Part I

1. The reason the Moon does not fall down and collide with the Earth is because

   (a) It is being pulled by the Sun and planets as well as by Earth.

   (b) The net force on it is zero.

   (c) It is beyond the main pull of Earth's gravity.

   (d) None of the above.

2. The path of comets around the sun is elliptical and so the distance from the comet to the sun varies. The point of closest approach is called the perigee and the point of furthest reach is called the apogee. Suppose that for a particular comet the apogee is twice as far from the sun as the perigee. Comparing the strength of the force between the sun and the comet at the apogee and the perigee the force is

   (a) four times as strong at the perigee.

   (b) twice as strong at the perigee.

   (c) the same at the apogee and the perigee since acceleration constant along a closed orbit.

   (d) half as strong at the perigee.

3. A truck with a ball free to roll around in the back takes a a sharp turn to the right. Which of the following forces cause the ball to move to the left side of the truck?

   (a) gravity.

   (b) normal force.

   (c) centripetal force.

   (d) the absence of a force.

4. Which of the following statements is true of a satellite orbiting the earth on a circular path?

   (a) It moves with constant speed and acceleration of zero magnitude.

   (b) It moves with constant velocity and acceleration of constant magnitude.

   (c) It moves with variable velocity and acceleration of zero magnitude.

   (d) It moves with constant speed and acceleration of constant magnitude.

Part II

1. Suppose two identical satellites are put into orbit, one around earth and one around the moon. If the radius of the orbits are the same, which if any is moving faster? Why?

2. The moon's mass is about 1/100 the mass of the earth. It's radius is 1/4 the radius of the earth. Use the proportionalities in Newton's universal law of gravitation and the fact that on the earth the acceleration due to gravity is 9.8 m/s^2. To find the acceleration due to gravity on the moon's surface.

3. Suppose a satellite with mass m orbits the Earth with period T and radius R.

   (a) If another satellite with a larger mass orbits the Earth with the same period, would the radius of the orbit be larger, smaller or the same? Explain your answer.

   (b) If another satellite with the same mass orbits the earth with a longer period would the radius of the orbit be larger, smaller or the same? Explain your answer.

   (c) If a small amount of air resistance were to act on the satellite describe what would happen to the period and the radius of the orbit over time. Explain your answer.

4. When a star with sufficient mass consumes all its nuclear fuel it collapses under its own gravitational force to form a neutron star. These objects have about the same mass as our sun (2×10^{30} kg) but with a radius of only 10 km. Neutron stars rotate on their axis with a period of about one second. Consider a neutron star with this mass, radius and period.

   (a) What is the speed at the equator of the star?

   (b) What is the value of the acceleration due to gravity on the surface of a neutron star.

   (c) What would be the speed of an object in orbit just above the surface of the star? Comparing your answer to part (a), would it be possible to remain on this star without some other force than gravity holding you there?

   (d) If earth were to orbit this neutron star at the same radius at which it orbits the sun would its period be less than, more than, or equal to one earth year? Explain?