Pearson Edexcel

Mark Scheme (Results)

Summer 2019

Pearson Edexcel GCSE In Astronomy (1AS0)
Paper 1: Naked eye 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** Cassiopeia B is incorrect because the stars are not in the shape of the constellation Cassiopeia. C is incorrect because the stars are not in the shape of the constellation Cassiopeia. D is incorrect because the stars are not in the shape of the constellation Cassiopeia. (ii) **C** Pegasus A is incorrect because the stars are not in the shape of the constellation Pegasus. B is incorrect because the stars are not in the shape of the constellation Pegasus. D is incorrect because the stars are not in the shape of the constellation Pegasus. (iii) **B** Cygnus A is incorrect because the stars are not in the shape of the constellation Cygnus. C is incorrect because the stars are not in the shape of the constellation Cygnus. D is incorrect because the stars are not in the shape of the constellation Cygnus.	**(1)** **(1)** **(1)**

Question number	Answer	Mark
1(b)	(i) **C** Meteor A is incorrect because it lasts for much more than a few seconds. B is incorrect because it lasts for much more than a few seconds. D is incorrect because it lasts for much more than a few seconds. (ii) **B** Comet A is incorrect because it is not star-like with a fuzzy tail. C is incorrect because it is not star-like with a fuzzy tail. D is incorrect because it is not star-like with a fuzzy tail.	**(1)** **(1)**

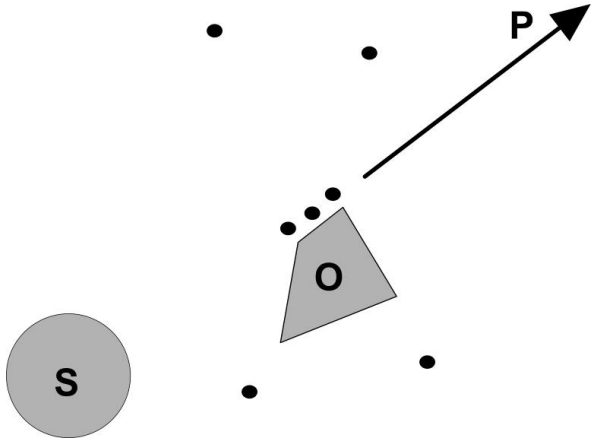
Question number	Answer	Mark
1(c)	Outline of solar disc during partial eclipse, as in example below. (Black background obviously not required).  Accept any orientation. Accept any size of solar disc. Line of intersection must be curved. *Reject:* Annular eclipse.	**(1)**

Question number	Answer	Mark
2(a)	(i) **C** Epicycles A is incorrect because it is an observation. B is incorrect because it was proposed by Kepler D is incorrect because it is an ancient idea. (ii) **B** Elliptical orbits A is incorrect because it is an observation. C is incorrect because it was proposed by Ptolemy D is incorrect because it is an ancient idea.	**(1)** **(1)**

Question number	Answer	Mark
2(b)	(i) **C** Always be above the horizon A is incorrect because this is not the behaviour of a circumpolar object. B is incorrect because this is not the behaviour of a circumpolar object. D is incorrect because this is not the behaviour of a circumpolar object. (ii) **C** 21st September A is incorrect because it is the date of the Spring Equinox B is incorrect because it is the date of the Summer Solstice D is incorrect because it is the date of the Winter Solstice	**(1)** **(1)**

Question number	Answer	Mark
2(c)	(i) **B** occultation A is incorrect because it does not describe an occultation. C is incorrect because it does not describe an occultation. D is incorrect because it does not describe an occultation. (ii) **C** opposition A is incorrect because it does not describe an occultation. B is incorrect because it does not describe an occultation. D is incorrect because it does not describe an occultation.	**(1)** **(1)**

Question number	Answer	Mark
2(d)	(i) **A** double B is incorrect because the force of gravity is proportional to mass C is incorrect because the force of gravity is proportional to mass D is incorrect because the force of gravity is proportional to mass (ii) **D** drop to one quarter A is incorrect because the force of gravity is inversely proportional to distance squared B is incorrect because the force of gravity is inversely proportional to distance squared C is incorrect because the force of gravity is inversely proportional to distance squared	**(1)** **(1)**

