



MARKSCHEME

May 2012

ASTRONOMY

Standard Level

Paper 1

8 pages

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Subject Details: Astronomy SL Paper 1 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions.

Maximum total = [**30 marks**].

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.
2. Each marking point has a separate line and the end is signified by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets () in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing **OWTTE** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. Indicate this with **ECF** (error carried forward).
10. Significant figures are **only** penalized where noted.
11. *EOR* : Evidence Of Rule : normally associated with a methodology used.
12. *ORA* : Or Reverse Argument.

The Stars

1. as you move towards the edge/limb, the light is coming from material with a lower average temperature / from material through the whole depth of the photosphere; towards the edge of the limb, you don't look so deeply into the Sun; **[1 max]**
The answer should reference the "depth" into the Sun or that the light is emitted from material with a higher (average) temperature.
Award [0] for "As you move towards the edge/limb, the material is colder/cooler".

2. Award **[1]** for each correct star in the stated constellation.

Constellation:

Orion

Stars:

Betelgeuse / Rigel / Bellatrix / Mintaka / Alnilam / Alnitak;

Constellation:

Cassiopeia

Stars:

Shedar / Caph / Ruchbah / Segin / Achird;

Constellation:

Ursa Major

Stars:

Dubhe / Merak / Phecda / Megrez / Alioth / Mizar / Alkaid;

Constellation:

Ursa minor

Stars:

Polaris / Kochab / Pherkad / Yildun / Ahfa al Farkadain / Anwar al Farkadain;

[2 max]

Award [1 max] if the stars are not in the stated constellation but they are in the same constellation.

3. *This marking point is for the fact that the neutrinos are a product of the core fusion.*
Any one of the following: [1 max]
 (solar) neutrinos/they are created/produced/formed in fusion;
 (solar) neutrinos/they are created/produced/formed in the core;
 (solar) neutrinos/they are created/produced/formed in hydrogen burning;

This marking point is for the fact that they escape from the Sun and reach us very quickly.

Any one of the following: [1 max]

- they escape from the sun at close to the speed of light;
 they reach us instantly;
 they take 8 minutes to get to us;
 they are unimpeded as they leave the Sun;

[2 max]

4. $L = \sigma AT^4 = \sigma 4\pi R^2 T^4$

$$\frac{L_A}{L_B} = \frac{\sigma 4\pi R_A^2 T^4}{\sigma 4\pi R_B^2 T^4} \text{ therefore } \left(\frac{R_A}{R_B}\right)^2 \approx \frac{L_A}{L_B} = \frac{10^3}{10^{-3}} = 10^6$$

$$\frac{R_A}{R_B} \approx \sqrt{10^6} = 10^3$$

[3]

Award [1] for $L = \sigma AT^4$

Award [1] for $\left(\frac{R_A}{R_B}\right)^2 = \frac{L_A}{L_B}$

Award [1] for 10^3

Award [3 max] for the correct answer.

The Planets

5. the amount of (solar) radiation reflected off the planet/atmosphere;
with respect to the incident radiation; [2]
Award [2] for “The fraction of reflected (solar) radiation” / “The percentage of reflected (solar) radiation”.

6. $e = \sqrt{1 - \left(\frac{b}{a}\right)^2} = 0.04878$
so $\frac{b}{a} = \sqrt{1 - e^2}$
 $\frac{b}{a} = \sqrt{1 - (0.04878)^2} = 0.9988$ [3]
Award [1] for $\frac{b}{a} = \sqrt{1 - e^2}$
Award [1] for 0.9988
Award [1] for showing 4 significant figures regardless of the actual number stated.

7. *Liquid Water: [1 max]*
it is needed to allow chemical mobility / to act as a medium for chemicals to come together;
it is relatively inert;
it has a very large specific heat capacity/latent heat;

Temperature: [1 max]
the temperature needs to be high enough to allow reactions to take place;
if the temperature is too high, chemicals/proteins will denature; [2 max]
Award [0] for “If the temperature is too high, chemicals/proteins will be destroyed”.

8. (meteor crater) Arizona (USA); [1]

Galaxies

9. *NGC1569*:
irregular;
- M31*:
(barred) spiral; [2]
10. *Rotation Curve*: [1 max]
a graph/plot of the rotational speed of an object against its distance from the rotational centre;
a graph/plot to indicate the mass of the rotating body/galaxy;
- Blue-shift*: [1 max]
the contraction of the wavelength of light;
the change to the light from an object as a result of the fact that it is moving towards us; [2 max]
11. orbits the centre with circular/elliptical motion;
oscillating/moving up and down periodically through the disc; [2]
12. protons;
electrons;
atomic nuclei;
helium nuclei/atoms/alpha particles; [1 max]

Cosmology

13.

Parallel lines	Stay parallel ✓	Diverge	Intersect
Internal angles of a triangle	Less than 180°	Equal to 180° ✓	Greater than 180°
Circumference of a circle	Less than $2\pi r$	Equal to $2\pi r$ ✓	Greater than $2\pi r$

[3]

14. the change/shift of wavelength is twice as big for *A* than *B*;
the relative/recessional speed of *A* is twice that of *B*;
A is twice the distance from us than *B*;

[2 max]

15. there was a time when the universe/spacetime expanded at faster than the speed of light;

Plus any one of the following: [1 max]

- the universe seems to have a geometry which is flat;
material in spatially opposite directions, at the edge of the observable universe to have been in contact / the universe seems to be homogeneous / *OWTTE*;
the cosmic background radiation is isotopic / *OWTTE*;

[2 max]