Pearson Edexcel

Mark Scheme (Results)

November 2021

Pearson Edexcel GCSE In Astronomy (1AS0)
Paper 2: Telescopic astronomy

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question number	Answer	Mark
1 (a)(i)	NOT Image A – planetary nebula **Image B – galaxy** NOT Image C – emission nebula NOT Image D – globular cluster	1

Question number	Answer	Mark
1 (a)(ii)	NOT Image A – planetary nebula NOT Image B – galaxy NOT Image C – emission nebula **Image D – globular cluster**	1

Question number	Answer	Mark
1 (a)(iii)	**Image A – planetary nebula** NOT Image B – galaxy NOT Image C – emission nebula NOT Image D – globular cluster	1

Question number	Answer	Mark
1 (a)(iv)	NOT Image A – planetary nebula NOT Image B – galaxy **Image C – emission nebula** NOT Image D – globular cluster	1

Question number	Answer	Mark
1 (b)(i)	Use of spacecraft/rockets/probes	1

Question number	Answer	Mark
1 (b)(ii)	A NOT Capture Theory - is a correct response B NOT Co-accretion Theory - is a correct response C NOT Giant Impact hypothesis - is a correct response **D Steady State Theory**	1

Question number	Answer	Mark
2 (a)(i)	NOT A – Cassegrain reflector (has a convex secondary mirror) NOT B – Galilean refractor (does not have a secondary mirror) NOT C – Keplerian refractor (does not have a secondary mirror) **D Newtonian reflector**	1

Question number	Answer	Mark
2 (a)(ii)	**A Cassegrain reflector** B NOT Galilean refractor (does not have a hole in its objective) C NOT Keplerian refractor (does not have a hole in its objective) D NOT Newtonian reflector (does not have a hole in its objective)	1

Question number	Answer	Mark
2 (a)(iii)	A NOT Cassegrain reflector (uses a converging eyepiece) **B Galilean refractor** C NOT Keplerian refractor (uses a converging eyepiece) D NOT Newtonian reflector (uses a converging eyepiece)	1

Question number	Answer	Mark
2 (b)	A NOT 0.05 mm (incorrect answer) B NOT 20 mm (incorrect answer) **C 50 mm** D NOT 60 mm (incorrect answer)	1

Question number	Answer	Mark
2 (c)	Matthew's telescope has a greater light grasp (1) By a factor of 4 (1)	2

Question number	Answer	Mark
3 (a)(i)	Any **TWO** from: • Spiral (S) • Barred Spiral (SB) • Irregular (I) • Lenticular (SO)	**2**

Question number	Answer	Mark
3 (a)(ii)	55 (54.8) (million light years)	**1**

Question number	Answer	Mark
3 (b)	To increase the baseline/effective objective diameter (1) Or Telescopes operating as an aperture synthesis system (array) (1) Thus improving resolution (1)	**2**

Question number	Answer	Mark
3 (c)	Either: Observed as an (eclipsing) X-ray source (1) Due to material falling into black hole from companion star (1) Or Two (identical) galaxies observed (1) Due to gravitational lensing (1) Or (Proper) Motion of stars near a black hole (1) Due to their gravitational orbits around the black hole (1)	**2**

Question number	Answer	Mark
4 (a)(i)	Any **ONE** from: Binary – two stars gravitationally bound to each other (1) Double – line of sight effect i.e. not actually close to each other (1)	**1**

Question number	Answer	Mark
4 (a)(ii)	Maximum brightness at 150% (1) Figure showing 'dips' alternating between short and long. Figure should indicate same period, 2 short dips of the same length and 2 long dips of the same length. (1) Long dip at 50% brightness and short dip at 100% brightness (1)	**3**

Question number	Answer	Mark
4 (b)(i)	Regular 'dips' in the brightness (apparent magnitude) of a star (1) Indicate the presence of an exoplanet passing in front of /blocking some light from the star (1)	**2**

Question number	Answer	Mark
4 (b) (ii)	Any **THREE** from: • LIQUID water • (Suitable) atmosphere • Suitable temperature range • Suitable gravity	**3**

Question number	Answer	Additional guidance	Mark
5 (a)(i)	Star does not have enough mass/gravity to produce a black hole or neutron degeneracy pressure balances gravitational collapse	Reject star is too small	**1**

