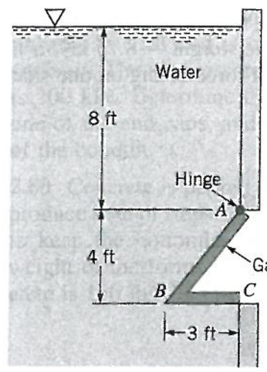
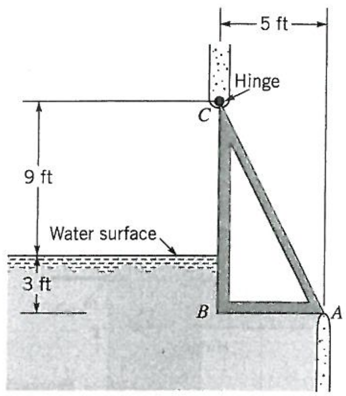


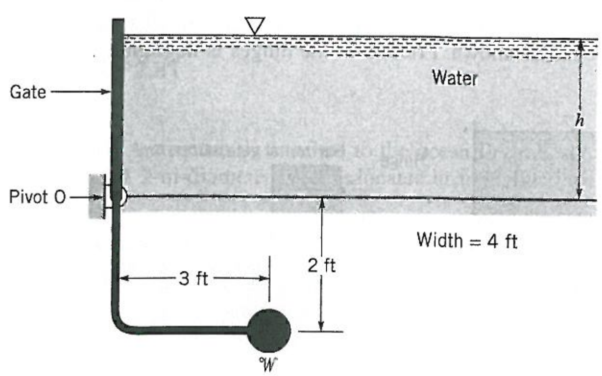
■ **Figure P2.95**

2.96 A gate having the cross section shown in Fig. P2.96 is 4 ft wide and is hinged at *C*. The gate weighs 18,000 lb, and its mass center is 1.67 ft to the right of the plane *BC*. Determine the vertical reaction at *A* on the gate when the water level is 3 ft above the base. All contact surfaces are smooth.



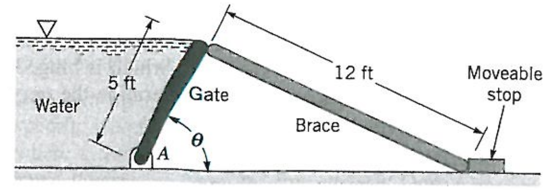
■ **Figure P2.96**

2.97 The massless, 4-ft-wide gate shown in Fig. P2.97 pivots about the frictionless hinge O. It is held in place by the 2000 lb counterweight, $\mathcal{W}$. Determine the water depth, *h*.



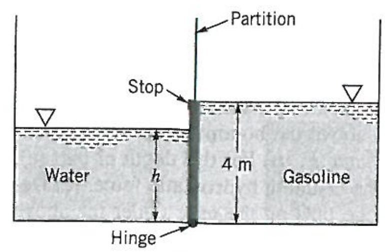
■ **Figure P2.97**

***2.98** A 200-lb homogeneous gate 10 ft wide and 5 ft long is hinged at point *A* and held in place by a 12-ft-long brace as shown in Fig. P2.98. As the bottom of the brace is moved to the right, the water level remains at the top of the gate. The line of action of the force that the brace exerts on the gate is along the brace. (**a**) Plot the magnitude of the force exerted on the gate by the brace as a function of the angle of the gate, θ, for $0 \leq \theta \leq 90°$. (**b**) Repeat the calculations for the case in which the weight of the gate is negligible. Common on the result as $\theta \rightarrow 0$.



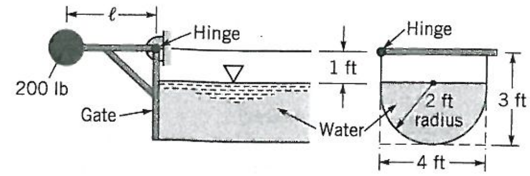
■ **Figure P2.98**

2.99 An open tank has a vertical partition and on one side contains gasoline with a density $\rho = 700 \text{ kg/m}^3$ at a depth of 4 m, as shown in Fig. P2.99. A rectangular gate that is 4 m high and 2 m wide and hinged at one end is located in the partition. Water is slowly added to the empty side of the tank. At what depth, *h*, will the gate start to open?



■ **Figure P2.99**

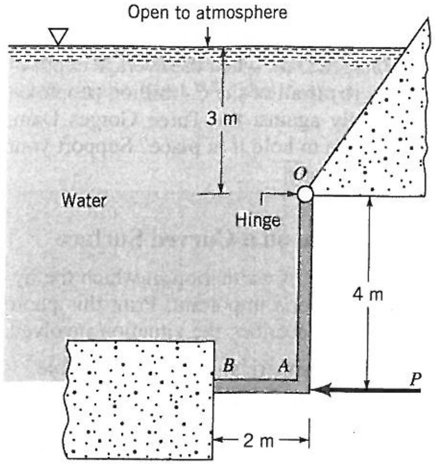
2.100 A 4-ft by 3-ft massless rectangular gate is used to close the end of the water tank shown in Fig. P2.100. A 200-lb weight attached to the arm of the gate at a distance ℓ from the frictionless hinge is just sufficient to keep the gate closed when the water depth is 2 ft, that is, when the water fills the semicircular lower portion of the tank. If the water were deeper, the gate would open. Determine the distance ℓ.



