Practice Problems - Chapter 13

Problem 1)

A couple of asronauts agree to rondezvous in space after hours! The plan is let the gravity bring them together. One of them has a mass of 65 kg and the other a mass of 72 kg, and they start from rest 20.0 m apart.

a) Make a free body diagram of each astronaut, and use it to find his/ her initial acceleration. As a rough approximation, we can model the astonauts as spheres.

b) If the astronauts' acceleration remained constant, how many days would they have to wait before reaching each other? (Careful! They both have acceleration towasd each other.)

c) Would their acceleration, in fact, remain constant? If not,would it increase or decrease? Why?

Problem 2)

At what distance above the surface of the earth is the acceleration due to earth's gravity 0.980 m/s^2 if the acceleration due to gravity at the surface is 9.8 m/s^2?

Problem 3)

Ten days after it was launched toward Mars in December 1998, the Mars Climate Orbiter spacecraft (mass 629 kg) was 2.87 x 10^6 km from earth and traveling at 1.2 x 10^4 km/h relative to the earth. At this time, what were

a) the spacecraft's kinetic energy relative to earth and

b) the potential energy of earth-spacecraft system?

Problem 4)

Two satellites are in circular orbits around a planet that has radius 9.00 x 10^6 m. One satellite has mass 68.0 kg, orbital radius 5.00 x 10^7 m, and initial speed 4800 m/s. The second satellite has mass 84.0 kg and and orbital radius 3.00 x 10^7 m. What is the orbital speed of this second satellite?

Problem 5)

In 2004 astronomers reported the discovery of a large Jupiter-sized planet orbitting very close to star HD 179949. The orbit was just 1/9 of the distance of Mercury from our sun, and it takes the planet only 3.09 days to make one orbit (assumed to be circular).

a) What is the mass of this star? Express your answer in kilograms and as a multiple of our sun's mass

b) How fast (in km/s) is this planet moving? $m_S = 1.99\ 10^{30}$ kg

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