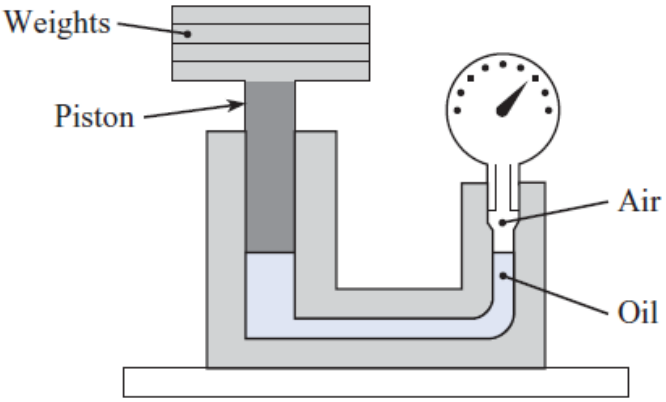
3.6 WILEY GO The Crosby gage tester shown in the figure is used to calibrate or to test pressure gages. When the weights and the piston together weigh 140 N, the gage being tested indicates 200 kPa. If the piston diameter is 30 mm, what percentage of error exists in the gage?

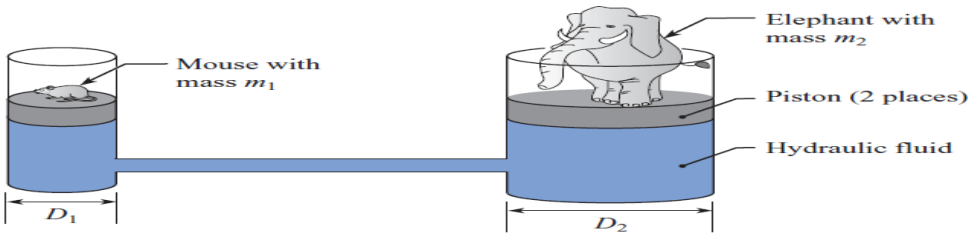


PROBLEM 3.6

3.7 WILEY PLUS As shown, a mouse can use the mechanical advantage provided by a hydraulic machine to lift up an elephant.

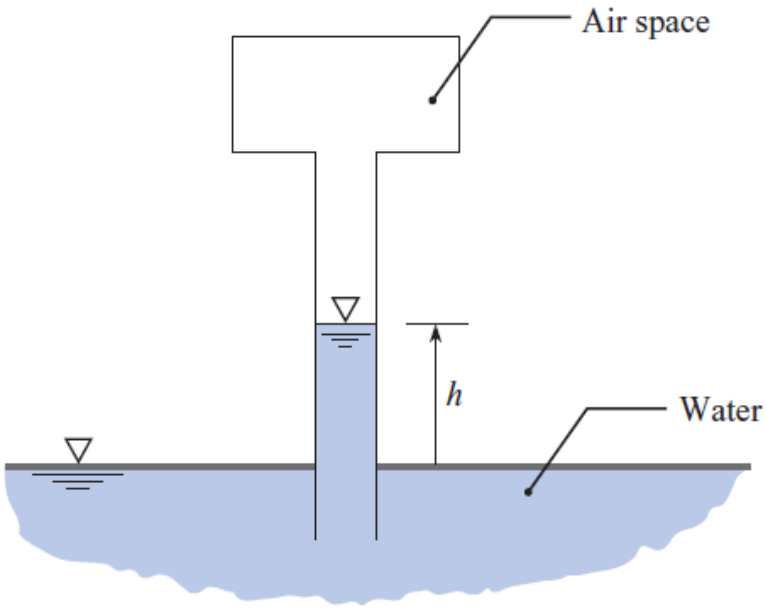
a. Derive an algebraic equation that gives the mechanical advantge of the hydraulic machine shown. Assume the pistons are frictionless and massless.

b. A mouse can have a mass of 25 g and an elephant a mass of 7500 kg. Determine a value of D_1 and D_2 so that the mouse can support the elephant.



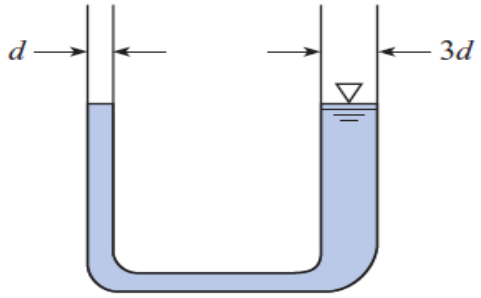
PROBLEM 3.7

3.15 As shown, an air space above a long tube is pressurized to 50 kPa vacuum. Water (20°C) from a reservoir fills the tube to a height h. If the pressure in the air space is changed to 25 kPa vacuum, will h increase or descrease and by how much? Assume atmospheric pressure is 100 kPa.



