

PHYSICS



EXAM QUESTION PACK

TOPIC 7: ASTRONOMY (PACK 2)

SCORE

/34

PERCENTAGE

%

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Q1.

The Asteroid Belt is part of our Solar System.

Vesta is an asteroid in the Asteroid Belt.

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

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q2.

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

(Total for question = 1 mark)

Q3.

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)

(Total for question = 2 marks)

Q4.

This picture shows Galileo holding a telescope.



(a) Explain the purpose of the eyepiece in a telescope.

(2)

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.....

(b) Galileo drew pictures of his observations of Jupiter.
Nowadays we can take photographs.
Suggest how photographs would have helped Galileo.

(1)

.....

.....

.....

.....

(c) The telescope collects light reflected from Jupiter.
The light has a frequency of 4.30×10^{14} Hz and a speed of 3.00×10^8 m/s.
Calculate the wavelength of the light.

(3)

wavelength = ... m

*(d) Galileo's observations of the moons of Jupiter disproved the geocentric model.
However, these observations were not enough to prove the heliocentric model of the Solar System.
Explain why Galileo's observations disproved one model but were not enough to prove the other model.

(6)

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(Total for Question = 12 marks)

Q5.

State **two** advantages of using a camera, rather than the unaided eye, for studying stars.

1

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2

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.....

Q6.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ~~☒~~ and then mark your new answer with a cross ☒ .

The Asteroid Belt is part of our Solar System.

Vesta is an asteroid in the Asteroid Belt.

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

(Total for question = 1 mark)

Q7.

(i) A long time ago, scientists believed that the Earth was at the centre of the Solar System.

Evidence has since proved that the Sun is at the centre of the Solar System.

State **one other** idea about the Solar System that **has** changed over time.

(1)

.....

.....

.....

.....

(ii) Figure 4 shows data for some of the planets of the Solar System.

