Q4 The Moon's mass is 7.35×10^{22} kg; its surface area is 3.8×10^{13} m^2, and its observed surface heat flow today is about 20 mW m^{-2}. What percentage of the Moon's heat flow could be attributed to radioactive decay if it is assumed (for simplicity) that the Moon contains the same type of heat-producing isotopes as the Earth, and that the present rate of heat production from each isotope is the same per kilogram of Moon as it is per kilogram of Earth? (You will need to refer to Table 3.2 on p. 60 of Book 2.) Pencil across *one* cell in row 4.

KEY for Q4

A 0.30%
B 10%
C 35%
D 50%
E 75%
F 150%
G 200%

Q5 Since the main text of Book 2 was finalized, many more outstanding Magellan radar images have been obtained of impact structures on Venus. One of them, named Meitner after a distinguished woman physicist, is about 150 km in diameter. What sort of structure would you expect it to be? Pencil across *one* cell in row 5.

KEY for Q5

A A simple pit crater.
B A deep, bowl-shaped crater.
C A rampart crater.
D A crater with central peak and rim terraces.
E A crater with a central peak cluster, or fragmentary peak ring.
F A peak-ring basin.
G A multi-ring basin.

Q6 Which *one* of the statements in the key is *true*? Pencil across *one* cell in row 6.

KEY for Q6

A Basalt lavas are found on all the solid bodies in the Solar System.
B Volcanism on Mars probably ceased more than 1 billion years ago.
C The atmospheric density and surface gravity of Mars combine to ensure that pyroclastic particles have a lower terminal fall speed there than on Earth.
D A peak in the centre of a lunar crater is invariably a sign of volcanic origin of the crater.
E Lavas that are otherwise equivalent, and are at the same temperature on a similar slope, would be thicker on Venus than on Earth.

Q7 What characterizes volcanism on Io? Select *two* options from the key: pencil across *two* cells in row 7.

KEY for Q7

A The volcanism is driven largely by heat from the decay of ^{40}K.
B The volcanism is driven largely by tidal heating.
C There is negligible pyroclastic activity.
D The lavas are composed primarily of sulphur.
E Convective eruption columns form very readily.
F The dominant volatile in the lavas is probably water.
G The dominant volatile in the lavas is probably sulphur dioxide.

PART B

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

Q8 Between which of the following pairs of molecules would it be relatively easy to distinguish using gas chromatography–mass spectrometry on a spacecraft. Assume that these molecules are composed of the most abundant isotopes ^{1}H, ^{12}C, ^{14}N, ^{16}O, and ^{32}S. Pencil across *two* cells in row 8.

KEY for Q8

A NH_3 and OH
B CO_2 and C_3H_8
C O_2 and O_3
D S_2 and O_2
E H_2 and H_2^+
F NO and C_2H_6

Q9 It has been predicted that water would form clouds in Saturn's atmosphere at 250 K. What would be the partial pressure of water vapour in equilibrium with the surounding atmosphere if this were so, and would the clouds be formed from liquid water droplets or ice crystals? (Note that saturation vapour pressure diagrams apply on *any* planet.) Pencil across *one* cell in row 9.

KEY for Q9

A 10^{-2} bar; water droplets
B 10^{-3} bar; water droplets
C 10^{-4} bar; water droplets
D 10^{-6} bar; water droplets
E 10^{-2} bar; ice crystals
F 10^{-3} bar; ice crystals
G 10^{-4} bar; ice crystals
H 10^{-6} bar; ice crystals

Q10 Select from the key the reaction that requires a third body, M, i.e. another atom or molecule, to be involved simultaneously in the collision. Pencil across *one* cell in row 10.

KEY for Q10

A $N_2O + O \longrightarrow 2NO$
B $NO + O \longrightarrow NO_2$
C $NO_2 + O_3 \longrightarrow NO_3 + O_2$
D $N + H_2 \longrightarrow NH + H$
E $NO_2 \longrightarrow NO + O$

Q11 Select from the key two properties that a molecule *must* possess in order to be able to contribute significantly to the greenhouse effect. Pencil across *two* cells in row 11.

KEY for Q11

A More than two atoms.
B A strong absorption in the ultraviolet.
C A strong absorption in the infrared.
D For triatomic molecules, two or more different types of atom.
E No strong absorption in the infrared.
F No strong absorption in the visible.