Fluid Dynamics: Additional Problems

1. The circular top pf a can of soda has a radius of 0.0320 m. The pull-tab has an area of 3.80×10^{-4} m^2. The absolute pressure of the carbon dioxide in the can is 1.40×10^5 Pa. Find the force that this gas generates
    a. on top of the can (including the pull-tab's area) and
    b. on the pull-tab itself.

2. High-heeled shoes can cause tremendous pressure to be applied to a floor. Suppose the radius of a heel is 6.00×10^{-3} 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.

3. 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,
    a. how much does the atmosphere's pressure cause the piston to compress?
    b. How much work does the atmosphere to in compressing the spring?

4. 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 kg/m^3.
    a. 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)?
    b. For comparison, determine the weight of a jumbo jet whose mass is 1.2×10^5 kg.

5. 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.
    a. What is the pressure at this hole when the cork is in the hole?
    b. What is the pressure when the cork is removed and the water is allowed to squirt onto the ground?

6. 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? $\rho_{ethanol} = 785.06$ kg/m^3

7. 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 gal = 3.79×10^{-3} m^3) flow in a day?

8. A small crack forms at the bottom of a 15.0 m high dam. The effective crack area through which the water leaves is 1.00×10^{-3} m^2.
    a. What is the speed of the water flowing through this crack?
    b. How many cubic meters of water per second flow through the crack?

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