# UNIT II: Worksheet 5

1. An interplanetary spaceship passes through the point in space where the gravitational forces from the sun and the earth on the ship exactly cancel.
   a. How far from the center of the earth is it?

   b. What, if anything, happens to the spaceship when it passes through the point described in part (a)? Explain.

2. The typical adult human has a mass of about 70 kg. What force does a full moon exert on such a human when it is directly overhead with its center 378,000 km away?

3. The sun has a mass 333,000 times that of the earth. For a person on earth, the average distance to the center of the sun is 23,500 times the distance to the center of the earth. In magnitude, what is the ratio of the sun's gravitational force on you to the earth's gravitational force on you?

4. Calculate the magnitude and direction of the net gravitational force on the moon due to the earth and the sun when the moon is in each of the positions shown. (Note that the figure is not drawn to scale. Assume that the sun is in the plane of the earth-moon orbit, even though this is not actually the case. You will need to research astronomical data.
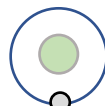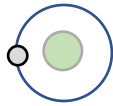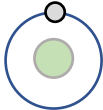
5. Titania, the largest moon of the planet Uranus, has 1/8 the radius of the earth and 1/1700 the mass of earth.
   a. What is the acceleration due to gravity at the surface of Titania?

   b. What is the average density of Titania? (This is less than the density of rock, which is one piece of evidence that Titania is made primarily of ice.)

6. Suppose a tunnel runs through Earth from pole to pole. Assume that Earth is a nonrotating, uniform sphere with density ρ.
   a. Find the gravitational force on a particle of mass m dropped into the tunnel when it reaches a distance r from Earth's center.
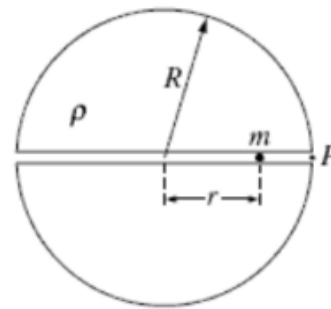
   b. With what speed would a 16-gram pencil pass through the center of Earth if it were dropped into the tunnel? The average density of Earth is 5520 kg/m³. Ignore air resistance.