9.2 Fluids: Pressure and Pascal's Principle

25. **MC** For a liquid in an open container, the total pressure at any depth depends on (a) atmospheric pressure, (b) liquid density, (c) acceleration due to gravity, (d) all of the preceding. (d)

26. **MC** For the pressure–depth relationship for a fluid ($p = \rho gh$), it is assumed that (a) the pressure decreases with depth, (b) a pressure difference depends on the reference point, (c) the fluid density is constant, (d) the relationship applies only to liquids. (c)

27. **MC** When measuring automobile tire pressure, what type of pressure is this: (a) gauge, (b) absolute, (c) relative, or (d) all of the preceding? (a)

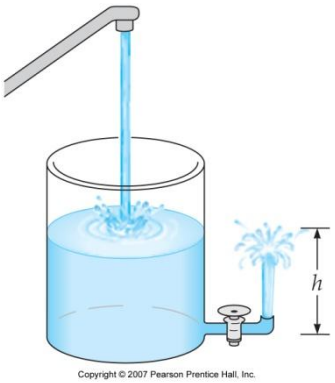
35. **IE** ● In his original barometer, Pascal used water instead of mercury. (a) Water is less dense than mercury, so the water barometer would have (1) a higher height than, (2) a lower height than, or (3) the same height as the mercury barometer. Why? (b) How high would the water column have been? (a) (1) a higher height than (b) 10 m

36. ● If you dive to 10 m below the surface of a lake, (a) what is the pressure due to the water alone? (b) What is the total or absolute pressure at that depth? (a) 9.8×10^4 Pa (b) 2.0×10^5 Pa

39. ● The gauge pressure in both tires of a bicycle is 690 kPa. If the bicycle and the rider have a combined mass of 90.0 kg, what is the area of contact of *each* tire with the ground? (Assume that each tire supports half the total weight of the bicycle.) 6.39×10^{-4} m^2

44. ●● To drink a soda (assume same density as water) through a straw requires you to lower the pressure at the top of the straw. What does the pressure need to be at the top of a straw that is 15.0 cm above the surface of the soda in order to get soda to your lips? 9.98×10^4 Pa

46. ●● Here is a demonstration Pascal used to show the importance of a fluid's pressure on the fluid's depth (Fig. 9.31): An oak barrel with a lid of area 0.20 m^2 is filled with water. A long, thin tube of cross-sectional area 5.0×10^{-5} m^2 is inserted into a hole at the center of the lid, and water is poured into the tube. When the water reaches 12 m high, the barrel bursts. (a) What was the weight of the water in the tube? (b) What was the pressure of the water on the lid of the barrel? (c) What was the net force on the lid due to the water pressure? (a) 5.9 N (b) 1.2×10^5 Pa (c) 2.4×10^4 N



50. ●● A cylinder has a diameter of 15 cm (^Fig. 9.32). The water level in the cylinder is maintained at a constant height of 0.45 m. If the diameter of the spout pipe is 0.50 cm, how high is *h*, the vertical stream of water? (Assume the water to be an ideal fluid.) 0.45 m

53. ●● A hydraulic lift in a garage has two pistons: a small one of cross-sectional area 4.00 cm^2 and a large one of cross-sectional area 250 cm^2. (a) If this lift is designed to raise a 3500-kg car, what minimum force must be applied to the small piston? (b) If the force is applied through compressed air, what must be the minimum air pressure applied to the small piston? (a) 549 N (b) 1.37×10^6 Pa

9.3 Buoyancy and Archimedes' Principle

57. **MC** A wood block floats in a swimming pool. The buoyant force exerted on the block by water depends on (a) the volume of water in the pool, (b) the volume of the wood block, (c) the volume of the wood block under water, (d) all of the preceding. (c)

58. **MC** If a submerged object displaces an amount of liquid of greater weight than its own and is then released, the object will (a) rise to the surface and float, (b) sink, (c) remain in equilibrium at its submerged position. (a)

