites or waves do not accept idea that telescope is closer to object in space	(2) AO1

Total for Question 6 = 9 mark



Question Number	Answer	Mark			
4(a)	<table border="1"> <tr> <td>D</td><td>vector</td><td>vector</td></tr> </table> is the only correct answer A 'scalar scalar' is incorrect, both force and velocity are vectors B 'scalar vector' is incorrect, with force being described incorrectly as a scalar C 'vector scalar' is incorrect, with velocity being described incorrectly as a scalar	D	vector	vector	(1) AO 1 1
D	vector	vector			

Question Number	Answer	Additional guidance	Mark
4(b)(i)	gravitational / centripetal (1)	accept gravity / weight/ gravitational field strength	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
4(b)(ii)	arrow from the satellite towards the centre of Earth - by eye (1)	direction must be clear	(1) AO 2 1

Question Number	Answer	Additional guidance	Mark
4(c)(i)	wavelength (of e.m. radiation) increased / frequency decreased (1) as the (star) moves away (from us) (1)	don't penalise planet instead of object stretched/moves to(wards) red end of spectrum spectral lines move to the red end of the spectrum	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
4(c)(ii)	an explanation linking: - big bang has expanding universe (1) - with galaxies moving away (from each other) (1)	from (original) explosion started at a point accept stars moving away (not objects or planets now) the further away they are the greater is their (recessional) speed idea	(2) AO 1 1

Question Number	Answer	Additional guidance	Mark
4(c)(iii)	microwave		(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
4(c)(iv)	(radiation) that comes from all over the sky / space / the universe	from the big bang / explosion	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
4(c)(v)	an explanation linking: - the Big Bang theory has a beginning / initial explosion (1) - that releases/gives out radiation (1)	explosion from a point radiation still present	(2) AO 1 1

(Total for Question 4 = 11 marks)



Question number	Answer	Additional guidance	Mark
4 (a)	substitution (1) $\frac{3.4 \times 10^{29}}{2.0 \times 10^{30}}$ evaluation (1) 0.17	award 1 mark for 1.7 to any incorrect power of 10 ignore any units given award full marks for the correct answer without working	(2)

Question number	Answer	Additional guidance	Mark
4(b)(i)	accept any temperature between 5500 and 7500 (K) (1)		(1)

Question number	Answer	Additional guidance	Mark
4(b)(ii)	the greater the temperature the higher the brightness	or reverse argument allow luminosity for brightness allow heat for temperature	(1)

Question number	Answer	Additional guidance	Mark
4(b)(iii)	the greater the mass the higher the brightness	or reverse argument allow luminosity for brightness allow bigger/heavier for greater mass in this context	(1)

Question number	Answer	Additional guidance	Mark
4 (c)	A description to include any three of the following (smaller) nuclei / atoms / particles (1) come together / join (1) to produce a larger nucleus / atom / particle (1) needing high temperature / pressure (1) overcoming repulsion (between nuclei) (1) energy released (1)	two named eg hydrogen (nuclei) allow fuse not 'bond' helium for nucleus accept fast (moving) nuclei ignore energy created	(3)

Question number	Answer	Additional guidance	Mark
4 (d)	An explanation to include any three from: nebula as a cloud of gas/dust (1) gas / atoms pulled together / towards each other (1) by gravitational force (1) temperature increase (1) hot enough for nuclear fusion (1)	density increase gravity (acting) (resultant) heating	(3)

(Total for Question 4 = 11 marks)

Question number	Answer	Mark
4 (a)	The only correct answer is D the discovery of cosmic microwave background (CMB) radiation A is not correct because it does not indicate the Universe had a beginning B is not correct, it is evidence against the geocentric model of the Universe C is not correct, it is evidence for other solar systems	(1) AO1

Question number	Answer	Additional guidance	Mark
4(b)	A description to include: wavelength (of the light) (1) appears to increase (1) [increase must be linked with wavelength]	Red shift/Doppler effect (Red shift) shows galaxy moving away accept answers in terms of frequency	(2) AO1

