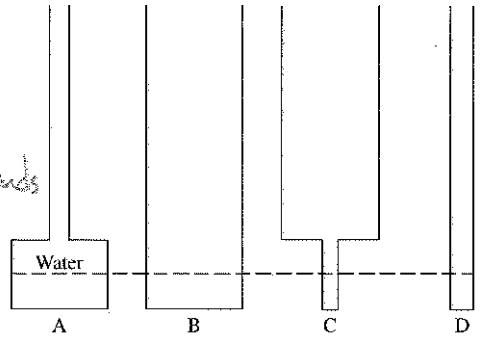
13.2 Pressure

13.3 Measuring and Using Pressure

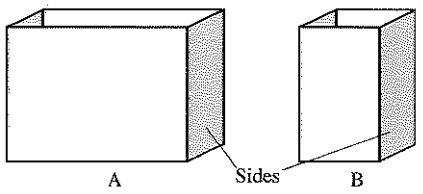
5. Rank in order, from largest to smallest, the pressures p_A to p_D in containers A through D at the depths indicated by the dashed line.

Order: $A = B = C = D$

Explanation:
For open containers of the same fluid, the pressure depends only on the depth, which is the same for all.



6. A and B are rectangular tanks full of water. They have equal depths, equal thicknesses (the dimension into the page) but different widths.



a. Compare the forces the water exerts on the bottoms of the tanks. Is F_A larger than, smaller than, or equal to F_B? Explain.

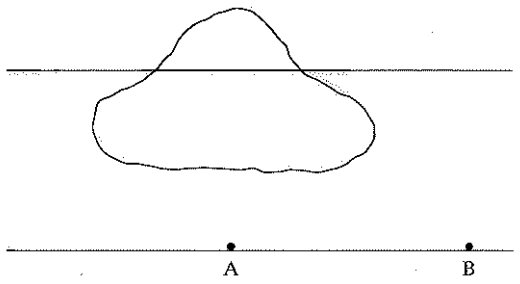
The force on the floor of tank A is greater than that on floor B. The weight of the water in A is greater than the weight of the water in B.

b. Compare the forces the water exerts on the sides of the tanks. Is F_A larger than, smaller than, or equal to F_B? Explain.

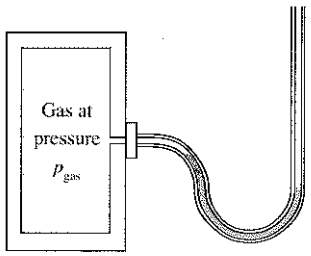
The forces on the sides of the tanks (identified above) are the same since the areas of the sides are the same and the water depth the same.

7. Is p_A larger than, smaller than, or equal to p_B? Explain.

Same. The pressure is distributed throughout the fluid and is equal at equal depths.

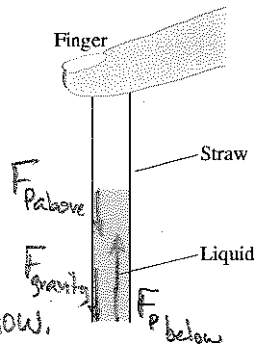


8. The figure shows a manometer like that of Figure 13.10 in the textbook, but here the height of the liquid is higher on the left side than on the right. Is this possible? If not, why not? If so, what can you say about the gas pressure in the tank?



This is possible if the gas in the container is at less than atmosphere pressure.

9. It is well known that you can trap liquid in a drinking straw by placing the tip of your finger over the top while the straw is in the liquid, and then lifting it out. The liquid runs out when you release your finger.



a. What is the *net* force on the cylinder of trapped liquid?

Zero, as evidenced by its equilibrium status (not accelerating). Gravity is balanced by a net pressure force from below.

b. Three forces act on the trapped liquid. Draw and label all three on the figure.

c. Is the gas pressure inside the straw, between the liquid and your finger, greater than, less than, or equal to atmospheric pressure? Explain, basing your explanation on your answers to parts a and b.

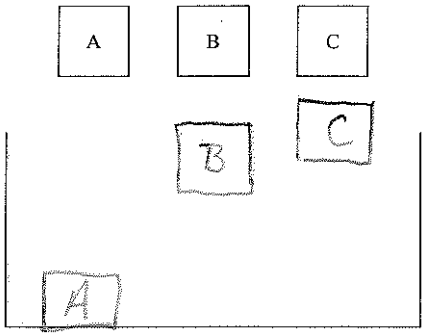
The gas pressure inside the straw is less than atmospheric pressure. The net force due to the pressure forces from above and below points up.

d. If your answer to part c was "greater" or "less," how did the pressure change from the atmospheric pressure that was present when you placed your finger over the top of the straw?

