The Open University

Science Supplementary Material
S281 Astronomy and Planetary Science

Course and assignment number:

Tutor Marked Assignment

S281 03

Make sure you know how to complete and send in your TMA and PT3 form: detailed instructions are given in your student handbook (or supplement).

Covering: **Block 2, Chapters 3–8**

Cut-off date:

Friday 29 July 1994

This assignment consists of four questions.

Question 1

This question relates to Block 2, Chapters 3 and 5, and carries 27% of the marks for this assignment.

Consider two similar hypothetical planets orbiting the Sun at similar distances from it. They have similar, approximately chondritic, compositions and bulk densities characteristic of the terrestrial planets. One is roughly the size of the Earth and the other has a diameter half that of the Earth. You are asked to consider the thermal evolution and volcanic history of the two planets, noting similarities and differences.

(a) (*9 marks*) In no more than *about 150 words* describe the potential sources of heat for the two planets and explain why the initial thermal energy of the larger planet would be greater.

(b) (*10 marks*) In no more than *about 150 words* overall,

- state how the planets lose heat to space, and explain why the smaller planet loses heat (per unit volume) more rapidly than the larger planet
- outline, for each planet, how heat reaches the surface from the interior
- subsequent to planetary formation, describe the changes with time of the rate of heat production, the rate of heat flow to the surface, and the degree of volcanism; state why volcanism might be extinct on the smaller planet.

(c) (*8 marks*) In no more than *about 150 words* summarize the similarities and differences between the two planets with respect to composition of lava, the ease with which magma reaches the planetary surface, and the length and thickness of lava flow.

Question 2

This question relates to Block 2, Chapter 6, and carries 25% of the marks for this assignment.

(a) (*15 marks*) The average lifetimes of a molecule of CO_2 in the Earth's atmosphere and in Mars's atmosphere are about three years. Describe the likely fates that would befall a molecule of CO_2 that lead to its removal from (i) the Earth's atmosphere and (ii) Mars's atmosphere. Include any relevant chemical equations in your answer.

(b) (*10 marks*) (i) The atmosphere of Venus contains vastly more CO_2 than the atmosphere of Earth. Discuss the reasons for this difference. (ii) Explain why the lifetime of a CO_2 molecule in the lower troposphere of Venus is much longer than on Earth. (You are not expected to cite evidence for the scenario that you describe in (i) and in (ii).)

Question 3

This question relates to Block 2, Chapters 6 and 7, and carries 22% of the marks for this assignment.

Reproduced on p. 7 is an extract from *New Scientist* about a possible substantial atmosphere on Triton in the past. Read this article and then answer the following questions.

Make clear in your answer which information you are quoting comes from the article, and which from S281. If you have used information from other OU sources or outside the Course, give references to your source. (Such reading is not necessary to answer the question.)

(a) (*2 marks*) What evidence on the surface of Triton supports the idea of a substantial atmosphere in the past? (*1 or 2 sentences*)

(b) (*7 marks*) List the main constituents and the trace constituents of the proposed atmosphere. Write *about 100 words* comparing the composition of this atmosphere with that of Neptune, Titan and the Earth and commenting on your comparison.

(c) (*6 marks*) From the discussion of planetary atmospheres in Book 2, Chapters 6 and 7, put forward one suggestion as to why N_2 is the form of nitrogen found in the proposed atmosphere of Triton. Use information in the article to discuss the feasibility of your suggestion. (*3 or 4 sentences*)

(d) (*7 marks*) The article proposes that Triton's atmosphere was subject to the greenhouse effect. It is stated that the most important greenhouse gas was hydrogen, H_2. In *about 100 words*, describe the greenhouse effect, and discuss whether you would expect H_2 to be important in producing this effect.