Lab 1 – Writing Equations in Microsoft Word

Example 1
In like manner the net force \( dF_y \) involves \(-\partial p/\partial y\), and the net force \( dF_z \) concerns \(-\partial p/\partial z\). The total net-force vector on the element due to pressure is

\[
dF_{\text{press}} = \left(-i \frac{\partial p}{\partial x} - j \frac{\partial p}{\partial y} - k \frac{\partial p}{\partial z}\right) dx \, dy \, dz
\]  

(2.8)

We recognize the term in parentheses as the negative vector gradient of \( p \). Denoting \( \mathbf{f} \) as the net force per unit element volume, we rewrite Eq. (2.8) as

\[
\mathbf{f}_{\text{press}} = -\nabla p
\]  

(2.9)

Example 2
This is the Reynolds transport theorem for an arbitrary fixed control volume. By letting the property \( B \) be mass, momentum, angular momentum, or energy, we can rewrite all the basic laws in control-volume form.

\[
\frac{d}{dt}(B_{\text{syst}}) = \frac{d}{dt}\left(\int_{CV} \beta \rho dV\right) + \int_{CS} \beta \rho V \cos \theta \, dA_{\text{out}} - \int_{CS} \beta \rho V \cos \theta \, dA_{\text{in}}
\]  

(3.10)

Example 3
This is a straightforward application of dimensional-analysis principles from Chap. 5. As a matter of fact, it was given as an exercise (Prob. 5.20). For each function in Eq. (11.21) there are seven variables and three primary dimensions (\( M, L, \) and \( T \)); hence we expect \( 7 - 3 = 4 \) dimensionless pis, and that is what we get. You can verify as an exercise that appropriate dimensionless forms for Eqs. (11.21) are

\[
\frac{gH}{n^2D^2} = g_1\left(\frac{Q}{nD^3}, \frac{\rho n D^2}{\mu}, \frac{\epsilon}{D}\right)
\]

\[
\frac{bhp}{\rho n^3 D^5} = g_2\left(\frac{Q}{nD^3}, \frac{\rho n D^2}{\mu}, \frac{\epsilon}{D}\right)
\]  

(11.22)
The quantities $\rho n D^2/\mu$ and $e/D$ are recognized as the Reynolds number and roughness ratio, respectively. Three new pump parameters have arisen:

Capacity coefficient $C_Q = \frac{Q}{nD^3}$

Head coefficient $C_H = \frac{gH}{n^2D^2}$

Power coefficient $C_P = \frac{bhp}{\rho n^3D^5}$

(11.23)

Note: Ignore the color change in the font in Eq. (11.23)