Question number	Answer	Additional guidance	Mark
4 (c)	similarity (both have) expanding <u>Universe</u> (1) difference one from: Steady State, Universe has no beginning (1) Steady State theory requires the continual formation of new matter, the Big Bang theory does not (1)	different interpretation of CMBR	(2) AO1

Question number	Answer	Additional guidance	Mark
4 (d)(i)	1050 ± 20 (km/s)		(1) AO3

Question number	Answer	Additional guidance	Mark
4 (d)(ii)	attempt at $\frac{\Delta y}{\Delta x}$ (1) evaluation (1) 70 ± 5 unit (1) km/s/Mpc	could be seen on graph award 2 marks for correct answer without working independent mark km/s Mpc s⁻¹ or per second	(3) AO3

Question number	Answer	Additional guidance	Mark
4 (d)(iii)	an explanation linking: points are scattered widely about the line (on graph) (1) giving wide range of possible gradients (1)	there are many possible best fit lines	(2) AO3

(Total for Question 4 = 11 marks)



Question number	Answer	Additional guidance	Mark
4 (a) (i)	$(1.98 - 1.86) = (+/-) 0.12$		(1) AO2

	Answer	Additional guidance	Mark
4(a)(ii)	$(\text{velocity} =) \frac{330 \times 0.12}{1.86} \quad (1)$ $(+/-) 21.3 \text{ (m/s)} \quad (1)$	ecf from 4ai accept numbers that round to 21 (m/s) award 1,2 marks for (i) and (ii) for the correct answer for (ii) even without working	(2) AO2

	Answer	Additional guidance	Mark
4 (b)	(there is) an increase in wavelength (of light) (1) shows <u>galaxies</u> are moving away (from Earth) (1)	allow wavelength stretches allow red shift ignore shift to red end of spectrum ignore objects / stars / planets	(2) AO1

	Answer	Additional guidance	Mark
4 (c)	1(.0) (1) mm (1)	Allow values between 1.0 and 1.9 allow 1×10^{-3} m or 0.001 m for 2 marks if nothing in answer line, credit answer indicated in table	(2) AO3

	Answer	Additional guidance	Mark
4 (d)(i)	gravitational attraction / gravitational force (causing collapse) (1)	allow gravity ignore weight ignore gpe ignore gravitational energy	(1) AO1

	Answer	Additional guidance	Mark
4 (d)(ii)	An explanation linking: (gravity causing) increase in temperature (1) (until hot enough for) fusion (1) (until) balance (between gravity and fusion/thermal) (1)	allow increase in pressure/density hydrogen to form helium allow nuclear reactions ignore fission allow equilibrium / counteracts	(3) AO1

Total for Question 4 = 11 marks.

	Answer Additional guidance	Mark
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8(a)	C Mars and Jupiter A, B and D are not correct because these are not the location of the asteroid belt	(1) AO1
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	Answer	Additional guidance	Mark
8(b)	rearrangement and substitution (1) $(t =) \frac{2.2 \times 10^{12}}{1.9 \times 10^4}$ evaluation (1) $1.2 \times 10^8 \text{ (s)}$	allow numbers that round to 1.2×10^8 e.g. 1.1579×10^8 award full marks for correct answer without working.	(2) AO2

	Answer	Additional guidance	Mark
8(c)	An explanation linking two from: $a = \frac{\Delta v}{t}$ (1) velocity/ acceleration is a vector (1) the direction (of Vesta/velocity) is changing (1)	velocity is changing vector has magnitude and direction	(2) AO1

	Answer	Additional guidance	Mark
8(d)	An explanation linking: Vesta (also) radiates (energy) (1) the same amount of energy that it absorbs (1) in the same time (1)	allow emits (OWTE)for radiates 'Vesta radiates at the same average power that it absorbs' scores all three MPs 'Vesta radiates energy at the same <u>rate</u> that it absorbs' scores all three MPs	(3) AO1