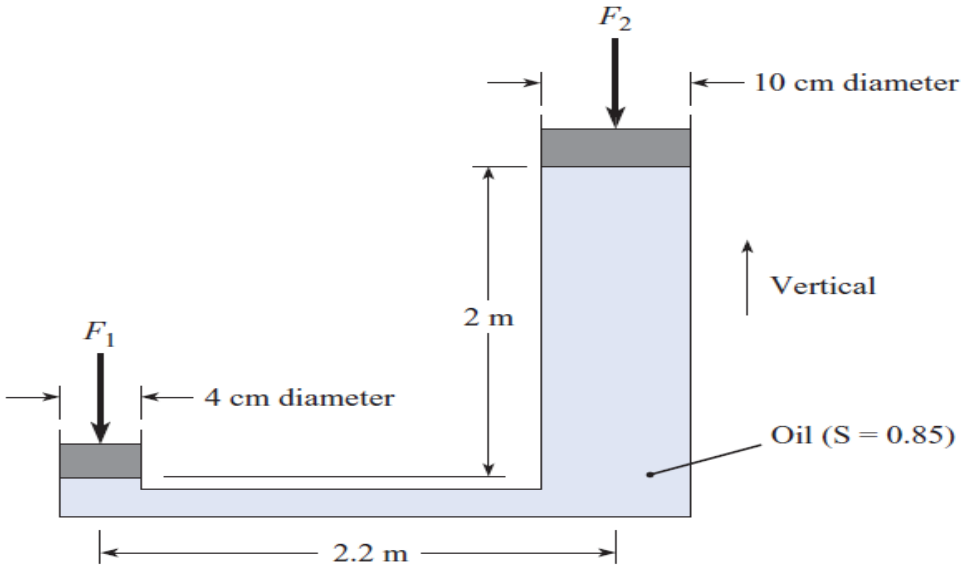
PROBLEM 3.15

3.17 This manometer contains water at room temperature. The glass tube on the left has an inside diameter of 1 mm ($d = 1.0$ mm). The glass tube on the right is three times as large. For these conditions, the water surface level in the left tube will be (a) higher than the water surface level in the right tube, (b) equal to the water surface level in the right tube, or (c) less than the water surface level in the right tube. State your main reason or assumption for making your choice.



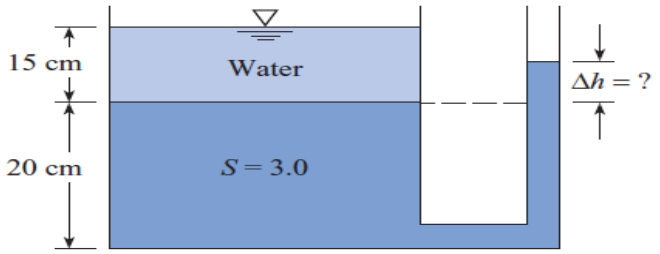
PROBLEM 3.17

3.18 WILEY PLUS If a 200 N force F_1 is applied to the piston with the 4 cm diameter, what is the magnitude of the force F_2 that can be resisted by the piston with the 10 cm diameter? Neglect the weights of the pistons.



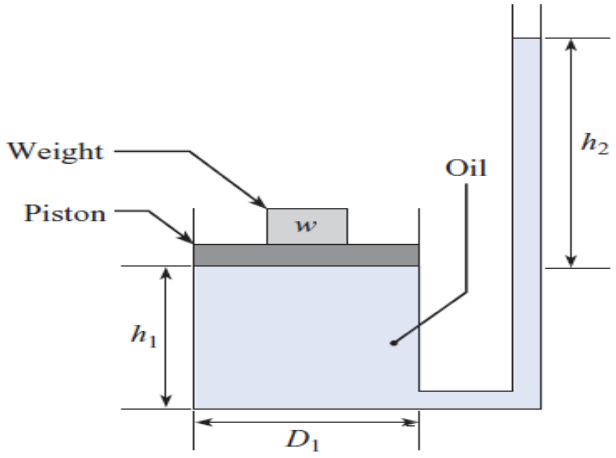
PROBLEM 3.18

3.24 WILEY PLUS A tank is fitted with a manometer on the side, as shown. The liquid in the bottom of the tank and in the manometer has a specific gravity (S) of 3.0. The depth of this bottom liquid is 20 cm. A 15 cm layer of water lies on top of the bottom liquid. Find the position of the liquid surface in the manometer.