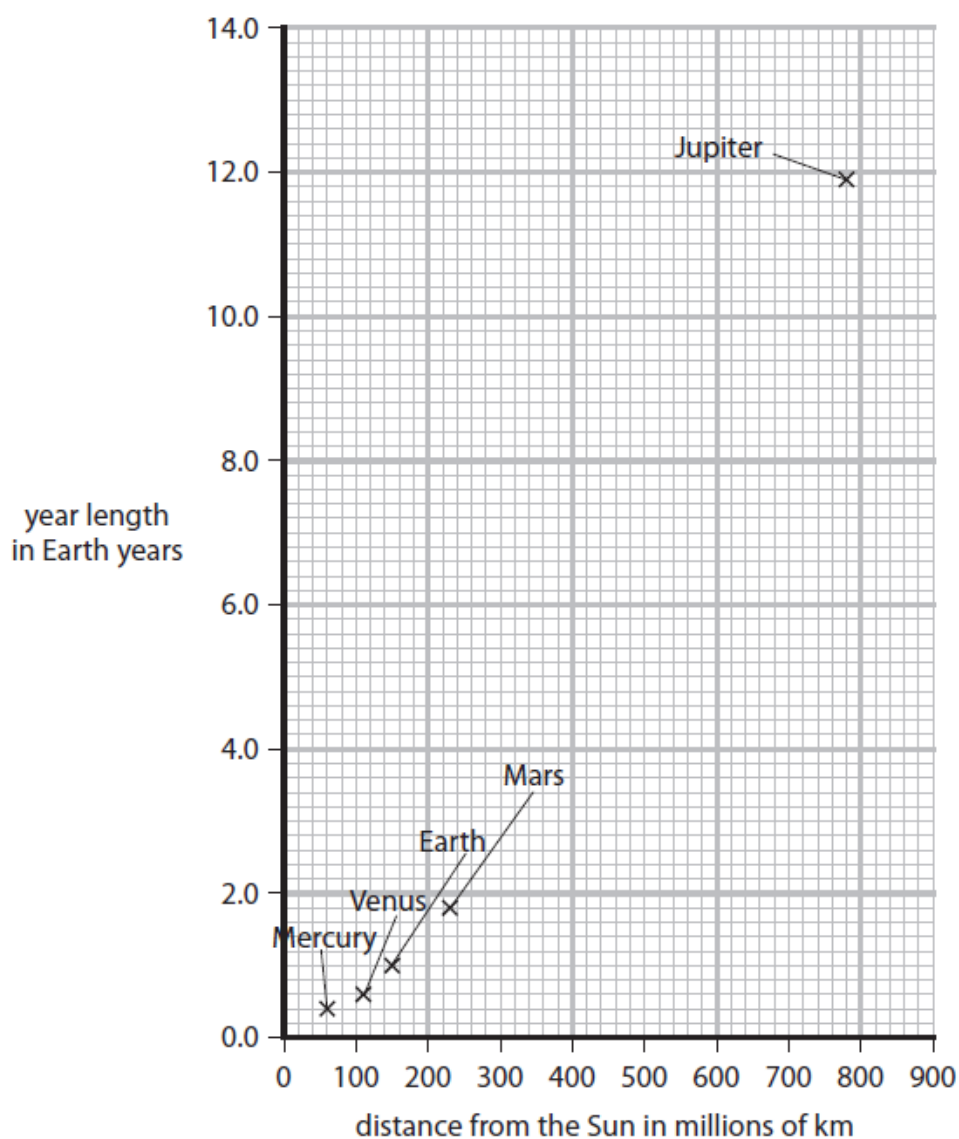


Figure 4

Ceres is an asteroid that orbits the Sun between Mars and Jupiter. It takes Ceres 4.6 Earth years to make one orbit of the Sun.

Use the graph to estimate the distance of Ceres from the Sun.

Show your working.

(3)

distance of Ceres from the Sun = ... millions of km

(Total for question = 4 marks)

Q8.

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)

.....

.....

.....

.....

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

(2)

.....

.....

.....

.....

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

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

(1)

.....

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

(1)

.....

.....

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

(2)

.....

.....

.....

.....

(Total for question = 8 marks)

Q9.

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.

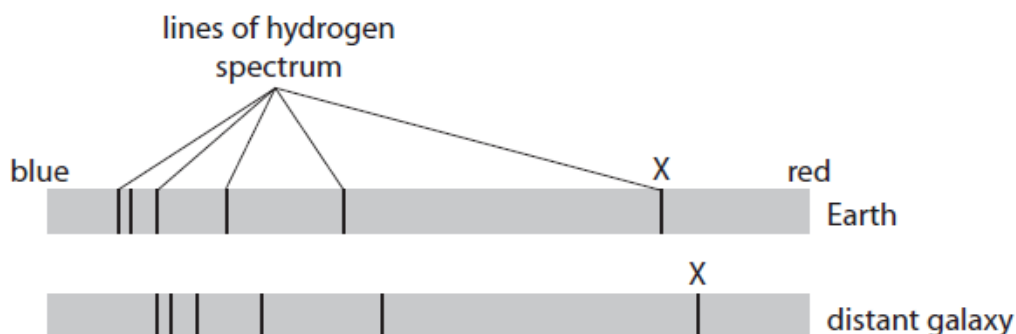


Figure 7

The wavelength of line X on Earth, $\lambda_0 = 6.56 \times 10^{-7}\text{m}$

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, $c = 3.00 \times 10^8$ 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 6.92×10^{-7} m.

Explain how this provides evidence that the Universe is expanding.

(2)

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.....

(Total for question = 6 marks)

Q10.

Our Sun is a main sequence star.

It will stay as a main sequence star for millions of years, continuing to radiate energy.

(i) Our Sun was formed from a nebula.

Describe the formation of our Sun from nebula to main sequence.

(2)

.....

.....

.....

.....

(ii) Our Sun will go through many stages.

Which of these stages will our Sun go through?

Put a cross (☒) in the box next to your answer.

(1)

- ☐ **A** a black hole
- ☐ **B** a neutron star
- ☐ **C** a supernova
- ☐ **D** a white dwarf

Q11.

