HW#08 Solutions

Physics 107, Dr. Gladden, Fall 2006

Chap. 9: Gravity

Solutions to Chapter 9 Exercises

4. The force of gravity is the same on each because the masses are the same, as Newton's equation for gravitational force verifies.

10. Astronauts are weightless because they lack a support force, but they are well in the grips of Earth gravity, which accounts for them circling the Earth rather than going off in a straight line in outer space.

12. The forces between the apple and Earth are the same in magnitude. Only the corresponding accelerations of each are different.

15. Although the forces are equal, the accelerations are not. The much more massive Earth has much less acceleration than the Moon. Actually Earth and Moon *do* rotate around a common point, but it's not midway between them (which would require both Earth and Moon to have the same mass). The point around which Earth and Moon rotate (called the *barycenter*) is within the Earth about 4600 km from the Earth's center.

19. Your weight would decrease if the Earth expanded with no change in its mass and would increase if the Earth contracted with no change in its mass. Your mass and the Earth's mass don't change, but the distance between you and the Earth's center does change. Force is proportional to the inverse square of this distance.

25. In a car that drives off a cliff you "float" because the car no longer offers a support force. Both you and the car are in the same state of free fall. But gravity is still acting on you, as evidenced by your acceleration toward the ground. So, by definition, you would be weightless (until air resistance becomes important). 26. Gravitational force is indeed acting on a person who falls off a cliff, and on a person in a space shuttle. Both are falling under the influence of gravity.

37. No. Tides are caused by differences in gravitational pulls. If there are no differences in pulls, there are no tides.

43. Yes, the Earth's tides would be due only to the Sun. They'd occur twice per day (every 12 hours instead of every 12.5 hours) due to the Earth's daily rotation.

53. $F \sim m_1 m_2/d^2$, where m_2 is the mass of the Sun (which doesn't change when forming a black hole), m_1 is the mass of the orbiting Earth, and d is the distance between the center of mass of the Earth and the Sun. None of these terms change, so the force F that holds the Earth in orbit does not change. (There may in fact be black holes in the galaxy around which stars or planets orbit.)

Chapter 9 Problem Solutions

2. In accord with the inverse-square law, four times as far from the Earth's center diminishes the value of g to $g/4^2$, or $g/16$, or **0.6 m/s^2**.

4. It is $g = GM/r^2 = (6.67 \times 10^{-11})\ (3.0 \times 10^{30})/(8.0 \times 10^{3})^2 =$ **3.1×10^{12} m/s^2**, 300 billion times g on Earth.

5. $g =$ = = 9.24 N/kg or 9.24 m/s^2; 9.24/9.8 = 0.94 or **94%.**