

AST 101 ANSWERS TO ASSIGNMENT 9N

CHAPTER 21 "Mercury"

Questions

10. Although the physical principle of gravitational tidal lock on Mercury by the Sun is the same as with the Moon by the Earth, the resonance is different. That is, the ratio of the rotational period to the period of revolution differs. For the Earth-Moon system, the ratio, or resonance, is 1:1; for Sun-Mercury, it is 3:2, that is, three rotations for every two revolutions. (You have memorized the terms rotation and revolution from early in the course, haven't you?) The period of revolution of Mercury is 88^d; its period of rotation is 59^d.

12. Its density is quite high for an object of its low mass, implying a higher proportion of heavier elements than that for any other planet in our solar system. As I've said a number of times, the cosmic abundances of the elements and meteorite samples tell us that iron, and to a lesser extent, nickel, are the most abundant of the heavier elements. The discovery of a weak magnetic field by Mariner 10 — of any field at all was surprising — implies that Mercury's iron core is molten, in order to facilitate the electric currents needed for the dynamo production of such a magnetic field. The author points out that astronomers did not expect such a field because such a small object as Mercury should be cooled down so as to solidify its core well before now. I speculate that Mercury may be in a situation identical to that of Io at Jupiter (stuck between the massive Jupiter on one side and Io on the other) — that tidal stresses from the Sun, and perhaps Venus, along with Mercury's eccentric orbit, add just enough internal strains to cause frictional heat sufficient to at least partially melt the core. General note: Scientific speculation may be plausible, but it has not yet been checked out. When I meet an expert on Mercury, I'll run this idea by him/her.

CHAPTER 22.1 "Venus"

Questions

1. Because they are neighboring planets, not far from one another, their basic data (size, mass, density) are very similar, and they both are the same type of planet with extensive atmospheres.
3. Three features, all appearing in long lines. 1) mountain ranges, 2) rift valleys, 3) volcanoes dotting out a long, usually curved line

Problems

1. This is a common distance equals rate times time problem ($d = rt$), an straightforward situation so long as the rate (speed) is constant. Travel time will therefore equal the distance divided by the rate ($t = d / r$). Since radio waves are electromagnetic radiation like visible light, only much less energetic, they travel at the speed of light, 3.00×10^5 km/s. (Did you see the hint on the assignment sheet?).

The nearest distance, with Venus at inferior conjunction, is Earth's distance to the Sun, 149.6 x

10^6 km, minus Venus' distance from the Sun, 108.2×10^6 km, which equals 41.4×10^6 km, or, in strict scientific notation, 4.14×10^7 km. Then,

$$t = \frac{4.14 \times 10^7 \text{ km}}{3.00 \times 10^5 \text{ km/s}} \quad \text{or} \quad t = 1.38 \times 10^2 \text{ s} = 138 \text{ s}$$

138 seconds (dividing by 60 s/m) is 2 minutes and 18 seconds, one way travel time for radio signals. To reflect back to Earth, as the question requests, it would take 4 minutes and 36 seconds.

The farthest distance, with Venus at superior conjunction, is Earth's distance to the Sun, 149.6×10^6 km, plus Venus' distance from the Sun, 108.2×10^6 km, which equals 257.8×10^6 km, or, in strict scientific notation, 2.578×10^8 km. Then,

$$t = \frac{2.578 \times 10^8 \text{ km}}{3.00 \times 10^5 \text{ km/s}} \quad \text{or} \quad t = 0.859 \times 10^3 \text{ s} = 859 \text{ s}$$

859 seconds (dividing by 60 s/m) is 14 minutes and 19 seconds, one way travel time for radio signals. To reflect back to Earth, as the question requests, it would take 28 minutes and 38 seconds.