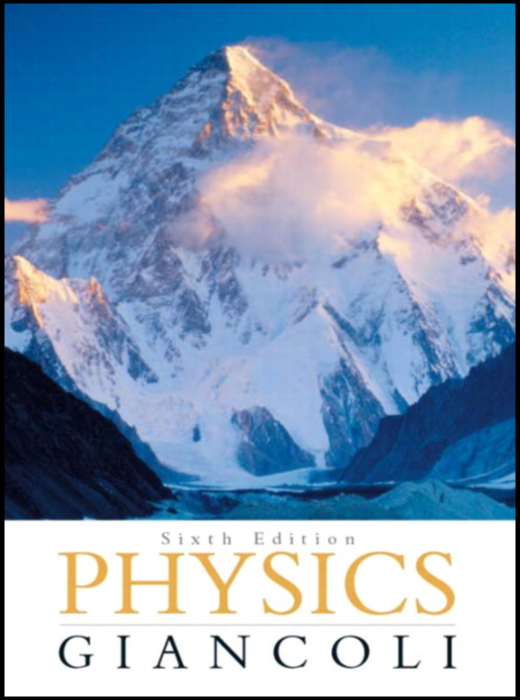

ConcepTest PowerPoints

Chapter 10

Physics: Principles with Applications, 6th edition

Giancoli

ConcepTest 10.1 Density

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?

1) yes
2) no

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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?

1) yes
2) no

Since density is defined as $\rho = M/V$, 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.

ConcepTest 10.2 Too Much Pressure

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?

1) the pressure on your skin

2) the net applied force on your skin

3) both pressure and net applied force are equivalent

4) neither pressure nor net applied force are relevant here

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1) the pressure on your skin

2) the net applied force on your skin

3) both pressure and net applied force are equivalent

4) neither pressure nor net applied force are relevant here

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.

ConcepTest 10.3 On a Frozen Lake

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?

1) stand absolutely still and don't move a muscle

2) jump up and down to lessen your contact time with the ice

3) try to leap in one bound to the bank of the lake

4) shuffle your feet (without lifting them) to move towards shore

5) lie down flat on the ice and crawl toward shore

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4) shuffle your feet (without lifting them) to move towards shore

5) 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.

ConcepTest 10.4 Bubbling Up

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

1) bubble diameter decreases
2) bubble diameter stays the same
3) bubble diameter increases

ConcepTest 10.4 Bubbling Up

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

1) bubble diameter decreases
2) bubble diameter stays the same
3) 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.

ConcepTest 10.5 Three Containers

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?

1) container 1
2) container 2
3) container 3
4) all three are equal

ConcepTest 10.5 Three Containers

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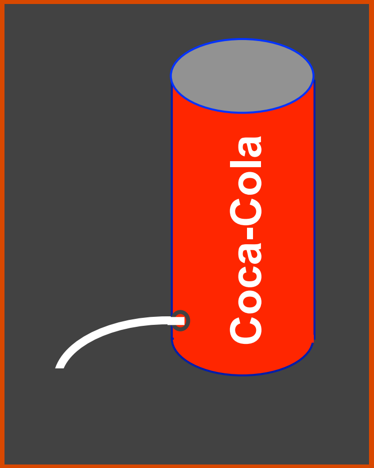
1) container 1
2) container 2
3) container 3
4) all three are equal

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.

ConcepTest 10.6 The Falling Bucket

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:

1) diminish
2) stop altogether
3) go out in a straight line
4) curve upwards



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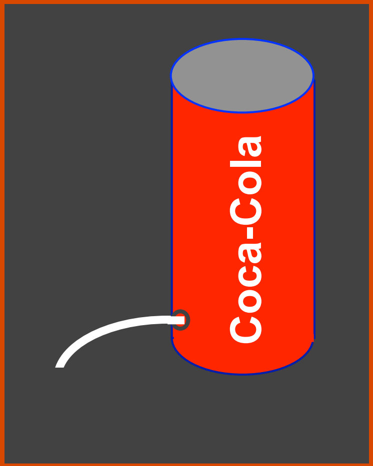
1) diminish
2) stop altogether
3) go out in a straight line
4) curve upwards

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!



ConcepTest 10.7a The Straw I

When you drink liquid through a straw, which of the items listed below is primarily responsible for this to work?

1) water pressure
2) gravity
3) inertia
4) atmospheric pressure
5) mass

ConcepTest 10.7a The Straw I

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1) water pressure
2) gravity
3) inertia
4) atmospheric pressure
5) mass

