

Planetary Geology

Answer 3 questions. You have 2½ hours. Please begin each question on a new sheet of paper.

The numbers in square brackets in the right-hand margin indicate the provisional allocation of maximum marks per sub-section of a question.

Question 1

This question relates to the photograph of the Palus Epidemiarum area of the Moon, attached at the end of this paper

[a] Estimate the size of the crater identified as 'X' (at approximate location I5). Describe any features which helped you make this choice. [3 marks]

[b] Describe (with a suitable diagram where necessary) the formation and structure of 2 of the following:

- (i) Wrinkle ridges
- (ii) Sinuous Rilles
- (iii) Graben

For both of the features you have chosen, you should give an approximate location on the map for the feature. [6 marks]

[c] Why is it particularly useful to compare crater forms on the Moon and Mercury? [3 marks]
What does this comparison tell us about the impact cratering process?

[d] The forms of craters on Mercury, Venus, Mars, and the Moon differ considerably. With the aid of diagrams, describe the differences between the impact craters observed on each of these bodies. Include an explanation for each of the differences discussed. [8 marks]

Question 2

- [a] Describe the 3 main stages of crater formation on the Moon [6 marks]
- [b] What is meant by a 'hypervelocity impact' ? [1 mark]
- [c] *Sketch* the relationship between depth and diameter for fresh lunar craters. [1 mark]
- [d] Illustrating your answer, describe the morphology of the Orientale impact basin. How does the Orientale basin differ from most impact basins on the Moon ? [7 marks]
- [e] What are KREEP rocks ? How does their distribution vary between the Imbrium and the Orientale impact basins ? What does this tell us about the lunar crust in these two areas ? [5 marks]

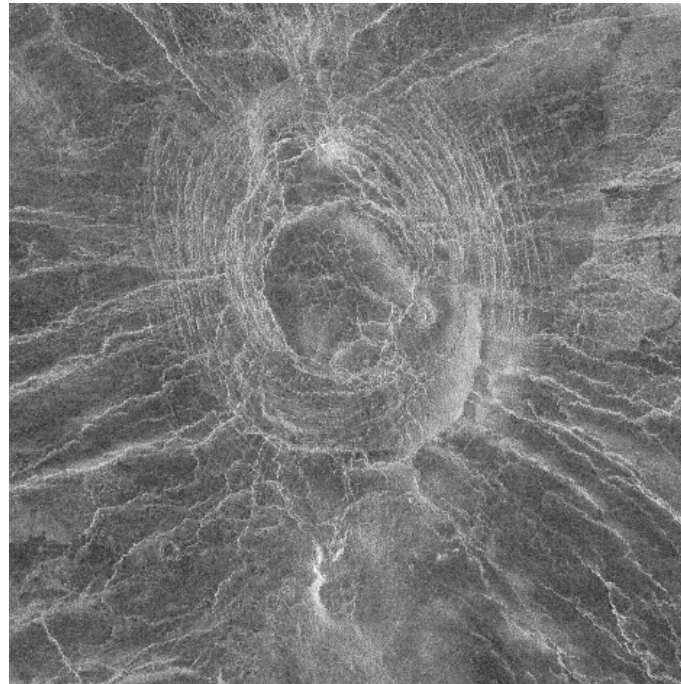
Question 3

- [a] What is meant by relative and absolute dating ? Give an example for each method [2 marks]
- [b] Describe the techniques of Gamma ray spectrometry and X-ray Fluorescence. [8 marks]
On what planet would X-ray fluorescence be particularly suitable ?
- [c] Describe how Neutron Spectrometry was used on the Lunar Prospector mission to infer the presence of water. Why can we only infer that water is present ? [7 marks]
- [d] Apart from spectroscopic techniques, what methods can be used to determine information about the Moon's INTERIOR composition and structure. Indicate on which space missions these techniques have been used. [3 marks]

Question 4

[a] Venus differs from the Earth significantly. In particular, it has a very dense atmosphere. Therefore radar imaging is used in place of photography in order for geologists to learn about the planets surface. Figure 1 contains a radar image of the surface of Venus.

Figure 1.



