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Mark Scheme (Results)

Summer 2016

Pearson Edexcel GCSE in Astronomy (5AS01/01)
Unit 1: Understanding the Universe

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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	Notes	Marks
1 (a)	**B** Orion		**1**
(b)	**D** Sirius		**1**
(c)	**D** Nebula		**1**

Question number	Answer	Notes	Marks
2 (a)	**A** William Herschel		1
(b)	**D** Variable star		1
(c)	**B** Goldilocks Zone		1
(d)	**B** 21st March		1
(e)	**C** Exoplanets		1

Question number	Answer	Notes	Marks
3 (a)	Heliocentric / helio-centred	*Reject:* Sun-centred or Copernican	**1**
(b)	It made predictions of the positions of the planets easier/quicker to calculate. OR: Explained retrograde motion of planets	*Accept: Better predictions* *Reject:* It had the Sun at the centre / didn't have the Earth at the centre	**1**
(c)	*Any 2 from:* Moons orbiting Jupiter Phases of planet Venus Earth-like / relief features on Moon Milky Way resolved into individual stars	*Insufficient:* Sunspots Invention of telescope	**2**

Question number	Answer	Notes	Marks
4 (a)	Moving / curtains / streamers of (coloured) light	*Insufficient:* Patches of light	**1**
(b)	Point of light moving quickly / steadily across sky	*Insufficient:* Point of light / dot	**1**
(c)	(Bright) Streak of light / bright meteor Meteor brighter than -3	*Insufficient:* meteor	**1**
(d)	Just visible / very faint object	*Insufficient:* Point of light or star	**1**

Question number	Answer	Notes	Marks
5 (a)	**C** Mercury		**1**
(b)	**B** Neptune		**1**
(c)	**D** Venus		**1**
(d)	**D** Venus		**1**

Question number	Answer	Notes	Marks
6 (a) (i)	**B** Rille		**1**
(ii)	**C** Terra		**1**
(iii)	**A** Mare		**1**
(b)	*Any two from:* Far side of Moon has more craters Far side of Moon has fewer maria Far side has more highland/terrae Far side appears lighter	*Reject:* darker, colder invisible	**1** (both required)

Question number	Answer	Notes	Marks
7 (a) (i)	3000 – 5000	*Reject:* Answer outside this range. Ignore units	**1**
(ii)	Arrow(s) are horizontal or slightly inclined towards equator	*Accept:* to left or right	**1**
	Both arrows are same length and reflections of each other in equator		**1**
(b)	Use of projection or filtering light entering telescope	*Insufficient:* 'Solar telescope'	**1**
	Clear labelled diagram showing correct practical set-up		**1**
	QWC: *'write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear'* Student answer clearly legible with correct SP&G and correct use of any one of the following terms: Projection Pinhole Image Telescope H-alpha Absorption		**1**

Question number	Answer	Notes	Marks
8 (a)	Either mathematical calculation / prediction of position and		**1**
	Any one of Irregularities in orbit of Uranus Gravitational pull of another planet Identified from telescope search Named astronomer, e.g. Adams/Le Verrier/ Galle/d'Arrest In 1846		**1**
(b)	*Any two from:* Some moons orbiting amongst Neptune's rings One very large moon (Triton) Triton has retrograde / highly inclined / almost circular orbit Triton large enough to have atmosphere Triton likely to be captured from KBOs/TNOs Capture of Triton destroyed previous satellites Nereid has highly elliptical orbit		**2**

Question number	Answer	Notes	Marks
9 (a) (i)	**C** Mercury		**1**
(ii)	**B** Conjunction		**1**
(b)	Sequence S V E or E V S		**1**
(c)	*Any two from* Disc of Venus appears very small in sky Sun is very bright Telescope needed to observe it in detail Transits not accurately predicted		**2**
(d)	Venus (or Earth) has a tilted **orbit / orbital plane** compared to each other / ecliptic or orbits only cross/align in two places	*Reject:* Venus/Earth is tilted Accept: Inclined to ecliptic =2	**1** **1**

