PHYSICS 1030
Homework #8

(Due Nov. 20, 2018, 11:59 pm)

1. (Serway 14-4) Estimate the total mass of the Earth's atmosphere. (The radius of the Earth is 6.37×10^6 m, and atmospheric pressure at the surface is 1.013×10^5 Pa.)

2. (Serway 14-11) (a) Calculate the absolute pressure at the bottom of a freshwater lake at a point whose depth is 27.5 m. Assume the density of the water is 1.00×10^3 kg/m^3 and that the air above is at a pressure of 101.3 kPa.

3. (Serway 14-30) The United States possesses the ten largest warships in the world, aircraft carriers of the *Nimitz* class. Suppose one of the ships bobs up to float 11.0 cm higher in the ocean water when 50 fighters take off from it in a time interval of 25 min., at a location where the free-fall acceleration is 9.89 m/s^2. The planes have an average laden mass of 29,000 kg. Find the horizontal area enclosed by the waterline of the ship.

4. (Serway 14-33) A wooden block of volume 5.24×10^{-4} m^3 floats in water, and a small steel object of mass m is placed on top of the block. When $m = 0.310$ kg, the system is in equilibrium and the top of the wooden block is at the level of 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 greater than 0.310 kg?

5. (Serway 14-41) A large storage tank, open at the top and filled with water, develops a small hole in its side at a point 16.0 m below the water level. The rate of flow from the leak is found to be 2.50×10^{-3} m^3/min. Determine (a) the speed at which the water leaves the hole and (b) the diameter of the hole.

6. (Serway 14-45) A legendary Dutch boy saved Holland by plugging a hole of diameter 1.20 cm in a dike with his finger. If the hole was 2.00 m below the surface of the North Sea (density 1030 kg/m^3), (a) what was the force on his finger? (b) If he pulled his finger out of the hole, during what time interval would the released water fill 1 acre of land to a depth of 1 ft? Assume the hole remained constant in size.

7. An old TV commercial for Prell shampoo showed a woman dropping a pearl into a bottle of the shampoo to showcase that the shampoo is "rich" and "luxurious" (i.e., high viscosity). Find (a) the terminal velocity of a pearl falling through a bottle of Prell shampoo, and (b) the drag (resistive) force on the pearl at this terminal velocity. (c) If the same pearl takes 5.0 sec to fall through 8 inches of a bottle of Acme shampoo, then what is the dynamic viscosity of Acme shampoo, in centipoise?

Use the following data: pearl diameter, 9 mm; pearl mass: 5.25 carets; Prell shampoo kinematic viscosity: 4500 centipoise (cP). A *caret* is a unit of mass equal to 0.2 grams. For viscosity, 1 Pa sec = 1000 centipoise (cP).

8. Water flows through a channel of diameter 1.00 cm at a speed of 2.20 cm/s. Do you expect this flow to be laminar or turbulent?