PHY121 Summer 2018
Problem Set #7
Due Tuesday 6/12

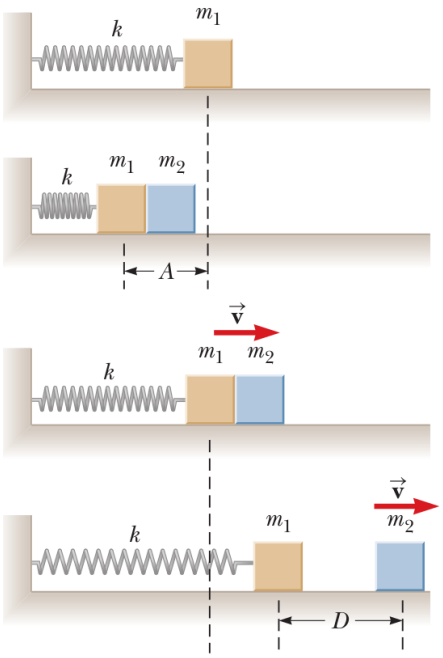
1. An object of mass m_1 = 8.5 kg is in equilibrium when connected to a light spring of constant k = 90 N/m that is fastened to a wall. A second object, m_2 = 6.75 kg, is slowly pushed up against m_1, compressing the spring by A = 0.215 m. The system is then released and both objects start moving to the right on the frictionless surface.

   (a) When m_1 reaches the equilibrium point, m_2 loses contact with m_1 and moves to the right with speed v. Explain why the two objects lose contact with each other.

   (b) Determine the value of v.

   (c) Describe the resulting motion of m_1.

   (d) How far apart are the objects when the spring is fully stretched for the first time?



2. A large man sits on a four-legged chair with his feet off the floor. The combined mass of the man and the chair is 125 kg. If the chair legs are circular and have a radius of 0.45 cm at the bottom, what pressure does each leg exert on the floor?

3. A wooden block of volume 6.35×10^{-4} m^3 floats in water, and a small steel object of mass m is placed on top. When $m = 0.45$ kg, the system is in equilibrium when the top of the block is just level with the water.

   (a) What is the density of the wood?

   (b) What happens to the block when the steel object is replaced by an object whose mass is less than 0.45 kg?

   (c) What happens to the block when the steel object is replaced by an object whose mass is greater than 0.45 kg?

4. A plastic sphere floats in water with 60% of its volume submerged. The same sphere floats in glycerin with 45% of its volume submerged. Determine:

   (a) The density of the sphere.

   (b) The density of the glycerin.

5. A family maintains a large tank (diameter 0.86 m) with an open top, containing water for emergencies. The water can drain from the tank through a horizontal hose. The hose ends with a nozzle of diameter 2.35 cm. A rubber stopper is inserted into the nozzle. The water level in the tank is kept 9.4 m above the nozzle.

   (a) Calculate the force of friction exerted on the stopper by the nozzle.

   (b) The stopper is removed. How much water (in kg) flows from the nozzle in 2 hours?