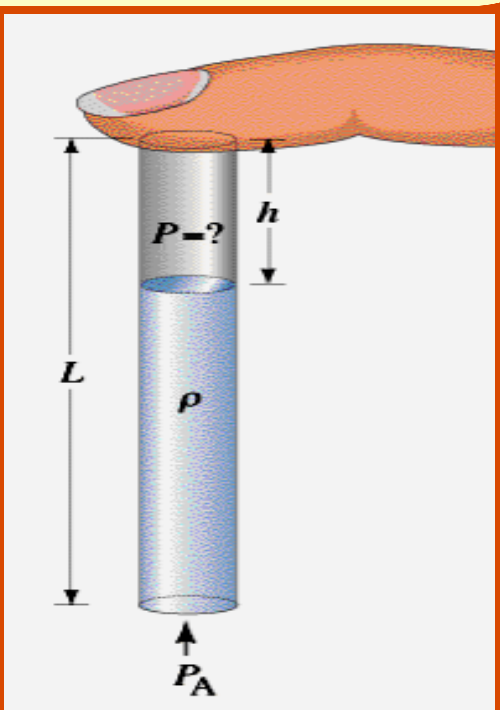
When you suck on a straw, you expand your lungs, which reduces the air pressure inside your mouth to less than atmospheric pressure. Then the atmospheric pressure pushing on the liquid in the glass provides a net upward force on the liquid in the straw sufficient to push the liquid up the straw.

Follow-up: Is it possible to sip liquid through a straw on the Moon?

ConcepTest 10.7b The Straw II

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?

1) greater than P_A
2) equal to P_A
3) less than P_A



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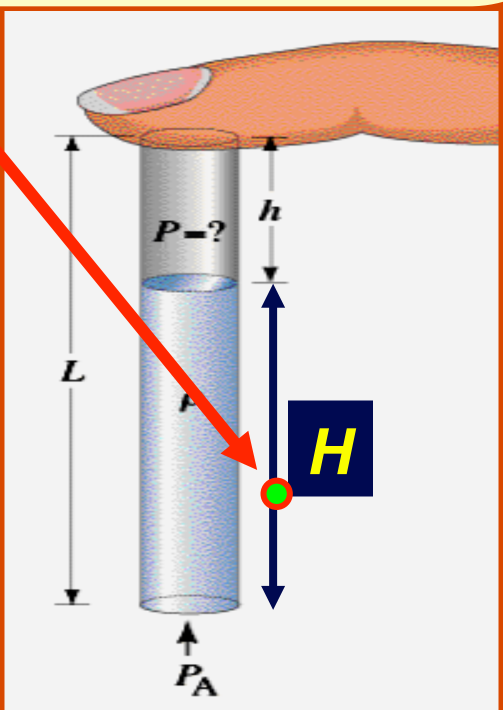
1) greater than P_A
2) equal to P_A
3) less than P_A

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**.



ConcepTest 10.7c The Straw III

In a mercury barometer at atmospheric pressure, the height of the column of mercury in a glass tube is 760 mm. If another mercury barometer is used that has a tube of larger diameter, how high will the column of mercury be in this case?

1) greater than 760 mm
2) less than 760 mm
3) equal to 760 mm

ConcepTest 10.7c The Straw III

In a mercury barometer at atmospheric pressure, the height of the column of mercury in a glass tube is 760 mm. If another mercury barometer is used that has a tube of larger diameter, how high will the column of mercury be in this case?

1) greater than 760 mm
2) less than 760 mm
3) equal to 760 mm

While the weight of the liquid in the tube has increased (volume = height x area) due to the larger area of the tube, the net upward force on the mercury (force = pressure x area) has also increased by the same amount! Thus, as long as the pressure is the same, the height of the mercury will be the same.

ConcepTest 10.8 Thermometers

Thermometers often use mercury or alcohol in a thin glass tube, but barometers never use alcohol. Why?

1) mercury is less flammable than alcohol
2) mercury's color is easier to see than alcohol
3) mercury is less toxic than alcohol
4) mercury is more dense than alcohol
5) mercury is cheaper than alcohol

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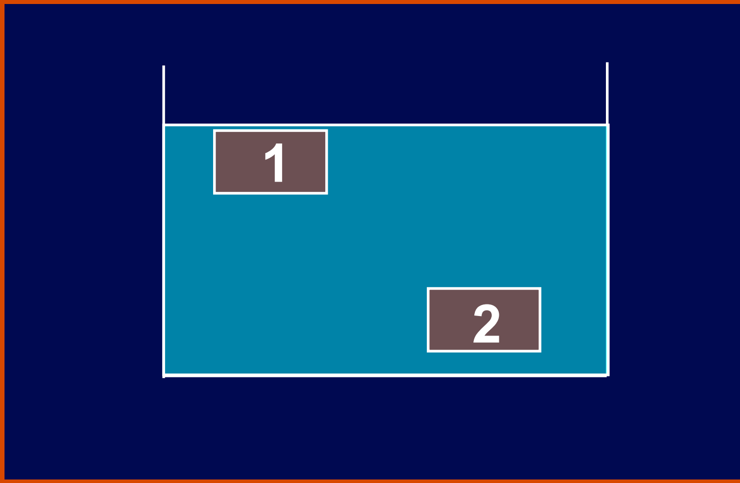
2) mercury's color is easier to see than alcohol
3) mercury is less toxic than alcohol
4) mercury is more dense than alcohol
5) mercury is cheaper than alcohol

Mercury is very dense, so the height of the column that supports atmospheric pressure is only 760 mm. A water barometer would require a height of about 10 m, which would be inconvenient. Alcohol is less dense than water, so that would be even worse!

