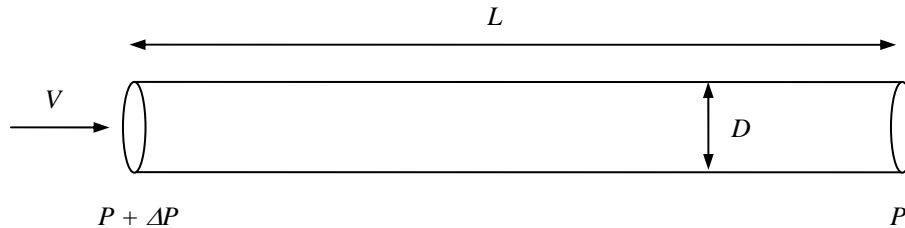


Supplementary Homework Problem (HW Set 20)**Due at the beginning of Lecture 22**Dimensional analysis of pipe friction

Consider a fluid flow through the a horizontal, circular pipe:



The pressure drop, from the inlet to the outlet, due to friction in the pipe, ΔP , depends on the following fluid properties and geometry parameters:

- fluid density, ρ
- flow velocity, V
- pipe diameter, D
- fluid viscosity, μ
- pipe surface roughness, ε
- pipe length, L

In dimensional form, the dependency can be expressed as

$$\Delta P = f(\rho, V, D, \mu, \varepsilon, L).$$

Perform a dimensional analysis on the above functional dependency by choosing the fluid density, the flow velocity and the pipe diameter as the repeating variables.

What are $\Pi_1, \Pi_2, \Pi_3, \dots$ in the equivalent non-dimensional representation?

$$\Pi_1 = g(\Pi_2, \Pi_3, \dots).$$