Figure 3 shows a photograph of galaxy D.

This photograph was taken by a student at his home.



(Source: Paul Curtis)

Figure 3

State **two** ways that the student can improve the observational techniques so that the quality of the image is improved.

(2)

1

.....

2

.....

(Total for question = 2 marks)

Q12.

Two theories about the Universe are the Steady State Theory and The Big Bang Theory.

(i) The table shows some ideas about the Universe.

Which row of the table applies to the Steady State Theory?
Put a cross (☒) in the box next to your answer.

(1)

	the Universe....	the Universe....
☐ A	... is not expanding	... had a beginning
☐ B	... is expanding	... had a beginning
☐ C	... is not expanding	... did not have a beginning
☐ D	... is expanding	... did not have a beginning

(ii) State the name of the discovery that persuaded most scientists to prefer the Big Bang Theory to the Steady State Theory.

(1)

.....

Q13.

Figure 2 shows some lines in the absorption spectra from four different galaxies (A, B, C, and D) and from a laboratory source.

All the spectra are aligned and to the same scale.

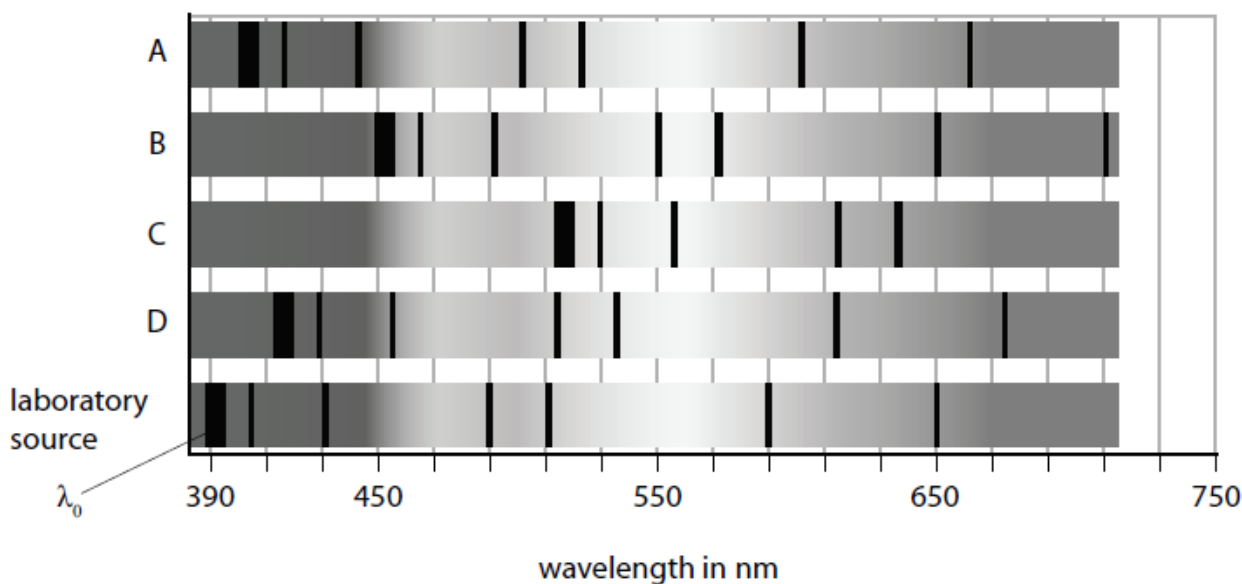


Figure 2

(i) Explain, using Figure 2, which galaxy is furthest away from us.

(3)

.....

.....

.....

.....

.....

.....

(ii) In Figure 2, the reference wavelength, λ_0 , is shown at 390 nm.

Estimate the change in the reference wavelength, $\Delta\lambda$, for the light from galaxy D.

(1)

$\Delta\lambda = \dots\dots\dots$ nm

(iii) Calculate the speed, v , of galaxy D.

