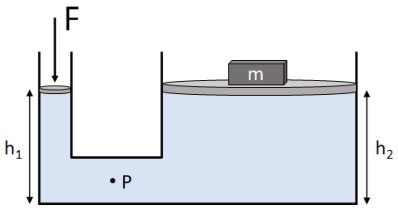
Physics 202
Individual Quizbit | Fluid Dynamics

Work individually to produce a single handwritten solution to these questions. The first part of activity is a timed quiz, where you are graded on effort and completeness. Turn that into Gradescope under the associated timed assignment. Then you will have until the end of the week to submit to a separate Gradescope assignment a well organized and thorough solution. Start with fundamental principles and use multiple representations to communicate understanding of the physics.

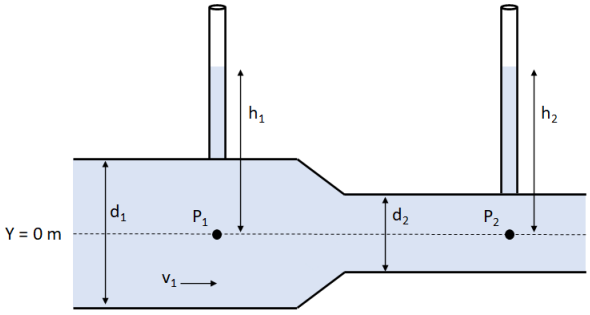
For question 1, **fill in the square** next to all correct answers. Each correctly bubbled answer will receive two points. There are **3** correct answers in this section and only the first **3** filled in answers will be graded. There is no partial credit.

1. A hydraulic system is set up with a force F pushing on a small piston and a mass, m, resting on a piston with a larger diameter. **P** is a point in the fluid. The system is initially at equilibrium with the pistons at the same height, $\mathbf{h_1 = h_2}$. The force, F, is then increased and the system is allowed to reach a new equilibrium. Which of the following statements must be true about the new equilibrium state?



□ (a) The pressure pushing up on the large piston is larger than during first equilibrium.
□ (b) The pressure pushing up on the large piston is smaller than during first equilibrium.
□ (c) The pressure pushing up on the large piston is the same as during first equilibrium.
□ (d) The change, $|\Delta \mathbf{h_1}|$, between equilibriums is larger than $|\Delta \mathbf{h_2}|$.
□ (e) The change, $|\Delta \mathbf{h_1}|$, between equilibriums is smaller than $|\Delta \mathbf{h_2}|$.
□ (f) The pressure at point **P** is larger than during first equilibrium.
□ (g) The pressure at point **P** is smaller than during first equilibrium.
□ (h) The pressure at point **P** is the same as during first equilibrium.

2. A pipe with flowing water narrows to half its original diameter. Two vertical tubes are attached to the pipe, one before and one after the pipe narrows. These tubes each allow water from the pipes into them, are very long, and are open to the atmosphere at the top. The height of water in the tubes is measured to be $\mathbf{h_1}$ and $\mathbf{h_2}$ respectively (these heights are ***not*** drawn to scale in the picture!). The velocity of water in the pipe before it narrows is $\mathbf{v_1 = 0.3\ m/s}$. Note: the density of water is 1000 kg/m^3.



(a) We will start with Sensemaking this time! Do you expect $\mathbf{h_1}$ or $\mathbf{h_2}$ to be larger? Explain. Proportionality and related quantities sensemaking techniques may be useful here.
(b) What is the velocity, $\mathbf{v_2}$, of the fluid in the pipe after it narrows?
(c) What is the difference in pressure, $\mathbf{P_2 - P_1}$?

Follow-up for revised solution. **Not due during timed quiz**.
(d) Using pressure at a depth and your found pressure difference from part (c), what is the difference in height $h_2 - h_1$? Does this match your expectation from (a)?