In this image, what do the radar bright zones indicate ? [2 marks]

Name the type of feature depicted in this image and describe how it probably formed [3 marks]

Describe, with the aid of a sketch, the geological features that are observable in **this example**. Also indicate the likely cross-sectional profile of the feature. [5 marks]

[b] Explain the difference between meteorite falls and meteorite finds. Discuss the compositional differences seen between the two and the implications that this has for the true population of meteorite classes close to the Earth. [2 marks]

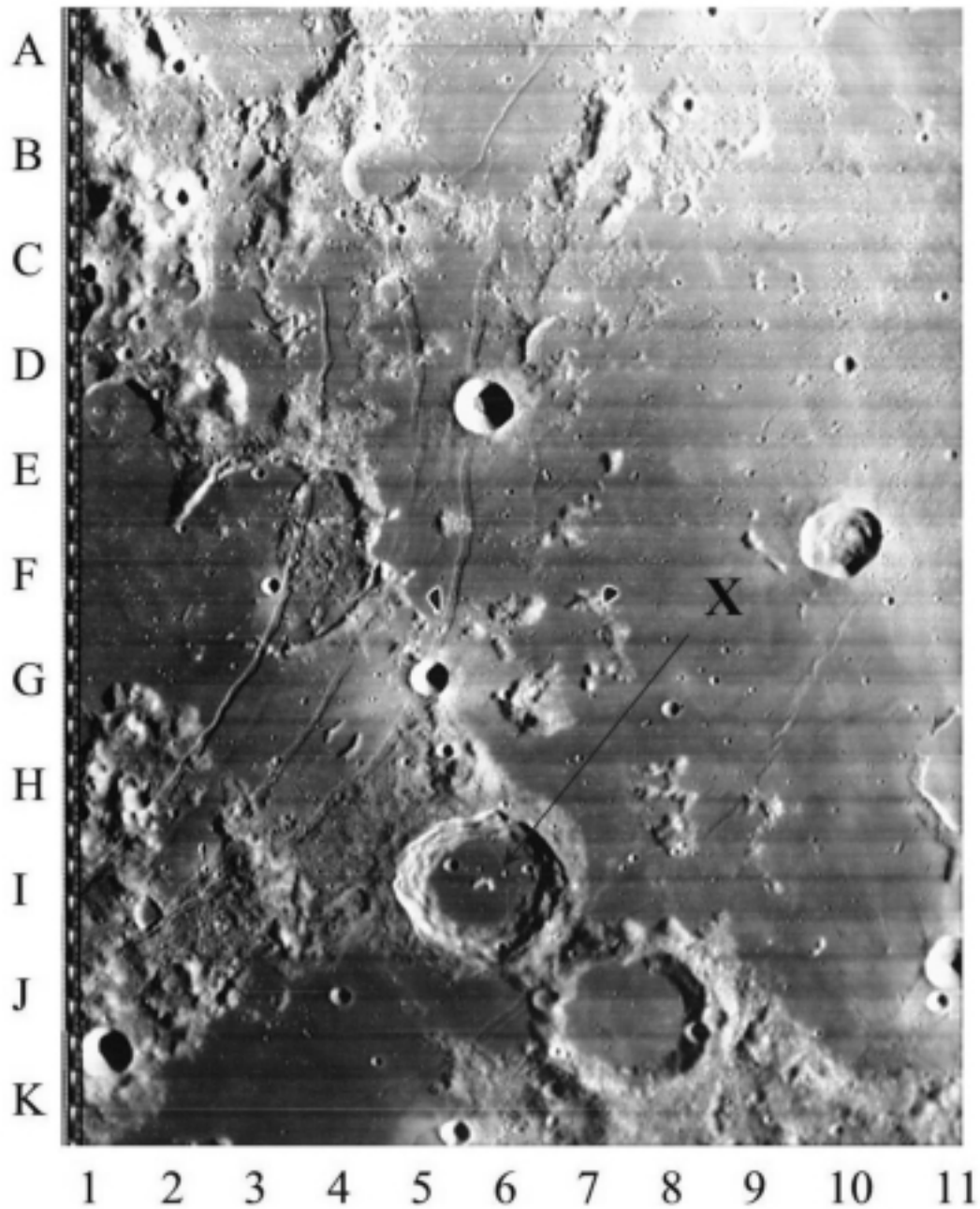
Give a short description of the three major classes of meteorite: the irons, stony-irons and stones. Compare their densities and compositions. [8 marks]

Question 5

- [a] Geological features on solar system bodies are seldom observed in pristine condition. Subsequent impacts, wind erosion, water erosion and lava flows all alter the forms of impact craters and volcanic features. On Mars, wind erosion is particularly efficient, why? [2 marks]
- [b] Describe how the wind contributes to the erosion of the surface features of Mars. Name the three different wind erosion processes that occur on the Martian surface. [6 marks]
- [c] Name and describe in detail two of the various features on Mars which indicate that water may once have existed on its surface. Use diagrams to show their morphology [6 marks]
- [d] Water, at least in ice form, still exists in the outer regions of the Solar System, in particular on the Galilean satellites. Describe, with the aid of diagrams, the role water ice and perhaps liquid water take in the evolution of the interiors of the satellites of the outer planets, starting from an undifferentiated body. Include discussions of the gravitational stability of the satellites at various stages, and how varying the radius of the satellite affects its evolution. [6 marks]

End of Paper

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Photograph for Question 1

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