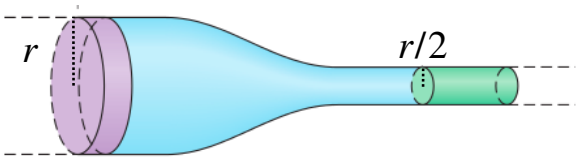
Javier Duarte, Department of Physics
University of California San Diego
Physics 2C, Winter 2020

Reading Assignment due Thursday 1/9: Submit via Gradescope by 11:30am

1. The equation of continuity says that $v_1 A_1 = v_2 A_2$.
   (a) What are the dimensions[1] of the terms in this equation?
   (b) What are the SI units of the terms in this equation?
   (c) The quantiy vA is called the "volume flow rate." What do you think the quantity ρvA is called (hint: what are the dimensions?)?
   (d) If the radius of a pipe with circular cross section shrinks by a factor of two, what will happen to the speed of the water as it flows from the larger end to the smaller end?

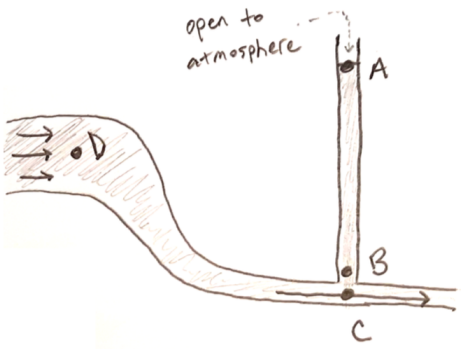


2. Bernoulli's equation is

$$p_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = p_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2 \tag{1}$$

   (a) What are the dimensions of the terms in this equation? Note that for an equation to make sense, every term must have the same dimensions.
   (b) The proof of Bernoulli's equation depends on the fact that points 1 and 2 are describing points in a fluid in the same *streamline*. Explain how to tell whether two points are in the same streamline.
   (c) Which points in the following picutre are related by a streamline? The water in the column (points A and B) is at rest, but the water in the pipe (points C and D) is moving.

[1] To clarify the distinction between dimensions and SI units, here are some examples: length, time, and mass are dimensions, and the corresponding SI units are meters, seconds, and kilograms.



(d) If the flow is steady, then points B and C (very close to each other) have almost the same pressure (even though fluid is moving at point C and not at point B). Explain with a FBD.

For extra practice (not due): From Chapter 14 of Knight, 4th edition: Conceptual Questions: 10. Exercises: 28, 29, 30.