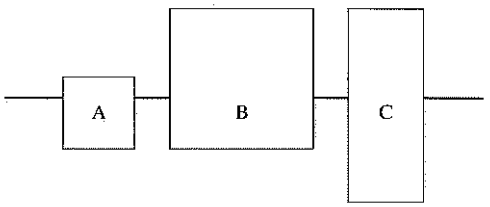
After placing your finger over the top of the straw, as it is removed from the liquid the liquid in the straw moves down the straw, increasing the volume of air trapped in the straw and decreasing its pressure.

13.4 Buoyancy

10. Three blocks of identical size, A, B, and C, are to be gently placed into a large tank of water. Block A has a density of 2 g/cm^3, block B has a density of 0.9 g/cm^3, and block C has a density of 0.5 g/cm^3. On the figure, draw and label each block in its final equilibrium position in the water.



11. Rank in order, from the largest to smallest, the densities of blocks A, B, and C.

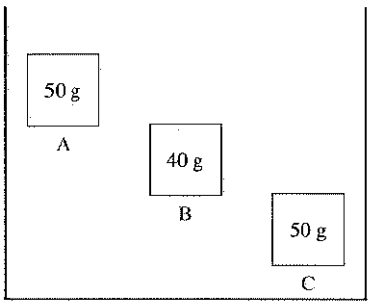


Order: A > C > B

Explanation:

An object has a larger density the larger the fraction submerged when floating.

12. Blocks A, B, and C have the same volume. Rank in order, from largest to smallest, the sizes of the buoyant forces F_A, F_B, and F_C on A, B, and C.



Order: $F_A = F_B = F_C$

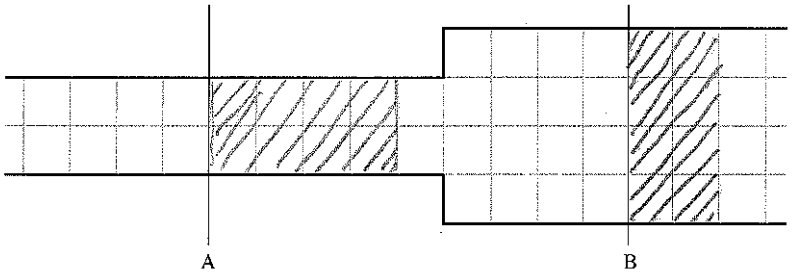
Explanation:

The bouyant force is equal to the weight of fluid displaced. Since the blocks are the same size and all fully submerged, their displacements are all equal.

13.5 Fluids in Motion

13.6 Fluid Dynamics

13. A stream flows from left to right through the constant-depth channel shown below in an overhead view. A 1 m × 1 m grid has been added to facilitate measurement. The fluid's flow speed at A is 2 m/s.

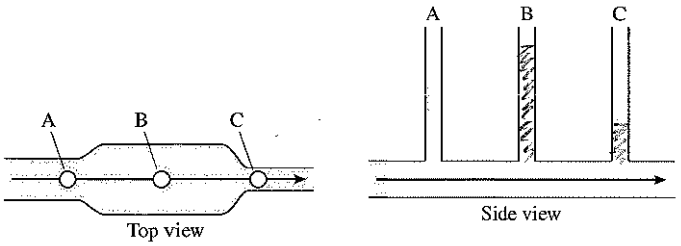


a. Shade in squares to represent the water that has flowed past point A in the last two seconds.

b. Shade in squares to represent the water that has flowed past point B in the last two seconds. Explain.

The same volume of fluid passes through the two cross sections in the same amount of time. This is the basis of the continuity equation.

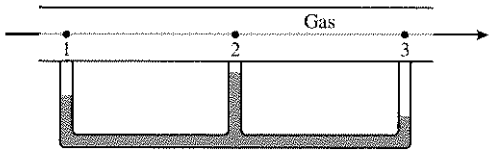
14. Liquid flows through a tube whose width varies as shown. The liquid level is shown for pipe A, which is open at the top, but not for pipes B and C. Draw an appropriate level of liquid in pipes B and C to indicate the fluid pressures at those points.



Slower flow ⇒ higher pressure.
Continuity equation yields

$V_C > V_A > V_B$.

15. Gas flows through a pipe. You can't see into the pipe to know how the inner diameter changes. Rank in order, from largest to smallest, the gas speeds v_1 to v_3 at points 1, 2, and 3.

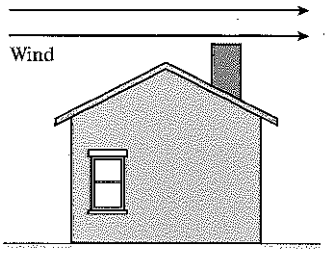


Order: $V_2 > V_1 > V_3$

Explanation:

Point 2 has the lowest pressure because it draws the liquid the furthest up the tube, followed by point 1, then point 3. Lower pressure means higher speed.

16. Wind blows over a house. A window on the ground floor is open. Is there an air flow through the house? If so, does the air flow in the window and out the chimney, or in the chimney and out the window? Explain.



Air flows in the window and out the chimney. The high speed of the air at the chimney results in a lower relative pressure.