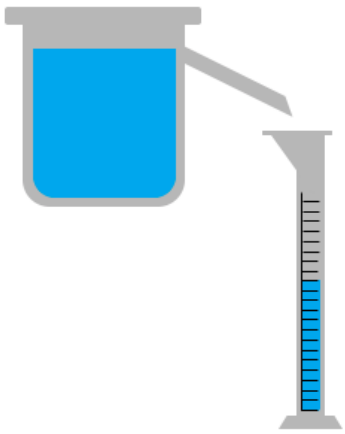
Problem 1

The glass beaker shown below is filled to its maximum height with water. (Any more water would escape through the downspout.) Then an object is gently placed in the beaker. All of the spilled water is collected and measured in the graduated cylinder.

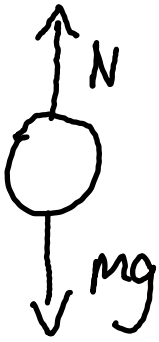


(a) Suppose the object **floats** in the water. Which physical properties of the object can be determined by measuring the amount of spilled water? (Hint: draw a free-body diagram for the floating object.)

(i) Mass?
(ii) Volume?
(iii) Density?
(iv) Weight?

(b) Suppose the object **sinks** in the water. Which physical properties of the object can be determined by measuring the amount of spilled water? (Hint: draw a free-body diagram for the sunken object.)

(i) Mass?
(ii) Volume?
(iii) Density?
(iv) Weight?



Problem 2

According to the EPA, the average shower in the United States lasts for about eight minutes and consumes roughly 60 liters of water. For the following questions, use the assumptions of ideal fluid flow (perfectly laminar flow, no losses due to viscosity, etc.).

(a) Suppose that a shower head contains 48 pinholes, each with a diameter of 1.0 mm. What is the speed of the water stream as it exits from each pinhole? (Hint: $1.0\,\text{m}^3 = 1{,}000\,\text{L}$.)

$.000125 \div (48 \cdot .0005^2 \cdot \pi)$

$= 3.316\ m/s$

(b) Suppose that the shower is being fed by standard ½ inch copper pipe, which has an inner diameter of 13.8 mm. What is the speed of the water as it passes through this section of pipe? Compare your answer here with the answer in part (a). Which speed should be larger?

$A_1 V_1 = A_2 V_2$

$3.316(48 \cdot .0005^2 \cdot \pi) = V_2(6.9^2 \cdot \pi)$

(c) What is the **gauge** pressure in the section of pipe that is just behind the shower head, but at the same height as the shower head? Note that when the water leaves the shower head, its pressure must be in equilibrium with the surrounding air.