

**Concept-Development  
Practice Page****19-1***Archimedes' Principle I*

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

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

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

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

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d. What is the buoyant force on the balloon?

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e. Sketch a pair of vectors in Figure 1: one for the weight of the balloon and the other for the buoyant force that acts on it. How do the size and directions of your vectors compare?

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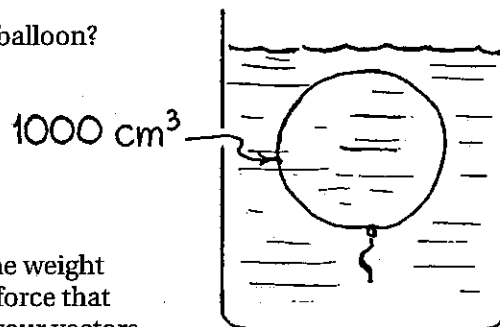
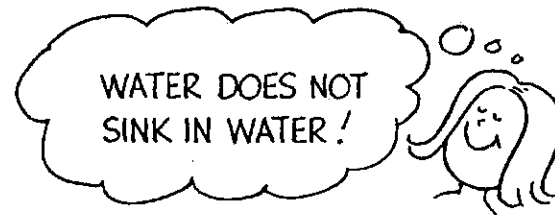


Figure 1

2. 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.

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

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

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

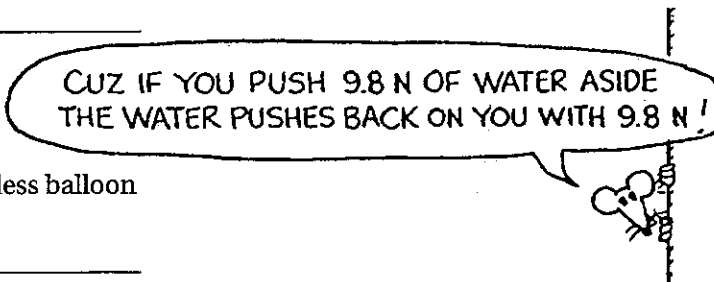
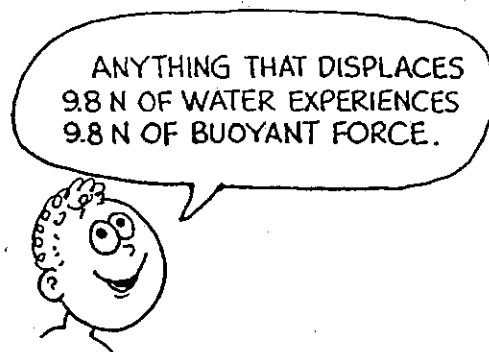
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d. What is the buoyant force on the massless balloon?

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

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**Conceptual PHYSICS**

3. Assume the balloon is replaced by a 0.5-kilogram piece of wood that has exactly the same volume ( $1000 \text{ cm}^3$ ), as shown in Figure 2. The wood is held in the same submerged position beneath the surface of the water.

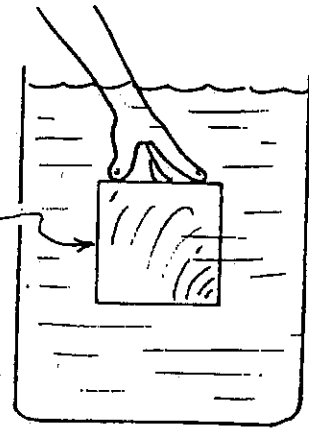
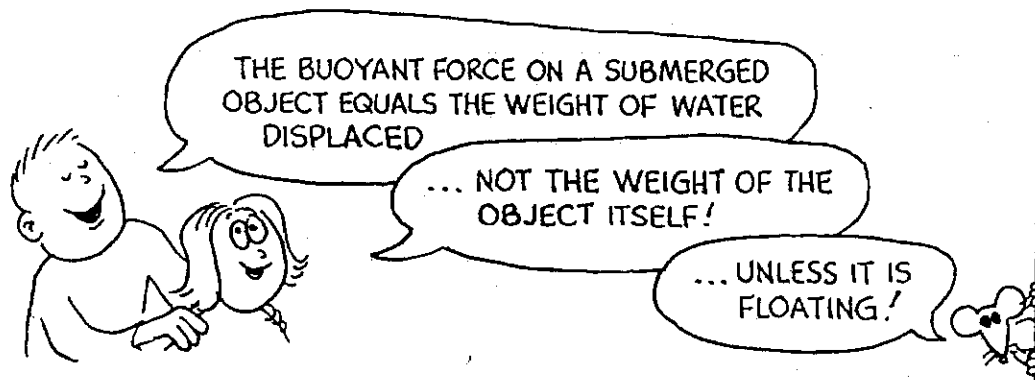


Figure 2

- What volume of water is displaced by the wood?  $1000 \text{ cm}^3$   
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- What is the mass of the water displaced by the wood?  
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- What is the weight of the water displaced by the wood?  
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- How much buoyant force does the surrounding water exert on the wood?  
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- When the hand is removed, what is the net force on the wood?  
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- In which direction does the wood accelerate when released? \_\_\_\_\_



4. Repeat parts *a* through *f* in the previous question for a 5-kg rock that has the same volume ( $1000 \text{ cm}^3$ ), as shown in Figure 3. Assume the rock is suspended by a string in the container of water.

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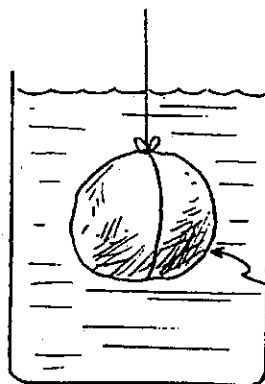


Figure 3

