10.303 & 14.301 Fluid Mechanics

Homework Assignment #1 Fall 2006

Fluid Properties and Units Consistency

1. The information printed on the outside of a can of soda indicates that the can contains 355 mL of soda. The mass of a full can is 0.369 kg while an empty can weighs 0.153 N. Determine the specific weight, density, and specific gravity of the soda.

2. The efficiency, η, of a pump is defined as the dimensionless ratio of the power delivered to the fluid (P_A = power added) to the power required to drive the pump (P_I = power input),

$$\eta = \frac{P_A}{P_I} = \frac{Q\Delta p}{P_I}$$

where Q is the volume flow rate and Δp is the pressure rise produced by the pump.

Suppose that a certain pump develops a pressure rise of 35 psi when its flow rate is 40 L/s. If the input power is 16 hp, what is the pump efficiency?

3. A formula to estimate the volume flow rate, Q, flowing over a dam of length B is given by

$$Q = 3.09BH^{3/2}$$

where H is the depth of water above the top of the dam. This specific relationship is only valid when Q is given in ft^3/s and B and H are in feet.

a. For this situation, what are the units associated with the constant c = 3.09?

b. What would be the value and units of the constant if we wanted to write an equivalent expression using SI units, with Q in m^3/s and B and H in meters?

4. A rigid tank contains 20 lbm of air at 20 psia and 70 F. More air is added to the tank until the pressure and temperature rise to 35 psia and 90 F, respectively. Determine the amount of air added to the tank.

5. Water at 15 C and 1 atm pressure is heated to 95 C at constant pressure. Using a constant volume expansion coefficient at the average temperature, estimate the actual change in water density that occurs. Also compare your estimated value with tabulated data.