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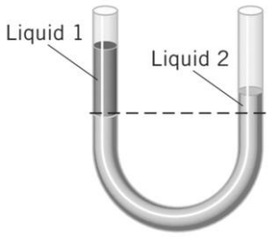
TUTORIAL MODULE 7, ELEMENTARY PHYSICS 1B (FI-1102)
1ST SEMESTER, ACADEMIC YEAR 2020-2021
TOPIC: Fluids

A. QUESTION

1. Two objects differ in density and mass. Object A has a mass that eight times the mass of object B. The density of object A is four times the density of object B. How do their volumes compare? (a) $V_A = \frac{1}{2}V_B$, (b) $V_A = V_B$, (c) $V_A = 2V_B$, (d) Not enough information is given to compare their volumes.

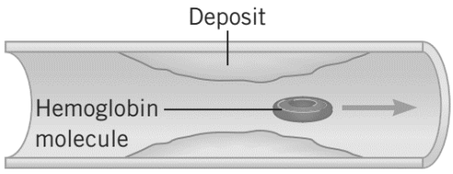
2. As you climb a mountain, your ears "pop" because of the changes in atmospheric pressure. In which direction, outward or inward, does your eardrum move (a) as you climb up and (b) as you climb down?

3. Two liquids, 1 and 2, are in equilibrium in a U-tube that is open at both ends, as in the drawing. The liquids do not mix, and liquid 1 rests on top of liquid 2. How is the density ρ_1 of liquid 1 related to the density ρ_2 of liquid 2? (a) ρ_1 is equal ρ_2 because the liquids are in equilibrium. (b) ρ_1 is greater than ρ_2. (c) ρ_1 is less than ρ_2. (d) There is not enough information to tell which liquid has the greater density.



4. As a person dives toward the bottom of a swimming pool, the pressure increases noticeably. Does the buoyant force acting on her also increase? Neglect any change in water density with depth.

5. Blood flows through a section of a horizontal artery that is partially blocked by a deposit along the artery wall. A hemoglobin molecule moves from the narrow region into the wider region. What happens to the pressure acting on the molecule? (a) The pressure increases. (b) The pressure decreases. (c) There is no change in the pressure.

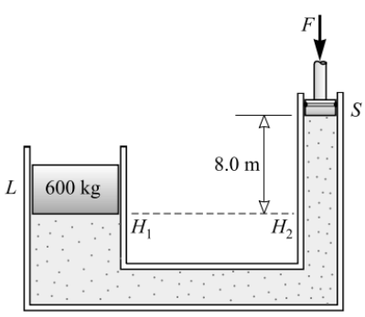


B. PROBLEMS

1. An office window has dimensions 3.4 m by 2.1 m. As a result of the passage of a storm, the outside air pressure drops to 0.96 atm, but inside the pressure is held at 1.0 atm. What net force pushes out on the window?

2. The maximum depth d_{max} that a diver can snorkel is set by the density of the water and the fact that human lungs can function against a maximum pressure difference (between inside and outside the chest cavity) of 0.050 atm. What is the difference in d_{max} for fresh water ($\rho = 0{,}998 \times 10^3$ kg/m^3) and the water of the Dead Sea (the saltiest natural water in the world, with density of 1.5×10^3 kg/m^3)?

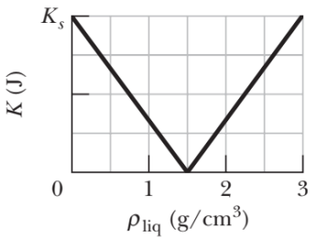
3. For the system shown in figure, the cylinder on the left, at L, has a mass of 600 kg and a cross-sectional area of 800 cm^2. The piston on the right, at S, has a cross-sectional area of 25 cm^2 and a negligible weight. If apparatus is filled with oil ($\rho_{oil} = 0{,}78$ g/cm^3), find the force F required to hold the system, in equilibrium as shown.



