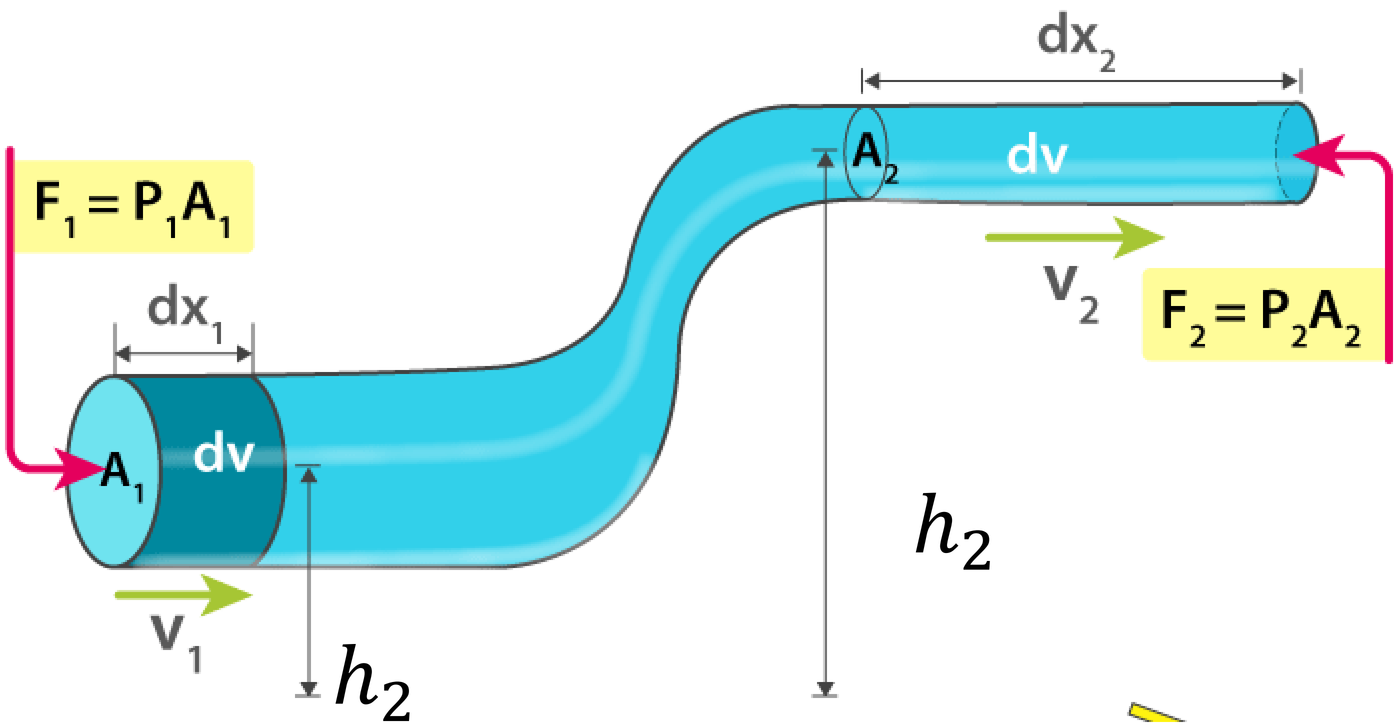
Pressure in fluids



$$Work = P_1A_1dx_1 - P_2A_2dx_2 = -\Delta P dV \quad = \quad Energy\ Change = \Delta\left(\frac{\rho v^2}{2} + \rho g h\right)dV$$

$$\frac{\rho v^2}{2} + \rho g h + P = const$$

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- **Hydrostatic Pressure** (static fluid in the presence of gravity):

$$\Delta P = -\rho g \Delta h$$

- **Bernoulli Principle** (fluid in motion, no gravity):

$$P + \frac{\rho v^2}{2} = const$$

Homework

A ball of radius r is moving in air with speed v.

a) Find the extra pressure ΔP in a stagnation point in front of it, where air moves together with the ball. It is best to work in the reference frame where the ball is stationary, and air flow moves with speed v towards it. Use Bernoulli's principle. Air density is ρ.

b) Assuming that this extra pressure is roughly constant everywhere in front of the ball (not true, really), estimate the total air resistance force that acts on the ball.

c) Use your result from part (b) to estimate the speed with which a ping pong ball of radius r=1cm, and mass m=4g would fall in Earth gravity, in the presence of air (ρ=1.2kg/m^3).