Static Fluids

Consider a balloon filled with 1 liter of water (1000 cm^3) in equilibrium in a container of water, as shown in Figure 1.
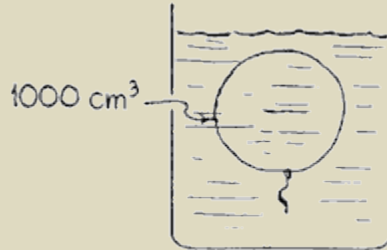
1000 cm^3

Figure 1

1. a. What is the mass of the 1 liter of water?

   b. What is the weight of the 1 liter of water?

   c. What is the weight of water displaced by the balloon?

   d. What is the buoyant force on the balloon?

   e. Discuss where these two vectors should be drawn on Figure 1: one for the weight of the balloon and the other for the buoyant force that acts on it.

2. How does the size and directions of your vectors compare?

Refer to the following information for the next five questions.

3. As a thought experiment, pretend we could remove the water from the balloon but still have it remain the same size of 1 liter. Then inside the balloon is a vacuum.

ANYTHING THAT DISPLACES 9.8 N OF WATER EXPERIENCES 9.8 N OF BUOYANT FORCE.

CUZ IF YOU PUSH 9.8 N OF WATER ASIDE THE WATER PUSHES BACK ON YOU WITH 9.8 N !

a. What is the mass of the liter of nothing?

b. What Is the weight of the liter of nothing?

c. What is the weight of water displaced by the massless balloon?

d. What is the buoyant force on the massless balloon?

e. In which direction would the massless balloon be accelerated?

4.

Assume the balloon is replaced by a 0.75-kilogram piece of wood that has exactly the same volume (1000 cm^3), as shown in Figure 2. The wood is held in the same submerged position beneath the surface of the water.
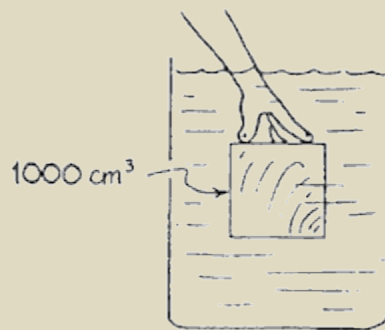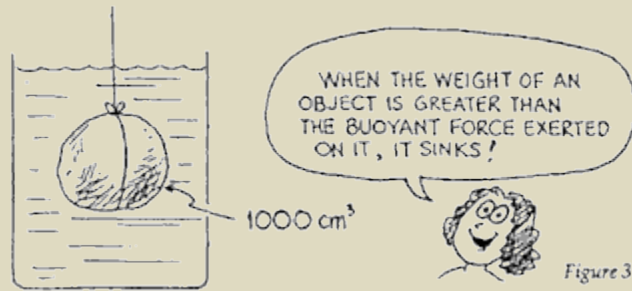

1000 cm^3

Figure 2

a. What volume of water is displaced by the wood?

b. What is the mass of the water displaced by the wood?

c. What is the weight of the water displaced by the wood?

d. How much buoyant force does the surrounding water exert on the wood?

e. When the hand is removed, what is the net force on the wood?

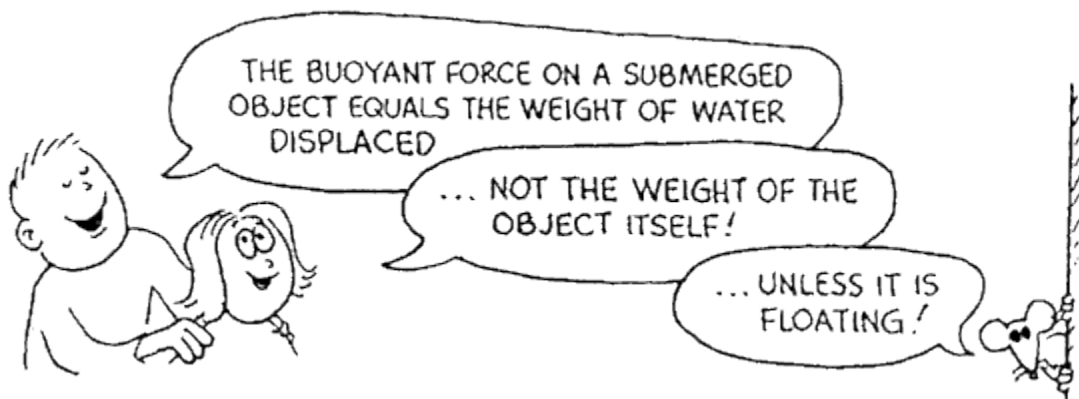f. In which direction does the wood accelerate when released?

5.

**Refer to the following information for the next six questions.**

Repeat parts a through f in the previous question for a 3-kg rock that has the same volume (1000 cm^3), as shown in Figure 3. Assume the rock is suspended in the container of water by a string.

WHEN THE WEIGHT OF AN OBJECT IS GREATER THAN THE BUOYANT FORCE EXERTED ON IT, IT SINKS!

1000 cm^3

Figure 3

a. What volume of water is displaced by the rock?

b. What is the mass of the water displaced by the rock?

c. What is the weight of the water displaced by the rock?

d. How much buoyant force does the surrounding water exert on the rock?

e. When the hand is removed, what is the net force on the rock?

f. In which direction does the rock accelerate when released?

THE BUOYANT FORCE ON A SUBMERGED OBJECT EQUALS THE WEIGHT OF WATER DISPLACED

... NOT THE WEIGHT OF THE OBJECT ITSELF!

... UNLESS IT IS FLOATING!

6. **Review**: Use the Periodic Table to help you answer the following questions.
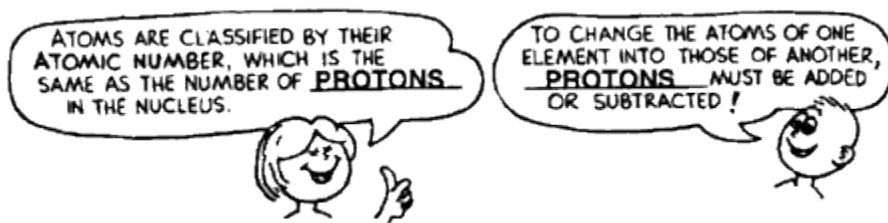
a. When the atomic nuclei of hydrogen and lithium are squashed together (nuclear fusion) the element that is produced is _____.

b. When the atomic nuclei of a pair of lithium nuclei are fused, the element produced is _____.

c. When the atomic nuclei of a pair of aluminum nuclei are fused, the element produced is _____.

d. When the nucleus of a nitrogen atom absorbs a proton, the resulting element is _____.

e. What element is produced when a gold nucleus gains a proton?

f. Which results in the more valuable product _____.
    i)   adding protons from the gold nuclei
    ii)   subtracting protons from the gold nuclei

g. What element is produced when a uranium nucleus ejects an elementary particle composed of two protons and two neutrons?

h. If a uranium nucleus breaks into two pieces (nuclear fission) and one of the pieces is zirconium (atomic number 40), the other piece is the element _____.

i. Which has more mass, a nitrogen molecule (N_2) or an oxygen molecule (O_2)? (Circle correct answer).
    i)   A nitrogen molecule.
    ii)   An oxygen molecule.

j. Which has the greater number of atoms? (Circle correct answer) 1 gram or He, 1 gram or Ne