

# HW10 Solutions, Physical Science

Gladden, Fall 2006

## Solutions to Chapter 13 Exercises

6. A sharp knife cuts better than a dull knife because it has a thinner cutting area which results in more cutting pressure for a given force.
11. Both are the same, for pressure depends on depth.
13. (a) The reservoir is elevated so as to produce suitable water pressure in the faucets that it serves. (b) The hoops are closer together at the bottom because the water pressure is greater at the bottom. Closer to the top, the water pressure is not as great, so less reinforcement is needed there.
34. The block of wood would float higher if the piece of iron is suspended below it rather than on top of it. By the law of flotation: The iron-and-wood unit displaces its combined weight and the same volume of water whether the iron is on top or the bottom. When the iron is on the top, more wood is in the water; when the iron is on the bottom, less wood is in the water. Or another explanation is that when the iron is below submerged buoyancy on it reduces its weight and less of the wood is pulled beneath the water line.
45. Since both preservers are the same size, they will displace the same amount of water when submerged and be buoyed up with equal forces. Effectiveness is another story. The amount of buoyant force exerted on the heavy gravel-filled preserver is much less than its weight. If you wear it, you'll sink. The same amount of buoyant force exerted on the lighter Styrofoam preserver is greater than its weight and it will keep you afloat. The *amount* of the force and the *effectiveness* of the force are two different things.
57. The strong man will be unsuccessful. He will have to push with 50 times the weight of the 10 kilograms. The hydraulic arrangement is arranged to his disadvantage. Ordinarily, the input force is applied against the smaller piston and the output force is exerted by the large piston; this arrangement is just the opposite.

## Chapter 13 Problem Solutions

4. First you must find the pressure. It is weight density  $\times$  depth =  $(10,000 \text{ N/m}^3)(2 \text{ m}) = 20,000 \text{ N/m}^2$ , or  $20,000 \text{ Pa}$ . Force is pressure  $\times$  area, and  $1 \text{ cm}^2 = 10^{-4} \text{ m}^2$ , so  $F = (20,000 \text{ N/m}^2)(10^{-4} \text{ m}^2) = 2 \text{ N}$ . It would be easy for the boy to exert this force. It is about the weight of a notebook or a small box of cereal. (Note: Air pressure is not figured into this calculation because its effect in pushing down on the water from above is canceled by its effect in pushing from outside the hole against the leaking water.)
10. The relative areas are as the squares of the diameters;  $6^2/2^2 = 36/4 = 9$ . The larger piston can lift 9 times the input force to the smaller piston.

## Solutions to Chapter 14 Exercises

4. When the diameter is doubled, the area is four times as much. For the same pressure, this would mean four times as much force.
  
8. The density of air in a deep mine is greater than at the surface. The air filling up the mine adds weight and pressure at the bottom of the mine, and according to Boyle's law, greater pressure in a gas means greater density.
  
11. If the item is sealed in an air-tight package at sea level, then the pressure in the package is about 1 atmosphere. Cabin pressure is reduced somewhat for high altitude flying, so the pressure in the package is greater than the surrounding pressure and the package therefore puffs outwards.
  
32. An object rises in air only when buoyant force exceeds its weight. A steel tank of anything weighs more than the air it displaces, so won't rise. A helium-filled balloon weighs less than the air it displaces and rises.
  
43. As speed of water increases, internal pressure of the water decreases.
  
45. Air moves faster over the spinning top of the Frisbee and pressure against the top is reduced. A Frisbee, like a wing, needs an "angle of attack" to ensure that the air flowing over it follows a longer path than the air flowing under it. So as with the beach ball in the previous exercise, there is a difference in pressures against the top and bottom of the Frisbee that produces an upward lift.
  
48. (a) Speed increases (so that the same quantity of gas can move through the pipe in the same time). (b) Pressure decreases (Bernoulli's principle). (c) The spacing between the streamlines decreases, because the same number of streamlines fit in a smaller area.
  
56. In accord with Bernoulli's principle, the sheets of paper will move together because air pressure between them is reduced, and less than the air pressure on the outside surfaces.