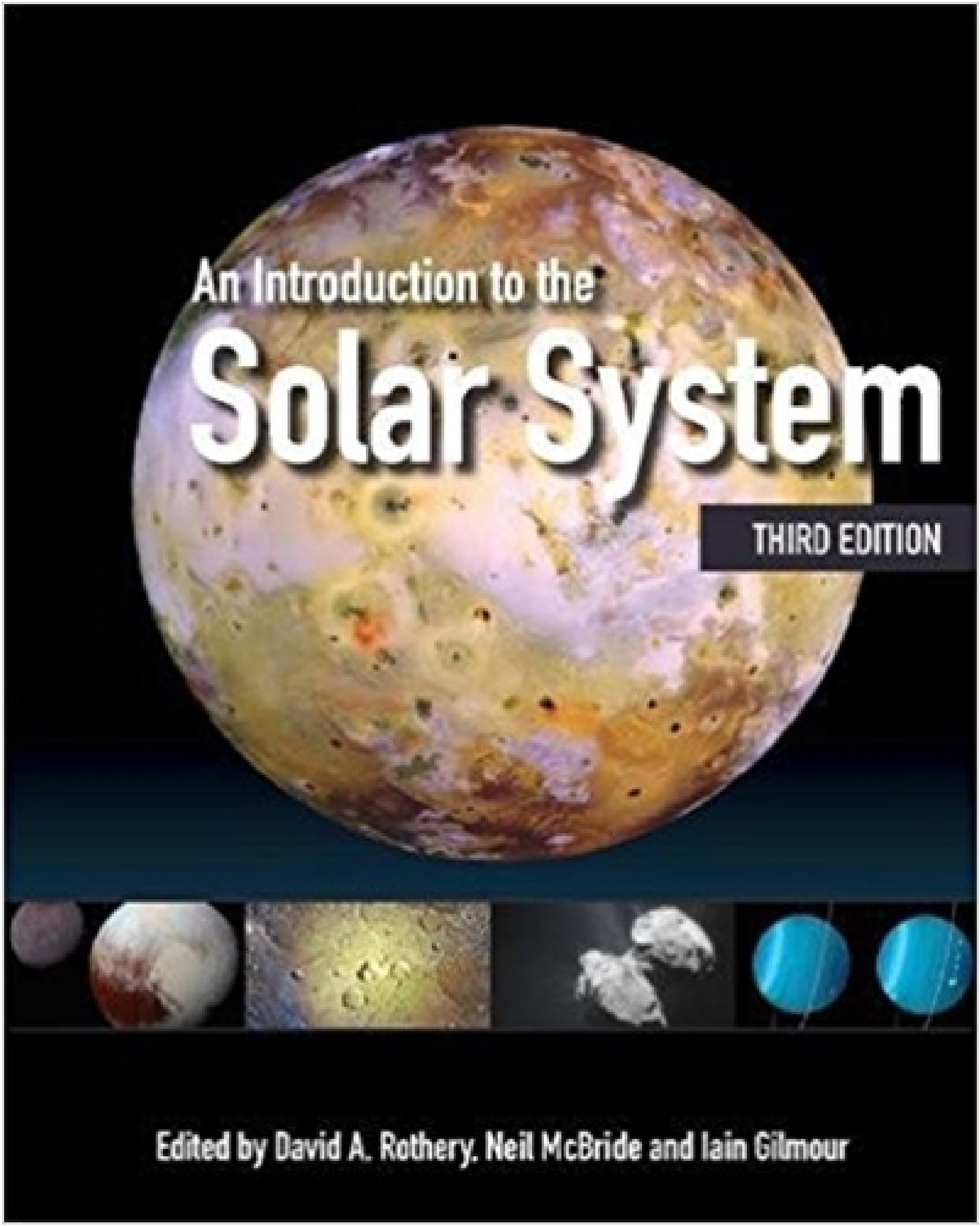
Solutions for Introduction to the Solar System 3rd Edition by Rothery

CLICK HERE TO ACCESS COMPLETE Solutions



Solutions

Self-assessment questions for *An Introduction to the Solar System*

Question 1

This question about the conditions on the surface of Venus, relates mainly to Chapters 1–3.
A major space agency is planning a mission to Venus code-named 'LN-Hi-water', which will involve a robotic lander imaging the landing site, and also determining the pressure, temperature and meteorological conditions at the planet's surface.