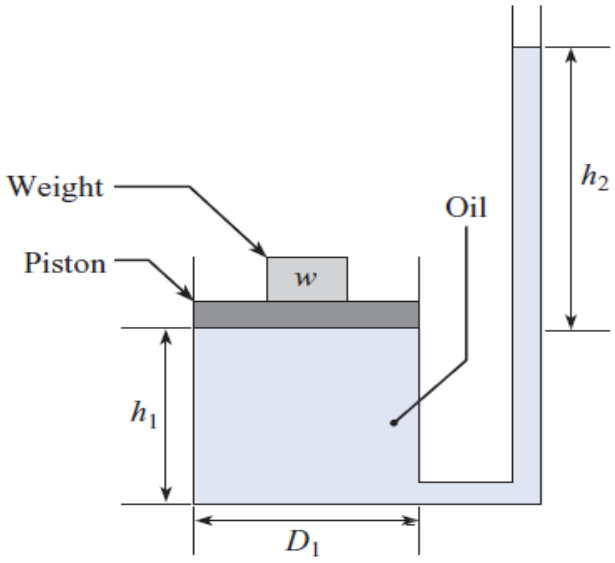
PROBLEM 3.24

3.26 As shown, a load of mass 5 kg is situated on a piston of diameter $D_1 = 120$ mm. The piston rides on a reservoir of oil of depth $h_1 = 42$ mm and specific gravity S = 0.8. The reservoir is connected to a round tube of diameter $D_2 = 5$ mm and oil rises in the tube to height h_2. Find h_2. Assume the oil in the tube is open to atmosphere and neglect the weight of the piston.



