Diploma Programme
Programme du diplôme
Programa del Diploma

Astronomy
Standard level
Paper 1

Friday 29 April 2022 (afternoon)

Candidate session number

45 minutes

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the **astronomy data booklet** is required for this examination paper.
- The maximum mark for this examination paper is **[30 marks].**

7 pages

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Answer **all** questions. Answers must be written within the answer boxes provided.

The Stars

1. (a) Identify the nuclear product released by the carbon-nitrogen-oxygen (CNO) cycle in stars. [1]

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(b) State the main difference between stars that use the proton-proton chain and stars that use the CNO cycle. [1]

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(c) The Sun contains elements that are much heavier than iron. Explain the process that led to the formation of those heavy atoms. [2]

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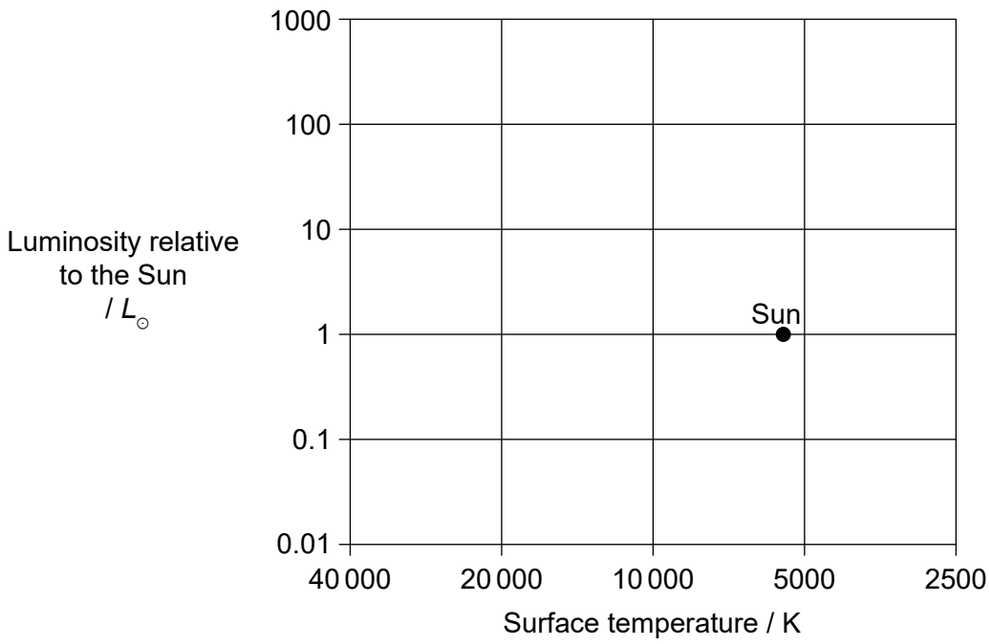
2. This Hertzsprung–Russell (HR) diagram shows the Sun's position.



(a) Hayashi tracks indicate the change in luminosity of T-Tauri stars. Sketch a Hayashi track that would lead to a star such as the Sun. [2]

(b) Describe the source of a protostar's luminosity while on a Hayashi track. [2]

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The Planets

3. Explain how the escape velocity of the Earth led to the Earth's atmosphere being high in nitrogen but low in hydrogen. [3]

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4. (a) Explain how the Earth became differentiated. [2]

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(b) Discuss how differentiation led to the Earth's magnetic field. [3]

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(c) Identify **one** benefit of the Earth's magnetic field to life on the Earth. [1]

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Galaxies

5. (a) A galaxy is classified as type E7.

(i) State the meaning of the E7 classification. [1]

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(ii) Identify **one** other characteristic of an E7 galaxy. [1]

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(b) Suggest **one** advantage of classifying galaxy types or spectral classes. [1]

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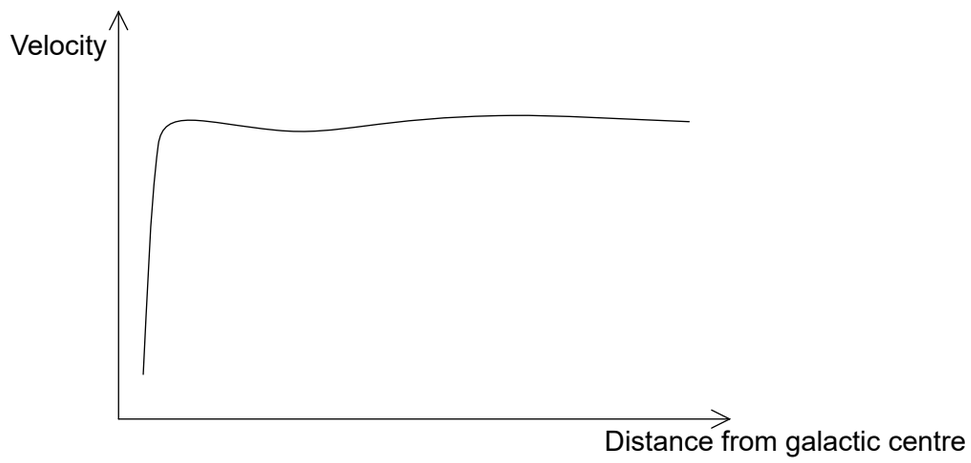
6. Evidence from the velocity of stars around the centre of spiral galaxies led to an unexpected rotation curve, shown on the graph.



(a) Draw the expected rotation curve on the same axes. [1]

(b) Explain why this curve was expected. [2]

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7. The observation of type Ia supernovae or of Cepheid stars can be used to measure the distance to other galaxies.

(a) Identify **one** advantage of using Cepheid stars rather than type Ia supernovae. [1]

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(b) Identify **one** advantage of using type Ia supernovae rather than Cepheid stars. [1]

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Cosmology

8. The inflation stage of the universe could only occur if the geometry of spacetime is flat.

(a) State **two** properties of a flat spacetime. [2]

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(b) Outline the future of a flat universe. [1]

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(c) Define inflation in this context. [1]

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(d) Name **one** property of the present universe that is fully explained by inflation. [1]

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Please **do not** write on this page.

Answers written on this page
will not be marked.