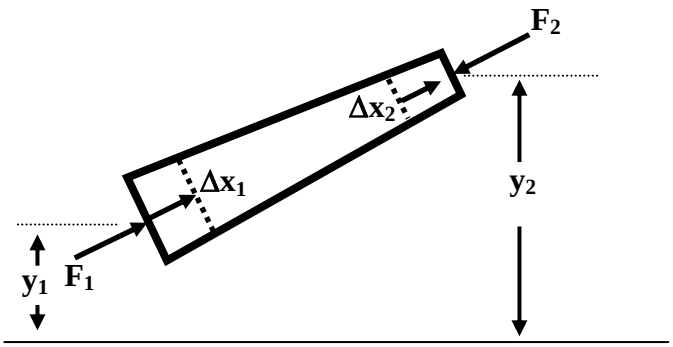
Fluids

I. Bernoulli's Equation

At every point in an ideal fluid, the pressure, velocity and height of the fluid are related by the following expression known as Bernoulli's Equation:

Bernoulli's Equation

Consider a fluid flowing through a pipe as shown below.



The work done on the fluid by an external force F_1 in displacing the fluid by Δx_1 is

The work done on the fluid by an external force F2 as the fluid is displaced by Δx_2 is

Assuming that there are no other un-conservative forces acting on the fluid, we have from conservation of mechanical energy

The kinetic energy of the fluid at position 1 is given by

The kinetic energy of the fluid at position 2 is given by

The gravitational potential energy at point 1 is given by

The gravitational potential energy at point 2 is given by

Substituting our results into our conservation of mechanical energy equation and performing some algebra gives us Bernoulli's equation.

1. According to Bernoulli's equation a faster moving fluid applies a lower pressure upon an object than a slower moving fluid.

Because Bernoulli's equation is just a consequence of applying conservation of energy to a fluid, many of our past fluid results are special cases of Bernoulli's and we can also explain many interesting new things including aerodynamic lift. What is important to remember is that no matter what we call it, we are still simply analyzing systems using energy analysis!!!

Example: Air Foil

Example: Rising (actually less dropping) Fastball