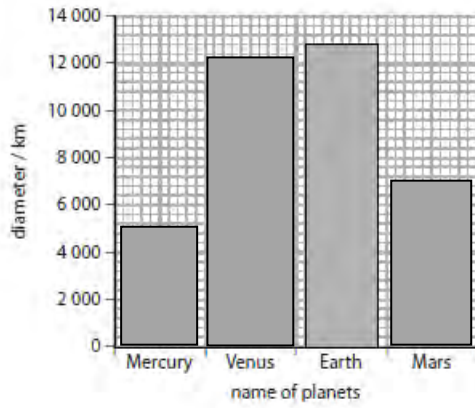


Question Number	Answer	Acceptable answers	Mark
1(a)(i)	Milky Way	Accept any spelling	(1)

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	<input checked="" type="checkbox"/> D white dwarf		(1)

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	 <p>Mercury 4 900 km Venus 12 100 km Mars 6 800 km</p> <p>Three correct (2) One or two correct (1) + or – one square Judge by eye</p>		(2)

Question Number	Answer	Acceptable answers	Mark
1 (b) (ii)	<p>Correct information from table 1.52 (1)</p> <p>Conversion to kilometres (1.52) x 150 000 000 (1)</p>	<p>Seen anywhere in the answer</p> <p>Incorrect information shown to be used correctly (1)</p> <p>Correct answer, no working scores full marks 228 000 000 / 2.28×10^8 (km)</p> <p>228 to any power of 10, allow 1 mark if no other mark awarded.</p> <p>225 000 000 / 2.25×10^8 (km), allow max 1 mark if no working shown.</p>	(2)

Question Number		Indicative Content	Mark
QWC	*)	<p>A description including some of the following points</p> <p>In Solar System</p> <ul style="list-style-type: none"> • Use of telescopes • Search for evidence of conditions needed for life e.g. water/oxygen/bacteria on other planets • Manned missions (to the Moon) • Unmanned missions/probes to other planets e.g. Mars, Jupiter, Saturn, Mercury • Landers / robots / rovers sample soil • Information transmitted back to Earth <p>Throughout the Universe</p> <ul style="list-style-type: none"> • Search for extra-terrestrial intelligence (SETI) • Use radio telescopes • Search for (regular pattern of) radio signals • Search for other planetary systems • Discovery of other planetary systems (capable of supporting life) • Broadcasting signals/ sending out messages (to extra terrestrial intelligences) 	(6)
Level	0	No rewardable content	
1	1 - 2	<ul style="list-style-type: none"> • A limited description giving a (named) way of searching for evidence e.g. SETI OR using telescopes OR send messages to space OR spacecraft • The answer communicates ideas using simple language and uses limited scientific terminology • Spelling, punctuation and grammar are used with limited accuracy 	
2	3 - 4	<ul style="list-style-type: none"> • A simple description of any TWO of the searches for evidence e.g space probes go to other planets and telescopes are used OR radio telescopes and looking for radio waves from space. • The answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • Spelling, punctuation and grammar are used with some accuracy 	
3	5 - 6	<ul style="list-style-type: none"> • A detailed description of searches for evidence within AND outside the solar system e.g. Unmanned space probes go to other planets and radio telescopes search for radio signals from space. • The answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • Spelling, punctuation and grammar are used with few errors 	

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	cosmic microwave background (radiation) all three words needed		(1)

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	(the) Big Bang (theory)		(1)

Question Number	Answer	Acceptable answers	Mark
2(a)(iii)	change in the (observed) frequency or wavelength of light/radiation (received from a distant galaxy)	light/absorption lines is/are shifted toward red end of spectrum light/radiation has longer wavelength/lower frequency waves are more spread out/stretched Ignore references to sound or colour of light eg galaxies/light appear(s) red(er)	(1)

Question Number	Answer	Acceptable answers	Mark
2(a)(iv)	An explanation linking the following: - It/the Universe is expanding (1) some galaxies are (moving) faster (than others) (1)	they/ galaxies are moving further/away (from the Earth/us) the further away the galaxy is the greater the red-shift/the faster the galaxy is moving (some galaxies) are moving away faster (than others) gains 2 marks IGNORE references to planets/stars	(2)

Question Number	Answer	Acceptable answers	Mark
2(b)(i)	D red giant then white dwarf		(1)

Question Number	Answer	Acceptable answers	Mark
2(b)(ii)	<p>an explanation linking two of the following:</p> <ul style="list-style-type: none"> • Different/more wave(length)s/frequencies (now) detected/collected (1) • because telescopes positioned above Earth's atmosphere or by radio telescopes (1) <p>OR</p> <ul style="list-style-type: none"> • weaker signal(s) (now) detected/collected (1) • because modern telescopes are more powerful/have greater magnification or positioned above Earth's atmosphere/ on top of mountains (1) <p>If no other marks awarded allow 1 mark for idea that: Electronic(s)/computers can process/improve the data/signal information/waves/radiation</p>	<p>named type of em radiation accept CMB for microwave</p> <p>space telescope or named space telescope</p> <p>(because) less or no light/radiation is absorbed by Earth's atmosphere Accept named space telescope eg Hubble/Planck/Compton etc</p> <p>Ignore references to clearer images/more detail/can see further/photographs</p>	(2)

