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Bernoulli's Equation in Static Fluid

1. An important "vital sign" for monitoring human health is blood pressure. In particular, doctors want to know what the pressure of a patient's blood is as it passes through the heart.

(a) Why is blood pressure normally measured with a cuff around the upper arm with the person sitting upright?

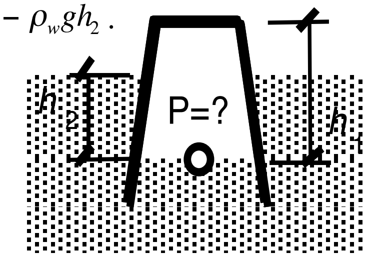
(b) Suppose you want to measure the blood pressure of a person and for whatever reason (perhaps due to injury), you are not able to use an upper arm of the person to measure the blood pressure, and you have to use a leg instead. In what position would you place the person before making the measurement? Why?

(c) Given that you want to find the pressure at heart level, what percent error would you get if you measured a patient's blood pressure on the patient's leg while the patient was sitting up? (Assume a distance between heart and leg of $0.5m$ and a normal blood pressure of $95mmHg$)

2. To reach an absolute pressure of 3 Atm, you must dive down (in water) to depth of approximately 20 m. Why is the answer not 30 m (assuming for every 10*m* you increase by a factor of 1Atm on average)?

3. A cup is inverted into some water. If ρ_w is the density of water and ρ_a is the density of the air inside the cup, what is the pressure P of the air just above the water surface inside the cup in terms of the given quantities?

(a) $P = P_{atm} + \rho_0 g h_1$. (b) $P = P_{atm} + \rho_a g h_2$. (c) $P = P_{atm} + \rho_a g h_1$.
(d) $P = P_{atm} + \rho_w g h_1$. (e) $P = P_{atm} + \rho_w g h_2$. (f) $P = P_{atm} - \rho_w g h_2$.



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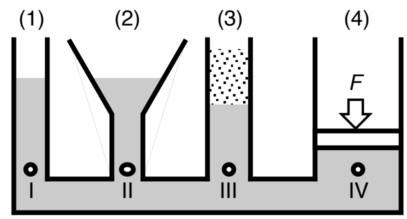
4. The device shown at right was constructed in a physics lab. When this system reaches equilibrium, the water levels in each tube are shown below. Tubes 1 and 2 are both open to the air. Tube 3 is open to the air but has some less dense oil on top of the water in the tube. Tube 4 has a piston in it with a force *F* applied (perhaps a weight rests on the piston). At which point (I, II, III, or IV) will the hydrostatic pressure be the greatest, or will all of the pressures be the same? Explain, describing in particular how tubes 2, 3, and 4 differ from tube 1.



5. Three cups inverted into water are shown below. Cup 1 has a water level inside that is below the water level exposed to the atmosphere. Cup 2 has a water level inside that is above the water level exposed to the atmosphere. Cup 3 has a layer of oil (which is less dense than water) atop the water level inside of it. Cup 2 and cup 3 have the same *volume* of air trapped in them.

All three cups have air trapped inside of them. Apply the Bernoulli's equation to each cup so you can rank the pressures (P_1, P_2, P_3) of the air pockets trapped inside them, from least to greatest pressure.