ConcepTest 10.9 Two Bricks

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:

1) greater
2) the same
3) smaller



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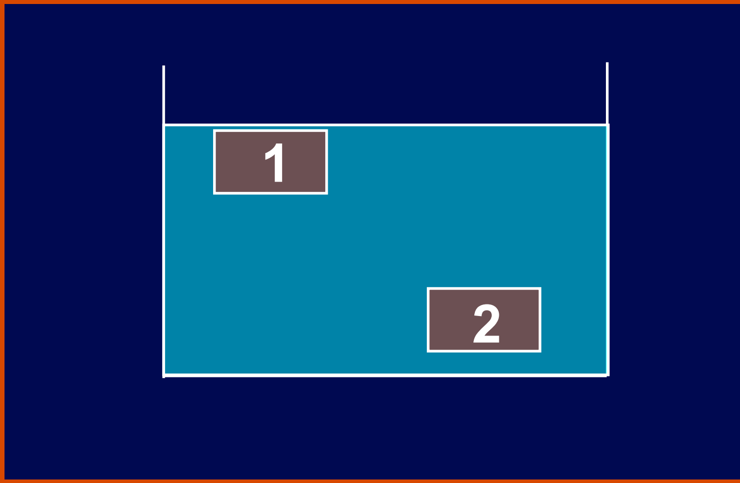
1) greater
2) the same
3) smaller

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.**



ConcepTest 10.10a Cylinder and Pail I

An aluminum cylinder and a pail together weigh 29 N, as read on a scale. With the cylinder submerged, the scale reads 20 N. If the displaced water is poured into the pail, what will the scale read?

1) less than 20 N
2) 20 N
3) between 20 N and 29 N
4) 29 N
5) greater than 29 N

ConcepTest 10.10a Cylinder and Pail I

An aluminum cylinder and a pail together weigh 29 N, as read on a scale. With the cylinder submerged, the scale reads 20 N. If the displaced water is poured into the pail, what will the scale read?

1) less than 20 N
2) 20 N
3) between 20 N and 29 N
4) 29 N
5) greater than 29 N

The buoyant force is equal to the weight of the displaced fluid. Thus, the reduction in the "apparent" weight of the cylinder when it is submerged is exactly equal to the weight of the water that overflowed. When that water is poured back into the pail, the total weight returns to its original value of 29 N.

ConcepTest 10.10b Cylinder and Pail II

When the cylinder is lowered into the water, how will the scale readings for the cylinder and the water change?

1) cylinder's scale will decrease, but water's scale will increase
2) cylinder's scale will increase, but water's scale will decrease
3) cylinder's scale will decrease, but water's scale will not change
4) both scales will decrease
5) both scales will increase

ConcepTest 10.10b Cylinder and Pail II

When the cylinder is lowered into the water, how will the scale readings for the cylinder and the water change?

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2) cylinder's scale will increase, but water's scale will decrease
3) cylinder's scale will decrease, but water's scale will not change
4) both scales will decrease
5) both scales will increase

The buoyant force of the water on the cylinder is an upward force that reduces the "apparent" weight as read on the scale. However, by Newton's Third Law, there is an equal and opposite reaction force. So, if the water pushes up on the cylinder, then the cylinder must push down on the water, thus increasing the scale reading of the water.

ConcepTest 10.11 On Golden Pond

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)?

1) rises
2) drops
3) remains the same
4) depends on the size of the steel

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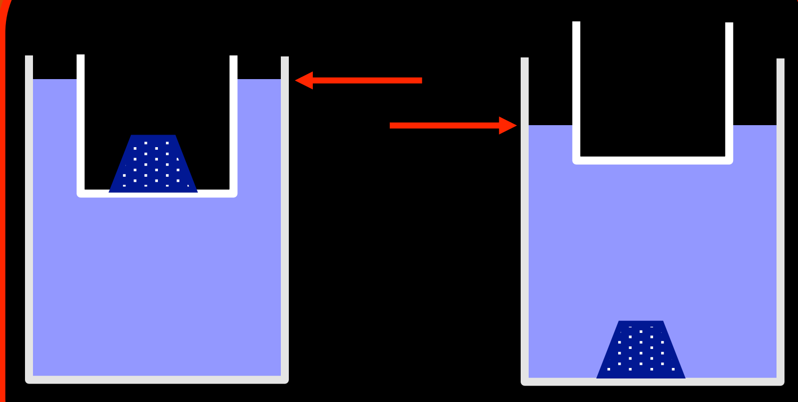
1) rises
2) drops
3) remains the same
4) depends on the size of the steel

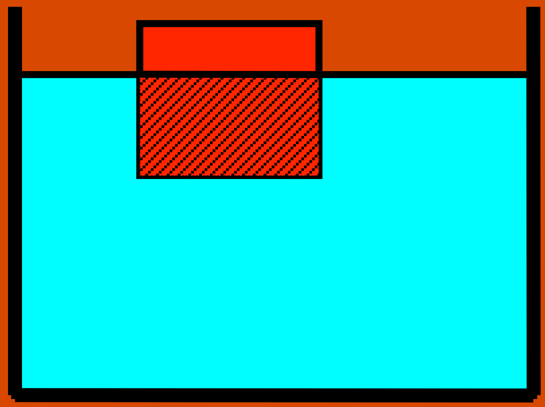
Initially the chunk of steel "floats" by sitting in the boat. The buoyant force is equal to the **weight** of the steel, and this will **require a lot of displaced water** to equal the weight of the steel. When thrown overboard, the steel sinks and **only displaces its volume in water**. This is not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



ConcepTest 10.12a Archimedes I

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?

