Pearson Edexcel

Mark Scheme (Results)

Summer 2019

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)	**A** crater	(1)

Question number	Answer	Mark
1(a) (ii)	**D** moons	(1)

Question number	Answer	Mark
1(a)(iii)	**C** globular cluster	(1)

Question number	Answer	Mark
1(b)(i)	**C** rille	(1)

Question number	Answer	Mark
1(b)(ii)	**A** aeroplane	(1)

Question number	Answer	Mark
1(b)(iii)	**C** galaxy	(1)

Question number	Answer	Mark
1(c)	Any dot (1) Umbra and penumbra (1)	(2)

Question number	Answer	Mark
2(a)	**C** geocentric	(1)

Question number	Answer	Mark
2(b)(i)	**C** mantle	(1)

Question number	Answer	Mark
2(b)(ii)	**D** outer core	(1)

Question number	Answer	Mark
2(c)	Photographed by spacecraft / satellites / Apollo (1) which have orbited the Moon (1)	(2)

Question number	Answer	Mark
2(d)	Any TWO from: • Very few / no maria on far side • More craters on far side • Lighter on far side (due to lack of maria) • No rilles / wrinkle ridges (or other maria features) on far side	(2)

Question number	Answer	Mark
3(a)	W – Radiation zone X – Convection zone Y – Core Z – Photosphere Any 2 correct (1) All 4 correct (2)	**(2)**

Question number	Answer	Mark
3(b)	**B** corona, chromosphere, photosphere, sunspot	**(1)**

Question number	Answer	Mark
3(c)	**C** heliosphere	**(1)**

Question number	Answer	Mark
3(d)	**D** 4 hydrogen nuclei produce 1 helium nucleus	**(1)**

Question number	Answer	Mark
3(e)	Suitable diagram (1) Showing projection method or use of H-alpha filter (or neutral density filter) at objective end(1)	**(2)**

Question number	Answer	Mark
3(f)	**B** 9.8	**(1)**

Question number	Answer	Additional guidance	Mark
4(a)(i)	Orbiter named as most suitable space probe (1) Any ONE reason from (1) • Many orbits to survey (most of) the surface • Close to the surface for high resolution images • Journey time not really a factor (long journey time is not a disadvantage)	No marks if orbiter not selected	**(2)**

Question number	Answer	Mark
4(a)(ii)	Earth – Mars distance = 1.5 – 1.0 AU = 0.5 AU (1) = 0.5 x 1.5 x 10^8 km = 0.75 x 10^8 km (1) or = 7.5 x10^7 km	**(2)**

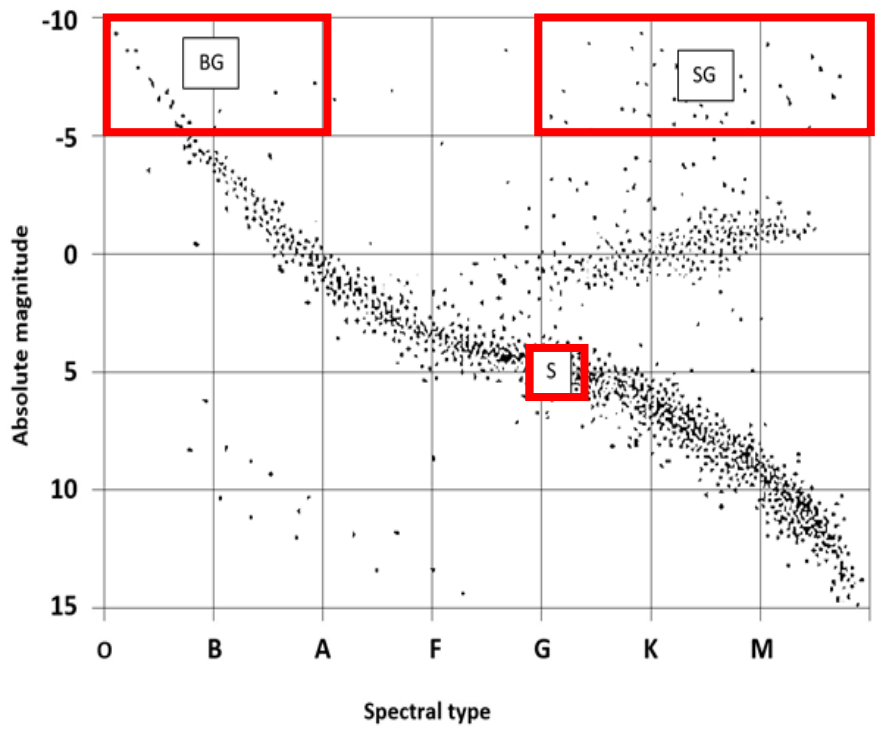
Question number	Answer	Mark
4(a)(iii)	Either: (1) • Earth – Mars distance is greater (than minimum distance / than at opposition) • Orbiter is not flying in a straight line Shown clearly on the diagram (1)	**(2)**

