Question Number	Answer	Acceptable answers	Mark
1(a)(i)	A		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	A description including any **two** of the following • above the/no atmosphere (1) • above the clouds / no clouds/no weather (1) • image is clearer/ more detailed/ not distorted/not blurred (1) • no light pollution (1) • no absorption (by atmosphere) of other named radiations e.g. X-rays (1)	no air/dust/pollution can see further /wider field of view/can use anytime **IGNORE** it is closer (to the stars/planets) **IGNORE** references to improving understanding / knowledge of space	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	Either **one** of the following • radio (waves) (1) • microwaves (1)		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	a description including any **two** of the following • collect more information / waves /data (1) • greater resolution /detail/ magnification (1) • other regions of the EM spectrum are used (1)	mention of specific data e.g. black holes/ red shift discover /new planets/stars/ galaxies etc (see) clearer/better images /closer view (can) see further (into space)/ smaller objects accept idea that they are not restricted to light e.g. (can) detect radiation /radio waves (from Big Bang/stars)/CMB **IGNORE** any references to "hearing".	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	(cloud of) dust and/or gases (1)	Accept hydrogen/helium Accept idea that it is where stars/planets are formed Ignore rocks/smoke	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	A description linking **three** of the following • when nebula reaches a critical mass (1) • nebula collapses/contracts (1) • (due to) gravitational attraction (1) • (gets) hot/ (makes) heat (1) • forms a protostar (1) • emits/produces light /radiation(1)	correct sequence is not required when nebula or dust/gas cloud is big (enough) gases/dust/nebula come together/pulled together/spiral /move faster gravity/gravitational (potential) energy transformed into thermal energy ignore starts to burn/explodes/friction starts nuclear reaction/fusion/ hydrogen turns into helium/new elements	**(3)**

Question Number	Answer	Acceptable answers	Mark
6(a)(i)	B		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	radio waves are not absorbed by the atmosphere	not affected by {light pollution / clouds}	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a) (iii)	an explanation including **two** of the following • 1 mm waves are in the microwave region (1) • which is (completely) absorbed by atmosphere (1) • space flight enabled telescopes to be put above atmosphere /in space (1)	 they are microwaves cannot be (easily) detected on Earth we needed to go above atmosphere / into space	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)(iv)	an explanation linking the following • light might be shifted into infrared region (1) • (some) infrared is (strongly) absorbed by atmosphere (1)		**(2)**

Question Number		Indi	Mark
QWC	*2(b)	A description to include some of the following facts: • observation of visible light led to discovery of red-shift. • galaxies are moving away from each other • CMBR detected in radio telescopes • space telescopes (such as COBE) gave more detail of CMBR • Big Bang and Steady State theories were proposed • distances to galaxies could be determined • Big Bang could explain red-shift • Steady State could explain red-shift The description gives some of the following details: • red-shift means lower frequency / longer wavelength • red-shift was greatest for the most distant galaxies • red-shift means universe is expanding • Big Bang / Steady State can explain an expanding universe • only Big Bang could explain CMBR • CMBR is residual radiation from the Big Bang The description gives some of the following reasons for scientists beliefs • observation of increasing red-shift with distance is a reason to believe in expanding universe	**(6)**
Level	**0**	No rewardable material	
1	**1-**	• a limited description of either red-shift or CMBR, e.g. light from galaxies was red-shifted OR Red-shift is evidence for Big bang. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3-**	• a description giving full detail of either red-shift or CMBR OR some detail of both red-shift and CMBR, e.g. light was seen to be shifted towards a longer wavelength. This means that the galaxies are moving away from each other. • 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**	• a detailed description of how both red-shift and CMBR give supporting evidence for the Big Bang theory, e.g. light was seen to be shifted towards a longer wavelength. This means that the galaxies are moving away from each other so the Universe must be expanding. This is evidence for the Big Bang theory. Cosmic Background Radiation coming from all directions provides further evidence for the Big Bang. • 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
3(a)	D the Universe (1)		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)	(nebula) main sequence (star) (1) AND red giant white dwarf (1) All three in correct order for 2 marks	 Red Giant White Dwarf (Main sequence) (1)	 **(2)**

Question Number	Answer	Acceptable answers	Mark
3(c)i	infrared (radiation)/(rays) (1)		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(c)ii	An explanation linking any two from • above the clouds / no clouds/ no weather (1) • image is clearer/more detailed/ not distorted/not blurred (1) • no light pollution (1) • (some) telescopes use gamma/ X-rays/ultraviolet /infrared/microwaves (1) • no absorption (by atmosphere) of gamma/ X-rays/ultraviolet /infrared/ microwaves (1)	Credit to be given for stating that all telescopes would be better in space, but size and weight may exclude e.g. Jodrell Bank from space. no {air/dust/pollution} wider field of view/ can use anytime IGNORE 'see further' IGNORE 'it is closer (to the stars/planets)' IGNORE: references to improving understanding / knowledge of space	**(2)**

Question Number		Indicative Content	Mark
QWC	***3*(d)**	A description including some of the following points • improved QUALITY eg higher or better magnification/ detail/resolution or clearer/brighter image **OR** MORE INFORMATION (than with naked eye) of image/data eg new planets/stars/nebulae/pulsars (This could be extra detail for greater magnification/resolution only) • detection of (non-visible) electromagnetic WAVES eg X-ray / UV / IR/ radio • TECHNOLOGY that enable collection of more data eg reflecting telescope/arrays ***and/or*** additions eg computer-aided /photographic connections or larger (objective) lens/mirror • POSITION of telescopes – eg orbital/outside atmosphere/on top of mountains/away from atmosphere/rays not absorbed/obscured/scattered by atmosphere. Ignore 'Hubble' or 'Compton'.	**(6) Exp**
Level	**0**	No rewardable content	
1	**1 - 2**	a limited description e.g. mention of any one example such as "magnifies stars/planets" OR "discovering new planets/stars" • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 4**	• a simple description e.g. mention of either two of the improvements **OR** extra detail about one of the improvements eg improvement **plus** example (ie Magnifies planets *so that craters/mountains may be seen)* • 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**	• a detailed description e.g. mention of three (or more) improvements **OR** two improvements **plus extra detail about one of them (ie Telescopes in space can detect X-Rays *that would be absorbed by the atmosphere*)** • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(Suitable extra detail shown in italics in examples above)

Total for Question 5 = 12 marks

Question Number	Answer	Acceptable answers	Mark
4(a)	D		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(b)	An explanation linking any two of (presence of Earth's) atmosphere (1) causes light to be absorbed/reduced in intensity (1) causes distortion of the image(1) (more) **light** pollution (1) (bigger) variations in temperature (1)	Accept reverse argument (more) air/ clouds/ pollution/ dust blocked / (more) difficult to see through blurs the image / refracts the light	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(c)	An explanation linking any three of galaxies moving (1) away from Earth / Sun (1) galaxy 2 (moving away) faster (than galaxy 1) (1) galaxy 2 is (likely to be) most distant galaxy (1)	galaxies are (moving) at different speeds / away from each other / universe is expanding	**(3)**

Question Number	Answer	Acceptable answers	Mark
4(d)	A description including the following stages (up to 3 marks) Protostar (1) Main sequence star (1) (super) red giant (1) supernova (1) neutron star (1) (even more massive star can become) black hole (1) more massive stars have shorter life (1) Three stages in the correct sequence (1)		**(4)**