Fluids

Physics Clicker Quizzes

Pressure

If one material has a higher density than another, does this mean that the molecules of the first material must be more massive than those of the second?

YES

NO

No

Since density is defined as ρ = *m* / *V*, the volume matters as well. Thus, it could be simply that the first material has a more compact arrangement of molecules, such that there are more molecules in a given volume, which would lead to a higher density.

Consider what happens when you push both a pin and the blunt end of a pen against your skin with the same force. What will determine whether your skin will be punctured?

A The pressure on your skin

B The net applied force on your skin

C Both pressure and net applied force are equivalent

D Neither pressure nor net applied force are relevant here

A **The PRESSURE on your skin**

The net force is the same in both cases. However, in the case of the pin, that force is concentrated over a much smaller area of contact with the skin, such that the pressure is much greater. Since the force per unit area (*i.e.*, pressure) is greater, the pin is more likely to puncture the skin for that reason.

You are walking out on a frozen lake and you begin to hear the ice cracking beneath you. What is your best strategy for getting off the ice safely?

A) Stand absolutely still and don't move
B) Jump up and down to lessen your contact time with the ice
C) Try to leap in one bound to the bank of the lake
D) Shuffle your feet (without lifting them) to move towards shore
E) Lie down flat on the ice and crawl toward shore

E Lie down flat on the ice and crawl toward shore

As long as you are on the ice, your weight is pushing down. What is important is not the net force on the ice, but the force exerted on a given small area of ice i.e., the pressure! By lying down flat, you distribute your weight over the widest possible area, thus reducing the force per unit area.

While swimming near the bottom of a pool, you breath out a small air bubble. As the bubble rises toward the surface, what happens to its diameter?

A) Bubble diameter decreases
B) Bubble diameter stays the same
C) Bubble diameter increases

C Bubble diameter increases

As the bubble rises, its depth decreases, so the water pressure surrounding the bubble also decreases. This allows the air in the bubble to expand (due to the decreased pressure outside) and so the bubble diameter will increase.

Three containers are filled with water to the same height and have the same surface area at the base, but the total weight of water is different for each. Which container has the greatest total force acting on its base?

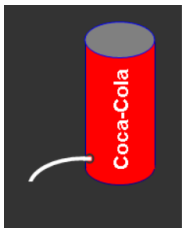
A 1
B 2
C 3
D All 3 equal

D

ALL 3 EQUAL !

The pressure at the bottom of each container depends only on the height of water above it! This is the same for all the containers. The total force is the product of the pressure times the area of the base, but since the base is also the same for all containers, the total force is the same.

When a hole is made in the side of a Coke can holding water, water flows out and follows a parabolic trajectory. If the container is dropped in free fall, the water flow will:

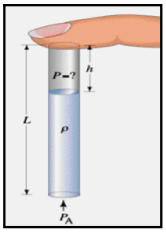


A) Diminish
B) Stop altogether
C) Flow out in a straight line
D) Curve upwards

B *Stop all together*

Water flows out of the hole because the water pressure inside is larger than the air pressure outside. The water pressure is due to the *weight* of the water. When the can is in free fall, the water is *weightless*, so the water pressure is zero, and hence no water is pushed out of the hole!

You put a straw into a glass of water, place your finger over the top so no air can get in or out, and then lift the straw from the liquid. You find that the straw retains some liquid. How does the air pressure P in the upper part compare to atmospheric pressure P_A?



A greater than P_A
B equal to P_A
C less than P_A

C *less than P_A*

Consider the forces acting at the bottom of the straw:

$$P_A - P - \rho g h = 0$$

This point is in equilibrium, so net force is zero.

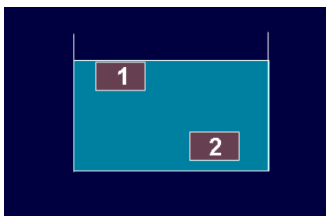
Thus:

$$P = P_A - \rho g h$$

and so we see that the pressure *P* inside the straw must be *less* than the outside pressure P_A.