1) 1/4
2) 1/3
3) 4/3
4) 3/4
5) 2/1



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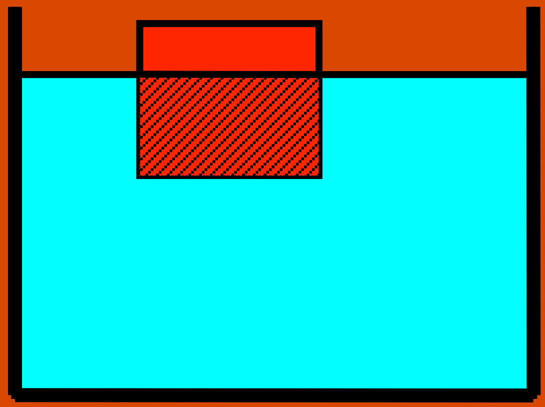
1) 1/4
2) 1/3
3) 4/3
4) 3/4
5) 2/1

Remember that we have:

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

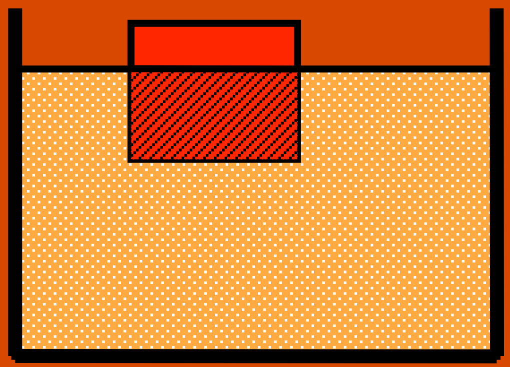
so if the ratio of the **volume of the displaced water to the volume of the object is 3/4**, the object has **3/4 the density of water**.



ConcepTest 10.12b Archimedes II

The object is now placed in oil with a density half that of water. What happens?

1) it floats just as before
2) it floats higher in the water
3) it floats lower in the water
4) it sinks to the bottom



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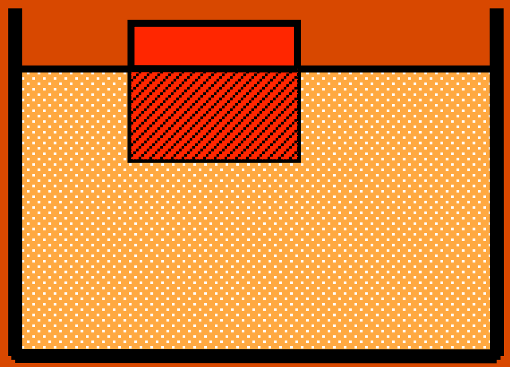
The object is now placed in oil with a density half that of water. What happens?

1) it floats just as before
2) it floats higher in the water
3) it floats lower in the water
4) it sinks to the bottom

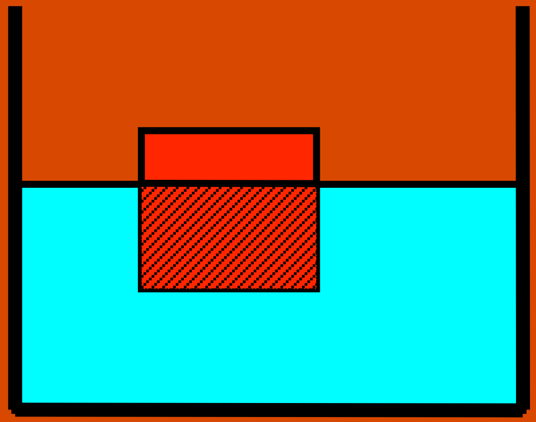
We know from before that the **object has 3/4 the density of water**. If the water is now replaced with oil, which has **1/2 the density of water**, the **density of the object is larger than the density of the oil**. Therefore, it must sink to the bottom.