(a) Outline the basic design requirements that will enable the lander's sensitive instruments to survive long enough to send data back to the orbiting spacecraft. (*4 or 5 sentences*)

(b) Describe the types of surface features and conditions that the lander's cameras are likely to observe. (*8–10 sentences*)

Question 2

This question is about the internal heating and volcanism of terrestrial-like planetary bodies and relates mostly to Chapters 2 and 3.

(a) Both the Earth and Io are volcanically active terrestrial-like bodies with broadly similar bulk (i.e. chondritic) compositions. In each case, identify the most common (i.e. volumetrically significant) lava products currently erupted on these two bodies. (*2 or 3 sentences*)

(b) Describe what is meant by the term 'primordial heat', and briefly outline its causes in terms of energy conversion processes. (*4 or 5 sentences*)

(c) Tidal and radiogenic heating are together responsible for the long-term internal heating of terrestrial-like bodies (e.g., Table 1). Briefly describe these processes, and outline how they might vary during the lifetime of such a body. (*5 or 6 sentences*)

(d) Complete Table 1 by entering the appropriate rates of current global heating for each process on Io and Earth, and from these data indicate the relative importance of the main sources of ongoing internal heating that contribute to this volcanism. (Note: you will need to calculate the rate of heat production in watts (W) generated by tidal and radiogenic heating within the Earth using the data in Chapter 2 and Appendix A. Show your working where appropriate, and express your answer to 1 significant figure.)

Table 1 Current global heat production in Io and the Earth.

Body	Tidal heat production/W	Radiogenic heat production/W
Io		
Earth		

Self-assessment questions for *An Introduction to the Solar System*

Question 1

For detail to the following answers refer to Sections 1.1.2, 2.5.4, 3.3.3 and 3.4.4 and Appendix A (p.389)

(a) Any lander design will have to contend with ensuring the safe delivery of the instrument package to the surface; this would require slowing/braking of the package's descent through the atmosphere.
The composition of the upper atmosphere is highly corrosive and passage through the clouds of Venus's atmosphere would allow exposure to these, so the lander package would need to be resistant to droplets of sulfuric acid.
Instruments would also require protection from impact with an uneven and rocky surface.
Once delivered, the package would need to withstand the high pressures (c. 92.1 bar, OR more than 90 times the pressure experienced on Earth;
The instrumentation would also need to withstand the high temperatures c. 733 K or 460 °C that characterize the conditions on the surface of Venus.

(b) *A good answer would include most of the following*
There would be an absence of any water (surface conditions are too hot), so the surface would be rock.
Since there is no water, there would be no life.
The surface is too hot for aqueous chemistry, so aqueous corrosion is unlikely (i.e. 'rusting').
However, the action of components in the atmosphere has are likely to have given rise to some degree of weathering/alteration, whilst wind action will have caused some erosion.
Therefore, some sediment or regolith may be discernable as well as rock fragments, for instance, as seen on Venera lander images (e.g Figure 1.7).
The surface of Venus is characterized by numerous major, and innumerable small volcanoes, so it is possible that part of one or more of these would be in view. The surface is also predominantly covered by extensive lava flows, and there may be a covering of pyroclastic material.
The relatively young surface (500 Ma) means there are likely to be fewer impact craters (than compared with the Moon or Mercury), whilst a thick atmosphere would have prevented smaller meteorites reaching the surface so there are likely to be few small impact craters.
However, depending on the landing site, a larger impact basin may be present.
Due to the thick atmosphere, the Sun may not be visible, and the surface would be illuminated with a diffused light.