Use the equation

$$v = c \frac{\Delta\lambda}{\lambda_0}$$

[c = speed of light = 3×10^8 m/s]

(2)

v = ... m/s

(Total for question = 6 marks)

Q14.

A star has evolved to become a neutron star.

The mass, M, of the neutron star, of radius R, is given by

$$M = \frac{4 \times \pi \times D \times R^3}{3} \quad \text{where D is a constant}$$

$$M = 4 \times 10^{30} \text{ kg}$$

$$D = 6 \times 10^{17} \text{ kg/m}^3$$

Use the equation to calculate the value for R.

(2)

R = ... m

(Total for question = 2 marks)

Mark Scheme

Q1.

	Answer	Additional guidance	Mark
	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

Q2.

Question Number	Answer	Mark			
	<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			

Q3.

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

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

Q4.

Question Number	Answer	Acceptable answers	Mark
(a)	An explanation linking any two of: MP1 magnify (1) with one of: MP2 the (real) image from objective (lens) (1) MP3 to provide greater detail (1)	enlarges / bigger ignore zooming the real image (in the telescope) / image at focal point ignore make it clearer inversion of image focuses image	(2)

Question Number	Answer	Acceptable answers	Mark
(b)	One sensible suggestion, such as - made recording results {easier /quicker} (1) - results more convincing to other people (1) - photograph is to scale (1)	For example, don't have to keep looking through telescope would be (better) proof / evidence (i.e. between geo- and helio-centric models) (eg multiple photographs would prove movement/orbit of moons) (photograph) is more {accurate / precise / reliable}/ can measure (relative) separations of moons (from planet) better ignore more detail/clearer/zooming	(1)

Question Number	Answer	Acceptable answers	Mark
(c)	Substitution (1) $3.0 \times 10^8 = 4.3 \times 10^{14} \times \lambda$ Transposition (1) $(\lambda =) \frac{3.0 \times 10^8}{4.3 \times 10^{14}}$ Evaluation (1) $6.98 \times 10^{-7} \text{ (m)}$	Substitution and transposition in either order Ignore triangle correct answer no working = 3 power of ten error = 2 to at least 2sf (eg 7.0/6.97.....)x10 ⁻⁷ Ignore powers of 10 until evaluation	(3)

Question Number	Indicative content		Mark
QWC	* (d)	A description to include some of the following points description of models • geocentric • heliocentric description of one set of observations of Jupiter's moons explanation of how observation contradicts geocentric but does not prove the other NB beware that you do not reward repetitions of the question stem	(6)
Level	0	no rewardable material	
1	1-2	• a limited explanation of the geocentric AND the heliocentric model such as <i>geocentric model said everything orbited the Earth while the other was for everything going round the Sun. OR</i> clearly explains the one model and describes Galileo's observations eg <i>geocentric model said everything orbited the Earth but Galileo observed that Jupiter had moons going around it</i> • the answer communicates ideas using simple language and uses limited scientific terminology e.g. allow confusion between geocentric and heliocentric • spelling, punctuation and grammar are used with limited accuracy	
2	3-4	• a simple explanation of geocentric AND heliocentric models AND Galileo's observations of Jupiter's moons/explains heliocentric not proved e.g. <i>The geocentric model said everything orbited the Earth while the heliocentric was for everything orbiting the Sun. Galileo observed that Jupiter had moons orbiting around it.</i> • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately e.g. correct use geocentric and heliocentric • spelling, punctuation and grammar are used with some accuracy	
3	5-6	• a detailed explanation of geocentric AND heliocentric models AND the role of Galileo in providing evidence against the geocentric BUT not enough for the heliocentric such as <i>The geocentric model said everything orbited the Earth while the heliocentric was for everything orbiting the Sun. Galileo's observations that Jupiter had moons orbiting around it showed that the geocentric model was wrong but not that Jupiter or anything else went around the Sun.</i> • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately e.g. distinguishes between the necessary and insufficient conditions • spelling, punctuation and grammar are used with few errors	

Q5.

