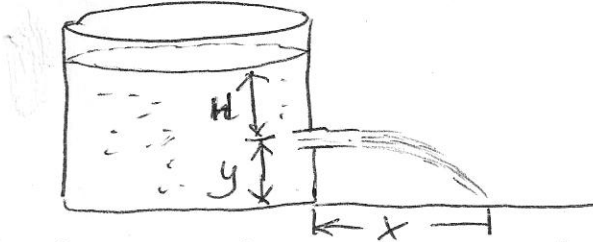
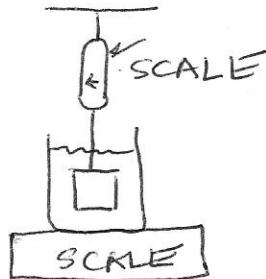


4C Problem set 1 – Fluids

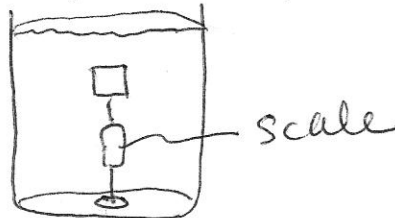
1. A large tank of water is tapped a distance H below the water surface by a small pipe as shown in the diagram. Find the distance x reached by the water flowing out the pipe.



2. A beaker of mass m_b contains a mass of water m_w and rests on a scale. A block of aluminum of mass m_a is suspended from a spring scale and submerged in the water. If the $m_a = m_w = 2m_b$, find the reading on the two scales. (The specific gravity of aluminum is 2.7)

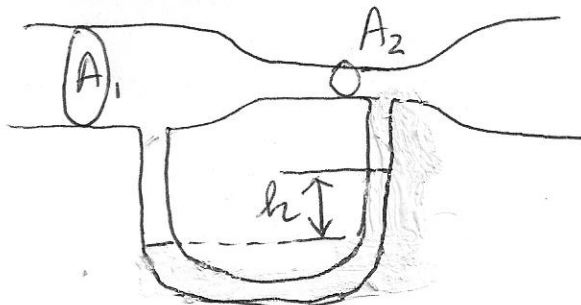


3. A large piece of cork has a mass m_c in air. When held submerged under water by a spring scale as shown, the spring scale reads m_c' . Find the density of the cork.



4. A firehose must be able to shoot water to the top of a building H tall when aimed straight up. Water enters this hose at a steady rate of Av and shoots out of a round nozzle. (a) what is the maximum diameter the nozzle can have? (b) if the nozzle diameter is twice as great, what is the maximum height the water can reach?
5. A plastic ball of radius r floats in water with $1/5$ of its volume submerged. (a) What force must you apply to the ball to hold it at rest completely below the surface? (b) If you let go, what is the acceleration at the instant of release?
6. A cubical block of wood of sides a and density of ρ_b floats in a liquid of density ρ_L . (a) What fraction of the block's volume is above the surface? (b) the liquid is more dense than water ρ_w and does not mix. If water is poured on the surface, how deep must the water layer be so that the water surface just rises to the top of the block.

7. The horizontal pipe shown has a cross sectional area of A_1 at the wider portions and $A_2 = \frac{1}{4} A_1$ at the narrow portion. Water is flowing in the pipe and the volume flow rate is X . Find (a) the flow speeds at the wide and narrow portions, (b) the pressure difference between these portions, (c) the difference in height between the mercury columns in the U-shaped tube.



8. A siphon is a device for removing liquid from a container that cannot be tipped. It operates as shown in the figure. The tube must initially be filled, but once this has been done the liquid will flow until its level drops below the tube opening at A. The liquid has density ρ and negligible viscosity. (a) with what speed does the liquid emerge from the tube at C? (b) what is the pressure in the liquid at the topmost point b? (c) What is the greatest height h_1 that the siphon can lift water?