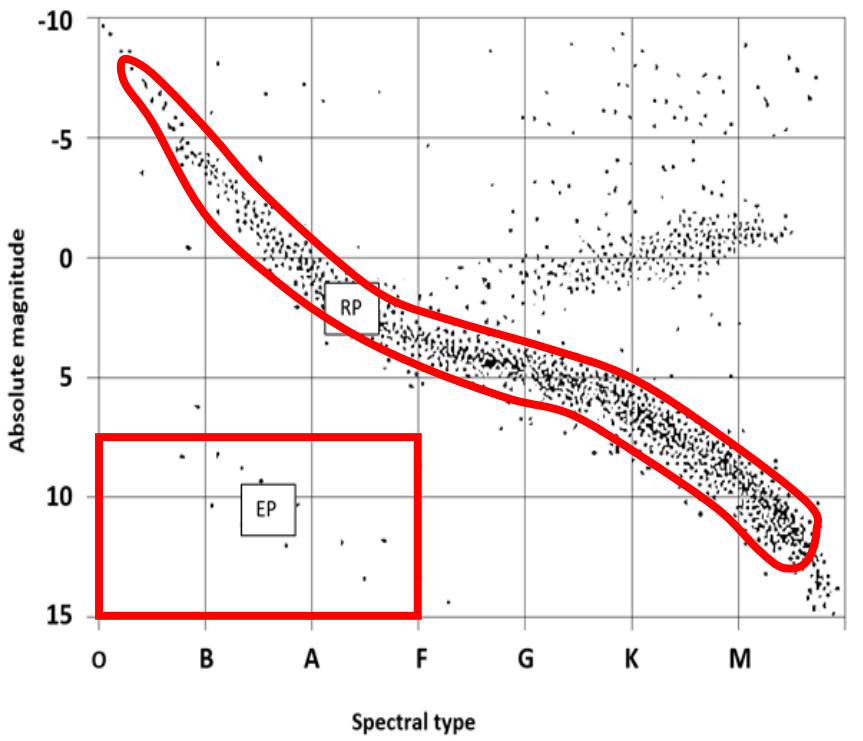
Question number	Answer	Mark
4(b)(i)	Any TWO from: (2)	**(2)**

	• Very high surface temperature • Very high atmospheric pressure • Very long day/night • No chance of water	

Question number	Answer	Mark
4(b)(ii)	Any ONE from: (1) • Similar mass • Similar diameter • Similar composition	**(1)**

Question number	Answer	Mark
5(a)	B A K (1)	(1)

Question number	Answer	Mark
5(b) (i) (ii) (iii)	 S (1) BG (1) SG (1) Anywhere in red region and clearly labelled	(3)

Question number	Answer	Mark
5(c) (i) (ii)	 RP – anywhere in main sequence (1) EP – anywhere in white dwarf (1) Anywhere in red region and clearly labelled	(2)