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	Universe		(1)

Question Number	Answer	Acceptable answers	Mark
3(a)(ii)	Milky Way		(1)

Question Number	Answer	Acceptable answers	Mark
3(b)(i)	<p>A description including:</p> <ul style="list-style-type: none"> • change in wavelength / frequency (1) • Correct change(s) (1) 	<p>wavelength increases (2)</p> <p>frequency decreases (2)</p>	(2)

Question Number	Answer	Acceptable answers	Mark
3(b)(ii)	<p>An explanation linking two of the following points</p> <ul style="list-style-type: none"> • red shift (1) • universe expanding (1) • (cosmic) microwave (background)(radiation) (1) 	<p>Accept initials (eg CMB)</p>	(2)

Number			
QWC	*3(c)	<p>A description including some of the following points</p> <p>Life cycle of a star similar of mass similar to that of our sun</p> <p>a. nebu / stellar nursery</p> <ul style="list-style-type: none"> • clouds of dust and gas • pulled together or collapsed by gravitational forces <p>b. Ou sun / main sequence</p> <ul style="list-style-type: none"> • stable state • hydrogen being converted to helium, nuclear fusion • huge amounts of heat and light produced • continues for many millions of years <p>c. r giant</p> <ul style="list-style-type: none"> • hydrogen runs out • star expands • star gets colder • uses up all its helium • outward forces decrease <p>d. white dwarf</p> <ul style="list-style-type: none"> • eventually collapses • due to own gravity • becomes much smaller and very dense <p>e. Sequ ce:</p> <ul style="list-style-type: none"> • Nebula / stellar nursery • (Protostar) • Star (main sequence) • Red Giant • White Dwarf • (Black Dwarf) <p>ignore references to planetary nebula)</p>	(6)
		Credit is given for correctly labelled diagrams.	
Level	0	no rewardable material	
1	1-	<ul style="list-style-type: none"> • a limited description including naming one of the stages (star alone is insufficient) e.g. A star can be a red giant • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy 	
2	3-	<ul style="list-style-type: none"> • a simple description including two consecutive stages in the correct sequence OR a description of one of the stages e.g. a nebula forms a (main sequence) star / Nebulae are clouds of dust and gas • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy 	
3	5 - 6	<ul style="list-style-type: none"> • a detailed description including naming three consecutive stages in the correct order AND a description of one stage e.g. A nebula is a cloud of gas and dust that forms a star which then becomes a red giant. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors 	

Question Number	Answer	Mark
4(a)(i)	the explosion of a massive star	(1)

Question Number	Answer	Mark						
4(a)(ii)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="3" style="text-align: center;">longest wavelength → shortest wavelength</td> </tr> <tr> <td style="text-align: center;">infrared</td> <td style="text-align: center;">visible light</td> <td style="text-align: center;">X-rays</td> </tr> </table> <p>All three must be correct</p>	longest wavelength → shortest wavelength			infrared	visible light	X-rays	(1)
longest wavelength → shortest wavelength								
infrared	visible light	X-rays						

Question Number	Answer	Acceptable answers	Mark
4(a)(iii)	<p>An explanation linking three of the following points</p> <ul style="list-style-type: none"> • discovery of objects not detectable by visible light (1) • more information / data can be collected (1) • different (electromagnetic) waves can give different types of information (1) • produce magnified images (1) • (space telescopes) produce clearer images / images unaffected by Earth's atmosphere (1) 	<p>allow specific examples e.g. (discovery of) black holes/CMB / pulsars</p> <p>different telescopes provide different data/ images</p> <p>brighter/more detailed images</p> <p>ignore idea 'can see further' unless qualified</p>	(3)

Question Number	Answer	Acceptable answers	Mark
4(b)	<p>Any two of the following points</p> <ul style="list-style-type: none"> • Spitzer observes /uses infrared (1) • infrared is heat (1) • Sun produces (large amounts of) heat / infrared (1) • small amount of heat from distant galaxies would not be detected (amongst radiation from the Sun) (1) 	<p>ignore idea 'to protect telescope from heat/damage'</p> <p>infrared (waves)/heat from the Sun would interfere with/swamp/ruin image (of distant galaxies)</p>	(2)

Question Number	Answer	Acceptable answers	Mark
4(c)(i)	<p>calculate one distance (1) e.g. 1.49×10^8 or 3.96×10^{13}</p> <p>evaluation (1) e.g. $(3.96 \times 10^{13} \div 1.49 \times 10^8)$ = 265 000</p> <p>e.g. inverse $(1.49 \times 10^8 \div 3.96 \times 10^{13})$ 3.77×10^{-6}</p> <p>e.g. from comparison of times $(2\,200\,000 \div 8.3)$ = 265 000</p>	<p>accept 149 400 000 or 39 600 000 000 000</p> <p>265 060 265 771.18</p> <p>Give 2 marks for a correct evaluation with no working shown or no distance calculation</p> <p>Give 2 marks for two correct distances and a correct comparative statement</p>	(2)

Question Number	Answer	Acceptable answers	Mark
4(c)(ii)	the stars are so distant that a large unit of distance is needed	<p>the numbers (of km or miles) would be too big (to understand)/ too long (to write down)</p> <p>(numbers of) light years are more manageable/ easier to understand</p>	(1)