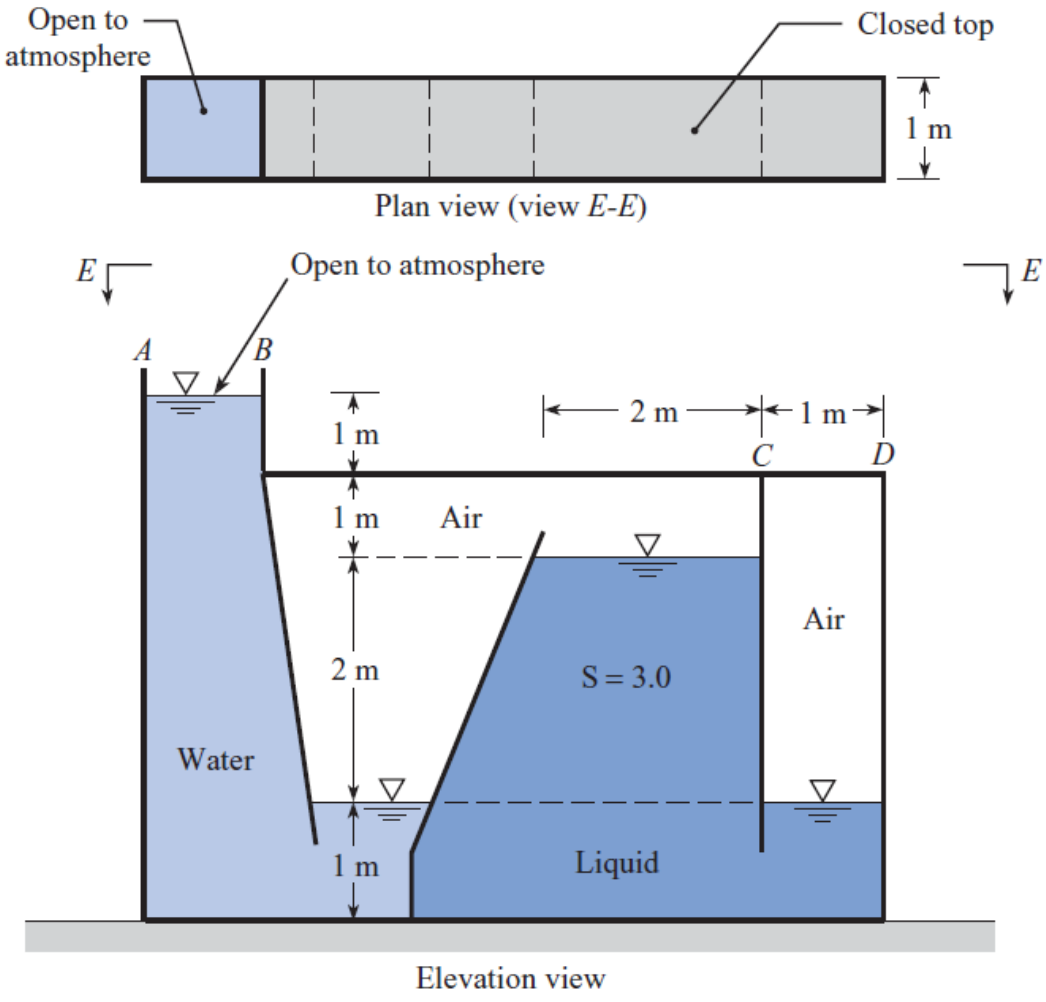
PROBLEMS 3.25, 3.26

3.26 As shown, a load of mass 5 kg is situated on a piston of diameter $D_1 = 120$ mm. The piston rides on a reservoir of oil of depth $h_1 = 42$ mm and specific gravity S = 0.8. The reservoir is connected to a round tube of diameter $D_2 = 5$ mm and oil rises in the tube to height h_2. Find h_2. Assume the oil in the tube is open to atmosphere and neglect the weight of the piston.



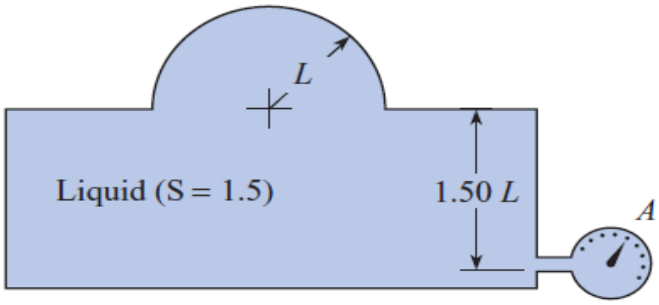
PROBLEMS 3.25, 3.26

3.27 WILEY GO What is the maximum gage pressure in the odd tank shown in the figure? Where will the maximum pressure occur? What is the hydrostatic force acting on the top (*CD*) of the last chamber on the right-hand side of the tank? Assume $T = 10°C$.



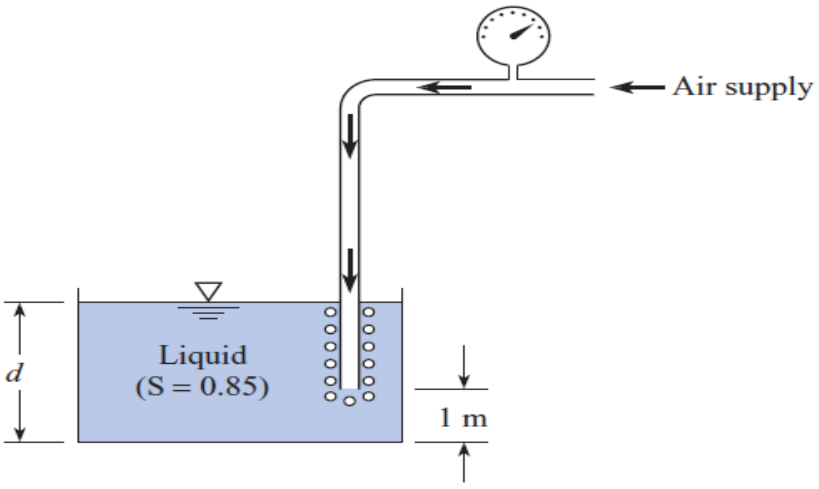
PROBLEM 3.27

3.30 Find the vertical component of force in the metal at the base of the spherical dome shown when gage *A* reads 5 psig. Indicate whether the metal is in compression or tension. The specific gravity of the enclosed fluid is 1.5. The dimension *L* is 2 ft. Assume the dome weighs 1000 lbf.