Question number	Answer	Mark
5 (a)(ii)	Any **TWO** from: • Made from neutrons • Small • (Very) dense • High surface gravity • Strong magnetic field • Rotates fast • Can produce a beam of radio waves	**2**

Question number	Answer	Additional guidance	Mark
5 (a)(iii)	Detected using radio telescopes (or reference to radio waves observed) (1) Regular 'pulses' of radio waves (1)	'Pulsars' on its own worth 1 mark. Explanation gets 2 marks	**2**

Question number	Answer	Mark
5 (b)	66 days (88 days -20 days) (2) If answer is incorrect: Evidence that absolute magnitude will reduce by 3 i.e. to -16.6 (1) or a time on graph shown at 88 days (1)	**2**

Question number	Answer	Mark
5 (c)	m = -10 (2) If answer is incorrect: m = -9 (1) Calculation: m = M + 10 Therefore, if m = -20 + 10 = **-10** or m = -19 + 10 = **-9**	**2**

Question number	Answer	Mark
6 (a)(i)	Hydrogen or H	1

Question number	Answer	Mark
6 (a)(ii)	A NOT comets (not often found in planetary ring systems) B NOT dwarf planets (not found in ring systems) C NOT meteorites (only found on surface of Earth) **D small moons**	1

Question number	Answer	Mark
6 (a)(iii)	Any **ONE** from: • Ice • Dust • Water	1

Question number	Answer	Mark
6 (b)	Any **THREE** from: • Early observations – ring system not visible • Early observations – it appeared that Saturn had two moons either side of the planet • Later observations – improved resolution • Later observations –Saturn's ring system visible	3

Question number	Answer	Mark
6 (c)	As you get closer to a planet, gravitational/tidal forces increase (1) These forces are sufficient to 'pull' a moon apart (or prevent moons from forming) (1) Material orbits planet and forms a ring system (1)	3

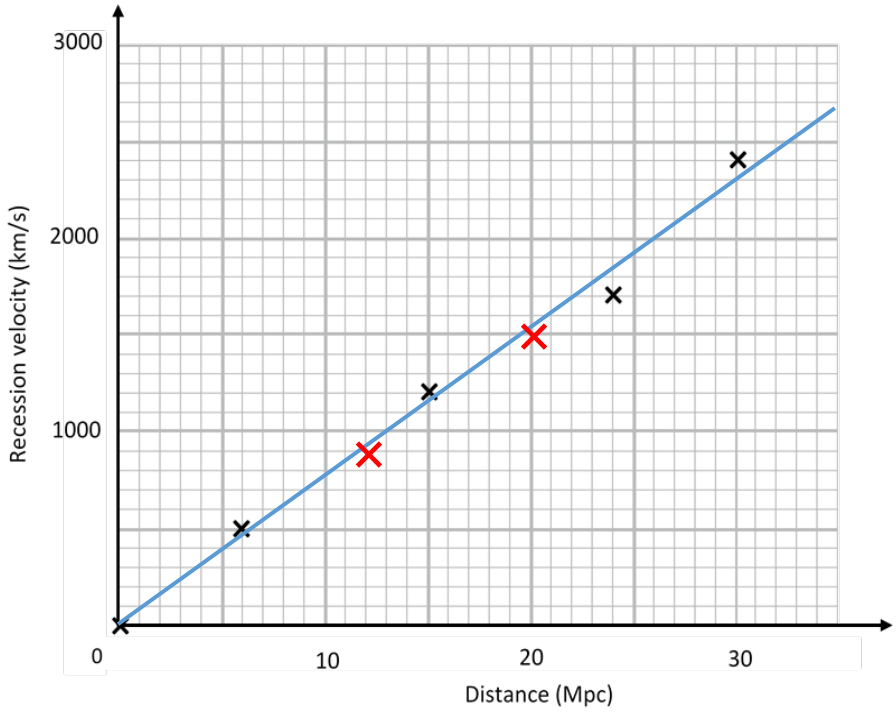
Question number	Answer	Mark
6 (d)	There is a drop in light level/the light fluctuates before and after main occultation (1) This is due to the star passing behind the Rings of Uranus (1)	2

Question number	Answer	Mark
7 (a)(i)	Any **TWO** from: • A group of galaxies (1) • Near the Milky Way (1) • That are gravitationally bound to each other (1)	**2**