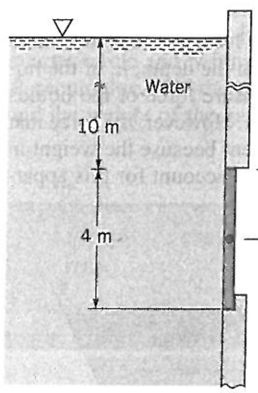
■ **Figure P2.100**

2.101 The rigid gate, *OAB*, of Fig. P2.101 is hinged at *O* and rests against a rigid support at *B*. What minimum horizontal force, *P*, is required to hold the gate closed if its width is 3 m? Neglect the weight of the gate and friction in the hinge. The back of the gate is exposed to the atmosphere.

2.102 A rectangular gate that is 2 m wide is located in the vertical wall of a tank containing water as shown in Fig. P2.102. It is desired to have the gate open automatically when the depth of water above the top of the gate reaches 10 m. (**a**) At what distance, *d*, should the frictionless horizontal shaft be located? (**b**) What is the magnitude of the force on the gate when it opens?

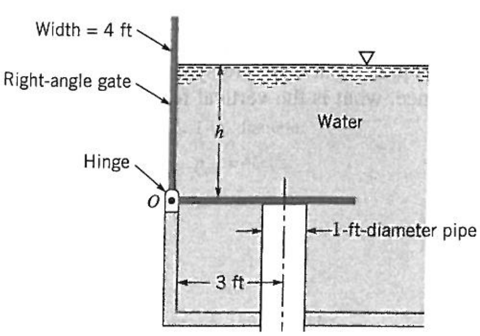


■ **Figure P2.101**



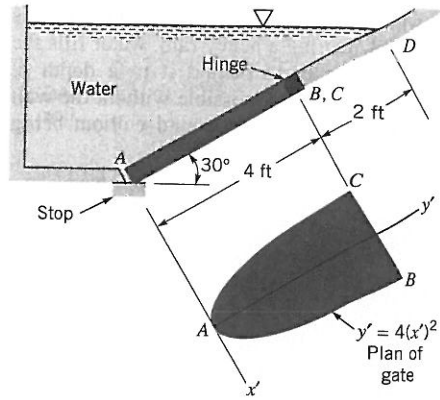
■ **Figure P2.102**

2.103 A thin 4-ft-wide, right-angle gate with negligible mass is free to pivot about a frictionless hinge at point O, as shown in Fig. P2.103. The horizontal portion of the gate covers a 1-ft-diameter drain pipe that contains air at atmospheric pressure. Determine the minimum water depth, h, at which the gate will pivot to allow water to flow into the pipe.



■ **Figure P2.103**

2.104 The inclined face AD of the tank of Fig. P2.104 is a plane surface containing a gate ABC, which is hinged along line BC. The shape of the gate is shown in the plan view. If the tank contains water, determine the magnitude of the force that the water exerts on the gate.



■ **Figure P2.104**

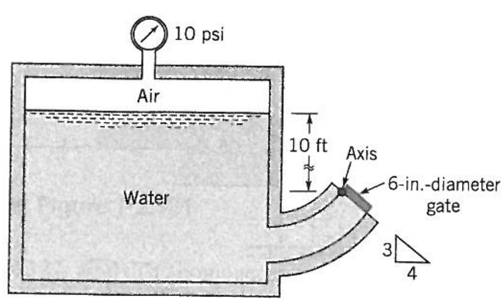
2.105 An open rectangular tank is 2 m wide and 4 m long. The tank contains water to a depth of 2 m and oil ($SG = 0.8$) on top of the water to a depth of 1 m. Determine the magnitude and location of the resultant fluid force acting on one end of the tank.

***2.106** An open rectangular settling tank contains a liquid suspension that at a given time has a specific weight that varies approximately with depth according to the following data:

h (m)	γ (N/m³)
0	10.0
0.4	10.1
0.8	10.2
1.2	10.6
1.6	11.3
2.0	12.3
2.4	12.7
2.8	12.9
3.2	13.0
3.6	13.1

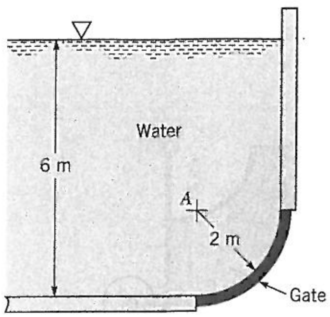
The depth $h = 0$ corresponds to the free surface. Determine, by means of numerical integration, the magnitude and location of the resultant force that the liquid suspension exerts on a vertical wall of the tank that is 6 m wide. The depth of fluid in the tank is 3.6 m.

2.107 The closed vessel of Fig. P2.107 contains water with an air pressure of 10 psi at the water surface. One side of the vessel contains a spout that is closed by a 6-in.-diameter circular gate that is hinged along one side as illustrated. The horizontal axis of the hinge is located 10 ft below the water surface. Determine the minimum torque that must be applied at the hinge to hold the gate shut. Neglect the weight of the gate and friction at the hinge.



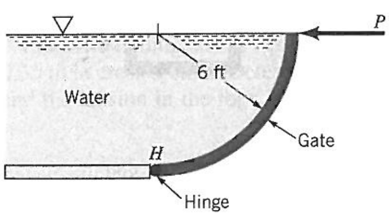
■ **Figure P2.107**

2.116 A 4-m-long curved gate is located in the side of a reservoir containing water as shown in Fig. P2.116. Determine the magnitude of the horizontal and vertical components of the force of the water on the gate. Will this force pass through point A? Explain.