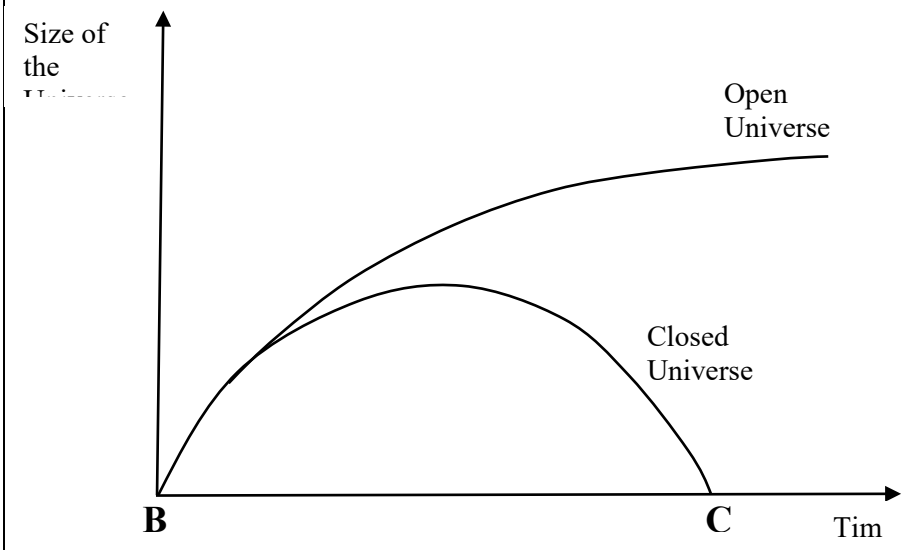
Question number	Answer	Mark
5(d)	They do not have a spectral type (no absorption spectra) (1) or not observed in visible spectrum (1)	(1)

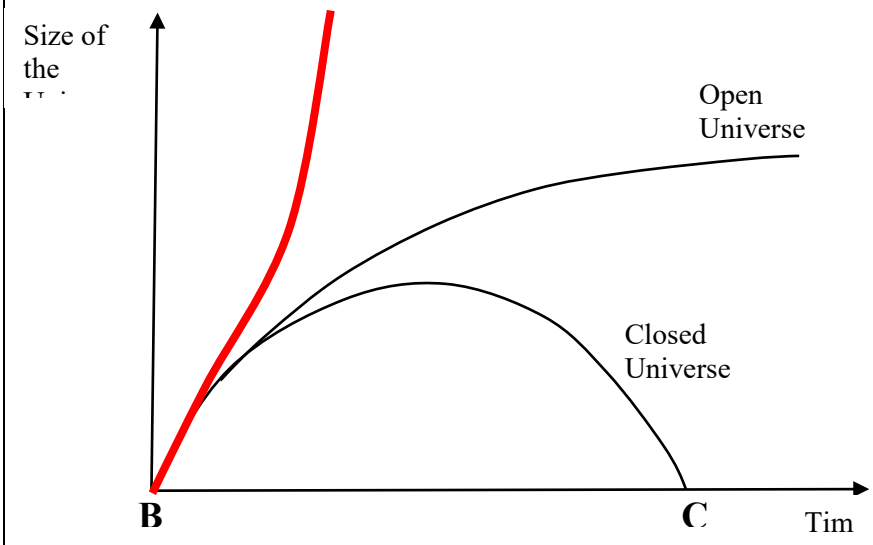
Question number	Answer	Mark
5(e)	The Sun's <u>mass</u> is below (1) the Chandrasekhar Limit (1) and therefore will not go supernova / will form a planetary nebula	(2)

