Name: _____

Stars Mark Scheme

GCSE Stars

**Date:**

**Time:**

**Total marks available:**

**Total marks achieved: _____**

## Mark Scheme

Q1.

| | Answer | Acceptable answers | Mark |
|---|---|---|---|
| | D the Universe (1) | | **(1)** |

Q2.

| | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(i)** | Milky Way<br><br>Accept any spelling | | **(1)** |
| **(ii)** | ☒ **D**white dwarf | | **(1)** |

Q3.

| | Answer | Acceptable answers | Mark |
|---|---|---|---|
| | (nebula)<br><br>main sequence (star) (1)<br>AND<br>red giant<br>white dwarf (1)<br><br>All three in correct order for 2 marks | Red Giant<br>White Dwarf<br>(Main sequence) (1) | **(2)** |

Q4.

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

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

Q5.

| | **Answer** | **Acceptable answers** | **Mark** |
|---|---|---|---|
| **(i)** | D red giant then white dwarf | | **(1)** |
| **(ii)** | an explanation linking **two** of the following:<br>• Different/more wave(length)s/frequencies (now) detected/collected (1)<br>• because telescopes positioned above Earth's atmosphere or by radio telescopes (1)<br><br>OR<br><br>• weaker signal(s) (now) detected/collected (1)<br>• because modern telescopes are more powerful/have greater magnification **or** positioned above Earth's atmosphere/ on top of mountains (1)<br><br>If no other marks awarded allow 1 | <br><br>named type of em radiation accept CMB for microwave<br><br>space telescope or named space telescope<br><br><br><br><br>(because) less or no light/radiation is absorbed by Earth's atmosphere Accept named space telescope eg Hubble/Planck/Compton etc | **(2)** |

| | | | |
|---|---|---|---|
| | mark for idea that:<br>Electronic(s)/computers can process/improve the data/signal information/waves/radiation | Ignore references to clearer images/more detail/can see further/photographs | |

Q6.

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

Q7.

| | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(a)(i)** | cosmic microwave background (radiation)<br><br>all three words needed | | **(1)** |
| **(a)(ii)** | (the) Big Bang (theory) | | **(1)** |
| **(a)(iii)** | change in the (observed) frequency **or**wavelength of | light/absorption lines is/are shifted toward red end of spectrum | |

| | | | |
|---|---|---|---|
| | light/radiation (received from a distant galaxy) | light/radiation has longer wavelength/lower frequency<br><br>waves are more spread out/stretched<br><br>Ignore references to sound or colour of light eg galaxies/light appear(s) red(er) | **(1)** |
| **(a)(iv)** | An explanation linking the following:-<br><br>It/the Universe is expanding (1)<br><br>some galaxies are (moving)faster (than others) (1) | <br><br>they/ galaxies are moving further/away (from the Earth/us)<br><br>the further away the galaxy is the greater the red-shift/the faster the galaxy is moving<br><br>(some galaxies) are moving away faster (than others) gains 2 marks<br><br>IGNORE references to planets/stars | **(2)** |
| **(b)(i)** | D red giant then white dwarf | | **(1)** |
| **(b)(ii)** | an explanation linking **two** of the following:<br><br>• Different/more wave(length)s/frequencies (now) detected/collected (1)<br><br>• because telescopes positioned above Earth's atmosphere or by radio telescopes (1)<br><br>OR<br><br>• weaker signal(s) (now) detected/collected (1)<br><br>• because modern telescopes are more powerful/have greater magnification **or** positioned above Earth's atmosphere/ on top of mountains (1)<br><br>If no other marks awarded allow 1 mark for idea that: Electronic(s)/computers can process/improve the data/signal information/waves/radiation | <br><br>named type of em radiation accept CMB for microwave<br><br>space telescope or named space telescope<br><br><br><br><br><br>(because) less or no light/radiation is absorbed by Earth's atmosphere Accept named space telescope eg Hubble/Planck/Compton etc<br><br><br><br><br><br>Ignore references to clearer images/more detail/can see further/photographs | **(2)** |

Q8.

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(a)(i)** | B red giant (1) | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(a)(ii)** | C the Milky Way (1) | | **(1)** |