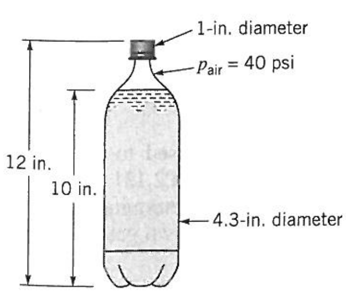
■ **Figure P2.116**

2.117 (WILEY) The 18-ft-long lightweight gate of Fig. P2.117 is a quarter circle and is hinged at H. Determine the horizontal force, P, required to hold the gate in place. Neglect friction at the hinge and the weight of the gate.



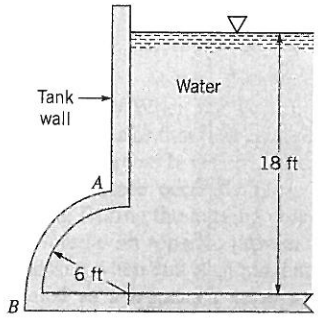
■ **Figure P2.117**

2.118 (Video) The air pressure in the top of the 2-liter pop bottle shown in **Video V2.6** and Fig. P2.118 is 40 psi, and the pop depth is 10 in. The bottom of the bottle has an irregular shape with a diameter of 4.3 in. (**a**) If the bottle cap has a diameter of 1 in. what is the magnitude of the axial force required to hold the cap in place? (**b**) Determine the force needed to secure the bottom 2 in. of the bottle to its cylindrical sides. For this calculation assume the effect of the weight of the pop is negligible. (**c**) By how much does the weight of the pop increase the pressure 2 in. above the bottom? Assume the pop has the same specific weight as that of water.



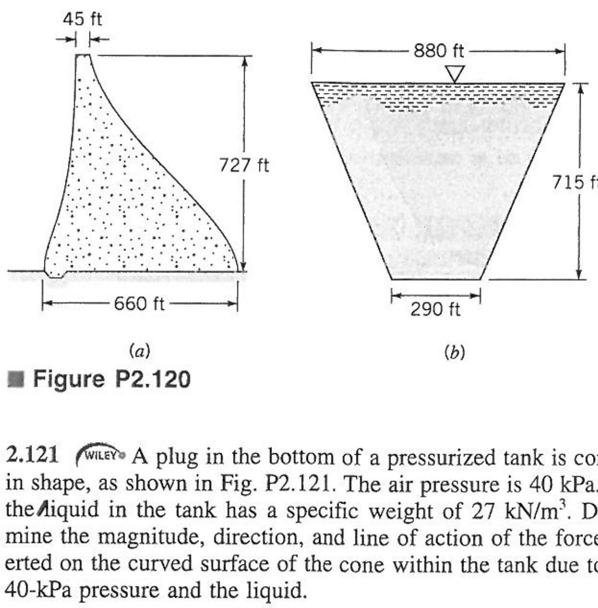
■ **Figure P2.118**

2.119 A tank wall has the shape shown in Fig. P2.119. Determine the horizontal and vertical components of the force of the water on a 4-ft length of the curved section AB.



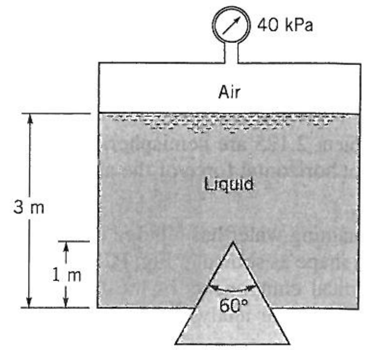
■ **Figure P2.119**

2.120 (Video) Hoover Dam (see **Video 2.5**) is the highest arch-gravity type of dam in the United States. A cross section of the dam is shown in Fig. P2.120(a). The walls of the canyon in which the dam is located are sloped, and just upstream of the dam the vertical plane shown in Figure P2.120(b) approximately represents the cross section of the water acting on the dam. Use this vertical cross section to estimate the resultant horizontal force of the water on the dam, and show where this force acts.



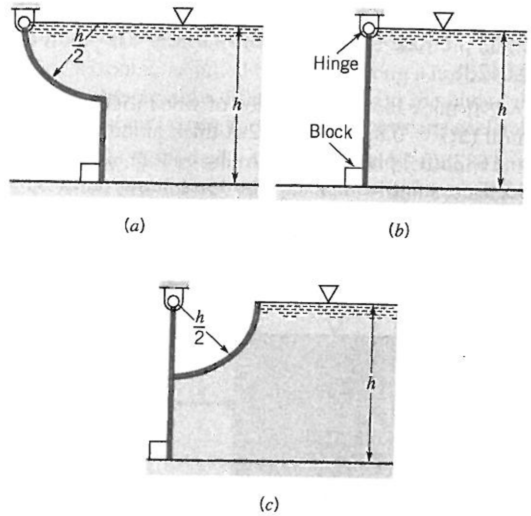
■ **Figure P2.120**

2.121 (WILEY) A plug in the bottom of a pressurized tank is conical in shape, as shown in Fig. P2.121. The air pressure is 40 kPa, and the liquid in the tank has a specific weight of 27 kN/m^3. Determine the magnitude, direction, and line of action of the force exerted on the curved surface of the cone within the tank due to the 40-kPa pressure and the liquid.



