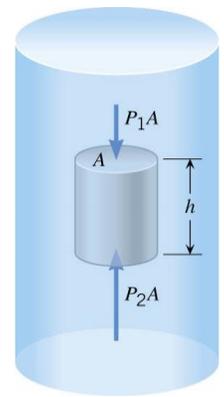


Archimedes' Principle

All fluids push things _____ because the pressure is _____ at greater _____
 The upward force is _____ **force**

$$F_B = mg = W_{\text{liquid}}$$



Archimedes' Principle

_____ **force** = _____ **of the displaced** _____

$$F_B = W_{ft}$$

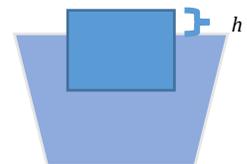
- If buoyant force _____ gravity, then it _____
- If buoyant force _____ gravity, then it _____
- An object will _____ if its average density _____ density of the fluid
- In other words, it will float if it _____ more fluid than its own _____

Specific Gravity

$$\text{specific gravity} = \frac{\bar{\rho}}{\rho_{ft}} = \text{fraction submerged}$$

- If specific gravity _____ 1 it _____
- If specific gravity _____ 1 it _____

An ice cube is floating in a glass of fresh water. The cube is 3 cm on each side. If the cube is floating so a flat face is facing up, what is the distance between the top of the cube and the water?



A man tied a bunch of helium balloons to a lawn chair and flew to a great altitude. If a single balloon is estimated as a sphere with a radius of 20 cm and is filled with helium, what is the net force on one balloon?

How many balloons would be required to lift a 80 kg man and chair?

Homework

1. Do fluids exert buoyant forces in a “weightless” environment, such as in the space shuttle? Explain your answer.
2. Will the same ship float higher in salt water than in freshwater? Explain your answer.
3. Marbles dropped into a partially filled bathtub sink to the bottom. Part of their weight is supported by buoyant force, yet the downward force on the bottom of the tub increases by exactly the weight of the marbles. Explain why.
4. Logs sometimes float vertically in a lake because one end has become water-logged and denser than the other. What is the average density of a uniform-diameter log that floats with 20.0% of its length above water? (OpenStax 11.37) **800 kg/m³**
5. Find the density of a fluid in which a hydrometer having a density of 0.750 g/mL floats with 92.0% of its volume submerged. (OpenStax 11.38) **815 kg/m³**
6. If your body has a density of 995 kg/m³, what fraction of you will be submerged when floating gently in: (a) Freshwater? (b) Salt water, which has a density of 1027 kg/m³? (OpenStax 11.39) **99.5% submerged, 96.8% submerged**
7. Bird bones have air pockets in them to reduce their weight—this also gives them an average density significantly less than that of the bones of other animals. Suppose an ornithologist weighs a bird bone in air and in water and finds its mass is 45.0 g and its apparent mass when submerged is 3.60 g (the bone is watertight). (a) What mass of water is displaced? (b) What is the volume of the bone? (c) What is its average density? (OpenStax 11.40) **41.4 g, 41.4 cm³, 1.09 g/cm³**
8. A rock with a mass of 540 g in air is found to have an apparent mass of 342 g when submerged in water. (a) What mass of water is displaced? (b) What is the volume of the rock? (c) What is its average density? Is this consistent with the value for granite? (OpenStax 11.41) **198 g, 198 cm³, 2.73 g/cm³**
9. Some fish have a density slightly less than that of water and must exert a force (swim) to stay submerged. What force must an 85.0-kg grouper exert to stay submerged in salt water if its body density is 1015 kg/m³? (OpenStax 11.44) **8.21 N**
10. A twin-sized air mattress used for camping has dimensions of 100 cm by 200 cm by 15 cm when blown up. The weight of the mattress is 2 kg. How heavy a person could the air mattress hold if it is placed in freshwater? (OpenStax 11.51) **2920 N**
11. A duck is floating on a lake with 25% of its volume beneath the water. What is the average density of the duck? (Cutnell 11.38) **250 kg/m³**
12. Only a small part of an iceberg protrudes above the water, while the bulk lies below the surface. The density of ice is 917 kg/m³ and that of seawater is 1025 kg/m³. Find the percentage of the iceberg's volume that lies below the surface. (Cutnell 11.40) **89.5%**