ConcepTest 10.12c Archimedes III

An object floats in water with 3/4 of its volume submerged. When more water is poured on top of the water, the object will:

1) move up slightly
2) stay at the same place
3) move down slightly
4) sink to the bottom
5) float to the top



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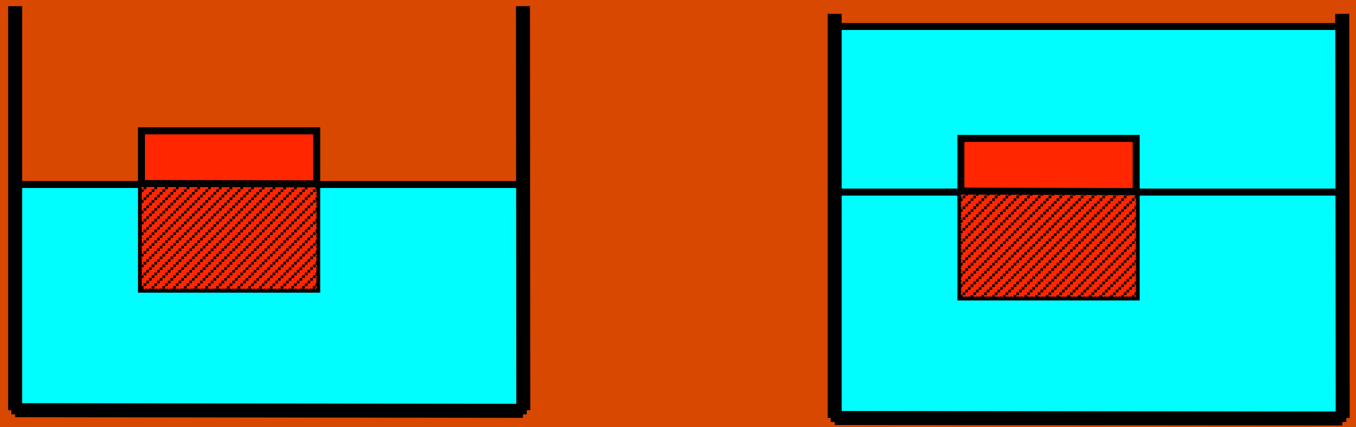
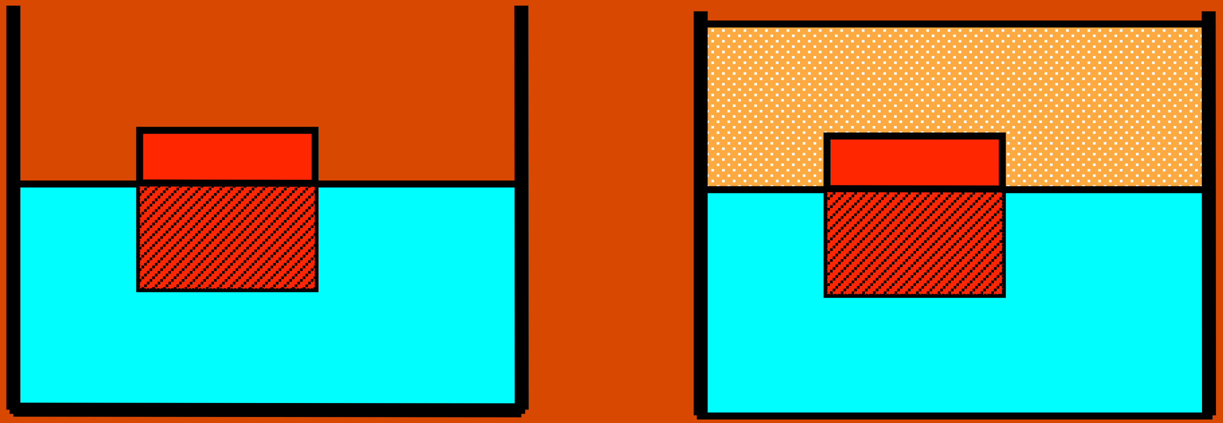


We already know that **density of the object is 3/4 of the density of water, so it floats in water** (i.e., the buoyant force is greater than its weight). When covered by more water, it must therefore float to the top.

ConcepTest 10.12d Archimedes IV

An object floats in water with 3/4 of its volume submerged. When oil is poured on top of the water, the object will:

1) move up slightly
2) stay at the same place
3) move down slightly
4) sink to the bottom
5) float to the top



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An object floats in water with 3/4 of its volume submerged. When oil is poured on top of the water, the object will:

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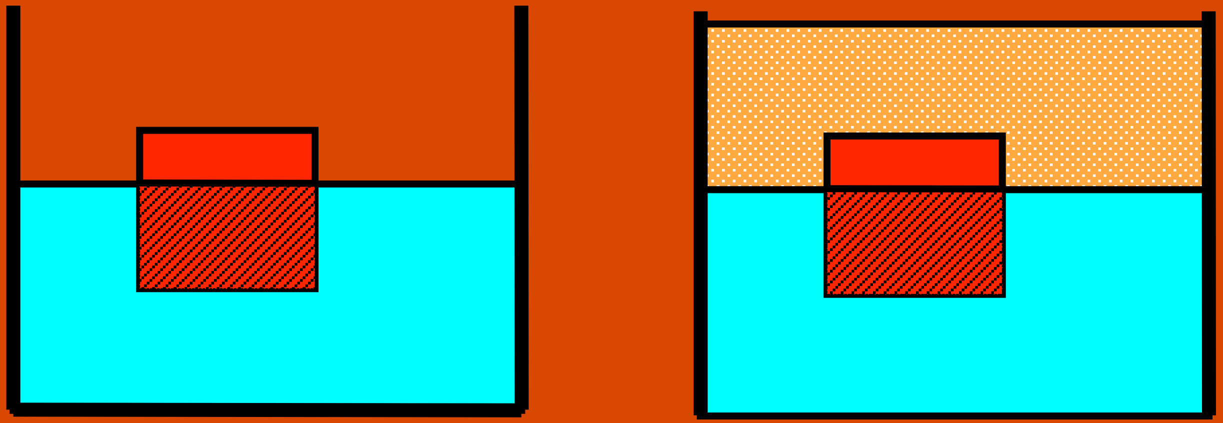