■ **Figure P2.121**

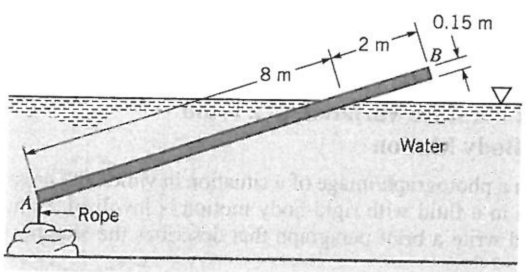
2.122 (WILEY) The homogeneous gate shown in Fig. P2.122 consists of one quarter of a circular cylinder and is used to maintain a water depth of 4 m. That is, when the water depth exceeds 4 m, the gate



■ **Figure P2.131**

2.134 A 3 ft × 3 ft × 3 ft wooden cube (specific weight = 37 lb/ft^3) floats in a tank of water. How much of the cube extends above the water surface? If the tank were pressurized so that the air pressure at the water surface was increased by 1.0 psi (i.e., 1 psig), how much of the cube would extend above the water surface? Explain how you arrived at your answer.

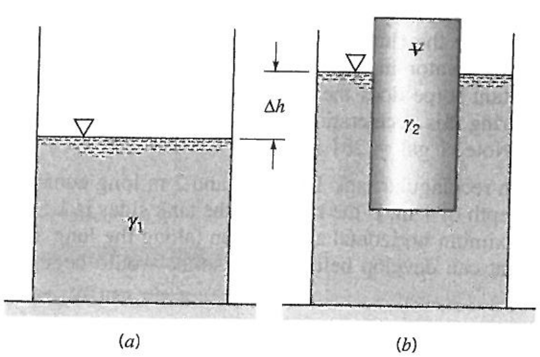
2.135 The homogeneous timber *AB* of Fig. P2.135 is 0.15 m by 0.35 m in cross section. Determine the specific weight of the timber and the tension in the rope.



■ **Figure P2.135**

2.136 A river barge, whose cross section is approximately rectangular, carries a load of grain. The barge is 28 ft wide and 90 ft long. When unloaded, its draft (depth of submergence) is 5 ft. and with the load of grain the draft is 7 ft. Determine: (**a**) the unloaded weight of the barge, and (**b**) the weight of the grain.

2.137 A tank of cross-sectional area *A* is filled with a liquid of specific weight γ_1 as shown in Fig. P2.137*a*. Show that when a cylinder of specific weight γ_2 and volume $\mathcal{V}$ is floated in the liquid (see Fig. P2.137*b*), the liquid level rises by an amount $\Delta h = (\gamma_2/\gamma_1)\,\mathcal{V}/A$.

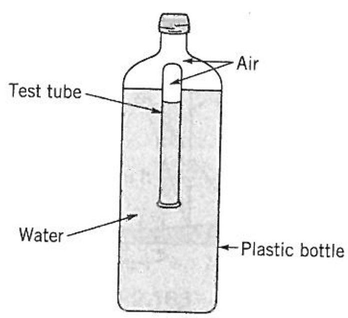


■ **Figure P2.137**

2.138 When the Tucurui Dam was constructed in northern Brazil, the lake that was created covered a large forest of valuable hardwood trees. It was found that even after 15 years underwater the trees were perfectly preserved and underwater logging was started. During the logging process a tree is selected, trimmed, and anchored with ropes to prevent it from shooting to the surface like a missile when cut. Assume that a typical large tree can be approximated as a truncated cone with a base diameter of 8 ft, a top diameter of 2 ft, and a height of 100 ft. Determine the resultant vertical force that the ropes must resist when the completely submerged tree is cut. The specific gravity of the wood is approximately 0.6.

†**2.139** Estimate the minimum water depth needed to float a canoe carrying two people and their camping gear. List all assumptions and show all calculations.

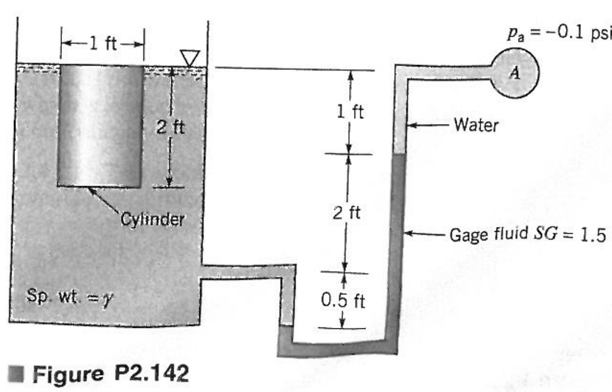
2.140 An inverted test tube partially filled with air floats in a plastic water-filled soft drink bottle as shown in **Video V2.7** and Fig. P2.140. The amount of air in the tube has been adjusted so that it just floats. The bottle cap is securely fastened. A slight squeezing of the plastic bottle will cause the test tube to sink to the bottom of the bottle. Explain this phenomenon.



■ **Figure P2.140**

2.141 An irregularly shaped piece of a solid material weighs 8.05 lb in air and 5.26 lb when completely submerged in water. Determine the density of the material.

