

Markscheme

Specimen paper

Astronomy

Standard level

Paper 1

This markscheme is **confidential** and for the exclusive use of examiners in this examination session.

It is the property of the International Baccalaureate and must not be reproduced or distributed to any other person without the authorization of the IB Global Centre, Cardiff.

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. *Chromosphere:*

Any two from for [1]:

- (part of the) atmosphere of the sun;
- layer outside/above the photosphere;
- (Sun's) atmosphere below the Corona;

Light year:

distance travelled by light in 1 year;

[2 max]

Note: No marks for stating a light year in "m", etc - this information is given on the Information Sheet.

2. *Correct period: 22 (years)*

Explanation:

- the abundance/amount of sunspots (on the photosphere) cycles over 11 years;
- but the magnetic poles also change/oscillate (between N and S) (producing the 22 year cycle);

[3]

[1 max] awarded for correct period, [2 max] for correct explanation.

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

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

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

[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

4. **[1]** for correct working;
 1400 MHz $1.4(3) \times 10^9$ (Hz) / 1.4(3) GHz; **[2 max]**

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.

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

[2]

Award [1] for continental drift as a long-term factor.
*Award [1] for asteroid impact **and** supernova event as short-term factors.*

Galaxies

7. *Redshift*: The shifting/moving of the wavelength of emitted light towards to the red of the spectrum;
HII region: Ionised nebula / region where star formation is happening / region ionised by nearby (OB type) stars; [2]

8. If the spiral arms were due to (a large amount of light output from) a fixed set of stars;
 then (with time), the spirals would be expected to wind up; [2]

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

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

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

11.		<i>Stay parallel</i>	<i>Diverge</i>	<i>Intersect</i>
	<i>Parallel lines:</i>			✓
		<i>Less than 180°</i>	<i>Equal to 180°</i>	<i>Greater than 180°</i>
	<i>Internal angles of a triangle:</i>			✓
		<i>Less than 2πr</i>	<i>Equal to 2πr</i>	<i>Greater than 2πr</i>
	<i>Circumference of a circle:</i>	✓		

[3]

12. $H_0 = 72 \text{ km s}^{-1} \text{ Mpc}^{-1} = 2.3 \times 10^{-18} \text{ s}^{-1}$

$$\text{Age} = \frac{1}{H_0} = \frac{1}{2.3 \times 10^{-18}} = 4.3 \times 10^{17} \text{ s} = 13.6 \text{ b years}$$

$$\text{Age} = \frac{1}{H_0};$$

Correct answer;

[2]

13. *Any two from:*
 Redshift data (for galaxies);
 The cosmic microwave background radiation;
 Spatial variations in the background radiation;
 Nuclear abundance;

[2 max]