With the oil on top of the water, there is an **additional buoyant force** on the object equal to the weight of the displaced oil. The effect of this extra force is to **move the object upwards** slightly, although it is not enough to make the object float up to the top.

ConcepTest 10.13a Helium Balloon I

A helium balloon in an air-filled glass jar floats to the top. If the air is replaced with helium, what will happen to the helium balloon?

1) it still floats at the top because it has positive buoyancy
2) it stays in the middle because it has neutral buoyancy
3) it sinks to the bottom because it has negative buoyancy
4) the balloon shrinks in size due to the surrounding helium
5) the balloon grows in size due to the lack of surrounding air

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4) the balloon shrinks in size due to the surrounding helium
5) the balloon grows in size due to the lack of surrounding air

The balloon floats initially because the displaced air weighs more than the balloon, so the buoyant force provides a net upward force. When the balloon is in the lighter helium gas (instead of air), the displaced helium gas does not provide enough of an upward buoyant force to support the weight of the balloon.

ConcepTest 10.13b Helium Balloon II

Now the jar is lifted off the table, but the jar remains inverted to keep the helium gas in the jar. What will happen to the balloon?

1) it floats at the top of the jar
2) it floats at the bottom of the jar, but still fully inside the jar
3) it floats below the bottom of the jar, sticking halfway out the bottom
4) it sinks down to the surface of the table

ConcepTest 10.13b Helium Balloon II

Now the jar is lifted off the table, but the jar remains inverted to keep the helium gas in the jar. What will happen to the balloon?

1) it floats at the top of the jar

2) it floats at the bottom of the jar, but still fully inside the jar

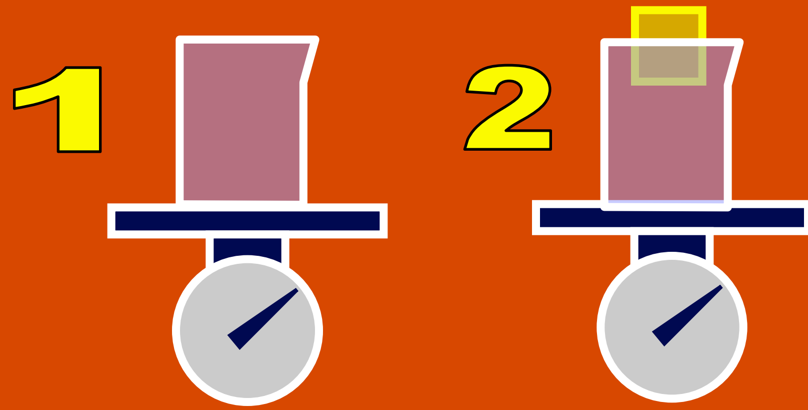
3) it floats below the bottom of the jar, sticking halfway out the bottom

4) it sinks down to the surface of the table

The balloon sinks in the helium gas (fluid #1), until it hits the surface of the air (fluid #2). Since the balloon floats in air, it will float on the surface of the air, and therefore remain inside the jar, but at the bottom.

ConcepTest 10.14a Wood in Water I

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?

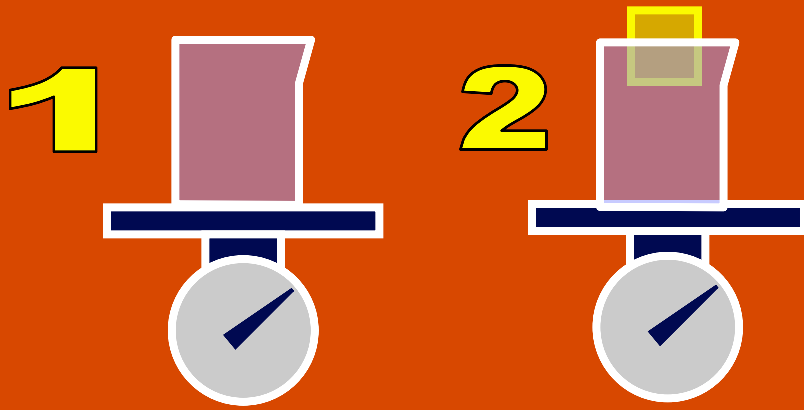


3 same for both

ConcepTest 10.14a Wood in Water I

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?