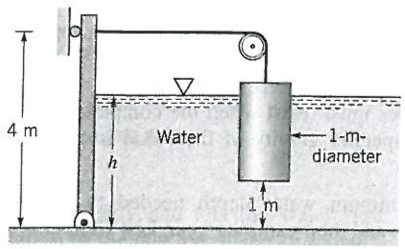
2.142 A 1-ft-diameter, 2-ft-long cylinder floats in an open tank containing a liquid having a specific weight γ. A U-tube manometer is connected to the tank as shown in Fig. P2.142. When the



■ **Figure P2.142**

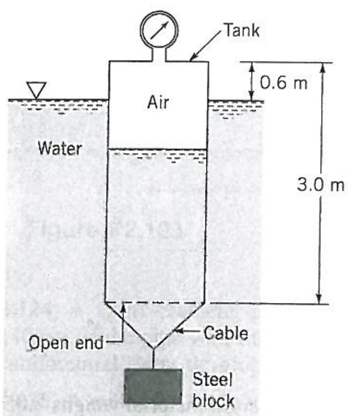
pressure in pipe A is 0.1 psi below atmospheric pressure, the various fluid levels are as shown. Determine the weight of the cylinder. Note that the top of the cylinder is flush with the fluid surface.

2.143 A 1-m-diameter cylindrical mass, M, is connected to a 2-m-wide rectangular gate as shown in Fig. P2.143. The gate is to open when the water level, h, drops below 2.5 m. Determine the required value for M. Neglect friction at the gate hinge and the pulley.



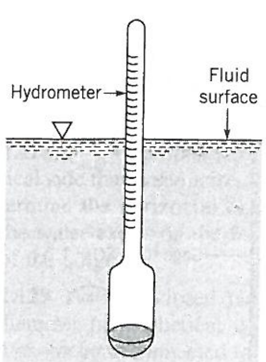
■ **Figure P2.143**

2.144 The thin-walled, 1-m-diameter tank of Fig. P2.144 is closed at one end and has a mass of 90 kg. The open end of the tank is lowered into the water and held in the position shown by a steel block having a density of 7840 kg/m^3. Assume that the air that is trapped in the tank is compressed at a constant temperature. Determine: **(a)** the reading on the pressure gage at the top of the tank, and **(b)** the volume of the steel block.



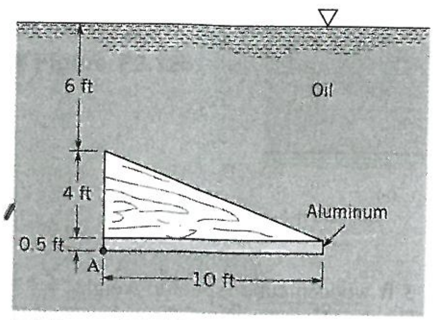
■ **Figure P2.144**

2.145 When a hydrometer (see Fig. P2.145 and **Video V2.8**) having a stem diameter of 0.30 in. is placed in water, the stem protrudes 3.15 in. above the water surface. If the water is replaced with a liquid having a specific gravity of 1.10, how much of the stem would protrude above the liquid surface? The hydrometer weighs 0.042 lb.



■ **Figure P2.145**

2.146 A 2-ft-thick block constructed of wood ($SG = 0.6$) is submerged in oil ($SG = 0.8$) and has a 2-ft-thick aluminum (specific weight = 168 lb/ft^3) plate attached to the bottom as indicated in Fig. P2.146. Determine completely the force required to hold the block in the position shown. Locate the force with respect to point A.



■ **Figure P2.146**

2.147 (See Fluids in the News article titled **"Concrete canoes,"** Section 2.11.1.) How much extra water does a 147-lb concrete canoe displace compared to an ultralightweight 38-lb Kevlar canoe of the same size carrying the same load?

2.148 An iceberg (specific gravity 0.917) floats in the ocean (specific gravity 1.025). What percent of the volume of the iceberg is under water?

Section 2.12 Pressure Variation in a Fluid with Rigid-Body Motion

2.149 Obtain a photograph/image of a situation in which the pressure variation in a fluid with rigid-body motion is involved. Print this photo and write a brief paragraph that describes the situation involved.

2.150 It is noted that while stopping, the water surface in a glass of water sitting in the cup holder of a car is slanted at an angle of 15° relative to the horizontal street. Determine the rate at which the car is decelerating.

2.151 An open container of oil rests on the flatbed of a truck that is traveling along a horizontal road at 55 mi/hr. As the truck slows uniformly to a complete stop in 5 s, what will be the slope of the oil surface during the period of constant deceleration?

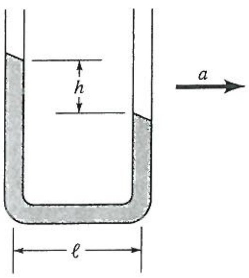
2.152 A 5-gal, cylindrical open container with a bottom area of 120 in.^{2} is filled with glycerin and rests on the floor of an elevator. **(a)** Determine the fluid pressure at the bottom of the container when the elevator has an upward acceleration of 3 ft/s^2. **(b)** What resultant force does the container exert on the floor of the elevator during this acceleration? The weight of the container is negligible. (Note: 1 gal = 231 in.^{3})

2.153 An open rectangular tank 1 m wide and 2 m long contains gasoline to a depth of 1 m. If the height of the tank sides is 1.5 m, what is the maximum horizontal acceleration (along the long axis of the tank) that can develop before the gasoline would begin to spill?

2.154 If the tank of Problem 2.153 slides down a frictionless plane that is inclined at 30° with the horizontal, determine the angle the free surface makes with the horizontal.