Question number	Answer	Mark
7 (a)(ii)	A NOT Andromeda galaxy (which is a member of the Local Group) **B Seyfert galaxy** C NOT Small Magellanic Cloud (which is a member of the Local Group) D NOT Triangulum galaxy (which is a member of the Local Group)	**1**

Question number	Answer	Mark
7 (b)	Any **TWO** from: • Reference to objects moving away from the Earth (1) • These objects are galaxies (1)	**2**

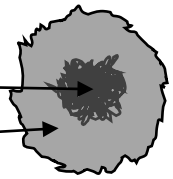
Question number	Answer	Mark
7 (c)	v = 290 (288) km s^{-1} (2) If answer is incorrect then: ratio substituted and calculated as $\frac{\lambda - \lambda_0}{\lambda_0} = \frac{0.60}{625.05}$ = 9.6 x 10^{-4} or 0.000 96 (1) or v = 0.000 96 c (1)	**2**

Question number	Answer	Mark
7 (d)(i)	Points plotted correctly (2) Suitable line of best fit (1) 	**3**

Question number	Answer	Mark
7 (d)(ii)	H_o = 77 (allow 74 to 80) (2) Evidence of a gradient being measured (1)	**2**

Question number	Answer	Mark
7 (d)(iii)	Age of Universe $= \frac{1}{\text{Hubble Constant}}$ / $\frac{1}{\text{Ho}}$ / reciprocal of Hubble constant (1)	**1**

Question number	Answer	Mark
8 (a)	**A averted vision** B NOT H-alpha filter (this is a suitable safe method) C NOT pinhole camera (this is a suitable safe method) D NOT telescopic projection (this is a suitable safe method)	**1**

Question number	Answer	Mark
8 (b)	Light and dark regions clearly indicated (1)  Umbra labelled (1) Penumbra labelled (1) A single dot gains no marks	**3**

Question number	Answer	Mark
8 (c)	Angular diameter = 18 seconds of arc (3) If answer is incorrect: Angular diameter = 0.3 minutes of arc (2) Ratio of $\frac{\text{diameter of sunspot}}{\text{diameter of Sun}} = \frac{14\,000}{1\,400\,000} = 0.01$ (1) Calculation: $\text{Angular diameter} = \frac{14\,000}{1\,400\,000} \times 30 \text{ minutes of arc}$ = 0.01 X 30 minutes of arc = 0.3 minutes of arc = 0.3 X 60 seconds of arc = 18 seconds of arc	**3**

<table>
<tr><th>Question number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>8 (d)</td><td>
Marking instructions
Markers must apply the descriptors in line with the general marking guidance and the qualities outlined in the levels-based mark scheme below.
<table>
<tr><th>Level</th><th>Mark</th><th>Descriptor</th></tr>
<tr><td></td><td>0</td><td>No rewardable material.</td></tr>
<tr><td>Level 1</td><td>1-2</td><td>Lacks clarity.
Basic interpretation and evaluation of the data/information may be attempted but will be limited and narrow in scope.
The response will contain basic information with little linkage between points made. Lines of reasoning may be attempted but are incomplete or lack clarity. A conclusion may be attempted but lacks support.</td></tr>
<tr><td>Level 2</td><td>3-4</td><td>Some structure.
Interpretation and evaluation of the data/information that
Attempts to synthesise and integrate relevant knowledge.
The response shows some linkages and lines of reasoning with some structure, leading to a conclusion that is partially
supported.</td></tr>
<tr><td>Level 3</td><td>5-6</td><td>Comprehensive and well structured.
Comprehensive interpretation and evaluation of the data/information that demonstrates the skills of synthesising
and integrating relevant knowledge throughout the response.
The response shows a well-developed, sustained line of scientific reasoning which is clear, coherent and logically structured, leading to a supported conclusion.</td></tr>
</table>
Indicative content guidance
The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:

Telescope A – Suitable because large aperture not really required (Sun is large and bright). Solar filter essential (unless using projection method)
Telescope B – Cheapest, good size aperture
Telescope C – Most expensive and database not required if only observing the Sun (which is easy to locate in the sky)
Telescope D – reasonable cost and H-alpha filter useful. finderscope not required to locate the Sun.