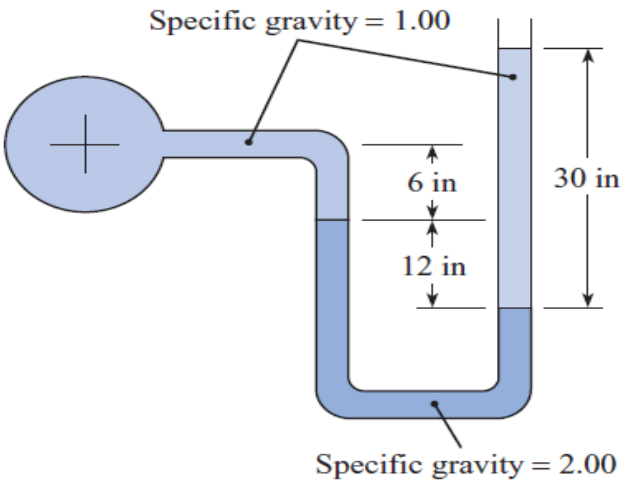
PROBLEM 3.30

3.33 One means of determining the surface level of liquid in a tank is by discharging a small amount of air through a small tube, the end of which is submerged in the tank, and reading the pressure on the gage that is tapped into the tube. Then the level of the liquid surface in the tank can be calculated. If the pressure on the gage is 15 kPa, what is the depth *d* of liquid in the tank?



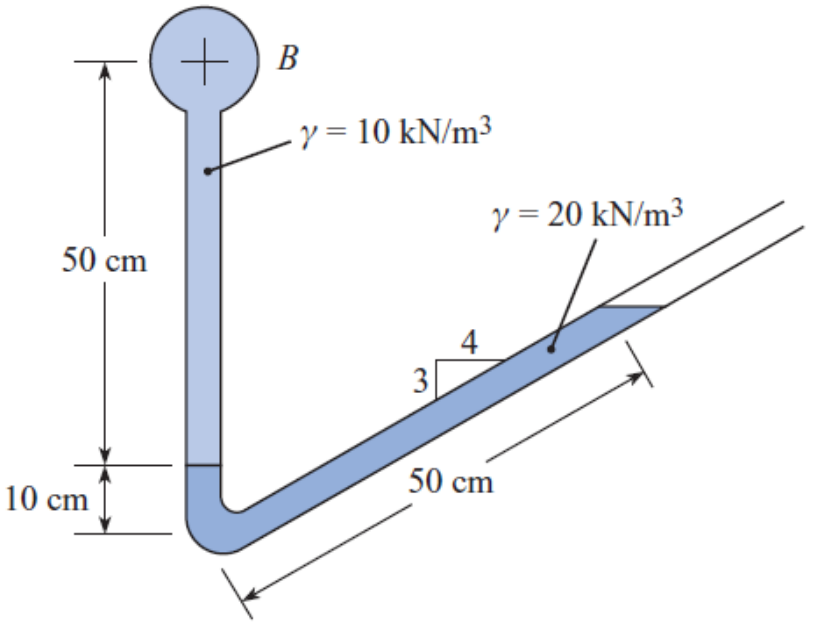
PROBLEM 3.33

3.47 WILEY PLUS Is the gage pressure at the center of the pipe (a) negative, (b) zero, or (c) positive? Neglect surface tension effects and state your rationale.



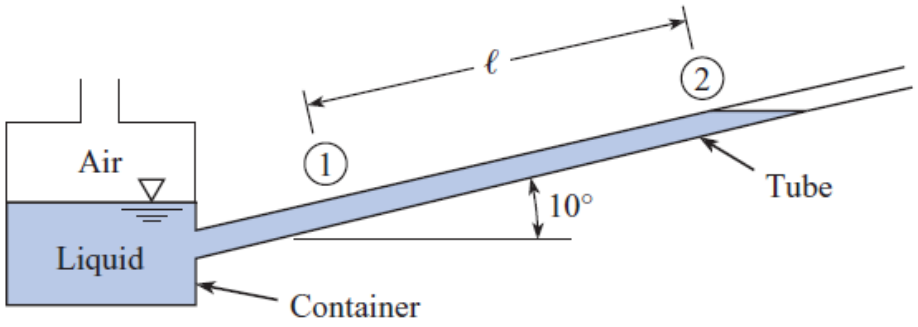
PROBLEM 3.47

3.50 WILEY PLUS What is the pressure at the center of pipe *B*?



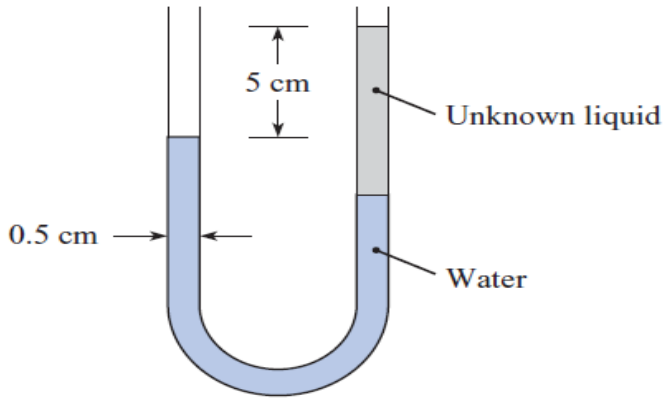
PROBLEM 3.50

3.52 The ratio of container diameter to tube diameter is 10. When air in the container is at atmospheric pressure, the free surface in the tube is at position 1. When the container is pressurized, the liquid in the tube moves 3 ft up the tube from position 1 to position 2. What is the container pressure that causes this deflection? The specific weight of the liquid is 50 lbf/ft^3.



