

Tutor Marked Assignment

Course and assignment number:

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, mainly**

Chapters 4-8

Cut-off date:

Friday 18 July 1997

In all calculations

- show details of your working;
- include units with all physical quantities;
- work to an appropriate number of significant figures.

Question 1

This question relates to Book 2, mainly Chapters 4-6, and carries 12% of the marks available for this assignment.

In July 1996, scientists at the Johnson Spaceflight Center published a paper suggesting that they had found persuasive evidence for the existence of life on Mars at some point in its history. Their evidence was based on detailed studies of a meteorite from Mars discovered in Antarctica in 1984. They found some complex organic compounds in the meteorite, and some curious structures reminiscent of bacteria. It appears that the meteorite had lain on the Antarctic ice for some 13 000 years, having been blasted off the Martian surface by an impact about 16 million years ago. The age of the rock is about 4.5 billion years. The age of the bacterial structures in the rock is poorly determined, but lies roughly between 3.6 and 1.4 billion years. At the present day, there is no evidence for the existence of life on Mars, and it is generally agreed that a requirement for life to have existed in earlier times is that temperatures should have been high enough to permit the existence of liquid water on or beneath the martian surface.

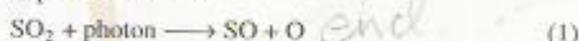
(a) (5 marks) What can you infer from Mars's cratering record about what sort of region on Mars the meteorite probably came from? (About 50 words at most)

(b) (7 marks) Assuming that the meteorite evidence does indeed indicate the existence of life, and that this would have required liquid water, outline the evidence that liquid water was present very early in martian history and not subsequently, thus favouring an age greater than 1.4 billion years for the bacterial structures. Evidence is provided in each of the Chapters 4-6 and in *Images of the Cosmos*. (About 100 words at most)

Question 2

This question relates to Block 2, Chapter 6, and carries 14% of the marks for this assignment.

The following reactions represent a scheme that has been suggested for the production of H₂SO₄ in the atmosphere of Venus.



(a) (4 marks) Which of the reactions 1-5 require a third body, M? Explain why M is needed. (About 50 words at most) **4**

(b) (6 marks) Which of the reactions 1-4 are necessarily exothermic and which necessarily endothermic? Justify your choices. (About 50 words at most)

(c) (4 marks) In one sentence, state what is meant by 'oxidation'. In which one or more of reactions 1-4 is sulphur oxidized? In which reaction(s) is sulphur reduced? **oxy-3,4,5 red-5**

N.B. In parts (b) and (c), note that reaction 5 is excluded from your consideration.

Question 3

This question relates to Book 2, Chapters 6 and 7, and carries 25% of the marks available for this assignment.

The space mission *Galileo* released a probe into the atmosphere of Jupiter. Amongst other instruments on board was a mass spectrometer. This measured the relative abundances of molecules in the atmosphere as it descended. Measurements were obtained from just above the ammonia cloud layer to a depth corresponding to just below the base of the H₂O cloud layer indicated in Figure 7.9 on p. 183 of Book 2. Table 1 gives the relative abundances of molecules in Jupiter's atmosphere (at the greatest depth of measurement) compared with solar abundances. The solar abundance of H₂ corresponds to the value as if all the hydrogen were in H₂. Otherwise, the solar abundances are calculated on the basis of elemental abundances. For example, the entry for CH₄ under solar abundance refers to the relative abundance of C. (Unlike Table 6.8 on p. 155 of Book 2, the solar abundance of H₂O is based on the abundance of O.)