Diploma Programme
Programme du diplôme
Programa del Diploma

Astronomy
Standard level
Paper 1

Thursday 2 May 2019 (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]**.

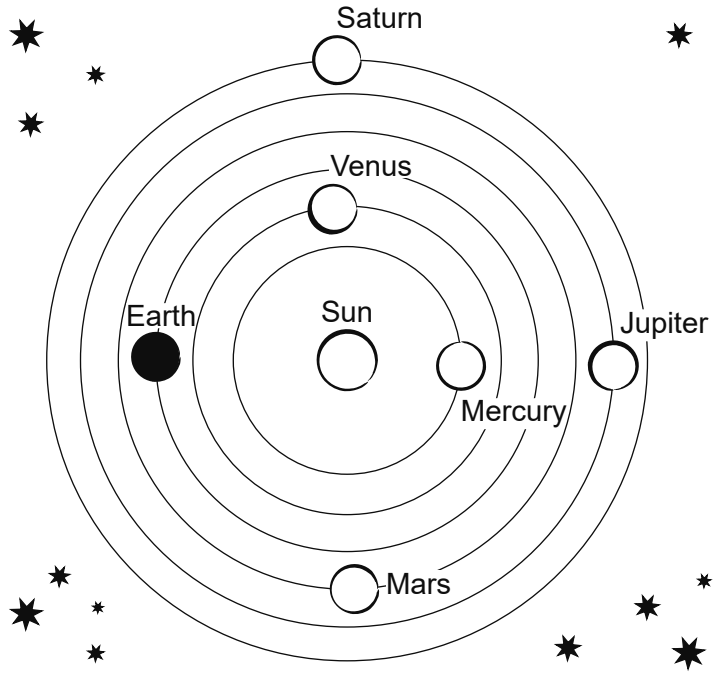
2219 – 9004

9 pages

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

The Stars

1. The diagram shows a simplified heliocentric universe.



(a) Identify **one** difference between this model and a geocentric universe. [1]

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(b) Derive Kepler's 3rd law from Newton's law of gravitation, assuming the orbits of the planets around the Sun are circular, so $F = \frac{mv^2}{r}$ applies. [2]

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(c) Identify **one** reason why Newton's law of gravitation was an improvement over Kepler's 3rd law. [1]

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2. The planets Jupiter and Saturn are clearly visible to the naked eye from Earth. Identify **three** factors that can explain why Saturn is never as bright as Jupiter in our night sky. [3]

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2: . . . . . .

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3: . . . . . .

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3. Outline the pressures in a white dwarf at the Chandrasekhar Limit. [2]

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Answers written on this page
will not be marked.

The Planets

4. Extrasolar planets were expected to follow the pattern of our Solar System, with gaseous planets found at a greater distance from a star than rocky planets.

Explain the suggested processes that would form rocky planets closer to a protostar than gaseous planets. [3]

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5. A rotating disc-shaped nebula has been proposed as a step in the formation of our solar system.

Identify **two** characteristics of our present solar system that are consistent with the shape and motion of such a nebula. [2]

Characteristic 1: . . . . . .

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Characteristic 2: . . . . . .