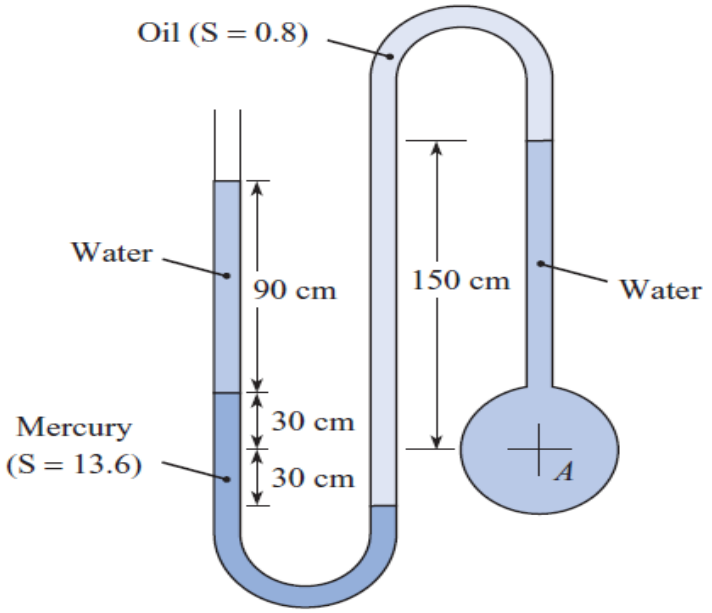
PROBLEMS 3.51, 3.52

3.54 A device for measuring the specific weight of a liquid consists of a U-tube manometer as shown. The manometer tube has an internal diameter of 0.5 cm and originally has water in it. Exactly 2 cm^3 of unknown liquid is then poured into one leg of the manometer, and a displacement of 5 cm is measured between the surfaces as shown. What is the specific weight of the unknown liquid?