<table>
<tr><th>Question number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>6(a)</td><td>
<table>
<tr><th></th><th>Observational evidence for the Steady State theory</th><th>Observational evidence for the Big Bang theory</th></tr>
<tr><td>Hubble Deep Field image</td><td>x</td><td>✓</td></tr>
<tr><td>Quasars</td><td>x</td><td>✓</td></tr>
<tr><td>Redshift of distant galaxies</td><td>✓</td><td>✓</td></tr>
<tr><td>The expanding Universe</td><td>✓</td><td>✓</td></tr>
</table>
2 rows correct (1)

3 rows correct (2)

4 rows correct (3)
</td><td>(3)</td></tr>
</table>

Question number	Answer	Mark
6(b) (i) (ii)	 B indicated correctly on the diagram (1) C indicated correctly on the diagram (1)	(2)

Question number	Answer	Mark
6(c)	Line starting at origin (1) and sloping up with increasing positive gradient (1) 	(2)

Question number	Answer	Mark
6(d)	Convert 0.78 Mpc into light years 0.78 x 3.26 = 2.54 Mly (1) Time taken = 2.5 million years (1) Allow 2.5 x 10^6 years or 2 500 000 years	**(2)**

Question number	Answer	Mark
7(a)	Saturn (1)	**(1)**

Question number	Answer	Additional guidance	Mark
7(b)	Any 3 from: Advantages (of sending a lander): • Can take samples of the water/surface (1) • and test for the presence of life (1) • Higher resolution images (closer) (1) Disadvantages (of sending a lander): • Could contaminate the environment (with bacteria etc. from Earth) (1) • More difficult to land softly on the surface (1) • More expensive to land softly on the surface (1)	If only one side of the argument explored, maximum 2 marks	**(3)**

Question number	Answer	Additional guidance	Mark
7(c)	Must reach escape velocity (1)	Do not accept because it is further	**(1)**

Question number	Answer	Mark
7(d)(i)	The moons generate internal <u>heat</u> (1) from tidal gravitational forces (1)	**(2)**

Question number	Answer	Mark
7(d)(ii)	Any 2 from: Comet does not generate internal heat or does not experience tidal forces (1) because it does not orbit close to a gas giant planet (1) Comet has no atmosphere (1)	**(2)**

Question number	Answer	Mark
7(e)	Drake (1)	**(1)**

Question number	**Answer**	**Mark**
7(f)	Europa has sufficiently large <u>gravity</u> (1) which is greater than the <u>elastic forces</u> (1) preventing planetary collapse. or Phoebe is so small (1) it cools too quickly to form a sphere (1)	**(2)**

Question number	Answer	Mark
8(a)(i)	Two stars that are gravitationally bound to each other (orbit their common centre of gravity) (1)	**(1)**

Question number	Answer	Mark
8(a) (ii)	Angle (diameter) of the sky that can be seen through a telescope (1)	**(1)**

Question number	Answer	Mark
8(a)(iii)	Measure separation between lines and diameter of circular field of view (1) Calculate $\frac{Diameter\ of\ circle}{Distance\ between\ lines} \times 2''$ = 33″ (1) Convert to arc minutes = 33″ / 60 = 0.55′ (1)	**(3)**

Question number	Answer	Mark
8(a) (iv)	$f_e = \frac{f_o}{M} = \frac{1.50}{50} = 0.03\ m$ (1) Correct substitution and evaluation required Convert to 30 mm (1)	**(2)**

Question number	Answer	Mark
8(b)	Fainter (1) Cannot be resolved (allow only see one star)(1)	(2)

Question number	Answer	Mark
8(c) (i)	Radio waves have longer wavelengths (than visible light) (1) Resolution reduces as wavelength increases (1)	(2)

Question number	Answer	Mark
8(c) (ii)	Aperture synthesis system (array) (1) accept: radio interferometer interferometer	(1)

Question number	Answer	Mark
9(a) (i)	Satellite / aircraft / meteor (1)	(1)

