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

$$d\mathbf{F}_{\text{press}} = \left(-\mathbf{i}\frac{\partial p}{\partial x} - \mathbf{j}\frac{\partial p}{\partial y} - \mathbf{k}\frac{\partial p}{\partial z}\right) dx\, dy\, dz \tag{2.8}$$

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

$$\mathbf{f}_{\text{press}} = -\nabla p \tag{2.9}$$

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.

$$\frac{d}{dt}(B_{\text{syst}}) = \frac{d}{dt}\left(\int_{\text{CV}} \beta\rho d\mathcal{V}\right) + \int_{\text{CS}} \beta\rho V \cos\theta\, dA_{\text{out}} - \int_{\text{CS}} \beta\rho V \cos\theta\, dA_{\text{in}} \tag{3.10}$$

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

$$\begin{aligned} \frac{gH}{n^2D^2} &= g_1\left(\frac{Q}{nD^3}, \frac{\rho n D^2}{\mu}, \frac{\epsilon}{D}\right) \\ \frac{\text{bhp}}{\rho n^3 D^5} &= g_2\left(\frac{Q}{nD^3}, \frac{\rho n D^2}{\mu}, \frac{\epsilon}{D}\right) \end{aligned} \tag{11.22}$$

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

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

$$\text{Head coefficient } C_H = \frac{gH}{n^2D^2} \tag{11.23}$$

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

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