# Questions

1. If one material has a higher density than another, must the molecules of the first be heavier than those of the second? Explain.
2. Consider what happens when you push both a pin and the blunt end of a pen against your skin with the same force. Decide what determines whether your skin is cut—the net force applied to it or the pressure.
3. A small amount of water is boiled in a 1-gallon metal can. The can is removed from the heat and the lid put on. As the can cools, it collapses and looks crushed. Explain.
4. An ice cube floats in a glass of water filled to the brim. What can you say about the density of ice? As the ice melts, will the water overflow? Explain.
5. Will an ice cube float in a glass of alcohol? Why or why not?
6.

*Pressure*

*Vapor in can returns to liquid lowering pressure inside*

*Density less than of water.*
*The displaced water will have the same volume as the water that made the ice.*
*No overflow.*

A submerged can of Coke® will sink, but a can of Diet Coke® will float. (Try it!) Explain.

- Why don't ships made of iron sink?

*Shaped to displace a lot of water.*

- A barge filled high with sand approaches a low bridge over the river and cannot quite pass under it. Should sand be added to, or removed from, the barge? [*Hint*: Consider Archimedes' principle.]

*Added, to make it float lower*

- Explain why helium weather balloons, which are used to measure atmospheric conditions at high altitudes, are normally released while filled to only 10–20% of their maximum volume.

*They will exand in the upper atmosphere where there's less pressure.*

- Will an empty balloon have precisely the same apparent weight on a scale as a balloon filled with air? Explain.

- Why do you float higher in salt water than in fresh water?

- Why does the stream of water from a faucet become narrower as it falls (**Fig. 10–43** )?

**Figure 10–43**
Question 12. Water coming from a faucet.

- Children are told to avoid standing too close to a rapidly moving train because they might get sucked under it. Is this possible? Explain.

- A tall Styrofoam cup is filled with water. Two holes are punched in the cup near the bottom, and water begins rushing out. If the cup is dropped so it falls freely, will the water continue to flow from the holes? Explain.

*More airflow over wings*

- Why do airplanes normally take off into the wind?

*Air pressure between them is lower*

- Two ships moving in parallel paths close to one another risk colliding. Why?

*Together*

- If you dangle two pieces of paper vertically, a few inches apart (**Fig. 10–44** ), and blow between them, how do you think the papers will move? Try it and see. Explain.

**Figure 10–44**
Question 17.

- Why does the canvas top of a convertible bulge out when the car is

# MisConceptual Questions

1. You hold a piece of wood in one hand and a piece of iron in the other. Both pieces have the same volume, and you hold them fully under water at the same depth. At the moment you let go of them, which one experiences the greater buoyancy force?
    a. The piece of wood.
    b. The piece of iron.
    c. They experience the same buoyancy force.
    d. More information is needed.

2. 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 (**Fig. 10–46** ). In which container does the water exert the greatest force on the bottom of the container?
    a. Container A.
    b. Container B.
    c. Container C.
    d. All three are equal. *(Same pressure at bottom.)*


**Figure 10–46**
MisConceptual Question 2.

3. Beaker A is filled to the brim with water. Beaker B is the same size and contains a small block of wood which floats when the beaker is filled with water to the brim. Which beaker weighs more?
    a. Beaker A.
    b. Beaker B.
    c. The same for both.

4. Why does an ocean liner float?
    a. It is made of steel, which floats.
    b. Its very big size changes the way water supports it.
    c. It is held up in the water by large Styrofoam compartments.
    d. The average density of the ocean liner is less than that of seawater.
    e. Remember the *Titanic*—ocean liners do not float.

5. A rowboat floats in a swimming pool, and the level of the water at the edge of the pool is marked. Consider the following situations. (i) The boat is removed from the water. (ii) The boat in the water holds an iron anchor which is removed from the boat and placed on the shore. For each situation, the level of the water will
    a. rise.
    b. fall.
    c. stay the same.

6.

You put two ice cubes in a glass and fill the glass to the rim with water. As the ice melts, the water level

a. drops below the rim.
b. rises and water spills out of the glass.
c. remains the same.
d. drops at first, then rises until a little water spills out.

7. Hot air is less dense than cold air. Could a hot-air balloon be flown on the Moon, where there is no atmosphere?
   a. No, there is no cold air to displace, so no buoyancy force would exist.
   b. Yes, warm air always rises, especially in a weak gravitational field like that of the Moon.
   c. Yes, but the balloon would have to be filled with helium instead of hot air.

