Answer THREE questions from Section A and THREE questions from Section B.

You are advised to spend no more than 10 minutes on each Section A answer, and about 30 minutes on each Section B answer.

The numbers in square brackets indicate the provisional allocation of maximum marks for sub-sections of the question.

SECTION A

1. Explain what is meant by the *parallax* of a star and define the *parsec*. [3]

Observationally, how can the value of the parsec in km be found? [4]

2. Discuss the origins of the system of apparent visual magnitude and its principal properties. [4]

Explain how the old visual system has been extended into UBV photometry. [3]

3. Explain how the observed strength of the absorption in a spectral line can vary with the temperature of a stellar atmosphere. [7]

4. Describe the features indicated by the phrase "crustal dichotomy of Mars." [4]

Describe briefly the most recent evidence (2001-2002) for large amounts of water ice in the soil layers near the surface of Mars. [3]

5. What are lunar maria and where are they located? [2]

How are the maria thought to have been formed? [2]

What two types of evidence are used to determine the relative and absolute ages of maria? What range of ages is found for the maria? [3]

6. Write brief notes on the main properties of comets, addressing both their orbital and physical characteristics. Use clearly labelled diagrams where appropriate. [7]

SECTION B.

7. List the different regions of the electromagnetic spectrum, in terms of the wavelength. [5]

Briefly describe the different types of observations of astronomical objects that can be made in different regions of the spectrum. [7]

Discuss the transmission of radiation through the Earth's atmosphere, stating what processes prevent its transmission in different wavelength regions. [8]

8. Outline the basis ideas of Bohr's theory of the hydrogen atom and how it leads to the emission and absorption of radiation in spectral lines. [8]

Discuss the hydrogen lines that are found in different regions of the spectrum. [8]

Provide examples of astronomical objects where the optical hydrogen lines (Balmer series lines) are seen in (a) absorption and (b) emission. [4]

9. Give an account of the structure of our Galaxy, indicating how the various regions can be observed. [10]

Describe how galaxies can be classified into different types and discuss the differences in their properties. [10]

10. Write short essays (including diagrams if appropriate) on any TWO (and only two) of the following three topics:

(a) The internal structure of the giant planets Jupiter and Saturn. [10]

(b) The Kuiper Belt. [10]

(c) A comparison of the composition of the atmosphere of Venus with that of the Earth, including an account of the probable history of both. Why are they so different today? [10]

11. State Kepler's three laws of planetary motion. [9]

Draw a diagram of the (exaggerated) elliptical orbit of a planet, and label the various parts (e.g., Sun, perihelion, semi-major axis, etc). [3]

State Newton's more general form of Kepler's Third law, using units of astronomical units for distance, years for time, and solar masses for mass. [2]

Callisto is 1,883,000 km from Jupiter and takes 16.689 days to complete one orbit. Use this information to calculate Jupiter's mass *in solar mass units*. [6]

[You may assume 1 AU = 149,600,000 km and 1 year = 365.25 days.]

12. Consider the two outermost giant planets Uranus and Neptune and answer the following questions about them.

What is the main composition of the atmospheres of both planets, and what gives them a strongly bluish tint when viewed visually with a large telescope? [2]

What is so unusual about the axis of rotation of Uranus? [2]

How were the rings of Uranus discovered? [2]

The average densities of Uranus and Neptune are 1318 and 1638 kg/m^{-3}, respectively. What do these results suggest regarding the bulk properties and compositions of the two planets? [4]

The average distance of Uranus from the Sun is about 19 AU and that of Neptune is about 30 AU. Measurements show that both planets have an average cloudtop temperature of 55 K. Their albedos are nearly the same, so how would you account for this difference? [4]

Describe the satellite system of Neptune, paying particular attention to the properties and orbital dynamics of Triton and Nereid. What hypothesis has been proposed to account for them? [6]