

Fluids Practice Problems

1. A piece of metal weighs 50.0 N (F_g) in air and 36.0 N in water (apparent weight).
 - a. What is the buoyant force on the piece of metal?
 - b. What is the volume of water displaced by the piece of metal?
 - c. What is the density of the metal piece. (Think $\rho = m/V$ and $F_g = \rho_{\text{metal}}gV$)
2. In a car lift, compressed air exerts a force on a piston with a radius of 5 cm. This pressure is transmitted to a second piston with a radius of 15 cm.
 - a. What force must the compressed air exert to lift a 1.33×10^4 N car?
 - b. What air pressure produces this force? Neglect the weight of the pistons.
3. Which of the following exerts the most pressure while resting on a floor?
 - a. a 25 N box with 1.5 m sides
 - b. a 15 N cylinder with a base radius of 1.0 m
4. When a vampire squid dives to a depth of 5.0×10^3 m, how much pressure, in Pa, must its body be able to withstand? Assume pressure at surface = 1.01×10^5 Pa (Hint: density of sea water = 1.025×10^3 kg/m³)
5. Steel is much denser than water. How, then, do steel boats float?
6. After a long class, a physics teacher stretches out for a nap on a bed of nails. How is this possible?
7. If you lay a steel needle horizontally on water, it will float. If you place the needle vertically into the water, it will sink. Explain why.
8. A typical silo on a farm has many bands wrapped around its perimeter. Why is the spacing between successive bands smaller toward the bottom of the silo?
9. When drinking through a straw, you reduce the pressure in your mouth and the atmosphere moves the liquid. Could you use a straw to drink on the moon?

A few more temperature and heat problems:

10. A room on the first floor of a hospital has a temperature of 20°C. A room on the top floor has a temperature of 22 °C. In which of these two rooms is the average kinetic energy of the air particles greater?
11. In terms of the kinetic theory of gases, explain why gases do the following:
 - a. expand when heated
 - b. exert pressure

Answers: 1a 14 N b. 1.43×10^{-3} m³ c. 3.56×10^3 kg/m³ 2. a. 1.48×10^3 N b. 1.88×10^5 Pa 3. (a)
4. 5.0×10^7 Pa