8. An object that can float in both water and in oil (whose density is less than that of water) experiences a buoyant force that is
   a. greater when it is floating in oil than when floating in water.
   b. greater when it is floating in water than when floating in oil.
   c. the same when it is floating in water or in oil.

9. As water flows from a low elevation to a higher elevation through a pipe that changes in diameter,
   a. the water pressure will increase.
   b. the water pressure will decrease.
   c. the water pressure will stay the same.
   d. Need more information to determine how the water pressure changes.

10. Water flows in a horizontal pipe that is narrow but then widens

and the speed of the water becomes less. The pressure in the water moving in the pipe is

a. greater in the wide part.
b. greater in the narrow part.
c. the same in both parts.
d. greater where the speed is higher.
e. greater where the speed is lower.

11. When a baseball curves to the right (a curveball), air is flowing
    a. faster over the left side than over the right side.
    b. faster over the right side than over the left side.
    c. faster over the top than underneath.
    d. at the same speed all around the baseball, but the ball curves as a result of the way the wind is blowing on the field.

12. How is the smoke drawn up a chimney affected when a wind is blowing outside?
    a. Smoke rises more rapidly in the chimney.
    b. Smoke rises more slowly in the chimney.
    c. Smoke is forced back down the chimney.
    d. Smoke is unaffected.

For assigned homework and other learning materials, go to the MasteringPhysics website.

## 10–2 Density and Specific Gravity

*Density = 2.7 X 10^3 kg/m^3.*

*M=(2.7X10^3) X(10^8) =2.7X10^11 kg*

1. (I) The approximate volume of the granite monolith known as El Capitan in Yosemite National Park (**Fig. 10–47** ) is about $10^8$ $m^3$. What is its approximate mass?

**Figure 10–47**
Problem 1.

*Density= 1.29 kg/m^3*
*M=1.29X (5.6X3.6X2.4) =62.4kg*

2. (I) What is the approximate mass of air in a living room 5.6 m × 3.6 m × 2.4 m?

*Density=19.3X10^3 kg/m^3*
*M=19.3X10^3X (.54X.31X.22) =7.1X10^2kg*

3. (I) If you tried to smuggle gold bricks by filling your backpack, whose dimensions are 54 cm × 31 cm × 22 cm, what would its mass be?
4. (I) State your mass and then estimate your volume. [*Hint:* Because you can swim on or just under the surface of the water in a swimming pool, you have a pretty good idea of your density.]

*M/10^3 m^3*

5. (II) A bottle has a mass of 35.00 g when empty and 98.44 g when filled with water. When filled with another fluid, the mass is 89.22 g. What is the specific gravity of this other fluid?
6. (II) If 4.0 L of antifreeze solution (specific gravity = 0.80) is added to 5.0 L of water to make a 9.0-L mixture, what is the specific gravity of the mixture?

## 10–7 Buoyancy and Archimedes' Principle

*7.8/13.6 =0.57 (ratio of densities)*

23. (II) What fraction of a piece of iron will be submerged when it floats in mercury?

*density=10^3X 9.28/(9.28-6.18) =3X10^3 kg/m^3*

24. (II) A geologist finds that a Moon rock whose mass is 9.28 kg has an apparent mass of 6.18 kg when submerged in water. What is the density of the rock?

25. (II) A crane lifts the 18,000-kg steel hull of a sunken ship out of the water. Determine (*a*) the tension in the crane's cable when the hull is fully submerged in the water, and (*b*) the tension when the hull is completely out of the water.

*Volume of hull: M/density =18X10^3/ 7.8X10^3 =2.3 m^3*

26. (II) A spherical balloon has a radius of 7.15 m and is filled with helium. How large a cargo can it lift, assuming that the skin and structure of the balloon have a mass of 930 kg? Neglect the buoyant force on the cargo volume itself.

*b) T= 1.8X10^4 g =1.8X10^5N*

27. (II) What is the likely identity of a metal (see **Table 10–1** ) if a sample has a mass of 63.5 g when measured in air and an apparent mass of 55.4 g when submerged in water?

*a) Buoyant force= 2.3X10^3g =0.23X10^5N So T=1.57X10^5N*

28.