

Markscheme

May 2015

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. *Main sequence:*

Any one from:

fusing hydrogen / hydrogen burning in the core;

the stage/part of a star's life which lasts for approximately 90 % of its total lifetime /

OWTTE;

Accept any answer which distinguishes main sequence stars from stars in the process of dying.

White dwarf:

Any one from:

the end of a star's life where the majority of the star is C, N and O;

the end of a star's life when the star's mass is less than approximately 8 solar masses; [2]

We need more here than simply the end of a star's life – since this could also be a N Star or B Hole. Whatever answer the student provides, it should distinguish the WD from the NS and BH.

2. $L \approx 4\pi R^2 \sigma T^4$;

(if the radius is halved $\left(\times \frac{1}{2}\right)$ and the temperature is doubled $(\times 2^4 = 16)$) the overall

effect is a change of 8;

$$L = (8 \times 3.8 \times 10^{26} \text{ W}) = 3.1 \times 10^{27} \text{ W};$$

[3]

M2 can be awarded from the equation in third marking point.

The question asks for the answer to be given in SI units and to 2 SF. These conditions are checked with the final mark and if either is wrong, the final mark is lost.

Award [3] for correct final answer.

3. $\text{energy} = mc^2 = 1 \times 9 \times 10^{16} = 9 \times 10^{16} \text{ J};$

The answer must include the correct SI units. Incorrect units or no units will lose the mark.

[1]

4. the light is described as black body/thermal/Planck curve/radiation;

Accept a curve that also shows the variation.

Wien's displacement law / $\lambda_{\text{max}} T = \text{constant};$

[2]

We need more for the second mark than simply "there is a relationship between the wavelength and temperature".

The Planets

5. *Retrograde motion:*

Any one from:

the rotational motion of an object which is in the opposite sense to the rotational motion of the object it is orbiting;

the apparent reverse motion of an object in the night sky, when it is outside the Earth’s orbit, and viewed from the Earth / **OWTTE**;

Synchronous orbit:

an orbit where an object has the same orbital period as its average rotational period;

[2]

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

identification that $\frac{b}{a}$ is equivalent to $\frac{100}{105}$ (or $\frac{95.2}{100}$);

$$e = \sqrt{1 - \left(\frac{100}{105}\right)^2} = 0.30(491);$$

[2]

The first mark should not be given for $\frac{b}{a} = 0.95$.

7.

Possible factors contributing to a mass-extinction event		
Factor	Long-term factor	Short-term factor
Massive volcanic activity		✓ ;
Sustained global warming	✓ ;	
An evolving biosphere	✓ ;	

[3]

8. $N = R \cdot f_p \cdot n_e \cdot f_1 \cdot f_i \cdot f_c \cdot L$

R : the average rate of formation of stars suitable for the development of intelligent life

OR

f_p : the fraction of those stars with planetary systems

OR

n_e : the number of planets, per solar system, with an environment suitable for life

OR

f_1 : the fraction of suitable planets on which life actually appears

OR

f_i : the fraction of life bearing planets on which intelligent life emerges

OR

f_c : the fraction of civilizations that develop a technology that releases detectable signs of their existence into space

OR

L : the length of time such civilizations release detectable signals into space;

[1]

If the student explains more than one term, it must be clear which term they are describing and if any term is incorrectly described, this would lose the mark (even if there is a term correctly explained).

Galaxies

9. *M101*: Sc;
IC 1613: Irregular; [2]

10. *Lenticular galaxy*:
 Any one from:
 a galaxy with a disc;
 very little stellar growth happening;
 looks like spiral galaxy without the arms;
Do not award the mark for just stating “it is intermediate between spiral and elliptical” – this is not descriptive enough.
- OB stars*:
 Any one from:
 main Sequence stars of the largest type;
 stars with a very short/the shortest (MS) lifetime;
 the hottest MS stars; [2]

11. $z = \frac{H_0 d}{c}$ therefore $d = \frac{zc}{H_0} = \frac{0.1 \times 3 \times 10^8 \times 10^6 \times 3.1 \times 10^{16}}{72 \times 10^3}$
 use of the correctly rearranged formula / evidence of the rule;
 correct conversion for H_0 ;
 $d = 1.29 \times 10^{25}$ (m); [3]

Cosmology

12. the Milky Way rotates;
stars rotate slower the further they are from the centre;
red-shift indicates they are moving away from us / blue-shift indicates they are moving towards us;
some stars are overtaking us / we are overtaking them / we are pulling away from some / they are moving away from us;
Stating "The MW shows differential rotation" score two marks. **[2 max]**

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. density < critical density;
ultimate fate of the universe is that it will expand forever / **OWTTE**; **[2]**
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