ME 3310 Thermodynamics I Homework Handout #1: 1.8, 31, 65, 66E, 69, 142, 144

Example 1: On the surface of the earth, a man weighs 150 lbf. What is his mass on earth? What is his mass on the moon?

Example 2: A woman weighs 180 lbf on her home planet where the acceleration due to gravity is 35 ft/s^2. How much would she weigh on a planet where the acceleration due to gravity was 25 ft/s^2?

1–8 Determine the mass and the weight of the air contained in a room whose dimensions are 6 m × 6 m × 8 m. Assume the density of the air is 1.16 kg/m^3.
Answers: 334.1 kg, 3277 N

1–12 EES A 5-kg rock is thrown upward with a force of 150 N at a location where the local gravitational acceleration is 9.79 m/s^2. Determine the acceleration of the rock, in m/s^2.

1–14 The value of the gravitational acceleration g decreases with elevation from 9.807 m/s^2 at sea level to 9.767 m/s^2 at an altitude of 13,000 m, where large passenger planes cruise. Determine the percent reduction in the weight of an airplane cruising at 13,000 m relative to its weight at sea level.

1–30 Consider a nuclear power plant that produces 1000 MW of power and has a conversion efficiency of 30 percent (that is, for each unit of fuel energy used, the plant produces 0.3 unit of electrical energy). Assuming continuous operation, determine the amount of nuclear fuel consumed by this plant per year.

1–31 Repeat Problem 1–30 for a coal power plant that burns coal whose heating value is 28,000 kJ/kg.

1–65 A vacuum gage connected to a tank reads 30 kPa at a location where the barometric reading is 755 mmHg. Determine the absolute pressure in the tank. Take $\rho_{Hg} = 13{,}590\ kg/m^3$. *Answer:* 70.6 kPa

1–66E A pressure gage connected to a tank reads 50 psi at a location where the barometric reading is 29.1 inHg. Determine the absolute pressure in the tank. Take $\rho_{Hg} = 848.4\ lbm/ft^3$. *Answer:* 64.29 psia

1–69 The basic barometer can be used to measure the height of a building. If the barometric readings at the top and at the bottom of a building are 730 and 755 mmHg, respectively, determine the height of the building. Assume an average air density of $1.18\ kg/m^3$.

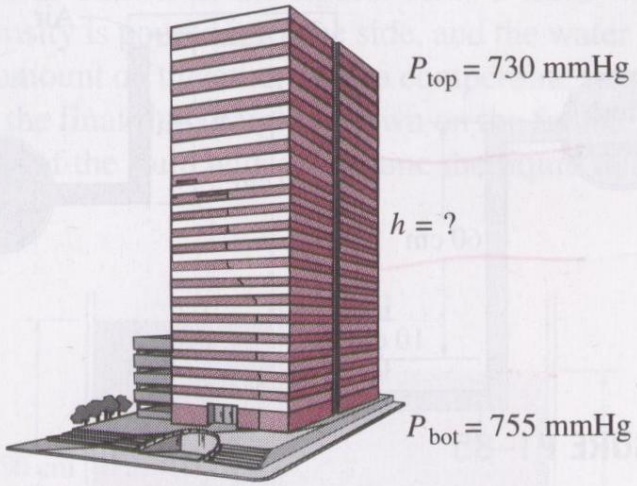

FIGURE P1–69

1–78 A mercury manometer ($\rho = 13{,}600\ kg/m^3$) is connected to an air duct to measure the pressure inside. The difference in the manometer levels is 15 mm, and the atmospheric pressure is 100 kPa. (*a*) Judging from Fig. P1–78, determine if the pressure in the duct is above or below the atmospheric pressure. (*b*) Determine the absolute pressure in the duct.

1–142 The lower half of a 10-m-high cylindrical container is filled with water ($\rho = 1000$ kg/m^3) and the upper half with oil that has a specific gravity of 0.85. Determine the pressure difference between the top and bottom of the cylinder.

Answer: 90.7 kPa

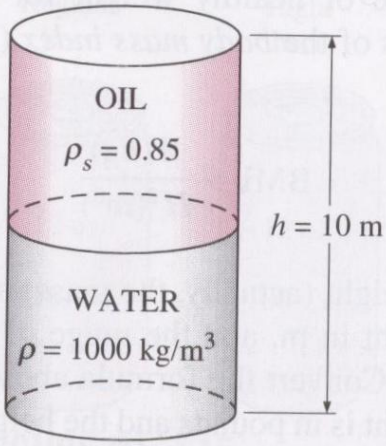

FIGURE P1–142

1–144 A pressure cooker cooks a lot faster than an ordinary pan by maintaining a higher pressure and temperature inside. The lid of a pressure cooker is well sealed, and steam can escape only through an opening in the middle of the lid. A separate metal piece, the petcock, sits on top of this opening and prevents steam from escaping until the pressure force overcomes the weight of the petcock. The periodic escape of the steam in this manner prevents any potentially dangerous pressure buildup and keeps the pressure inside at a constant value. Determine the mass of the petcock of a pressure cooker whose operation pressure is 100 kPa gage and has an opening cross-sectional area of 4 mm^2. Assume an atmospheric pressure of 101 kPa, and draw the freebody diagram of the petcock.

Answer: 40.8 g

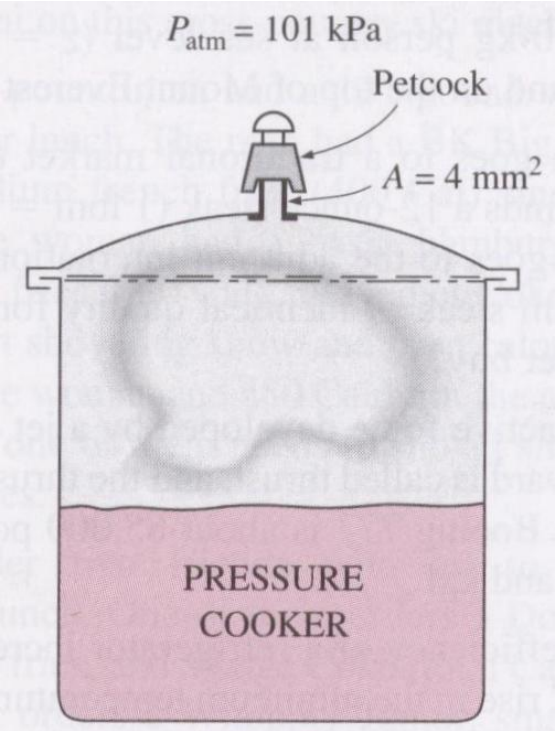

FIGURE P1–144