

Q5 The surface area of Venus is similar to that of the Earth, around $5.1 \times 10^8 \text{ km}^2$, and has shared a generally similar flux of impacting bodies. Recent studies by the Magellan spacecraft indicate that the average age of Venus's surface may be only 500 million years. Using the information in Figure 4.21, how many craters $>4 \text{ km}$ in diameter would you expect to find on Venus's surface? Ignore any effects of atmospheric shielding.

KEY for Q5

- | | |
|----------|-----------|
| A 586 | E 37 000 |
| B 3 700 | F 150 000 |
| C 10 000 | G 93 000 |
| D 25 000 | |

Pencil across one cell in row 5.

Q6 An explosive volcanic eruption propels a pumice fragment 5 cm in diameter to an altitude of 40 km in Mars's atmosphere while a south-easterly wind of 10 m s^{-1} is blowing. Over this altitude range the effective density of the atmosphere is roughly one-tenth of that at ground level. The fragment has a density of $1.5 \times 10^3 \text{ kg m}^{-3}$. How far from the volcano will the fragment fall, to a first approximation? Assume that the surrounding land is flat. Choose from the key the answer nearest to yours.

KEY for Q6

- | | |
|----------|-----------|
| A 0.3 km | E 7.7 km |
| B 1.0 km | F 14.6 km |
| C 3.0 km | G 39.2 km |
| D 5.8 km | |

Pencil across one cell in row 6.

Q7 A satellite of Jupiter (yet to be discovered!) has a radius of 1900 km and orbits 380 000 km from the planet. Perturbations of the trajectory of a visiting spacecraft suggest that it has a mass of $3 \times 10^{23} \text{ kg}$. What sort of surface features would you expect to see on the satellite? Choose the most appropriate answer from the key.

KEY for Q7

- A An icy surface, almost devoid of impact craters, like Europa.
- B An icy surface, thickly sprinkled with impact craters, like Callisto.
- C A surface like the Moon's, with impact craters and basalt lavas.
- D A surface mostly covered by young basalt lavas, like the Earth's.
- E An uncratered surface covered by sulphur flows, possibly like Io.
- F An uncratered surface covered by a mixture of sulphur and silicate flows, possibly like Io.
- G It seems to be in a class of its own and its surface features may not resemble any of the above.

Pencil across one cell in row 7.

PART B

This part covers mainly Chapters 6 and 7 of Book 2, and carries 40% of the marks for this assignment.

Q8 When Comet Shoemaker-Levy 9 hit Jupiter, spectrometers detected several molecules that may be constituents of Jupiter's atmosphere. Which one of the following molecules could *not* have been detected using its infrared spectrum?

KEY for Q8

- | | |
|--------------------------|-----------------|
| A NH_3 | D CO |
| B C_2H_2 | E S_2 |
| C C_2H_6 | F CS_2 |

Pencil across one cell in row 8.

Q9 A piece of atmosphere near the surface of Mars travels from the equator to 30° N . What speed relative to the surface would it gain due to the Coriolis effect? The surface speed of Mars at the equator is 240 m s^{-1} .

KEY for Q9

- | | |
|--------------------------|---------------------------|
| A 207 m s^{-1} | E 0.86 m s^{-1} |
| B 134 m s^{-1} | F 120 m s^{-1} |
| C 69 m s^{-1} | G 277 m s^{-1} |
| D 37 m s^{-1} | |

Pencil across one cell in row 9.

Q10 Which one of the reactions in the key for Q10 and Q11 requires a third body, M, in order to proceed from left to right?

KEY for Q10 and Q11

- A $\text{SO}_3 + \text{NO} = \text{SO}_2 + \text{NO}_2$
- B $\text{H}_2\text{S} + \text{H} = \text{HS} + \text{H}_2$
- C $\text{HS} + \text{HS} = \text{H}_2\text{S} + \text{S}$
- D $\text{SO}_3 = \text{SO}_2 + \text{O}$ ✓
- E $\text{HS} + \text{HS} = \text{H}_2 + \text{S}_2$
- F $\text{CO} + \text{S} = \text{COS}$ ✓
- G $\text{CO} + \text{S}_2 = \text{COS} + \text{S}$

Pencil across one cell in row 10.

Q11 Choose from the key for Q10 and Q11 one reaction that must be endothermic, going from left to right.

Pencil across one cell in row 11.