Question number	Answer	Notes	Marks
10 (a)	*Any two from:* Large objective lenses are difficult to make Large lenses are hard to support Reflectors can be made of multiple mirrors Telescopes with large lenses are difficult to keep stable and steer/point accurately Lenses introduce false colour/chromatic aberration Reflector design has higher resolution	*Insufficient:* Cheaper More powerful Easier to build	2 6
(b)	The mark scheme for this question is tiered depending on the complexity/detail level with which candidates discuss the advantages/disadvantages of each telescope.		

	Hale	**Hubble**
Simple statement	Bigger mirror	Is above atmosphere
Explanation	Gives improved light grasp or resolution	Gives brighter/sharper/higher contrast/lower distortion images. *Insufficient:* 'better' or 'clearer' images
Detail or quantitative comparison	Light grasp four times better or resolution twice as good	*Any one from:* Can observe in near UV/IR Unaffected by weather/Earth's rotation Harder to repair

Question number	Answer	Notes	Marks
11 (a)	To avoid risking human life in early missions / safer / easier cheaper / no return		**1**
(b) (i)	Lower gravity on Moon	*Reject:* **No** gravity	**1**
(ii)	No atmosphere / air resistance for parachutes		**1**
(c) (i)	Apollo (any number)	*Reject*: Eagle	**1**
(ii)	*Any two from:* Seismic measurements Charged particle measurements Solar Wind measurements Atmospheric pressure measurements Heat flows in/out of lunar surface LASER reflection measurements of distance to Earth Composition of lunar atmosphere Micrometeorite detection and measurement Surface gravity measurements Surface magnetic field measurements Rock samples	*Reject:* Any other answers	**2**
(d)	Sunlight is not **scattered**… … as the Moon has no atmosphere		**1** **1**

Question number	Answer	Notes	Marks
12 (a) (i)	09:00 / 9 o'clock / 9a.m.		**1**
(ii)	09:00 – −2m = **09:02** (08:58)	Reject: 09:08 or 09.12	**2** **(1)**
(iii)	09:10 – 09:02 = **8 mins**, 8m **/ 4** i.e. evidence of 4 mins representing 1° of longitude (= 2°W)	*NB:* No mark for answer (2°W)	**1** **1**
(b)	Curve drawn with similar U-shape Curve drawn higher than June curve	*Accept:* curve shifted left or right	**1** **1**

Question number	Answer	Notes	Marks
13 (a) (i)	*Diagram/explanation shows:* Oort Cloud centred around the Sun Highly elliptical orbit (open / closed) with Sun at focus		 1 1
(ii)	**P** marked as point on orbit closest to Sun.		1
(iii)	Gravitational pull of major planet / nearby star		1
(b)	100 10 (or evidence of squaring)		2 1
(c)	27(years) Evidence of 9^3 (=729)		2 1

Question number	Answer	Notes	Marks
14 (a)	Objects in the sky which never set / are always above the observer's horizon.	*Reject:* Always visible orbit Polaris	1
(b)			

	Viewed from **London** (Latitude: 52°N)	Viewed from **Brazil** (Latitude: 16°S)
Pole Star	C	N
Sun at midday on June 21st	R	R
Sirius (Declination: -16°)	R	Z
Orion's Belt (Declination: 0°)	R	R

	6 correct 4 or 5 correct 2 or 3 correct 0 or 1 correct		**3** **2** **1** **0**
(c)	*Any **two** from:* Most southerly point(s)/latitude where Sun is directly overhead at noon on Winter/Southern Summer solstice 21st December		**2**