</td><td>6</td></tr>
</table>

Question number	Answer	Mark
9 (a)(i)	Wavelength = 300 nm (1)	**1**

Question number	Answer	Mark
9 (a)(ii)	Colour = White / Blue-white / Blue (1)	**1**

Question number	Answer	Mark
9 (b)(i)	A NOT blue B NOT green C NOT infrared **D ultra violet**	**1**

Question number	Answer	Mark
9 (b)(ii)	Any **ONE** from: • Earth's atmosphere (e.g. ozone) • Interstellar medium • Proto-planetary discs of material around the star	**1**

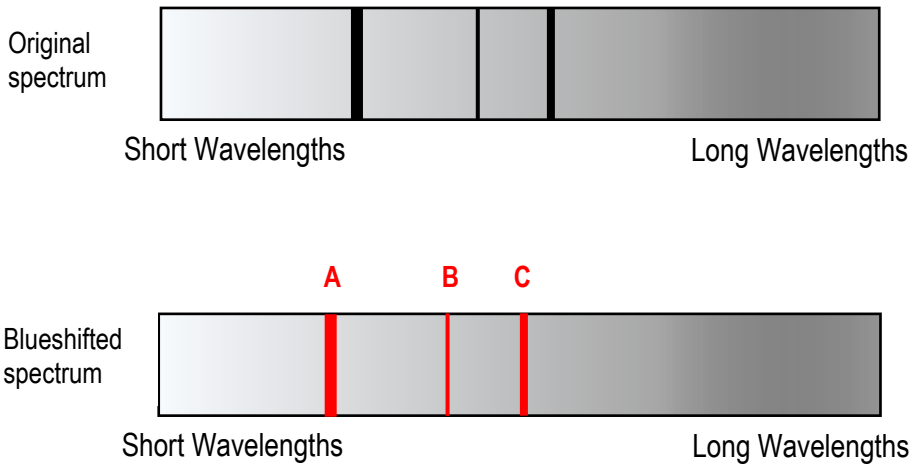
Question number	Answer	Mark
9 (b)(iii)	Any **THREE** from: • Observed peak wavelength has changed (increased) • Colour of star will appear to change • Star will appear 'redder' (or less blue) • Incorrect measurement of star's surface temperature • Stellar classification is based on star's temperature, thus incorrect classification	**3**

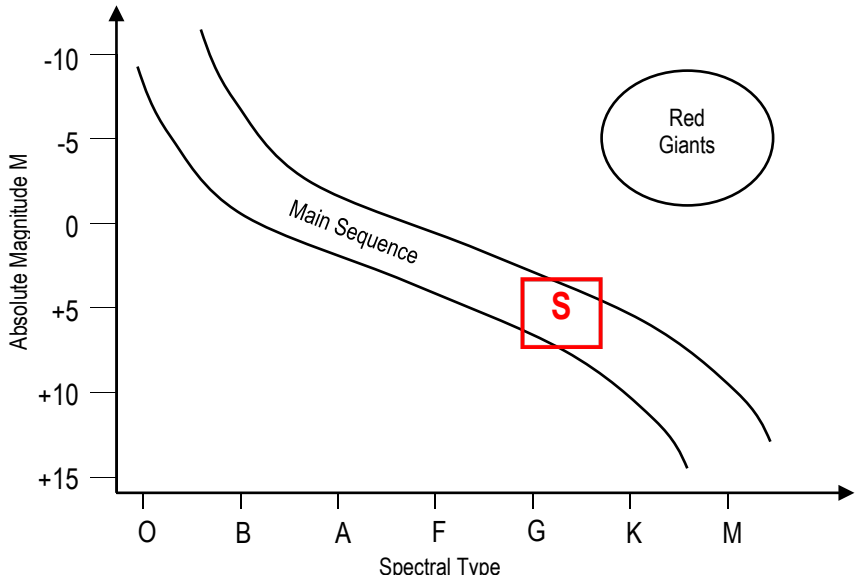
Question number	Answer	Mark
9 (c)(i)	A NOT Helium (O stars appear blue/white) B NOT Hydrogen (B stars appear blue/white) C NOT Metals, e.g. Sodium (G stars appear yellow) **D Molecules**	**1**

