PHYSICS 1030
Homework #5

(Due Oct. 18, 2016)

1. (Serway 6-2) Whenever two *Apollo* astronauts were on the surface of the Moon, a third astronaut orbited the Moon. Assume the orbit to be circular and 100 km above the surface of the Moon, where the acceleration due to gravity is 1.52 m/s^2. The radius of the Moon is 1.70×10^6 m. Determine (a) the astronaut's orbital speed, and (b) the period of the orbit.

2. A motorboat of mass m is acted on by a resisting force R which varies directly with the square of the velocity:

$$R = kv^2. \tag{1}$$

Suppose the power is cut off when the motorboat has a velocity v_0. (a) Find the expression for the acceleration of the motorboat, dv/dt, in terms of m, k, and v. (b) Is the acceleration constant? (c) What is the initial acceleration? (d) Find by integration the velocity at any time t. (e) If the initial velocity v_0 is 30 ft/s, and if the velocity decreases to 20 ft/s in 10 sec, find the resisting force R at a velocity of 30 ft/s. The mass m of the motorboat is 100 slugs.

3. (Serway 7-55) A baseball outfielder throws a 0.150-kg baseball at a speed of 40.0 m/s and at an initial angle of 30.0° to the horizontal. What is the kinetic energy of the baseball at the highest point of its trajectory?

4. (Serway 7-64) An inclined plane of angle θ has a spring of force constant k fastened securely at the bottom so that the spring is parallel to the surface. A block of mass m is placed on the plane at a distance d from the spring. From this position, the block is projected downward toward the spring with speed v as shown in Figure P7.63 of the text. By what distance is the spring compressed when the block momentarily comes to rest?

5. (Serway 8-5) A bead slides without friction around a loop-the-loop (Fig. P8.5 in the text). The bead is released from a height $h = 3.50R$. (a) What is its speed at point A? (b) How large is the normal force on the bead at point A if its mass is 5.00 g?

6. (Serway 8-12) A sled of mass m is given a kick on a frozen pond. The kick imparts to the sled an initial speed of 2.00 m/s. The coefficient of kinetic friction between sled and ice is 0.100. Use energy considerations to find the distance the sled moves before it stops.