Diploma in Astronomy—First Term 2004-5

Solar System: Problem Paper 3.

23rd November 2004

Solutions should be returned by Tuesday 7 December. After that date they can be accepted, but once model solutions are posted, they cannot receive credit for marks (but can count towards completion of the course). The weighting for each question is given in ().

1. Imagine you were an engineer in charge of landing an astronaut on Venus, who would have to be able to descend through the atmosphere and then move around on the surface taking samples of rocks, atmosphere, etc., and that survival for 24 hours was required, followed by ascent back to a spacecraft. List, in a little essay or paragraph, the specific hazardous conditions that exist in the atmosphere or on the surface, and outline what means the environment suit might use to provide protection against them. [200-300 words] (10)

2. The Galilean Moons are said by experts to have a "Laplace resonance" in their periods, close to but not exactly the simple ratio of 1:2:4 for Io (satellite 1), Europa (2) and Ganymede (3) as given in the text.

(a) This part is about using the right number of significant figures in a calculation. If the mean motion n is defined as $n = 360°/\text{Period(days)}$ and $P_1 = 1.769138\,\text{d}$, $P_2 = 3.551181\,\text{d}$, and $P_3 = 7.154553\,\text{d}$, verify to an appropriately correct number of significant figures that the Laplace resonance

$$n_1 - 3n_2 + 2n_3 = 0$$

is indeed precise. (6)

(Show your working, don't just say, "It is verified," without demonstrating it.)

(b) By what percentage is the 1:2:4 approximate resonance not accurate? For this part, look at the worst case of the three in which the true ratio is not equal to the approximate one. (4)

Total marks possible: 20