Question number	Answer	Mark
9(a) (ii)	Count the number of stars in photograph (in plane of Milky Way) 29 stars ± 3 (1) Calculate ratio of number of stars in each photograph = 1.73 – 2.13 (or reciprocal, 0.469 – 0.577) (1)	(2)

Question number	Answer	Mark
9(a) (iii)	<table><tr><th>Improvement</th><th>Reason</th></tr><tr><td>Take photos on same date</td><td>Images have same seeing conditions – difference between winter and summer skies</td></tr><tr><td>Take photos at same time</td><td>Images have same seeing conditions – difference between 'twilight' and middle of the night</td></tr><tr><td>Avoid Full Moon</td><td>Light pollution – will see fewer stars near the Moon</td></tr><tr><td>Take photos with same field of view</td><td>Images are sampling same <u>area</u> of the sky</td></tr><tr><td>Avoid horizon in photo</td><td>Stars not obscured by horizon/buildings/trees etc.</td></tr><tr><td>Take photos with same exposure time</td><td>Increased exposure results in more observable stars (fainter magnitude)</td></tr></table> Improvement (1) + reason (1) (max 6) Correct reason on its own does NOT get the mark.	(6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• A few inadequacies in the data are noted • A few shortcomings of the method used are identified • Some mention of relevant astronomical theory is made • At least one feasible suggestion for improving the method is made.
Level 2	3–4	• The major inadequacies in the data are noted • These are each linked to a particular shortcoming of the method used are identified • Relevant astronomical theory is used • Feasible suggestions for improving the method are made.
Level 3	5–6	• All inadequacies in the data are noted • These are each linked to a particular shortcoming of the method used are identified • Relevant astronomical theory is used to justify each of the above points • Detailed suggestions for improving the method are made by systematically addressing each of the identified issues.

Question number	Answer	Mark
9(b) (i)	More stars observed in a band (Milky Way) across the night sky. (1) Indicating a flat spiral shape – looking down the plane of this spiral. (1) or Elliptical galaxies stars more uniformly distributed. (1) If our galaxy were elliptical we would not observe a band of stars / Milky Way running across the night sky. (1)	**(2)**

Question number	Answer	Mark
9(b) (ii)	Observation of radio waves / 21 cm line. (1)	**(1)**

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

Question number	Answer	Mark
10(a) (ii)	-4 (1)	**(1)**

Question number	Answer	Mark
10(a) (iii)	Use the distance modulus formula i.e. M = m + 5 – 5 log d with correct substitution -4 = +1 +5 – 5 log d (1) log d = 2 (1) d = 100 pc (1) or Difference in absolute and apparent magnitude = 5 (1) Corresponds to a difference in brightness = 100 (1) Use of inverse-square law, star must be 10 times further away than 10 pc = 100 pc (1) Note – no ecf mark from 10 (b)	**(3)**

Question number	Answer	Mark
10(b) (i)	Any ONE from: (Heliocentric) Parallax (1) or Use of HR Diagram (1) or	**(1)**

	SN as Standard Candles (1)	

10(b) (ii)	Method for (Heliocentric) Parallax • Measure the change in position of a star (astrometry) (1) • after a long (6 month) period of time as Earth orbits the Sun (1) or Method for Use of HR Diagram: • Measure surface temperature of a star (spectral type) (1) • determine its absolute magnitude (and distance) from the HR diagram (1) or Method for SN as Standard Candles: • Measure the (maximum) apparent magnitude of a SN (1) • Calculate distance because all SN have the same absolute magnitude (1)	**(2)**

Question number	**Answer**	**Mark**
10(c)	Measure apparent magnitude of Delta-Cephei (1) With the aid of reference stars (1) Repeat on many (consecutive) nights (1) Plot a light curve of Delta-Cephei and determine its period (1) Determine absolute magnitude from period-luminosity relationship (Figure 16) (1) Calculate distance using distance modulus formula and average apparent magnitude of Delta-Cephei (1)	**(6)**

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