ANSWERS TO EVEN-NUMBERED CONCEPTUAL QUESTIONS

2. If we assume they are separated by about 10 m and their masses are estimated to be 70 kg and 40 kg, then, using the law of universal gravitation, we estimate a gravitational force on the order of 10^{-9} N.

4. To a good first approximation, your bathroom scale reading is unaffected because you, Earth, and the scale are all in free fall in the Sun's gravitational field, in orbit around the Sun. To a precise second approximation, you weight slightly less at noon and at midnight than you do at sunrise or sunset. The Sun's gravitational field is a little weaker at the center of the Earth than at the surface sub-solar point, and a little weaker still on the far side of the planet. When the Sun is high in your sky, its gravity pulls up on you a little more strongly than on the Earth as a whole. At midnight the Sun pulls down on you a little less strongly than it does on the Earth below you. So you can have another doughnut with lunch, and your bedsprings will still last a little longer.

6. Consider one end of a string connected to a spring scale and the other end connected to an object, of true weight w. The tension T in the string will be measured by the scale and construed as the apparent weight. We have $w - T = ma_c$. This gives, $T = w - ma_c$. Thus, the apparent weight is less than the actual weight by the term ma_c. At the poles the centripetal acceleration is zero. Thus, $T = w$. However, at the equator the term containing the centripetal acceleration is nonzero, and the apparent weight is less than the true weight.

8. If the acceleration is constant in magnitude and perpendicular to the velocity, the object is moving in a circular path at constant speed. If the acceleration is parallel to the velocity, the object is either speeding up, v and a in same direction, or slowing down, v and a in opposite directions.

10. Kepler's second law says that equal areas are swept out in equal times by a line drawn from the Sun to the planet. For this to be so, the planet must move fastest when it is closest to the Sun. This, surprisingly, occurs during the winter.

12. Yes. A weak, but nonzero, nonconservative force due to air resistance, opposes the motion of the satellite and causes its speed to decrease with time.