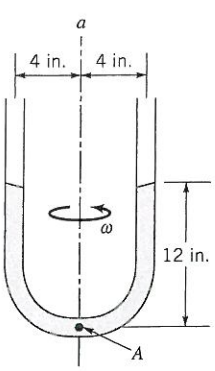
2.155 A closed cylindrical tank that is 8 ft in diameter and 24 ft long is completely filled with gasoline. The tank, with its long axis horizontal, is pulled by a truck along a horizontal surface. Determine the pressure difference between the ends (along the long axis of the tank) when the truck undergoes an acceleration of 5 ft/s^2.

2.156 The open U-tube of Fig. P2.156 is partially filled with a liquid. When this device is accelerated with a horizontal acceleration a, a differential reading h develops between the manometer legs which are spaced a distance ℓ apart. Determine the relationship between a, ℓ, and h.



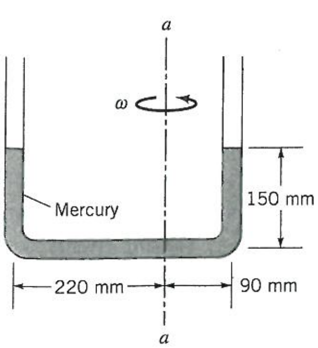
■ Figure P2.156

2.157 The U-tube of Fig. P2.157 is partially filled with water and rotates around the axis a–a. Determine the angular velocity that will cause the water to start to vaporize at the bottom of the tube (point A).



■ Figure P2.157

2.158 The U-tube of Fig. P2.158 contains mercury and rotates about the off-center axis a–a. At rest, the depth of mercury in each leg is 150 mm as illustrated. Determine the angular velocity for which the difference in heights between the two legs is 75 mm.



■ Figure P2.158

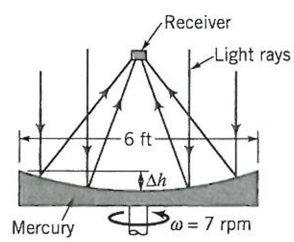
2.159 An open 1-m-diameter tank contains water at a depth of 0.7 m when at rest. As the tank is rotated about its vertical axis the center of the fluid surface is depressed. At what angular velocity will the bottom of the tank first be exposed? No water is spilled from the tank.

2.160 An open, 2-ft-diameter tank contains water to a depth of 3 ft when at rest. If the tank is rotated about its vertical axis with an angular velocity of 180 rev/min, what is the minimum height of the tank walls to prevent water from spilling over the sides?

2.161 A child riding in a car holds a string attached to a floating, helium-filled balloon. As the car decelerates to a stop, the balloon tilts backwards. As the car makes a right-hand turn, the balloon tilts to the right. On the other hand, the child tends to be forced forward as the car decelerates and to the left as the car makes a right-hand turn. Explain these observed effects on the balloon and child.

2.162 A closed, 0.4-m-diameter cylindrical tank is completely filled with oil ($SG = 0.9$) and rotates about its vertical longitudinal axis with an angular velocity of 40 rad/s. Determine the difference in pressure just under the vessel cover between a point on the circumference and a point on the axis.

2.163 (See Fluids in the News article titled **"Rotating mercury mirror telescope,"** Section 2.12.2.) The largest liquid mirror telescope uses a 6-ft-diameter tank of mercury rotating at 7 rpm to produce its parabolic-shaped mirror as shown in Fig. P2.163. Determine the difference in elevation of the mercury, Δh, between the edge and the center of the mirror.



■ Figure P2.163

■ Lab Problems

2.1 LP This problem involves the force needed to open a gate that covers an opening in the side of a water-filled tank. To proceed with this problem, go to Appendix H which is located in WileyPLUS or on the book's web site, www.wiley.com/college/munson.

2.2 LP This problem involves the use of a cleverly designed apparatus to investigate the hydrostatic, pressure force on a submerged rectangle. To proceed with this problem, go to Appendix H which is located in *WileyPLUS* or on the book's web site, www.wiley.com/college/munson.

2.3 LP This problem involves determining the weight needed to hold down an open-bottom box that has slanted sides when the box is filled with water. To proceed with this problem, go to Appendix H which is located in *WileyPLUS* or on the book's web site, www.wiley.com/college/munson.

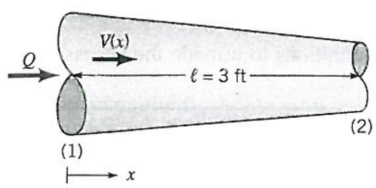
2.4 LP This problem involves the use of a pressurized air pad to provide the vertical force to support a given load. To proceed with this problem, go to Appendix H which is located in *WileyPLUS* or on the book's web site, www.wiley.com/college/munson.

■ Lifelong Learning Problems

2.1 LL Although it is relatively easy to calculate the net hydrostatic pressure force on a dam, it is not necessarily easy to design and

3.2 Air flows steadily along a streamline from point (1) to point (2) with negligible viscous effects. The following conditions are measured: At point (1) $z_1 = 2$ m and $p_1 = 0$ kPa; at point (2) $z_2 = 10$ m, $p_2 = 20$ N/m^2, and $V_2 = 0$. Determine the velocity at point (1).