Question number	Answer	Notes	Marks
15 (a) (i)	New		**1**
(ii)	Photosphere	*Insufficient:* Disc *Reject:* Corona	**1**
(b) (i)	Ellipse / Elliptical		**1**
(ii)	Establishes that shadow cone of Moon doesn't reach Earth's surface OR: angle of Moon's disc is less than angle of Sun's disc		**1**
	Labelled diagram to illustrate this.		**1**

Question number	Answer	Notes	Marks
16 (a) (i)	Planetary / Eskimo and Supernova Remnant / Crab (both required either order)		**1**
(ii)	Supernova Remnant / Crab		**1**
(iii)	Star Formation / Eagle and Absorption/Horsehead (both required either order)		**1**
(b) (i)	Tuning fork shaped diagram with galaxies		**1**
	Stem and tines of fork labelled with correct type of galaxy		**1**
	Progression of shape indicated along branches of diagram.		**1**
(ii)	**M** labelled half-way along Spiral or Barred Spiral fork (SBb)		**1**
(iii)	**E7** labelled on stem of fork, close to tines		**1**

Question number	Answer	Notes	Marks
17 (a)	Two stars/objects		**1**
	Linked by force of gravity / in orbit around each other	Insufficient 'close'	**1**
(b) (i)	Escape velocity greater than speed of light		**2**
	Extremely strong gravity pulls back even light/EM waves		**1**
(ii)	*Any **one** of three alternative answers:*		**2**
	Binary systems		
	Star orbiting black hole		**1**
	Shows gravitational pull of black hole		**1**
	Emissions from nearby mass		
	Material falling into black hole / accretion disc		**1**
	Emits strong X-ray signals		**1**
	Gravitational Lensing		
	Gravity of black hole bends space/light from another star		**1**
	Causes a double image of the star for viewers on Earth		**1**
(c)	X-rays do not penetrate the Earth's atmosphere		**1**
(d)	**25 000** / 2.5^{11} (=23 842) / 2.512^{11} (=25 131)	[Magnitude difference = 4.5 - -6.5 = 11 11 magnitudes = 2.5 x 100 x 100 = 25 000]	**2**
	11 (or clear evidence of an initial error carried forward, e.g. calculating 2.5^{10})		**1**

Question number	Answer	Notes	Marks
18 (a)	Star dims as planet transits / passes in front		**1**
(b)	150 000 km	[1st – 2nd contact time from graph = 1 hour 1 hour x 150 000 km/h – 150 000 km]	**2**
	Time of 1h read from graph		**1**
(c)	Very accurate measurement of star's position / astrometry	*Reject:* Transit method	**1**
	To detect tiny 'wiggles' as it is orbited by planet or		**1**
	Radial velocity / Doppler measurement		**1**
	To detect tiny 'wiggles' as it is orbited by planet		**1**

Question number	Answer	Notes	Marks
19 (a)	Universe was originally very small Expanded outwards after Big Bang		1 1
(b)	CMB = 'left over' radiation from the Big Bang Wavelength of CMB agreed with estimates of rate of cooling of Universe (or similar argument based on temperature)	*Accept:* 'echo of Big Bang'	1 1
(c)	Quasars are (only) observed at very large distances/high red-shifts Indicating early universe was different to present day (i.e. not Steady State) **QWC:** *'organise relevant information clearly and coherently, using specialist vocabulary when appropriate'* Student answer contains a clearly expressed argument with the correct use of **ANY TWO** of the following terms: Red shift Universe Steady State Luminosity Galaxy AGN Spectrum/a or Spectral line(s)		1 1 1

Question number	Answer	Notes	Marks
20 (a)	Group of nearby galaxies linked to Milky Way by gravity		1 1
(b) (i)	3.5 −11.5 Correct substitution of values and evaluation of log(1 000 000) = 6 *OR:* log(1000) + ecf = -31.5		3 2 1
(ii)	−1.5	[10 x closer = 100 x brighter = 5 mags]	2
	Any evidence of squaring or log (100 000)		1
(iii)	Bright object in night sky / easily visible to naked eye / large angle in sky		1

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