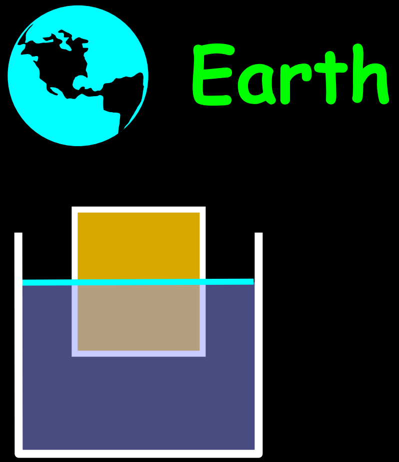
The block in B displaces an amount of water equal to its weight, since it is floating. That means that the weight of the overflowed water is equal to the weight of the block, and so the beaker in B has the same weight as that in A.

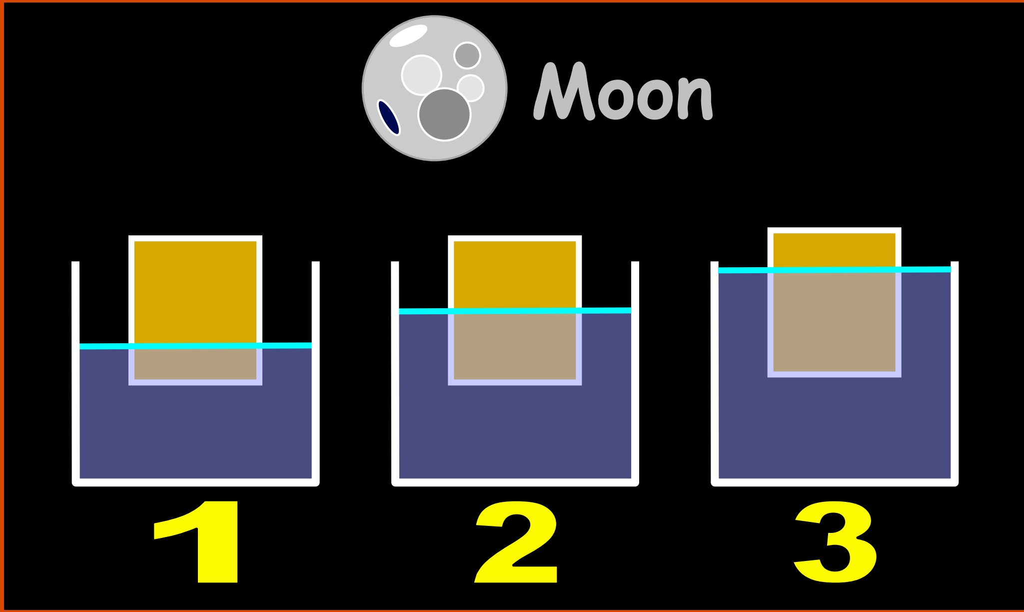


3 same for both

ConcepTest 10.14b Wood in Water II

A block of wood floats in a container of water as shown on the right. On the the Moon, how would the same block of wood float in the container of water?





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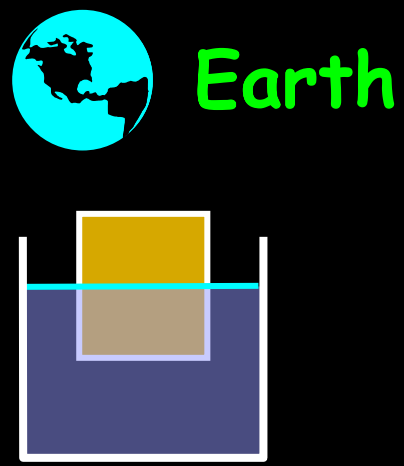
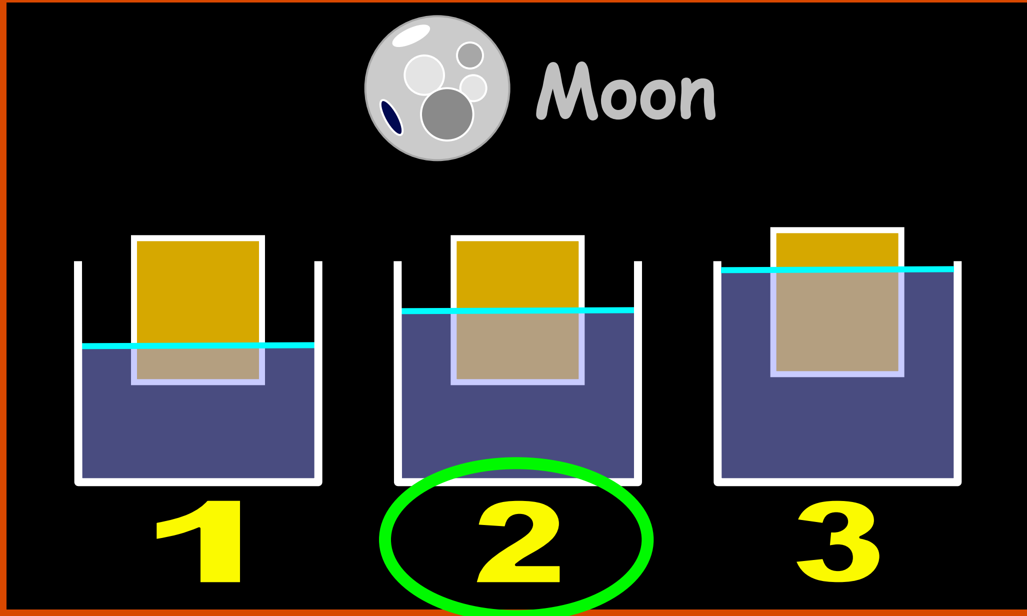


A floating object displaces a **weight of water equal to the object's weight**. On the Moon, the wooden block has **less weight**, but the water itself **also has less weight**.