3.3 Water flows steadily through the variable area horizontal pipe shown in Fig. P3.3. The centerline velocity is given by $\mathbf{V} = 10(1 + x)\hat{\mathbf{i}}$ ft/s, where x is in feet. Viscous effects are neglected. **(a)** Determine the pressure gradient, $\partial p/\partial x$, (as a function of x) needed to produce this flow. **(b)** If the pressure at section (1) is 50 psi, determine the pressure at (2) by (i) integration of the pressure gradient obtained in **(a)**, (ii) application of the Bernoulli equation.



■ **Figure P3.3**

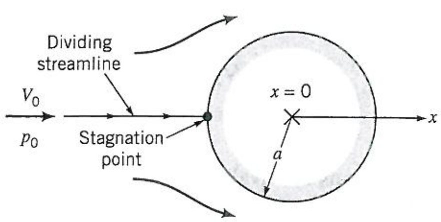
3.4 What pressure gradient along the streamline, dp/ds, is required to accelerate water in a horizontal pipe at a rate of 30 m/s^2?

3.5 At a given location the airspeed is 20 m/s and the pressure gradient along the streamline is 100 N/m^3. Estimate the airspeed at a point 0.5 m farther along the streamline.

3.6 What pressure gradient along the streamline, dp/ds, is required to accelerate water upward in a vertical pipe at a rate of 30 ft/s^2? What is the answer if the flow is downward?

3.7 The Bernoulli equation is valid for steady, inviscid, incompressible flows with constant acceleration of gravity. Consider flow on a planet where the acceleration of gravity varies with height so that $g = g_0 - cz$, where g_0 and c are constants. Integrate "$\mathbf{F} = m\mathbf{a}$" along a streamline to obtain the equivalent of the Bernoulli equation for this flow.

3.8 An incompressible fluid flows steadily past a circular cylinder as shown in Fig. P3.8. The fluid velocity along the dividing streamline ($-\infty \leq x \leq -a$) is found to be $V = V_0(1 - a^2/x^2)$, where a is the radius of the cylinder and V_0 is the upstream velocity. **(a)** Determine the pressure gradient along this streamline. **(b)** If the upstream pressure is p_0, integrate the pressure gradient to obtain the pressure $p(x)$ for $-\infty \leq x \leq -a$. **(c)** Show from the result of part **(b)** that the pressure at the stagnation point ($x = -a$) is $p_0 + \rho V_0^2/2$, as expected from the Bernoulli equation.



■ **Figure P3.8**

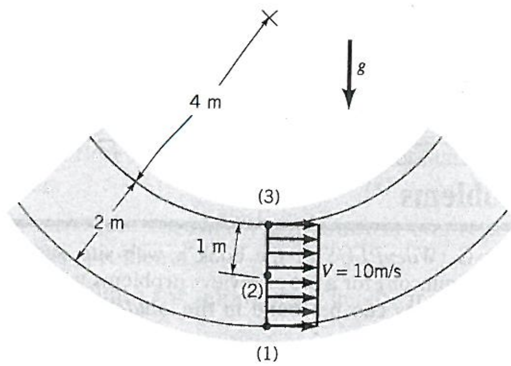
3.9 Consider a compressible liquid that has a constant bulk modulus. Integrate "$\mathbf{F} = m\mathbf{a}$" along a streamline to obtain the equivalent of the Bernoulli equation for this flow. Assume steady, inviscid flow.

Section 3.3 F = *m*a Normal to a Streamline

3.10 Obtain a photograph/image of a situation in which Newton's second law applied across the streamlines (as given by Eq. 3.12) is important. Print this photo and write a brief paragraph that describes the situation involved.

3.11 Air flows along a horizontal, curved streamline with a 20 ft radius with a speed of 100 ft/s. Determine the pressure gradient normal to the streamline.

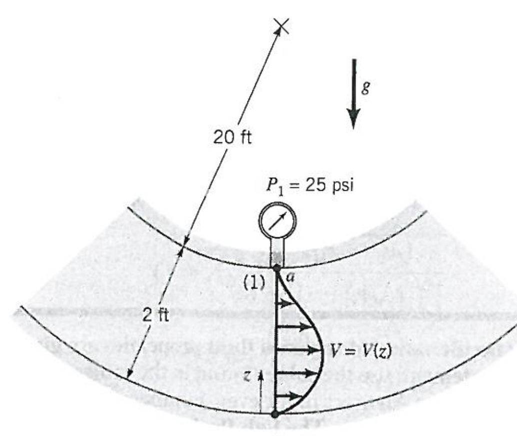
3.12 Water flows around the vertical two-dimensional bend with circular streamlines and constant velocity as shown in Fig. P3.12. If the pressure is 40 kPa at point (1), determine the pressures at points (2) and (3). Assume that the velocity profile is uniform as indicated.



■ **Figure P3.12**

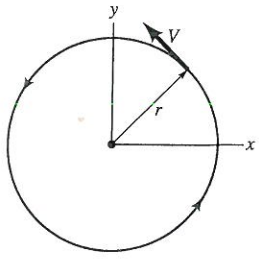
3.13 Water flows around the vertical two-dimensional bend with circular streamlines as is shown in Fig. P3.13. The pressure at point (1) is measured to be $p_1 = 25$ psi and the velocity across section a–a is as indicated in the table. Calculate and plot the pressure across section a–a of the channel [$p = p(z)$ for $0 \leq z \leq 2$ ft].

z (ft)	V (ft/s)
0	0
0.2	8.0
0.4	14.3
0.6	20.0
0.8	19.5
1.0	15.6
1.2	8.3
1.4	6.2
1.6	3.7
1.8	2.0
2.0	0



■ **Figure P3.13**

3.14 Water in a container and air in a tornado flow in horizontal circular streamlines of radius r and speed V as shown in **Video V3.6** and Fig. P3.14. Determine the radial pressure gradient, $\partial p/\partial r$, needed for the following situations: **(a)** The fluid is water with $r = 3$ in. and $V = 0.8$ ft/s. **(b)** The fluid is air with $r = 300$ ft and $V = 200$ mph.