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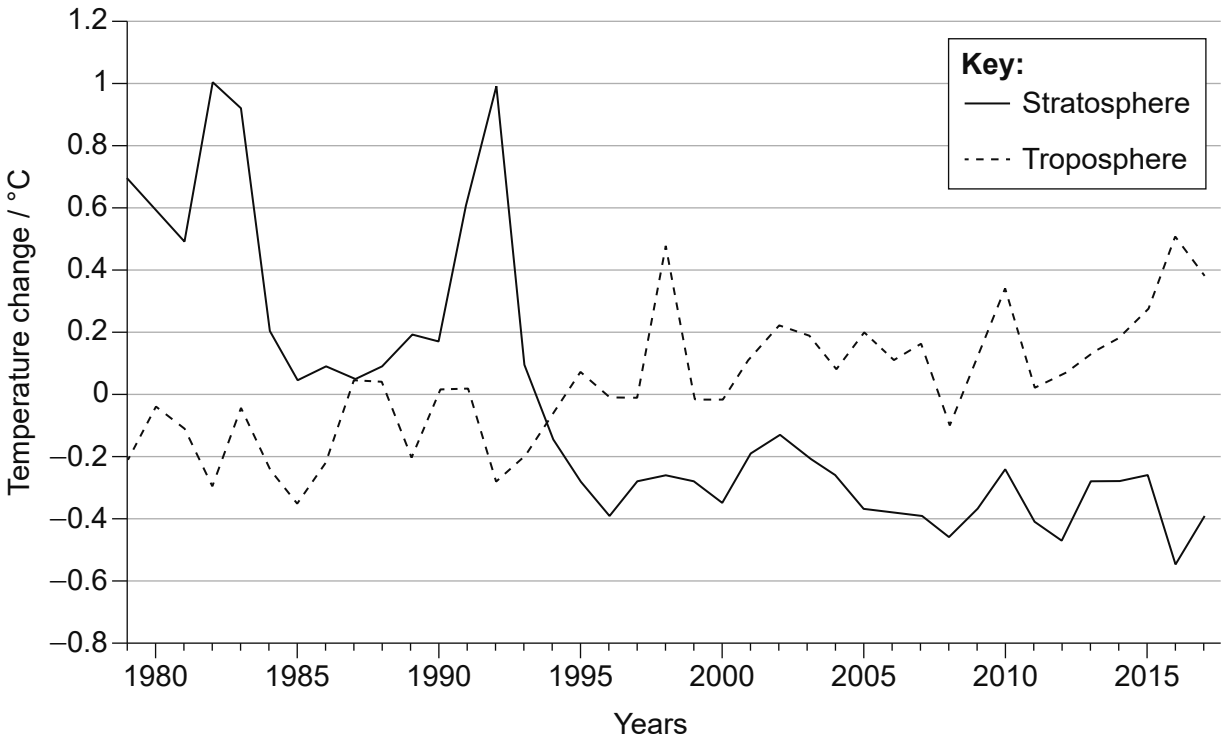
6. Since 1978 polar orbiting satellites have been measuring the temperature in layers of the atmosphere. The graph presents data for the troposphere and the stratosphere.



[Source: adapted from NOAA (National Oceanic and Atmospheric Administration), UAH (The University of Alabama Huntsville)]

(a) It has been suggested that any increased warming on Earth is due to variation in the output of the Sun, not increased greenhouse gases. This hypothesis predicts higher temperatures in all layers of the atmosphere.

Evaluate this hypothesis using only the data in the graph. [1]

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(This question continues on the following page)

(Question 6 continued)

(b) Explain why increased greenhouse gases in the troposphere could cause the observed trends. [3]

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Galaxies

7. Describe **two** characteristics of type Ia supernovae that allow their use when determining the distance to very distant galaxies. [2]

Characteristic 1: . . . . . .

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Characteristic 2: . . . . . .

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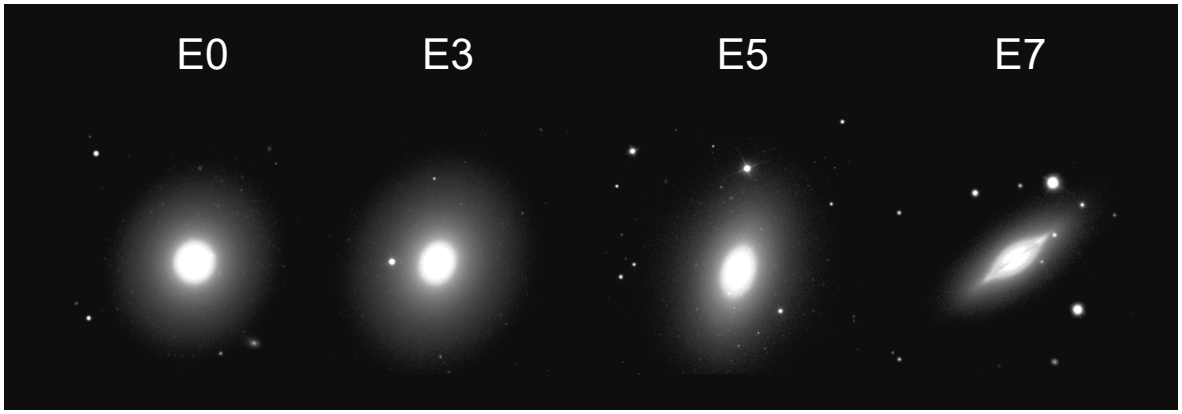
8. The diagram shows part of the Hubble classification for naming galaxies.



[Source: adapted from http://col21-perceret.ac-dijon.fr]

(a) Outline how the E subdivisions such as 0, 3, 5 and 7 are determined for elliptical galaxies. [2]

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(b) Compare and contrast a galaxy designated Sb with an elliptical galaxy designated E3. [3]

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Cosmology

9. Olbers' paradox predicted a bright sky at night.

(a) Explain the reasoning that led to Olbers' prediction of a bright night sky. [3]

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(b) Outline how our modern understanding of the universe solves Olbers' paradox. [2]

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