ConcepTest 10.15a 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:

(1) one quarter

(2) one half

(3) the same

(4) double

(5) four times

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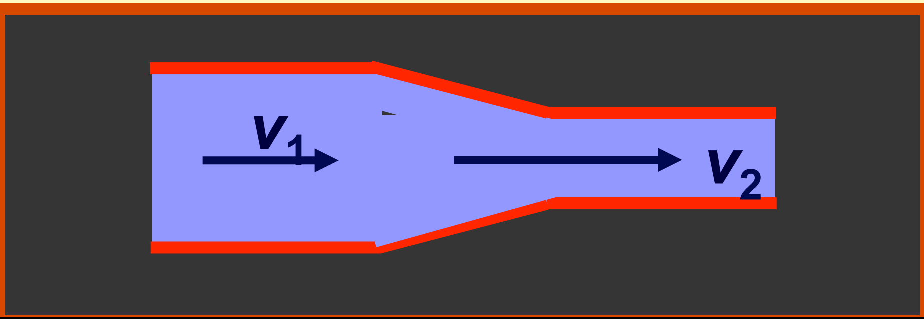
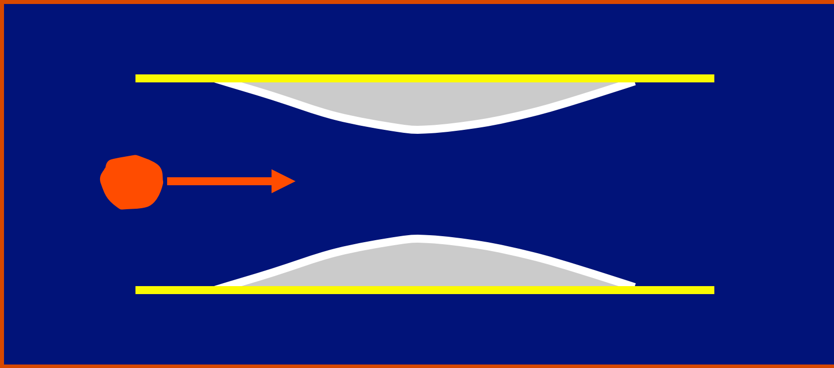


The area of the small pipe is ***less***, so we know that the water will flow ***faster*** there. Since $A \propto r^2$, when the **radius is reduced by 1/2**, the **area is reduced by 1/4**, so the **speed must increase by 4 times** to keep the flow rate $(A \times v)$ constant.

ConcepTest 10.15b Blood Pressure I

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:

1) increases
2) decreases
3) stays the same
4) drops to zero



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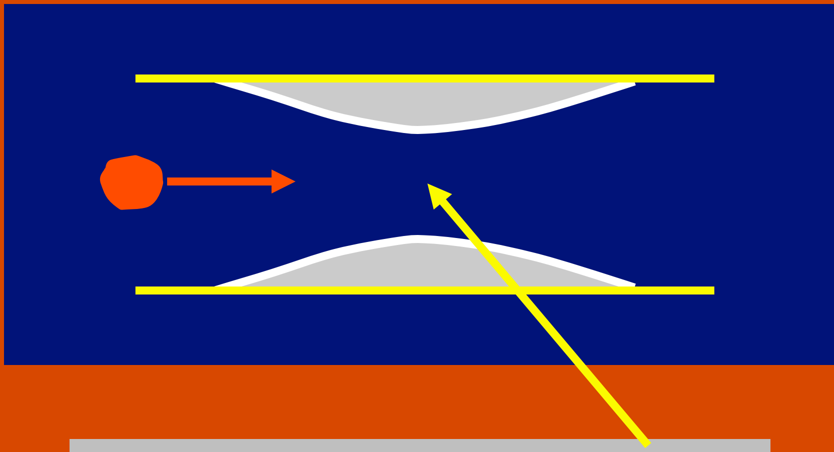
3) stays the same
4) drops to zero

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.



ConcepTest 10.15c Blood Pressure II

A person's blood pressure is generally measured on the arm, at approximately the same level as the heart. How would the results differ if the measurement were made on the person's leg instead?

1) blood pressure would be lower
2) blood pressure would not change
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Assuming that the flow speed of the blood does not change, then Bernoulli's equation indicates that at a lower height, the pressure will be greater.

ConcepTest 10.16 The Chimney

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

1) smoke rises more rapidly in the chimney
2) smoke is unaffected by the wind blowing
3) smoke rises more slowly in the chimney
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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.