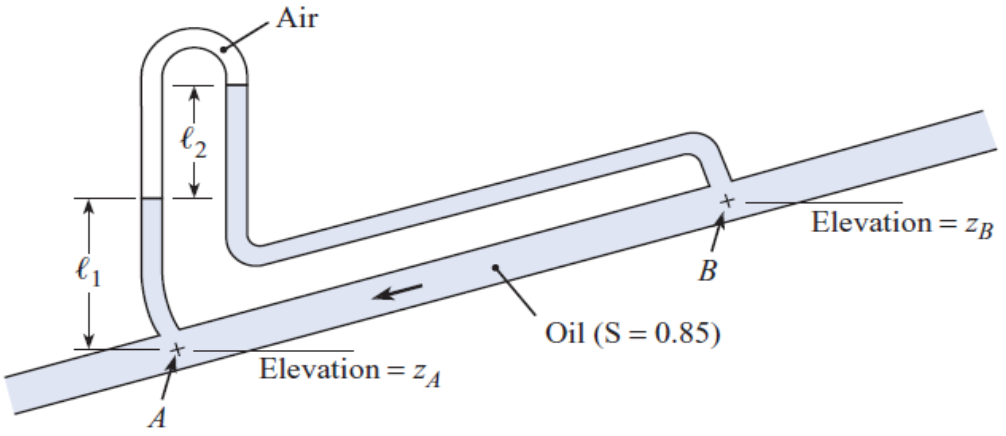
PROBLEM 3.54

3.56 WILEY PLUS Find the pressure at the center of pipe A. $T = 10°C$.



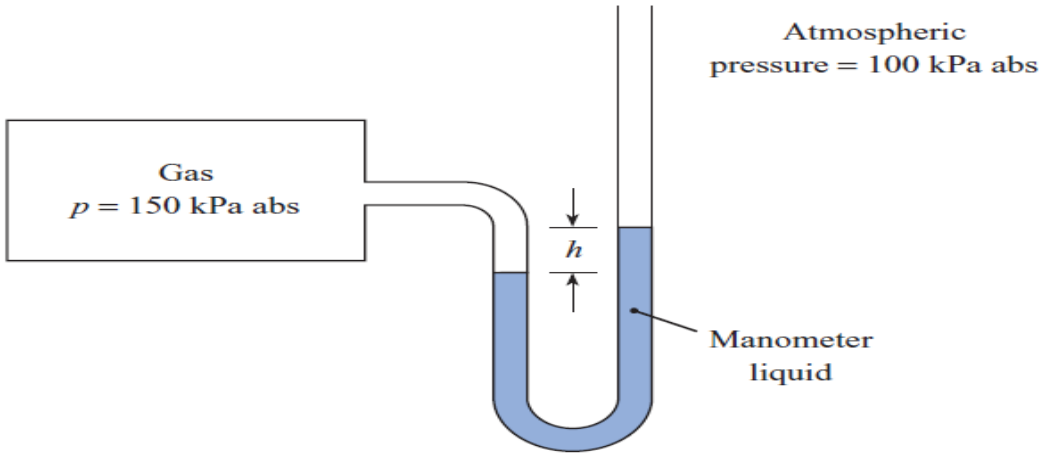
PROBLEM 3.56

3.57 Determine (a) the difference in pressure and (b) the difference in piezometric head between points A and B. The elevations z_A and z_B are 10 m and 11 m, respectively, $\ell_1 = 1$ m, and the manometer deflection ℓ_2 is 50 cm.

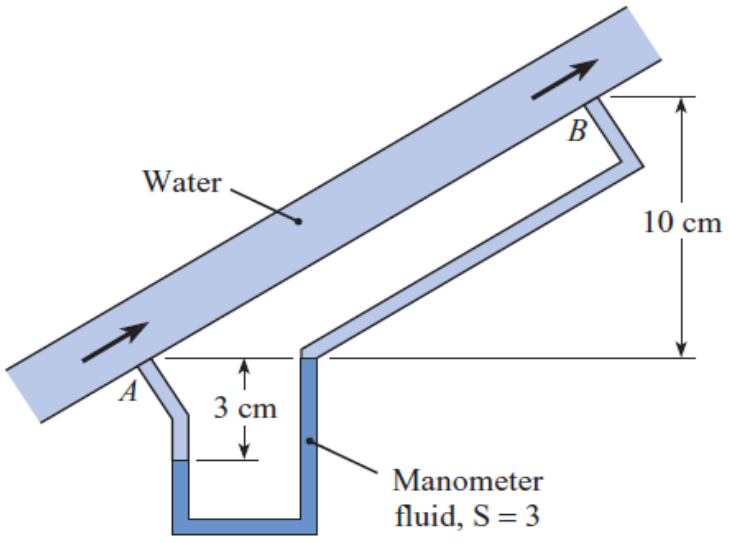


PROBLEM 3.57

3.58 The deflection on the manometer is h meters when the pressure in the tank is 150 kPa absolute. If the absolute pressure in the tank is doubled, what will the deflection on the manometer be?



3.61 A manometer is used to measure the pressure difference between points A and B in a pipe as shown. Water flows in the pipe, and the specific gravity of the manometer fluid is 2.8. The distances and manometer deflection are indicated on the figure. Find (a) the pressure differences $p_A - p_B$, and (b) the difference in piezometric pressure, $p_{z,A} - p_{z,B}$. Express both answers in kPa.



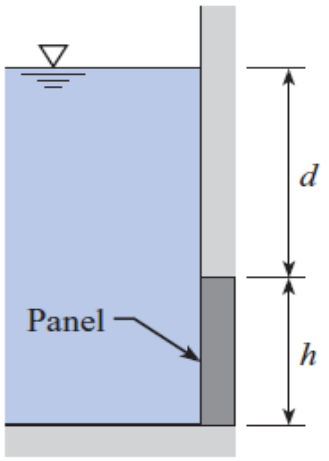
PROBLEM 3.61

3.70 WILEY PLUS As shown, water (15°C) is in contact with a square panel; $d = 1$ m and $h = 2$ m.

a. Calculate the depth of the centroid

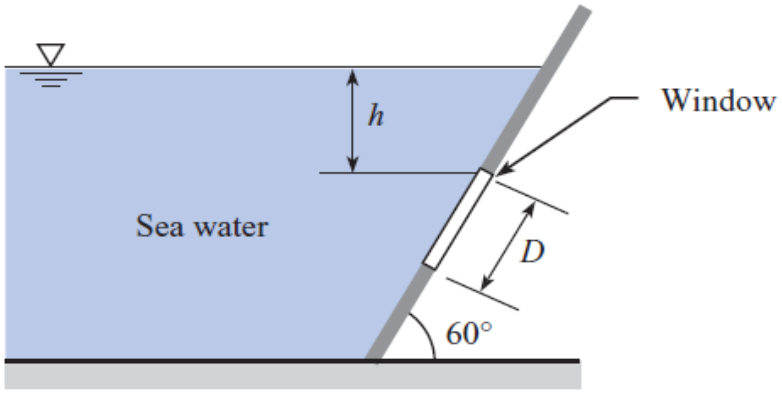
b. Calculate the resultant force on the panel

c. Calculate the distance from the centroid to the CP.