4. A rock is suspended by a light string. When the rock is in the air, the tension in the string is 39.2 N. When the rock is totally immersed in water ($\rho_{water} = 10^3$ kg/m^3), the tension is 28.4 N. When the rock is totally immersed in an unknown liquid, the tension is 18.6 N. What is the density of the unknown liquid?

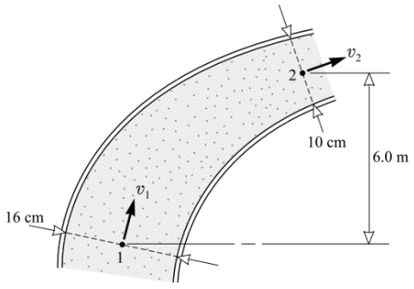
5. A plastic ball has radius 12.0 cm and floats in water ($\rho_{water} = 10^3$ kg/m^3) with 24.0% of its volume submerged. (a) What force must you apply to the ball to hold it at rest totally below the surface of the water? (b) If you let go of the ball, what is its acceleration the instant you release it?

6. A small solid ball is released from rest while fully submerged in a liquid and then its kinetic energy is measured when it has moved 4.0 cm in the liquid. Figure gives the results after many liquids are used: The kinetic energy K is plotted versus the liquid density ρ_{liq}, and $K_s = 1.60$ J sets the scale on the vertical axis. What are (a) the density and (b) the volume of the ball?

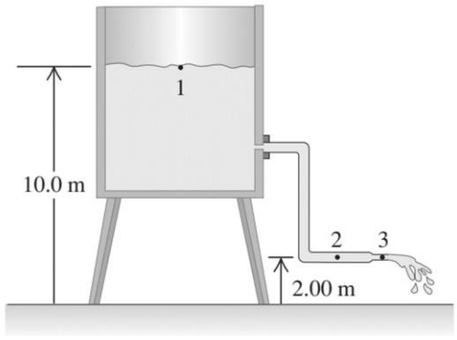


7. Water is flowing in a pipe with a varying cross-sectional area, and at all points the water completely fills the pipe. At point 1 the cross-sectional area of the pipe is 0.070 m^2 and the magnitude of the fluid velocity is 3.5 m/s. (a) What is the fluid speed at points in the pipe where the cross-sectional area is (i) 0.105 m^2 and (ii) 0.047 m^2 (b) Calculate the volume of water discharged from the open end of the pipe in 1.00 hour.

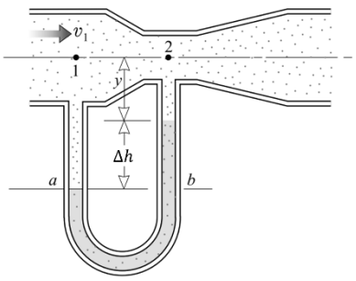
8. The pipe shown in figure has a diameter of 16 cm at section 1 and 10 cm at section 2. At section 1 the pressure is 200 kPa. Point 2 is 6.0 m higher than point 1. When oil of density 800 kg/m^3 flows at a rate of 0.030 m^3/s, find the pressure at point 2 if viscous effects are negligible.



9. Water ($\rho = 10^3$ kg/m^3) flows steadily from an open tank as in figure. The elevation of point 1 is 10.0 m, and the elevation of point 2 and 3 is 2.00 m. The cross-sectional area at point 2 is 0.0480 m^2; at point 3 it is 0.0160 m^2. The area of the tank is very large compared with the cross-sectional area of the pipe. Assuming that Bernoulli's equation applies, compute (a) the discharge rate in cubic meters per second and (b) the gauge pressure at point 2.



10. A venturi meter equipped with a differential mercury manometer is shown in figure. At the inlet, point 1, the diameter is 18 cm, while at the throat, point 2, the diameter is 9.0 cm. What is the flow of water through the meter if the mercury manometer reading is $\Delta h = 33$ cm? The density of water is 1 g/cm^3 and the density of mercury is 13,6 g/cm^3.



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