Question number	Answer	Mark
3(a)	 (i) S (ignore any arrows) (ii) O (iii) P (ignore arrow length; reject any points)	 **(1)** **(1)** **(1)**

Question number	Answer	Mark
3(b)	(i) Not a likely explanation Ancient monuments were generally closely aligned astronomically (ii) Not a likely explanation All visible stars formed long before Earth. (iii) Not a likely explanation Precession would move **all three** stars together, not relative to each other	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)**

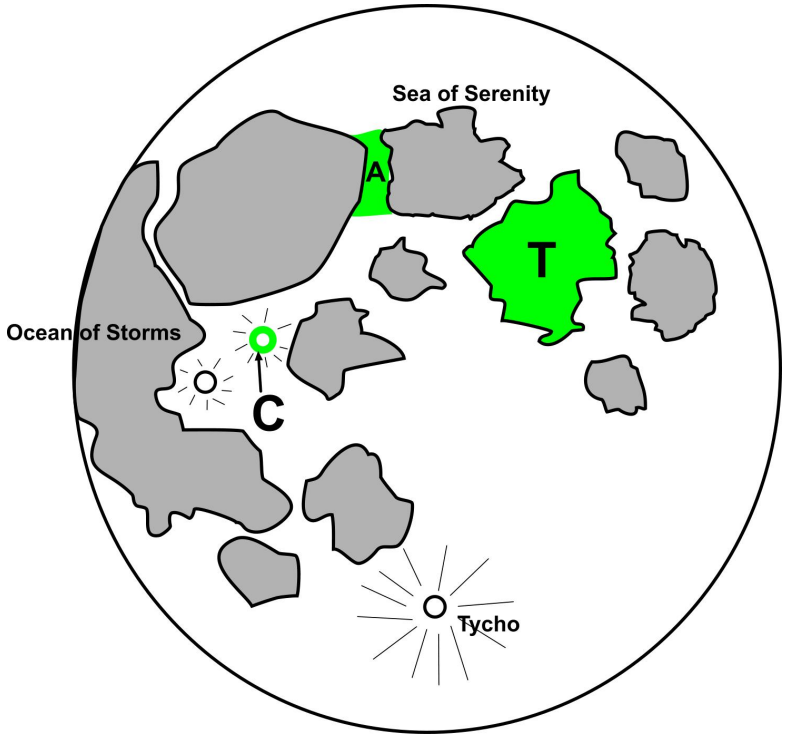
Question number	Answer	Mark
4(a)	Summer/Mid-summer Solstice 'Midsummer's Day' therefore scores **1.**	**(1)** **(1)**

Question number	Answer	Mark
4(b)	Rises and sets / Travels East to West Through Alice's overhead point/zenith *Insufficient:* 'highest point'	**(1)** **(1)**

Question number	Answer	Mark
4(c)	Point 'S'/this declination is overhead (from) Tropic of Cancer	**(1)** **(1)**

Question number	Answer	Mark
4(d)	Precession moves the stars **relative** to/'behind' point 'S' (on ecliptic).	**(1)** **(1)**

Question number	Answer	Mark
4(e)	On ecliptic **OR:** Sun/Moon/planets pass through them	**(1)**

Question number	Answer	Mark
5(a)	 i) **T** – indicating highlighted grey area ii) **C** – indicating highlighted circle/crater iii) **A** – indicating highlighted area between these grey areas.	**(1)** **(1)** **(1)**

Question number	Answer	Mark
5(b)	3 300 000 (km*) Allow:* 3 325 000 (x 19 = 1)	**(2)**

Question number	Answer	Mark
5(c)	98% (97.8%) 3 325 000 – 150 million = 146 675 000	**(2)** (1)

Question number	Answer	Mark
5(d)	Measuring angle close to 90°. Compound error from using earlier measurements.	**(1)** **(1)**

Question number	Answer	Mark
6(a) i	Star reaches highest point/crosses meridian/is due south Labelled diagram (required) shows this.	**(1)** **(1)**