Question Number	Answer	Acceptable answers	Mark
	Any two suitable such as: • Measurements can be taken (1) • Permanent record/evidence (1) • Can be magnified (1) • Can detect waves outside visible part of spectrum (1) • Long exposure (to see faint objects/track objects) (1)	Analysis/compare 'can record data' Taking photo is insufficient zoom in/show more detail can detect gamma rays, X-rays, ultraviolet, infrared Allow collect more light IGNORE better, brighter, clearer	(2)

Q6.

	Answer	Mark
	C Mars and Jupiter A, B and D are not correct because these are not the location of the asteroid belt	(1) AO1

Q7.

Question Number	Answer	Additional guidance	Mark
(i)	examples: planets have moons (1) the Earth rotates (spins) (1) planets orbit the Sun (1) Pluto is no longer a planet (1) orbits are elliptical (not circular) (1) there are more planets than previously thought (1) ours is not the only solar system (1) Earth is {round/spherical /not flat} (1) planets are not wandering stars (1)	answers must be to do with the solar system	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	smooth curve drawn on the graph (1) horizontal line drawn from 4.6 Earth years to intercept the drawn line/curve (1) EITHER: their reading from line / curve (1) OR 430±30 (million km) (1)	accept curve up to Mars followed by a straight line plot point /draw line at year length = 4.6 reading on distance axis ± half small square from their graph award full marks for the correct answer without working	(3)

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

Question Number	Answer	Additional guidance	Mark
(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
(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

Q9.

	Answer	Additional guidance	Mark
(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
(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
(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) <u>faster</u>	(2) AO1

Q10.

Question Number	Answer	Acceptable answers	Mark
(i)	Description including any two of: - gravity (1) (causes the) nebula to collapse/contract (1) (causes the) temperature to increase (1)	Pulls {particles/gas} together Forms protostar ke transferred to thermal energy KE/GPE ->thermal GPE -> KE until it was hot enough to start the reaction until fusion starts	(2)

Question Number	Answer	Acceptable answers	Mark
(ii)	D white dwarf		(1)

Q11.

Question number	Answer	Additional guidance	Mark
	Any two from the following improvements: • use wider aperture telescope/camera (1) • better quality objective lens (1) • use longer exposure time while telescope is locked onto star (1) • move telescope to better seeing conditions, e.g. dry desert, higher up a mountain, dark skies (1)	allow improvements from photography, e.g. use longer exposure time use a satellite telescope ignore use pc to adjust the sharpness of the image	(2)

Q12.

Question Number	Answer	Acceptable answers	Mark
(i)	D ..is expanding ... did not have a beginning		(1)

Question Number	Answer	Acceptable answers	Mark
(ii)	Cosmic Microwave Background (Radiation)	[order of words unimportant] CMB(R) reject 'CMB and red shift'	(1)

Q13.

Question number	Answer	Mark
(i)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (2 marks): - galaxy C has the greatest red shift (1) - so this galaxy has the greatest speed (1) - since the galaxy with the greatest speed will be furthest away, then galaxy C is at the furthest distance(1)	(3)

Question number	Answer	Additional guidance	Mark
(ii)	20 (nm)	Allow answers in the range 19 to 25	(1)

Question number	Answer	Additional guidance	Mark
(iii)	Substitution (1) $v = \frac{(3 \times 10^8) \times (20 \times 10^{-9})}{(390 \times 10^{-9})}$ Answer (1) = 15 400 000 (m/s)	allow ecf from (c)(i) power of 10 error = max 1 accept 15 384 615 (m/s) award full marks for correct numerical answer without working	(2)

Q14.

Question Number	Answer	Additional guidance	Mark
	rearrangement (1) $R^3 = \frac{3M}{4 \times \pi \times D}$ evaluation (1) (R =) 1.17×10^4 m	may be seen as substituted values or as the cube-root form or $R^3 = 1.59 \times 10^{12}$ allow numbers that round to 1.2×10^4 (m) award full marks for the correct answer without working	(2)