Velocity Vector:	$\vec{V} = u\vec{i} + v\vec{j} + w\vec{k}$
Acceleration Vector:	$\vec{a} = \frac{D\vec{V}}{Dt} = \frac{\partial \vec{V}}{\partial t} + u\frac{\partial \vec{V}}{\partial x} + v\frac{\partial \vec{V}}{\partial y} + w\frac{\partial \vec{V}}{\partial z}$
Shear Stress:	$\tau_w = \mu \left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x} \right) \Big\|_{y=0} = \mu \frac{\partial u}{\partial y} \Big\|_{y=0}$
Density:	$\rho = \frac{\text{mass}}{\text{volume}} = \left(\frac{slug}{ft^3}, \frac{kg}{m^3} \right)$
Specific Weight:	$\gamma = \rho g = \frac{\text{weight}}{\text{volume}} \quad \left(\frac{lbf}{ft^3}, \frac{N}{m^3} \right)$
Specific Gravity:	$SG = \frac{\rho_{liq}}{\rho_{water}}, \quad \rho_{liq} = SG\ \rho_{water}$
Mass flow rate	$\dot{m} = \rho V A$
Volumetric flow rate:	$\dot{V} = VA$
Conservation of Mass:	$\frac{\partial \rho}{\partial t} + \frac{\partial(\rho u)}{\partial x} + \frac{\partial(\rho v)}{\partial y} + \frac{\partial(\rho w)}{\partial z} = 0$
Incompressible Continuity Equation in Cartesian Coordinates:	$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0$

Navier Stokes Equations in Cartesian Coordinates:

$$\rho g_x - \frac{\partial p}{\partial x} + \mu \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} \right) = \rho \left(\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z} \right)$$

$$\rho g_y - \frac{\partial p}{\partial y} + \mu \left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2} + \frac{\partial^2 v}{\partial z^2} \right) = \rho \left(\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z} \right)$$

$$\rho g_z - \frac{\partial p}{\partial z} + \mu \left(\frac{\partial^2 w}{\partial x^2} + \frac{\partial^2 w}{\partial y^2} + \frac{\partial^2 w}{\partial z^2} \right) = \rho \left(\frac{\partial w}{\partial t} + u\frac{\partial w}{\partial x} + v\frac{\partial w}{\partial y} + w\frac{\partial w}{\partial z} \right)$$

Method of Repeating Variables (Π Theorem):
Six steps:

1. List the parameters in the problem and count their total number ***n***.
2. List the primary dimensions of each of the *n* parameters. The number of primary dimensions appearing is ***j***.
3. Calculate ***k***, the expected number of Π groups, *k = n - j.*
4. Choose ***j*** *repeating parameters.*
5. Construct the *k* Π groups and manipulate as necessary.
6. Write the final functional relationship and check algebra.

	Water	Mercury	Air
ρ, kg/m^3	998	13,550	1.20
ρg, N/m^3	9790	132,900	11.77
μ, kg/(m·s)	1.00 E-3	1.56 E-3	1.8 E-5

$g = 9.81 \quad \text{m/s}^2$ $\qquad P_{atm} = 101\,\text{kPa}$ $\qquad 0°\text{C} = 273\,\text{K}$