	Answer	Additional guidance	Mark
8(e)(i)	W (1)	accept watt(s) J/s do NOT accept Ws W/s watt(s) per second	(1) AO2

	Answer	Additional guidance	Mark
8(e)(ii)	evaluation of K (1) $K = 1^{(2)} \times 1400$ substitution (1) (intensity =) $\frac{1400}{2.4^2}$ evaluation (1) $240 \text{ (W/m}^2\text{)}$	1400 accept for one mark intensity = $\frac{K}{2.4^2}$ allow numbers that round to 240 e.g. 243.05 accept answers in terms of ratios award full marks for correct answer without working.	(3) AO2

Total for question 8 = 12 marks

	Answer	Additional guidance	Mark
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Question Number	Answer	Additional guidance	Mark
10(a)(i)	Antares (1)	accept phonetic spelling	(1) AO3.1

Question Number	Answer	Additional guidance	Mark
10(a)(ii)	the <u>greatest</u> / <u>biggest</u> / <u>largest mass</u> (in the table) (1)	(much) <u>larger</u> mass than the Sun / (much) <u>heavier</u> than the Sun allow heaviest ignore "biggest" alone ignore ref to age	(1) AO3.1

Question Number	Answer	Additional guidance	Mark
10(b)(i)	description to include (small) nuclei join / fuse / combine (1) to create larger nuclei (1)	do not accept atoms / particles for nuclei accept named nuclei hydrogen nuclei join to become helium (nuclei)	(2) AO1.1

Question Number	Answer	Additional guidance	Mark
10(b)(ii)	substitution and rearrangement (1) $(m =) \frac{3.9 \times 10^{26}}{[3.0 \times 10^8]^2}$ evaluation and unit(1) $4.3 \times 10^9 \text{ kg}$	$(m =) \frac{3.9 \times 10^{26}}{9.0 \times 10^{16}}$ allow values that round to $4.3 \times 10^9 \text{ kg}$ e.g. $4.333 \times 10^9 \text{ kg}$ 4.3×10^9 with no unit or the wrong unit scores 1 mark award full marks for the correct answer without working	(2) AO2.1

Question number	Indicative content	Mark
10c*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 Red-shift Description • increase in wavelength (detected) / decrease in frequency • Doppler effect (for light) • light from distant galaxies/stars Red-shift Support of Big Bang Theory • increase corresponds to moving away from each other • greater red-shift means moving (away) faster • more distant galaxies show greater red-shift • Universe is expanding / galaxies moving away CMB(R) Description • <u>microwave</u> radiation • detected everywhere CMB(R) Support of Big Bang Theory • left over from the start of the Universe / gamma rays released at Big Bang • indicates cooling • Universe had a (definite) beginning	(6) AO1

Level	Mark	Descriptor
	0	No rewardable material. relevant
Level 1	1-2	- Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) - Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	- Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) - Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	- Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) - Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)



Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> isolated statements: identifies 2 of: aspects of BB theory OR red shift OR CMBR	<u>Possible candidate responses</u> BB says Universe is expanding AND CMBR is evidence OR Red Shift and CMBR are evidence
Level 2	3–4	<u>Additional guidance</u> limited explanation: EITHER identifies & describes 1 piece of evidence; OR identifies & links 1 piece of evidence to the aspect of the BB theory it supports AND identifies the other piece of evidence	<u>Possible candidate responses</u> Red Shift (is the) increase in wavelength (detected) in light from distant galaxies. CMBR (is evidence) OR Red Shift indicates (all) galaxies are moving away from each other. CMBR (is evidence)
Level 3	5–6	<u>Additional guidance</u> detailed explanation: identifies AND describes 1 piece of evidence AND links it to the aspect of the BB theory it supports. AND identifies the other piece of evidence	<u>Possible candidate responses</u> Red Shift (is the) increase in wavelength (detected) in light from distant galaxies which indicates (all) galaxies are moving away from each other. CMBR (is evidence) OR CMBR microwave radiation detected everywhere which indicates the Universe had a beginning. Redshift (is evidence)

Total for Question 10 = 12 marks

