EQUATION SHEET EXAM #1 - ME 2030

Miscellaneous

$$v = \frac{1}{\rho} \qquad \gamma = \rho g \qquad SG = \frac{\rho}{\rho_{\mathrm{H_2O}}} \qquad p_{gage} = p_{absolute} - p_{atm} \tag{1}$$

Quality (using v as the relevant property)

$$v = (1-x)v_f + xv_g = v_f + x(v_g - v_f) \tag{2}$$

Ideal Gas Law

$$p = \rho RT \qquad pv = RT \qquad p\overline{v} = \overline{R}T \qquad pV = mRT \qquad pV = n\overline{R}T \tag{3}$$

Fluid Statics

$$-\nabla p - \gamma \hat{\mathbf{k}} = \rho \mathbf{a} \tag{4}$$

With $\mathbf{a} = \mathbf{0}$

$$\nabla p + \gamma \hat{\mathbf{k}} = 0 \tag{5}$$

in component form

$$\frac{\partial p}{\partial x} = 0 \quad \frac{\partial p}{\partial y} = 0 \quad \frac{\partial p}{\partial z} = -\gamma \tag{6}$$

therefore

$$\frac{dp}{dz} = -\gamma \tag{7}$$

Inviscid, Incompressible, Steady Flow

$$p + \frac{1}{2}\rho V^2 + \gamma z = \text{constant} \quad \text{along} \quad \text{streamline} \tag{8}$$

$$p + \rho \int \frac{V^2}{\mathbf{R}} dn + \gamma z = \text{constant} \quad \text{across} \quad \text{streamline} \tag{9}$$

where $\mathbf{R}$ is the radius of curvature.

Conservation of Energy - First Law of Thermodynamics

$$E = KE + PE + U \qquad \Delta E = Q - W \qquad \frac{dE}{dt} = \dot{Q} - \dot{W} \tag{10}$$

$$\eta = \frac{W_{cycle}}{Q_{in}} \text{(power cycle)} \qquad \beta = \frac{Q_{in}}{W_{cycle}} \text{(refrigeration cycle)} \qquad \gamma = \frac{Q_{out}}{W_{cycle}} \text{(heat pump cycle)} \tag{11}$$