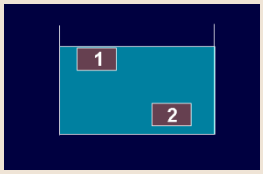
Buoyancy

Imagine holding two identical bricks in place under water. Brick 1 is just beneath the surface of the water, while brick 2 is held about 2 feet down. The force needed to hold brick 2 in place is:



A Greater
B The same
C Smaller

B **The same**

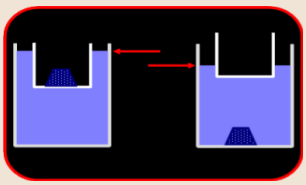


The force needed to hold the brick in place underwater is: $W - F_B$. According to Archimedes' Principle, F_B is equal to the weight of the fluid displaced. Since each brick displaces the same amount of fluid, then F_B is the same in both cases.

A boat carrying a large chunk of steel is floating on a lake. The chunk is then thrown overboard and sinks. What happens to the water level in the lake (with respect to the shore)?

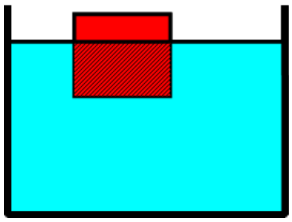
A Rises
B Drops
C Remains the same

B **Drops**



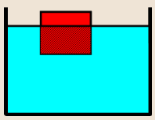
Initially the chunk of steel "floats" by sitting in the boat. The buoyant force is equal to the weight of the steel, and this will require a lot of displaced water to equal the weight of the steel. When thrown overboard, the steel sinks and only displaces its volume in water. This is not so much water, certainly less than before and so the water level in the lake will drop.

An object floats in water with 3/4 of its volume submerged. What is the ratio of the density of the object to that of water?



A) 1/4
B) 1/3
C) 4/3
D) 3/4
E) 2/1

D **3/4**

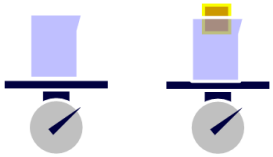


Remember:

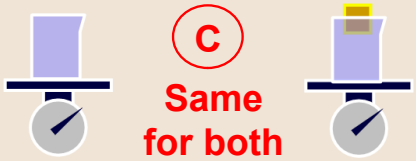
$$\frac{V_{fluid}}{V_{object}} = \frac{\rho_{object}}{\rho_{fluid}}$$

so if the ratio of the volume of the displaced water to the volume of the object is 3/4, the object has 3/4 the density of water.

Two beakers are filled to the brim with water. A wooden block is placed in the second beaker so it floats. Some of the water will overflow the beaker. Both beakers are then weighed. Which scale reads a larger weight?



A) B) C) Same for both



C **Same for both**

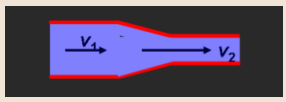
The block in B displaces an amount of water equal to its weight, since it is floating. That means that the weight of the overflowed water is equal to the weight of the block, and so the beaker in B has the same weight as that in A.

Fluid Flow

Water flows through a 1 cm diameter pipe connected to a 1/2 cm diameter pipe. Compared to the speed of the water in the 1 cm pipe, the speed in the 1/2 cm pipe is:

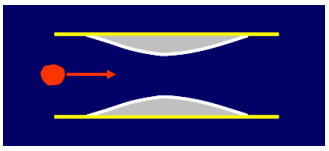
A) 1/4
B) 1/2
C) Same
D) Double
E) Four times

E **Four times**

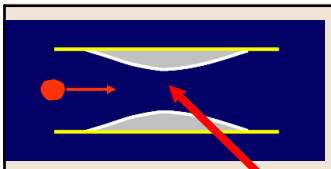


The area of the small pipe is ***less***, so we know that the water will flow ***faster*** there. Since $A \propto r^2$, when the radius is reduced by 1/2, the area is reduced by 1/4, so the speed must increase by 4 times to keep the flow rate ($A \times v$) constant.

A blood platelet drifts along with the flow of blood through an artery that is partially blocked. As the platelet moves from the wide region into the narrow region, the blood pressure:



A) Increases
B) Decreases
C) Stays the same
D) Drops to zero



B **Decreases**

speed is higher here (so pressure is lower)

The speed increases in the narrow part, according to the continuity equation. Since the speed is higher, the pressure is lower, from Bernoulli's principle.

How is the smoke drawn up a chimney affected when there is a wind blowing outside?

A) Smoke rises more rapidly
B) Smoke is unaffected by the wind
C) Smoke rises more slowly
D) Smoke is forced down the chimney

A **Smoke rises more rapidly**

Due to the speed of the wind at the top of the chimney, there is a relatively lower pressure up there as compared to the bottom. Thus, the smoke is actually drawn up the chimney more rapidly, due to this pressure difference.