59. **MC** Comparing an object's density (ρ_o) to that of a fluid (ρ_f), what is the condition for the object to float: (a) $\rho_o < \rho_f$, or (b) $\rho_f < \rho_o$? (a)

66. ● Suppose that Archimedes found that the king's crown had a mass of 0.750 kg and a volume of 3.980×10^{-5} m^3. (a) What simple approach did Archimedes use to determine the crown's volume? (b) Was the crown pure gold? (a) water displacement (b) no

67. ● A rectangular boat, as illustrated in ▼Fig. 9.35, is overloaded such that the water level is just 1.0 cm below the top of the boat. What is the combined mass of the people and the boat? 2.6×10^3 kg

69. ●● When a 0.80-kg crown is submerged in water, its apparent weight is measured to be 7.3 N. Is the crown pure gold? No

70. ●● A steel cube 0.30 m on each side is suspended from a scale and immersed in water. What will the scale read? 1.8×10^3 N

73. ●● An aquarium is filled with a liquid. A cork cube, 10.0 cm on a side, is pushed and held at rest completely submerged in the liquid. It takes a force of 7.84 N to hold it under the liquid. If the density of cork is 200 kg/m^3, find the density of the liquid. 1.00×10^3 kg/m^3 (probably H_2O)

76. ●●● A girl floats in a lake with 97% of her body beneath the water. What are (a) her mass density and (b) her weight density? (a) 9.7×10^2 kg/m^3 (b) 9.5×10^3 N/m^3

9.4 Fluid Dynamics and Bernoulli's Equation

79. **MC** If the speed at some point in a fluid changes with time, the fluid flow is *not* (a) steady, (b) irrotational, (c) incompressible, (d) nonviscous. (a)

80. **MC** An ideal fluid is not (a) steady, (b) compressible, (c) irrotational, or (d) nonviscous. (b)

81. **MC** Bernoulli's equation is based primarily on (a) Newton's laws, (b) conservation of momentum, (c) a nonideal fluid, (d) conservation of energy. (d)

82. **MC** According to Bernoulli's equation, if the pressure on the liquid in Fig. 9.19 is increased, (a) the flow speed always increases, (b) the height of the liquid always increases, (c) both the flow speed and the height of the liquid may increase, (d) none of the preceding. (c)

87. ● An ideal fluid is moving at 3.0 m/s in a section of a pipe of radius 0.20 m. If the radius in another section is 0.35 m, what is the flow speed there? 0.98 m/s

90. ●● The blood flow speed through an aorta with a radius of 1.00 cm is 0.265 m/s. If hardening of the arteries causes the aorta to be constricted to a radius of 0.800 cm, by how much would the blood flow speed increase? 0.149 m/s

91. ●● Using the data and result of Exercise 90, calculate the pressure difference between the two areas of the aorta. (Blood density: $\rho = 1.06\times10^3$ kg/m^3.) 53.6 Pa

94. ●● The spout heights in the a container are 10 cm, 20 cm, 30 cm, and 40 cm. The water level is maintained at a 45-cm height by an outside supply. (a) What is the speed of the water out of each hole? (b) Which water stream has the greatest range relative to the base of the container? Justify your answer. (a) 0.99 m/s; 1.7 m/s; 2.2 m/s; 2.6 m/s (b) 0.45 m, from $y = 20$ cm

96. ●●● As a fire-fighting method, a homeowner in the deep woods rigs up a water pump to bring water from a lake that is 10.0 m below the level of the house. If the pump is capable of producing a gauge pressure of 140 kPa, at what rate (in L/s) can water be pumped to the house assuming the hose has a radius of 5.00 cm? 71.9 L/s

107. A rock is suspended from a string in air. The tension in the string is 2.94 N. When the rock is then dunked into a liquid, and the rope let go slack, it sinks and comes to rest on a spring whose spring constant is 200 N/m. The spring's final compression is 1.00 cm. If the density of the rock is known to be 2500 kg/m^3, what is the density of the liquid? 8.0×10^2 kg/m^3