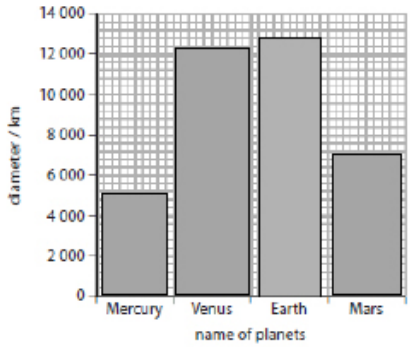
| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(a)(iii)** | D Proxima Centauri (1) | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(b)** | description to include:<br>• method (1)<br><br>• relevant detail (1) | <br>Telescope (inc. radio telescopes)<br>Lander (e.g. robots/drones)<br>Orbiter / Satellite<br><br>has camera / takes photos / collecting samples (e.g rocks) / analyse atmosphere / climate / signs of water / gases that will support life / can test for water/nutrients<br><br>ignore repeat of stem | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(c)(i)** | explanation linking two from:<br>• (on Earth) image is distorted / image not bright enough (ORA) (1)<br>• planets very small / far away (1)<br>• atmosphere (in way) / light pollution (1)<br>• can detect different parts of em spectrum (that are not detectable on Earth) (1)<br>• can keep it pointed at the same spot more easily (1) | Reverse arguments apply throughout<br><br>(above atmosphere gives) more defined / clearer / better image<br><br>obscured by clouds<br><br>waves can be detected (that are not detectable on Earth)<br><br>not affected by Earth's rotation | **(2)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(c)(ii)** | Suggestion:<br>• planet takes 150 days to orbit the star (1) | has 150 days in a year | **(1)** |

Q9.

| | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(a)(i)** | Milky Way | Accept any spelling | **(1)** |
| **(a)(ii)** | ☒ **D** white dwarf | | **(1)** |
| **(b)(i)** |  <br>Mercury 4 900 km<br>Venus 12 100 km<br>Mars 6 800 km<br><br>Three correct (2)<br>One or two correct (1)<br>+ or – one square<br>Judge by eye | | **(2)** |
| **(b)(ii)** | Correct information from table 1.52 (1)<br><br>Conversion to kilometres (1.52) × 150 000 000 (1) | Seen anywhere in the answer<br><br>Incorrect information shown to be used correctly (1)<br><br>Correct answer, no working scores full marks 228 000 000 / $2.28 \times 10^8$ (km)<br><br>228 to any power of 10, allow 1 mark if no other mark awarded.<br><br>225 000 000 / 2.25 x $10^8$ (km), allow max 1 mark if no working shown. | **(2)** |

| | | Indicative Content |
|---|---|---|
| **QWC** | ***(c)** | A description including some of the following points<br><br>In Solar System<br><br>• Use of telescopes<br>• Search for evidence of conditions needed for li water/oxygen/bacteria on other planets<br>• Manned missions (to the Moon) |

| | | | |
|---|---|---|---|
| | | • Unmanned missions/probes to other planets e<br>Jupiter, Saturn, Mercury<br>• Landers / robots / rovers sample soil<br>• Information transmitted back to Earth<br><br>Throughout the Universe<br><br>• Search for extra-terrestrial intelligence (SETI)<br>• Use radio telescopes<br>• Search for (regular pattern of) radio signals<br>• Search for other planetary systems<br>• Discovery of other planetary systems (capable<br>life)<br>• Broadcasting signals/ sending out messages (t<br>terrestrial intelligences) | |
| **Level** | **0** | No rewardable content | |
| **1** | **1 - 2** | • A limited description giving a (named) way of searching for evidence e.g. SETI **OR**using telescopes **OR**send messages to space **OR** spacecraft<br><br>• The answer communicates ideas using simple language and uses limited scientific terminology<br>• Spelling, punctuation and grammar are used with limited accuracy | |
| **2** | **3 - 4** | • 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.<br><br>• The answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• Spelling, punctuation and grammar are used with some accuracy | |
| **3** | **5 - 6** | • A detailed description of searches for evidence within **AND**outside the solar system<br>e.g. Unmanned space probes go to other planets and radio telescopes search for radio signals from space.<br><br>• The answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• Spelling, punctuation and grammar are used with few errors | |

Q10.

| | **Answer** | **Acceptable answers** | **Mark** |
|---|---|---|---|
| **(a)** | D the Universe (1) | | **(1)** |
| **(b)** | (nebula)<br><br>main sequence (star) (1)<br>AND<br>red giant | Red Giant<br>White Dwarf<br>(Main sequence) (1) | **(2)** |

| | | | |
|---|---|---|---|
| | white dwarf (1)<br><br>All three in correct order for 2 marks | | |
| **(c)i** | infrared (radiation)/(rays) (1) | | **(1)** |
| **(c)ii** | An explanation linking any two from<br><br>• above the clouds / no clouds/ no weather (1)<br><br>• image is clearer/more detailed/ not distorted/not blurred (1)<br><br>• no light pollution (1)<br><br>• (some) telescopes use gamma/ X-rays/ultraviolet /infrared/microwaves (1)<br><br>• no absorption (by atmosphere) of gamma/ Xrays/ 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.<br><br>no {air/dust/pollution}<br><br>wider field of view/ can use anytime<br><br>IGNORE 'see further'<br>IGNORE 'it is closer (to the stars/planets)'<br>IGNORE: references to improving understanding / knowledge of space | **(2)** |

