8 Universal Gravitation

1. The satellites of Mars, Phobos and Deimos, have mean orbital radii of 9.38×10^6 m and 2.35×10^7 m, respectively. The orbital period of Deimos is 30.30 hr. Use Kepler's third law of planetary motion to predict the period of Phobos.

2. Use Kepler's third law to predict the altitude of a Martian satellite that would have a period of 24.0 h.

3. Use Newton's form of Kepler's third law and the information about Deimos in Problem 1 to determine the mass of Mars.

4. The Martian moon, *Deimos*, has a mass of 2.4×10^{15} kg and an average radius of 6.4 km. What is the acceleration of gravity at its surface?

5. What is the gravitational attraction between two protons ($m_{\text{proton}} = 1.67 \times 10^{-27}$ kg) at a distance of 5.0×10^{-15} m, about the diameter of the nucleus of an atom?

6. Two bowling balls, each with a mass of 6.80 kg, are 1.00 m apart. Compare the weight of the first ball with the gravitational force exerted on it by the second ball.

7. Saturn's rings are made of particles moving in orbits around the planet. The inner edge of the closest ring has a radius of 6.7×10^4 km while the radius of the outer edge of the farthest ring is 4.8×10^5 km. The mass of Saturn is 5.69×10^{26} kg.

a. Calculate the velocity of a particle near the inner edge of the closest ring.

b. What is the period of this particle?

c. How do the answers of 6a and 6b compare to the velocity and period of a particle orbiting near the outer edge of the farthest ring?

8. The mass of the moon is 7.34×10^{22} kg and its average radius is 1785 km.

a. Between January, 1998, and December, 1998, the *Lunar Prospector* was in a nearly circular orbit around the moon at an altitude of 1.0×10^2 km. What was the period of the *Lunar Prospector* in minutes?

b. What was its velocity when it was in the orbit at 1.0×10^2 km?

9. At the moon's surface g_{Moon} has a value of 1.59 m/s^2. What is the value of the acceleration of gravity at an altitude of 1.00×10^2 km above the moon's surface?

10. Use Table 8-1 in the text to find the sun's gravitational field strength at Earth's orbit.