

## Fluid Dynamics: Additional Problems

- The circular top of a can of soda has a radius of 0.0320 m. The pull-tab has an area of  $3.80 \times 10^{-4} \text{ m}^2$ . The absolute pressure of the carbon dioxide in the can is  $1.40 \times 10^5 \text{ Pa}$ . Find the force that this gas generates
  - on top of the can (including the pull-tab's area) and
  - on the pull-tab itself.
- High-heeled shoes can cause tremendous pressure to be applied to a floor. Suppose the radius of a heel is  $6.00 \times 10^{-3} \text{ m}$ . At times during normal walking motion, nearly the entire body weight acts perpendicular to the surface of such a heel. Find the pressure that is applied to the floor under the heel because the weight of a 50.0 kg woman.
- A cylinder is fitted with a piston, beneath which is a spring, as in the drawing. The cylinder is open at the top. There is no friction. The spring constant of the spring is 2900 N/m. The piston has negligible mass and a radius of 0.030 m. When the air beneath the piston is completely pumped out,
  - how much does the atmosphere's pressure cause the piston to compress?
  - How much work does the atmosphere do in compressing the spring?
- The Mariana trench is located in the Pacific Ocean and has a depth of approximately 11,000 m. The density of seawater is approximately  $1025 \text{ kg/m}^3$ .
  - If a diving chamber were to explore such depths, what force would the water exert on the chamber's observation window (radius = 0.10 m)?
  - For comparison, determine the weight of a jumbo jet whose mass is  $1.2 \times 10^5 \text{ kg}$ .
- A water tower has a vertical pipe that is filled with water. The pipe is open to the atmosphere at the top. The pipe is 22 m high. At the bottom of this pipe is a hole with a cork in it.
  - What is the pressure at this hole when the cork is in the hole?
  - What is the pressure when the cork is removed and the water is allowed to squirt onto the ground?
- A buoyant force of 26 N acts on a piece of quartz that is completely immersed in ethyl alcohol. What is the volume of the quartz?  $\rho_{\text{ethanol}} = 785.06 \text{ kg/m}^3$
- Oil is flowing with a speed of 1.22 m/s through a pipeline with a radius of 0.305 m. How many gallons of oil ( $1 \text{ gal} = 3.79 \times 10^{-3} \text{ m}^3$ ) flow in a day?
- A small crack forms at the bottom of a 15.0 m high dam. The effective crack area through which the water leaves is  $1.00 \times 10^{-3} \text{ m}^2$ .
  - What is the speed of the water flowing through this crack?
  - How many cubic meters of water per second flow through the crack?
- An airplane wing is designed so that the speed of the air across the top of the wing is 248 m/s when the speed below the wing is 225 m/s. The density of air is  $1.29 \text{ kg/m}^3$ . What is the lifting force on a wing that is rectangular and 2 m x 10 m?

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10. Water is running out of a faucet, falling straight down, with an initial speed of 0.50 m/s. At what distance below the faucet is the radius of the stream reduced to half of its original radius at the faucet?

### ANSWERS

- |                           |                        |   |                                 |
|---------------------------|------------------------|---|---------------------------------|
| 1) a. 450 N               | b. 53.2 N              | 5) ???  | 9) $1.40 \times 10^5$ N         |
| 2) $4.33 \times 10^6$ Pa  |                        | 6) $3.3 \times 10^{-3} \text{ m}^3$                       | 10) 0.19 m                      |
| 3) 0.097 N                | b. 14 J                | 7) $0.356 \text{ m}^3/\text{kg}$ , $8.12 \times 10^6$ gal |                                 |
| 4) a. $3.5 \times 10^6$ N | b. $1.2 \times 10^6$ N | 8) a. 17.1 m/s  | b. $0.071 \text{ m}^3/\text{s}$ |