| | | **Indicative Content** | |
|---|---|---|---|
| **QWC** | ***(d)** | A description including some of the following points<br><br>• improved QUALITY eg higher or better magnifi detail/resolution or clearer/brighter image **OR**MORE INFORMATION (than with naked eye) image/data eg new planets/stars/nebulae/puls could be extra detail for greater magnification only)<br><br>• detection of (non-visible) electromagnetic WA UV / IR/ radio<br><br>• TECHNOLOGY that enable collection of more d reflecting telescope/arrays ***and/or***additions eg computer-aided /photographic connections or (objective) lens/mirror<br><br>• POSITION of telescopes – eg orbital/outside at top of mountains/away from atmosphere/rays absorbed/obscured/scattered by atmosphere. | |

| | | | |
|---|---|---|---|
| | | 'Hubble' or 'Compton'. | |
| **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"<br>• the answer communicates ideas using simple language and uses limited scientific terminology<br>• 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)*<br>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately<br>• 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 XRays *that would be absorbed by the atmosphere*)**<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately<br>• spelling, punctuation and grammar are used with few errors | |

*(Suitable extra detail shown in italics in examples above)*

Total for Question = 12 marks

Q11.

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(a)(i)** | A a black hole (1) | | **(1)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(a)(ii)** | A description including three from:<br><br>MP1 in a nebula (1)<br><br>MP2 (particles) attracted / come together by (force of) gravity (1)<br><br>MP3 pe/ke transferred to thermal/heat energy (gas begins to glow and forms protostar) (1)<br><br>MP4 until {hot / pressure / dense} enough to start nuclear reaction /fusion (1) | gas / gas and dust<br><br>core becomes hot / pressure increases / density increases<br><br>until fusion of hydrogen starts<br>hydrogen starts to become helium<br>condone "hydrogen burning" | **(3)** |

| Question Number | Answer | Acceptable answers | Mark |
|---|---|---|---|
| **(a)(iii)** | A suggestion involving two from:<br><br>MP1 the oldest star had not yet appeared when the {Big Bang happened / universe started}(1)<br><br>MP2 the Universe is older than the oldest star<br><br>MP3 star takes time to form (1)<br><br>MP4 can't be certain of this time (1) | stars formed after the Big Bang<br><br>the age of the oldest star is the minimum age of the Universe<br><br>estimation is not the same as accurate measurement<br>can't be sure there isn't an older star | **(2)** |

| Question Number | | Indicative Content | Mark |
|---|---|---|---|
| **QWC** | *** (b)** | An explanation including some of the following points<br><br>• light shifted to red end of spectrum<br>• light waves are stretched so wavelength increases<br>• reference to black or spectral lines moving to 'red end' (of absorption spectrum)<br>• frequency of wave from a moving source changes<br>• decrease in frequency means source moving away<br>• increase in frequency means source moving towards us<br>• red shift shows galaxies are moving away from us<br>• greater red shift indicates galaxy moving away faster<br>• further away galaxies give greater red shift<br>• (nearly) all galaxies show red-shift<br>• red shift shows decrease in frequency<br>• blue shift shows increase in frequency<br>• therefore galaxies are moving apart<br>• [mention of Doppler effect]<br>• [outline of Doppler effect] | **(6)** |

| Level | 0 | No rewardable content |
|---|---|---|
| 1 | 1 - 2 | • a limited explanation e.g. (light from) {galaxy / planet /object} moving away from us is shifted to red end of the spectrum OR red shift means {galaxy / planet /object) is moving away from us<br>• the answer communicates ideas using simple language and uses limited scientific terminology e.g. correct use of change of colour and movement<br>• spelling, punctuation and grammar are used with limited accuracy |
| 2 | 3 - 4 | • a simple explanation involving detail of meaning of different red shifts OR involving frequency / wavelength e.g. red shift shows galaxies moving away from us. More distant galaxies give greater red shift showing they are travelling faster away. OR light from galaxies/stars moving away is shifted to red end of the spectrum because of an (apparent) {increase in the wavelength/decrease in the frequency} (of light).<br>• the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately e.g. correct use of the terms galaxy/star, frequency, wavelength<br>• spelling, punctuation and grammar are used with some accuracy |
| 3 | 5 - 6 | • a detailed explanation correctly interpreting the (apparent) drop in frequency / increase in wavelength e.g. light from (most) galaxies is shifted towards the red end of the spectrum because of an {increase in the wavelength/decrease in the frequency}. This indicates that (most) galaxies are moving away from us, hence showing the Universe is expanding<br>• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately e.g. linkages must be clear between red-shift, movement and expansion of the Universe<br>• spelling, punctuation and grammar are used with few errors |