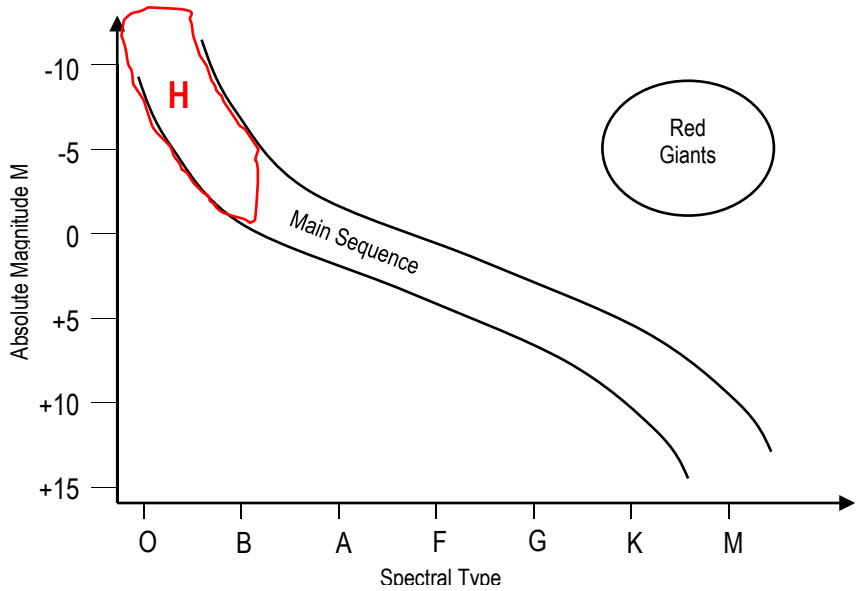
Question number	Answer	Mark
9 (c)(ii)	**A Helium** B NOT Hydrogen (B stars are cooler than O stars) C NOT Metals, e.g. Sodium (G stars are cooler than O stars) D NOT Molecules (M stars are cooler than O stars)	**1**

Question number	Answer	Mark
9 (c)(iii)	A NOT Helium (surface temp 50 – 25 thousand K) B NOT Hydrogen (surface temp 25 – 11 thousand K) **C Metals, e.g. Sodium** (surface temp 6 – 5 thousand K, Sun is a G2 star) D NOT Molecules (surface temp less than 3 500 K)	**1**

Question number	Answer	Mark
9 (c)(iv)	G	**1**

Question number	Answer	Mark
9 (d)	Lines drawn shifted to the left (1) Maintaining the same pattern (1) 	**2**

Question number	Answer	Mark
10(a)(i)		1

Question number	Answer	Mark
10(a)(ii)		1

<table>
<tr><th>Question number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>10 (b)</td><td>
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<tr><td>Level 2</td><td>3-4</td><td>Some structure.
Interpretation and evaluation of the data/information that
Attempts to synthesise and integrate relevant knowledge.
The response shows some linkages and lines of reasoning with some structure, leading to a conclusion that is partially supported.</td></tr>
<tr><td>Level 3</td><td>5-6</td><td>Coherent and logically structured.
Comprehensive interpretation and evaluation of the data/information that demonstrates the skills of synthesising
and integrating relevant knowledge throughout the response.</td></tr>
</table>

Indicative content guidance
The indicative content below is not prescriptive and candidates are not required to include all of it. Other relevant material not suggested below must also be credited. Relevant points may include:
Method -
• Determine star’s ABSOLUTE MAGNITUDE M using HR diagram and star’s spectral type
• Measure star’s APPARENT MAGNITUDE m (or brightness)
• Calculate star’s distance using M = m + 5 – 5logd
Problems with method –
• K and M stars can be both Main Sequence or Red Giants
• Thus giving 2 possible values for absolute magnitude.
• Giving 2 possible answers to the stars distance
• To determine distance for K and M stars the astronomer has to ascertain if they are Main Sequence or Red Giant (from detailed analysis of their spectra)
</td><td>6</td></tr>
</table>

Question number	Answer	Mark
10(c)(i)	Distance to galaxies is too large (1) Parallax angle too small to measure (1)	**2**

Question number	Answer	Additional guidance	Mark
10(c)(ii)	**1.1 arc seconds (3)** Calculation: Convert 6.0 l.y. into parsecs = 1.84 pc (1) Parallax angle = 1 / distance = 0.54 arc seconds (1) Angular movement = 2 x 0.56 = **1.1 arc seconds** (1)	If l.y. not converted to parsecs then award: 2 marks for 0.33 arc seconds 1 mark for 0.17 arc seconds	**3**