Question number	Answer	Mark
6(a) ii	Curved (non-flat) surface of Earth. *Allow:* different latitudes	**(1)**

Question number	Answer	Mark
6(a) iii	**28 800km** *Any 1:* • Angular difference = 7½^{o} **– 0^{o}** = 7½^{o} • 360^{o}/7½^{o} = 48x • 48 x 600km	**(2)**

Question number	Answer	Mark
6(a) iv	**Any 2 from:** • Observe from further south to increase angle (*Reject:* observe star (Canopus) from further north) • Choose another star to avoid observing on horizon Obtain a more accurate value for Rhodes-Alexandria distance Repeat and average observations / use multiple stars	**(2)**

Question number	Answer	Mark
6(b)	**580** (577.8) **(km)** *Any 1 from:* 360/ 5.2 (= 69 (69.23)) 40 000 / 69 (=580)	**(2)** (1)

Question number	Answer	Mark
7(a)	(i) **D** 11:33 A is incorrect because it is the Apparent Solar Time B is incorrect because it is the Local Mean Time C is incorrect because it is not related to the question (ii) **D** 11:33 A is incorrect because it is the Apparent Solar Time B is incorrect because it is the Local Mean Time C is incorrect because it is not related to the question (iii) **B** 11:21 A is incorrect because it is the Apparent Solar Time C is incorrect because it is not related to the question D is incorrect because it is the Greenwich Mean Time (iv) **A** 11:15 B is incorrect because it is the Local Mean Time C is incorrect because it is not related to the question D is incorrect because it is the Greenwich Mean Time	**(1)** **(1)** **(1)** **(1)**

Question number	Answer	Mark
7(b)	Identification one of the following causes. Explanation of how it introduces a difference between Solar and Mean time. **Eccentricity of Earth's Orbit**. Changing distance between Earth and Sun means changes in Earth's orbital speed resulting in changes in the Sun's apparent speed across the sky. **Obliquity of Ecliptic.** Tilt between Earth's orbital plane and spin axis changes apparent altitude of Sun in sky and thus its angular speed across the sky.	**(1)** **(1)**

Question number	Indicative content	Mark
7(c)	• Equation of Time is difference between Apparent Solar Time and Mean Solar Time • Apparent Solar Time can be found from a sundial or shadow stick • Mean Solar Time can be found from a clock • Effect of longitude on AST needs to be allowed for • Need to ensure no direct viewing of Sun • Easier to use MST as independent variable as it is easier to assess when it has reached a whole number of minutes (unlike AST).	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Presents a simple observing programme showing some awareness of the phenomenon under investigation • Identifies some feasible parameters such as location, and observing times. • No evidence of awareness of need for repeated observations or observation over an extended time period to achieve reliable data.
Level 2	3–4	• Presents a sound observing programme showing clear awareness of the phenomenon under investigation • Identifies a number of feasible parameters such as location, and observing times. • Shows awareness of need for repeated observations or observation over an extended time period to achieve reliable data.
Level 3	5–6	• Presents a detailed observing programme showing a thorough understanding of the phenomenon under investigation • Identifies all relevant parameters such as location, and observing times. • Shows a clear understanding of the need for repeated observations or observation over an extended time period to achieve reliable data and reflects this clearly in their design.

Question number	Answer	Mark
8(a)	• Appropriate and correctly-labelled scales on both axes • Points correctly plotted. • Smooth U-shaped curve through points.	**(1)** **(1)** **(1)**

Question number	Indicative content	Mark
8(b)	• Readings taken either side of local noon • Measurements taken on whole numbers of minutes • Intervals in readings are too large • Around noon, the Sun is moving one or two degrees between readings • An error of even one degree in latitude represents a substantial distance at sea [~70 miles] • Using the Sun's altitude as the **in**dependent variable may have been a more effective method • Altitude of Sun at noon correctly assessed from data (42^{o}) • Latitude calculation is incorrect: **Co-**latitude + 8^{o} = 42^{o}, giving correct latitude of 56^{o}.	**(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	Additional guidance	Mark
8(c)	**(i) 20º** *Any 1 from:* 13:20 – 12:00 = 1h 20m 1h 20m x 15 (= 20º) **(ii) 150º** **W**	(ignore any indication of +/- or direction of longitude difference) (allow +150º) Allow ECF from (i)	**(2)** **(1)** **(1)**