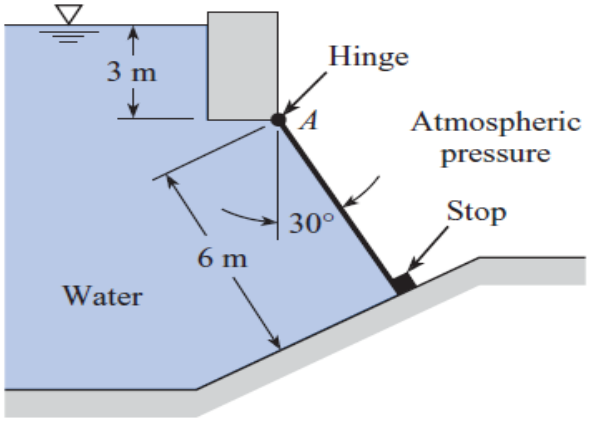
PROBLEM 3.70

3.71 WILEY GO As shown, a round viewing window of diameter $D = 0.5$ m is situated in a large tank of seawater ($S = 1.03$). The top of the window is 1.5 m below the water surface, and the window is angled at 60° with respect to the horizontal. Find the hydrostatic force acting on the window and locate the corresponding CP.



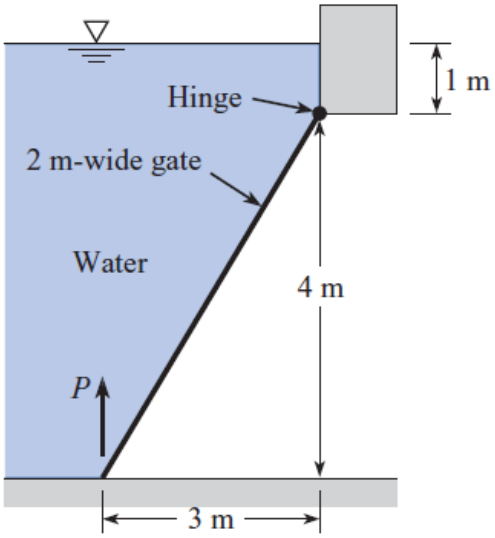
PROBLEM 3.71

3.75 The gate shown is rectangular and has dimensions 6 m by 4 m. What is the reaction at point *A*? Neglect the weight of the gate.



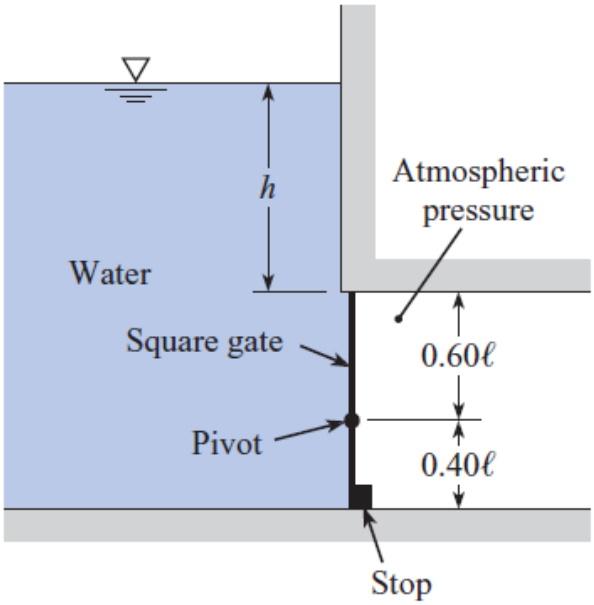
PROBLEM 3.75

3.76 WILEY PLUS Determine *P* necessary to just start opening the 2 m–wide gate.



PROBLEM 3.76

3.77 WILEY PLUS The square gate shown is eccentrically pivoted so that it automatically opens at a certain value of h. What is that value in terms of ℓ?



PROBLEM 3.77

Solutions