Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2016

Astronomy

Standard level

Paper 1

7 pages

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. *One year*:
time taken for a planet to orbit the Sun once;

Solar differential rotation:
rotational speed of the Sun depends on latitude; **[2]**

2. $F = \frac{L}{A} = \frac{3.84 \times 10^{26}}{4\pi \times \left(6.96 \times 10^{8}\right)^{2}} = 6.31 \times 10^{7}\ \text{W m}^{-2}$

$F = \sigma T^{4} = 5.67 \times 10^{-8} \times 5770^{4} = 6.28 \times 10^{7}\ \text{W m}^{-2}$;

6.31×10^{7} / $6.28 \times 10^{7}\ \left(W\ m^{-2}\right)$; **[2]**

3. ppI chain / proton-proton chain; **[1]**

4. *Any two from:*
planet is seen to have a larger movement in the night sky over a given period of time / planet has a large movement in the night sky over a given period of time compared to a star;
planets show retrograde motion / *OWTTE*;
star appears to be in a fixed position with respect to other stars while a planet moves across this pattern / planets move through the constellations while stars are fixed with respect to them / planets move through the celestial sphere while stars do not; **[2 max]**

*Students answer must make it clear how their answer is a difference. Answers need to either have references to both a star and a planet, or one could be stated with the reference to larg**er**, small**er**, etc.*
The reference to time in the first option is important.
Do not accept "planets to move across the sky" / "planets have a large movement across the sky".

The Planets

5. *Planetary differentiation:*
Any one for **[1]** *from:*
planet is layered;
planetary structure changes with depth;
process of causing material to rearrange itself with depth;

Terrestrial planet:
planets within the orbit of the asteroid belt / closer to the Sun than the asteroid belt; **[2]**

6. $e = \sqrt{1-\left(\frac{b}{a}\right)^2} = 0.0935$

$\frac{b}{a} = \sqrt{1-e^2}$;

$\left(\frac{b}{a} = \sqrt{1-(0.0935)^2} =\right) 0.996$;

answer given to 3 or 4 SF;
Accept ratio "a/b" or "b/a". **[3]**

7. Mercury;
Venus; **[2]**

8. $\text{KE} = \frac{1}{2}mv^2 = \frac{1}{2}\times 100\times\left(11\times 10^3\right)^2 = 6.05\times 10^9\text{J}$

$\frac{1}{2}\times 100\times\left(11\times 10^3\right)^2$;

6.05×10^9 / 6.1×10^9 / $6\times 10^9\,(\text{J})$; **[2]**

Galaxies

9. *M91:*
SB;
NGC 1427A:
irregular; **[2]**

10. disc;
halo; **[2]**

Do not accept "spiral arms".

11. have a spectral excess of some form / unusually large light output;
Do not accept "they have a very large light output".

(the light output is) due to an active galactic nucleus / due to an accreting (supermassive) black hole; **[2]**

12. $z = \frac{\Delta\lambda}{\lambda} = \frac{\left(\lambda_{observed} - \lambda_{emitted}\right)}{\lambda_{emitted}}$ leading to

$\lambda_{observed} = 656.3 + z\lambda_{emitted} = 656.3 + 65.63 = 721.9$ nm

correct calculation of $\Delta\lambda$;
721.9 / 722 nm; **[2]**

Cosmology

13. red-shift is due to the relative motion of an object;
cosmological red-shift is due to the expansion of spacetime; **[2]**

Do not accept "cosmological red-shift is due to the expansion of space / space and time".

14. E; **[1]**

15.

$6000\ \text{y} = 1.89 \times 10^{11}\ \text{s}$ therefore, $H_o = \frac{1}{1.89 \times 10^{11}} = 5.28 \times 10^{-12}\ \text{s}^{-1}$

$H_o = \frac{5.28 \times 10^{-12}}{10^3} \times 10^6 \times 3.1 \times 10^{16} = 1.637 \times 10^8\ \text{km s}^{-1}\ \text{Mpc}^{-1}$

$H_o = \frac{1}{\text{age of universe}}$;

$H_o = 5.28 \times 10^{-12}\ \text{s}^{-1}$;

1.637×10^8 / 1.64×10^8 / $1.6 \times 10^8\ \text{km s}^{-1}\ \text{Mpc}^{-1}$; **[3]**