Question number	Answer	Additional guidance	Mark
8(d)	(John) **Harrison** (Ignore first name)	*Allow:* Harrison, Harrisson or Harisson.	**(1)**

Question number	Answer	Mark
9(a)	*Any **2** of the following points, established by diagram or otherwise:* • RA of observer's meridian is 10h 42m • First Point of Aries is 10h 42m from meridian • Aldebaran is 6h 6m from meridian • RA of Aldebaran = 10h 42m - 6h 6m • i.e. 4h 36m from First Point of Aries. Diagram supporting on of the above.	**(2)** **(1)**

Question number	Answer	Mark
9(b)	*Any **1** of:* • Altitude of Celestial Equator on meridian is $90^o - 42^o = 48^o$ • Altitude of Aldebaran (64^o 30') therefore = Dec + 48^o • *Establishing NCP as 42^o above northern horizon and Aldebaran's co-declination as $138^o - 64^o$ 30' = 73^o 30'.* *Labelled diagram illustrating one of the above.*	**(1)** **(1)**

Question number	Answer	Mark
9(c)	**54^o 45'** *Up to **1** 'working' marks available for incorrect answers:* • Cel Eq is 38^o 15' above southern horizon in Oxford • Aldebaran's declination will put it a further 16^o 30' above the horizon.	**(2)**

Question number	Answer	Mark
9(d)	**(i) 4h 36m** LST = RA of objects on meridian, i.e. 10h42m – 6h 6m **(ii) 4h 36m** Mention of LST or RA of objects on meridian	**(2)** (1) **(2)** (1)

Question number	Answer	Mark
10(a)(i)	*Points established by diagram or otherwise:* • Solar eclipse occurs when Moon is between Earth and Sun • Lunar eclipse occurs when Moon is on opposite side of Earth to Sun • They can therefore be separated by **half** of a lunar orbit = ½ x 28 days.	**(1)** **(1)** **(1)**

Question number	Answer	Mark
10(a)(ii)	*Points established by diagram or otherwise:* • Moon is much smaller than cone of shadow behind Earth in a lunar eclipse • Moon fits almost exactly into line of sight 'cone' of rays to Sun in a solar eclipse • Comparison of shadow areas on Earth's surface (night hemisphere of Earth v. tip of shadow cone).	**(1)** **(1)** **(1)**

Question number	Answer	Mark
10(b)(i)	**23 (22.9) days** *Up to **2** 'working' marks available for incorrect answers:* • *Attempt to calculate T^2/r^3 for Moon's current orbit* • *Correct value for T^2/r^3, e.g. 0.00373, 745.29 etc* • *Correct substitution for new orbit, giving $T^2/52^3$ = their value.* **Correct Method:** *Current lunar orbit:* r = 380 000km / 6500 km =58.46 Earth radii. $T^2/r^3 = (27.3)^2 / (58.46)^3 = \underline{0.00373}$ (or equivalent in other units, such as 745.29 days^2/Moon orbital radii^3) *Lunar orbit of 52 Earth radii:* r = 52, giving; $T^2/52^3 = 0.00373$ $T = \sqrt{(0.00373 \times 52^3)}$ T = 22.9 days	**(3)**

Question number	Answer	Mark
10(b)(ii)	**580 000 (581 100) km** *Up to **3** 'working' marks available for incorrect answers:* • T^2/r^3 = 0.00373 (or their value from (i)) • Doubling Moon's sidereal period (2 x 27.3 = **54.6** days) • Calculating r = **90.4** Earth radii • Subtracting one Earth radius to find distance from Earth's surface. *Correct solution:* T^2/r^3 = 0.00373 (or their value from (i)) $(2 \times 27.3\text{days})^2 / r^3 = 0.00373$ $r = \sqrt[3]{[(2 \times 27.3\text{days})^2 / 0.00373]}$ r = 90.4 Earth radii (= 587 600km)	**(4)**

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