



MARKSCHEME

May 2013

ASTRONOMY

Standard Level

Paper 1

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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. *Parsec:* the **distance** an object would be in order to subtend **1 second of an arc** when viewed 6 months apart; [1]
The mark is for the student knowing that the parsec is a unit if “distance” linked to “1 second of an arc”.
Photosphere: outer layer of the Sun;
 outer 500 km of the Sun;
 the region from which light is seen;
 OWTTE; [1 max]

2. electrons relax / fall down to lower energy levels / band / orbitals;
 electrons fall down to $n = 2$ level;
 energy is conserved in such changes;
 energy change / difference becomes the light energy / photon energy; [2 max]

3. $4^1_1\text{H} \rightarrow {}^4_2\text{He} + 2\,{}^0_{+1}\text{e} + 2\nu + 2\gamma$; [2]
Award [1] if answer has H on the left and He, ${}^0_{+1}\text{e}$, ν , γ on the right.
This mark should be relatively easy.
Award [1] if the equation is balanced and has the right numbers for Baryon number and Charge number.

4. $d = \frac{1}{\theta} = \frac{1}{0.009} = 111\text{pc} = 3.4 \times 10^{18} \text{ m}$; [2]
Award [1] for correct method.
Award [1] for $3.4(3) \times 10^{18} \text{ (m)}$.

The Planets

5. the results of a giant impact (with the forming Earth);
 material thrown out from the Earth;
 gravitationally caught (by the Earth) / went into orbit (around the Earth); [3]

6. Similarity: field is similar to that of a bar magnet/dipolar;
 due to convection currents;
 magnetic field centred on centre for Earth, Jupiter and Saturn;
 field directs charged particles/solar rays around the planet;
 fields of Earth and Jupiter/Saturn have an orientation close to the spin axis; [1 max]

Difference: Earth: magnetism centred on centre but off-centre in Uranus and Neptune;
 Earth: convection in iron-rich material but metallic hydrogen for Jupiter/Saturn / layer of ice material in Uranus/Neptune;
 fields of Earth and Uranus/Neptune have an orientation close to the spin axis; [1 max]

7.

Possible factors contributing to a mass extinction event		
Factor	Long-term factor	Short-term factor
Asteroid impact		✓
Continental drift	✓	
Supernova event		✓

[2]

Award [1] for continental drift as a long-term factor.

*Award [1] for asteroid impact **and** supernova event as short-term factors.*

8. easily diffracted;
 spread out a lot;
 cover a wide volume/area;
 part of the EM spectrum less affected/scattered by material in space;
 signals would move at the speed of light;
 electromagnetic radiation is easy to generate/receive, at relatively low cost;
 for a wide range of frequencies, absorption in space is very weak;
 a reference to the link between the 21cm line and hydrogen; [1 max]

Galaxies

9. M100: spiral;
M49: elliptical; [2]

10. *Baade's window*: a tunnel of unobscured space towards the galactic centre (of the Milky Way);
a clear line to the centre of the galaxy;
a view 4° off the line to the galactic centre; [1 max]

- Nuclear bulge*: the central part of the galaxy;
the part of a galaxy containing a supermassive black hole; [1 max]

11. located in the inner parts of the halo;
located in the nuclear bulge;
elliptical orbits;
low metallicity / less than 1 % metallicity;
very old / older than 2 billion years;
low mass stars;
very high velocities (around the galactic centre); [2 max]

12. $f = \frac{a-b}{a} = 1 - \frac{b}{a}$

therefore

$\frac{b}{a} = 1 - f$ leading to $\frac{a}{b} = \frac{1}{1-f} = \frac{1}{1-0.70} = 3.3$; [2]

Award [1] for correct method.

Award [1] for 3.3.

The answer should be to the correct number of significant figures ie, 3.3 not 3, 3.33, etc.

Cosmology

- 13.** long range (compared to the nuclear forces);
photons are the virtual particles / works by exchanging photons/swapping photons;
some correct link to charge; *[2 max]*
- 14.** *The first marking point is for stating what Olber's paradox is:*
why the sky is dark at night;
the night sky should be bright;
the (night) sky should be filled with stars; *[1 max]*
- The second and third marking points are for some explanation:*
the universe may not be homogeneous;
the universe may not be isotropic;
the universe may not be infinite;
the light is red-shifted out of the visible; *[2 max]*
- 15.** the universe is everywhere both homogeneous and isotropic (if the scale is large enough);
the universe looks the same no matter where it is viewed from; *[1 max]*
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