■ Figure P3.14

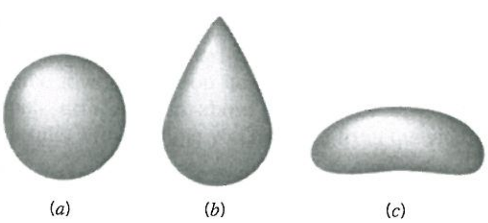
3.15 Air flows smoothly over the hood of your car and up past the windshield. However, a bug in the air does not follow the same path; it becomes splattered against the windshield. Explain why this is so.

Section 3.5 Static, Stagnation, Dynamic, and Total Pressure

3.16 Obtain a photograph/image of a situation in which the concept of the stagnation pressure is important. Print this photo and write a brief paragraph that describes the situation involved.

3.17 At a given point on a horizontal streamline in flowing air, the static pressure is −2.0 psi (i.e., a vacuum) and the velocity is 150 ft/s. Determine the pressure at a stagnation point on that streamline.

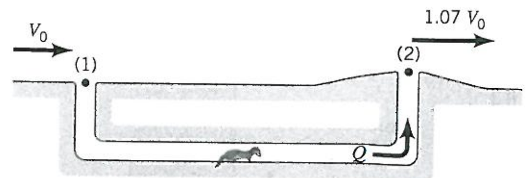
†3.18 A drop of water in a zero-g environment (as in the International Space Station) will assume a spherical shape as shown in Fig. P3.18*a*. A raindrop in the cartoons is typically drawn as in Fig. P3.18*b*. The shape of an actual raindrop is more nearly like that shown in Fig. 3.18*c*. Discuss why these shapes are as indicated.



■ Figure P3.18

3.19 When an airplane is flying 200 mph at 5000-ft altitude in a standard atmosphere, the air velocity at a certain point on the wing is 273 mph relative to the airplane. **(a)** What suction pressure is developed on the wing at that point? **(b)** What is the pressure at the leading edge (a stagnation point) of the wing?

3.20 Some animals have learned to take advantage of the Bernoulli effect without having read a fluid mechanics book. For example, a typical prairie dog burrow contains two entrances—a flat front door and a mounded back door as shown in Fig. P3.20. When the wind blows with velocity V_0 across the front door, the average velocity across the back door is greater than V_0 because of the mound. Assume the air velocity across the back door is $1.07V_0$. For a wind velocity of 6 m/s, what pressure differences, $p_1 - p_2$, are generated to provide a fresh airflow within the burrow?



■ Figure P3.20

3.21 A loon is a diving bird equally at home "flying" in the air or water. What swimming velocity under water will produce a dynamic pressure equal to that when it flies in the air at 40 mph?

†3.22 Estimate the pressure on your hand when you hold it in the stream of air coming from the air hose at a filling station. List all assumptions and show calculations. Warning: Do not try this experiment; it can be dangerous!

3.23 A person holds her hand out of an open car window while the car drives through still air at 65 mph. Under standard atmospheric conditions, what is the maximum pressure on her hand? What would be the maximum pressure if the "car" were an Indy 500 racer traveling 220 mph?

3.24 A Pitot-static tube is used to measure the velocity of helium in a pipe. The temperature and pressure are 40 °F and 25 psia. A water manometer connected to the Pitot-static tube indicates a reading of 2.3 in. Determine the helium velocity. Is it reasonable to consider the flow as incompressible? Explain.

3.25 A Bourdon-type pressure gage is used to measure the pressure from a Pitot tube attached to the leading edge of an airplane wing. The gage is calibrated to read in miles per hour at standard sea level conditions (rather than psi). If the airspeed meter indicates 150 mph when flying at an altitude of 10,000 ft, what is the true airspeed?

†3.26 Estimate the force of a hurricane strength wind against the side of your house. List any assumptions and show all calculations.

3.27 A 40-mph wind blowing past your house speeds up as it flows up and over the roof. If elevation effects are negligible, determine **(a)** the pressure at the point on the roof where the speed is 60 mph if the pressure in the free stream blowing toward your house is 14.7 psia. Would this effect tend to push the roof down against the house, or would it tend to lift the roof? **(b)** Determine the pressure on a window facing the wind if the window is assumed to be a stagnation point.

3.28 (See Fluids in the News article titled "**Pressurized eyes,**" Section 3.5.) Determine the air velocity needed to produce a stagnation pressure equal to 10 mm of mercury.

Section 3.6.1 Free Jets

3.29 Water flows through a hole in the bottom of a large, open tank with a speed of 8 m/s. Determine the depth of water in the tank. Viscous effects are negligible.

†3.30 Estimate the pressure needed at the pumper truck in order to shoot water from the street level onto a fire on the roof of a five-story building. List all assumptions and show all calculations.

3.31 Water flows from the faucet on the first floor of the building shown in Fig. P3.31 with a maximum velocity of 20 ft/s. For steady inviscid flow, determine the maximum water velocity