Properties of a System

Intensive Properties:

- **Density** \( \rho = \frac{m}{V} \) \((\text{kg/m}^3)\)
- **Specific gravity** \( \text{S.G.} = \frac{\rho}{\rho_{\text{H}_2\text{O}}} \) \(\rho_{\text{H}_2\text{O}} \approx 1000 \text{ kg/m}^3\)
- **Specific volume** \( v = \frac{V}{m} = \frac{1}{\rho} \) \((\text{m}^3/\text{kg})\)
- **Temperature**
  - \( T (^\circ \text{C} \text{ or } ^\circ \text{F} - \text{relative temperature}) \)
  - \( T (^\circ \text{K} \text{ or } ^\circ \text{R} - \text{absolute temperature}) \)
  
  \( ^\circ \text{K} = ^\circ \text{C} + 273 \)
  \( ^\circ \text{R} = ^\circ \text{F} + 459 \)

- **Pressure** \( P \) \((\text{Pa} = \text{N/m}^2, \text{kPa, bar} = 10^5 \text{ Pa})\)
  
  1 atm = 14.696 psi = 101,325 Pa

Extensive Properties:

- **Total mass**
- **Total volume**
- **Total energy**
**Buoyancy Force**

A buoyancy force is created by the increased pressure of a fluid with depth (note: the hydrostatic equation)

\[ dp = -\rho_f g \, dh \]

where \( \rho_f \) is the fluid density, \( g \) is local acceleration due to gravity, and \( h \) is the depth.

\( dp \) is the differential pressure and \( dh \) is the differential depth.

If a plate of thickness \( h \) is placed in a fluid, the pressure on the upper surface is less than that on the lower surface.

\[ F_b = F_{\text{bottom}} - F_{\text{top}} = \rho_f g(s + h)A - \rho_f g s A \]

or, \[ F_b = \rho_f g V \]

where \( V = h A \)

\( F_b \) is therefore the buoyancy force upward and is equal to the weight of the displaced fluid.