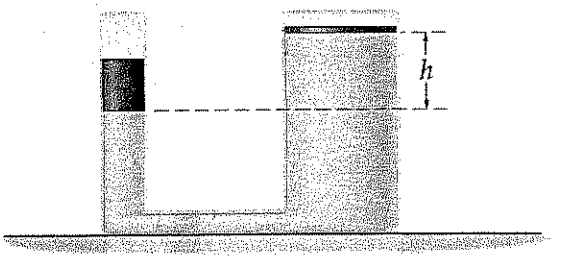
3. (Walker, 15.14) The density of mercury is 13,600 kg/m^3. As a storm front moves in, you notice that the column of mercury in a barometer rises to only 740 mm. What is the air pressure?

$P = \rho g h = 13600(10)(0.74) = \boxed{100640\ Pa}$

4. (Walker, 15.16) In the hydraulic system shown to the right, the piston on the left has a diameter of 4.5 cm and a mass of 1.7 kg. The piston on the right has a diameter of 12 cm and a mass of 3.2 kg. If the density of the fluid is 750 kg/m^3, what is the height difference h between the two pistons?



$P_{left} = \frac{17N}{\pi r_{left}^2} = \frac{17}{0.0016} = 10625\ Pa$

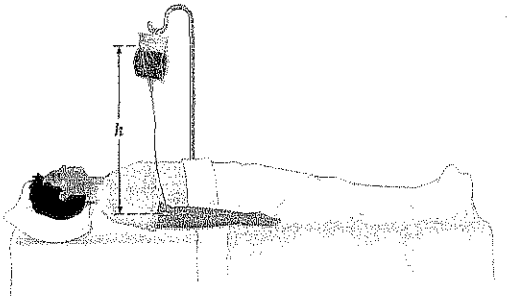
$P_{right} = \frac{32}{\pi r_{right}^2} + \rho g h = \frac{32}{0.02} + 750(10)(h) = 1600 + 7500h$

$7500h + 1600 = 10625$

$h = \boxed{1.2\ m}$

5. (Walker, 15.25) The patient in the diagram to the right is to receive an intravenous injection of medication. In order to work properly, the pressure of fluid containing the medication must be 109 kPa at the injection point.

   a. If the fluid has a density of 1020 kg/m^3, find the height at which the bag of fluid must be suspended above the patient. Assume that the pressure inside the bag is at 1 atm.



$\rho g h + P_{atm} = 109000$

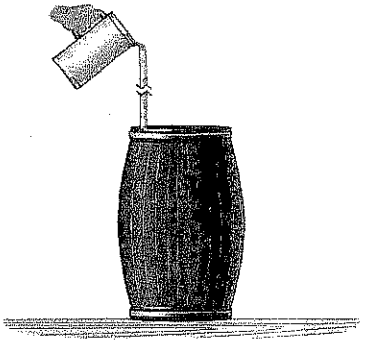
$1020(10)h + 100000 = 109000$

$\boxed{h = 0.88\ m}$

   b. If a less-dense fluid is to be used, must the height of suspension be increased or decreased?

increased

6. (Walker, 15.17) A circular wine barrel 75 cm in diameter will burst if the net upward force exerted on the top is 6430 N. A tube 1.0 cm in diameter extends into the barrel through a hole in the top as shown. Initially the barrel is filled to the top and the tube is empty above that level.



   a. What weight of water must be poured into the tube in order to burst the barrel?

$P_{bar} = \frac{6430}{\pi r^2} = \frac{6430}{\pi(0.375)^2} = 14554\ Pa$

$14554 = \rho g h = 1000(10)h$

   b. How high up the tube will this amount of water extend?

$V_{water} = h(\pi r^2) = 1.15 \times 10^{-4}\ m^3$

$mg = \rho V g = 1000(1.15 \times 10^{-4})(10)$

$= \boxed{1.15\ N}$

$\boxed{h = 1.46\ m}$