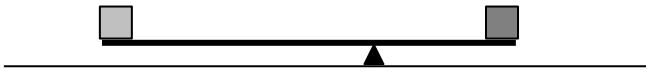
Quiz 7

Solutions

Choose the best answer.

1. A pair of blocks of the same shape and volume but different densities are balanced as shown on a plank of negligible mass and volume. This system is on the bottom of a tank which is slowly being filled with water. As the water level rises to submerge the blocks:



   ☛A. The system tips clockwise. [The buoyant forces (upward) are the same on both blocks, but the one on the left has a longer moment arm, so the effect of the torque is greater.]

   B. The system tips counter-clockwise.

   C. The system remains balanced.

   D. Which of these occurs cannot be determined from the information given.

Choose T or F depending on whether the statement is true or false.

2. As water flows from a hose through the constriction of a nozzle, the speed of flow and the pressure both increase. **F** {The pressure decreases.]

3. A pump sends water through a hose of cross-section area A to a vertical nozzle of cross-section area a, at the same height as the pump. The nozzle shoots water up to a height h above its opening. [Express answers in terms of the *given* quantities, g, air pressure P_0, and the density of water ρ.]

   a. What is the speed of the water as it leaves the nozzle?

   b. What is the speed of water in the hose?

   c. What pressure must the pump provide?

a. The water rises to height h while pressure remains air pressure, so we have $P_0 + \frac{1}{2}\rho v^2 = P_0 + \rho g h$, or $v^2 = 2gh$. (Like an object thrown into the air.)

b. By continuity, $Av_1 = av$, or $v_1 = (a/A)v$.

c. Comparing a point in the hose to the exit point from the nozzle, we have $P + \frac{1}{2}\rho {v_1}^2 = P_0 + \frac{1}{2}\rho v^2$. Using the results of (a) and (b), we find $P = P_0 + (1 - a^2/A^2)\rho g h$.