Thermodynamics Cheat Sheet

$$\Delta P = \rho g h$$
$$P\nu = RT$$
$$PV = mRT$$
$$P_v = \phi P_{\text{sat@T}}$$
$$T_R = T/T_{cr}$$
$$P_R = P/P_{cr}$$
$$P\nu = ZRT$$
$$R = R_u/M$$
$$\dot{W} = VI = I^2R$$
$$w = \int P\ dv$$
$$W = m\int P\ dv$$
$$dh = c_p\ dT$$
$$\sum_{inlets} \dot{m}_i - \sum_{outlets} \dot{m}_o = \frac{\mathrm{d}m_{cv}}{\mathrm{d}t}$$
$$v_x = v_f + x\left(v_g - v_f\right)$$
$$u_x = u_f + x\left(u_g - u_f\right)$$
$$h_x = h_f + x\left(h_g - h_f\right)$$
$$W = \int \bar{F}\cdot ds$$

$F = kx$ linear spring

$$SG = \rho/\rho_{\mathrm{H_2}O}$$
$$du = c_v\ dT$$
$$h = u + P\nu$$

$$x = \frac{m_{\text{vapor}}}{m_{\text{liquid}} + m_{\text{vapor}}}$$
$$\Delta\text{KE} = \frac{1}{2}m\left({V_2}^2 - {V_1}^2\right)$$
$$\Delta\text{PE} = mg\left(z_2 - z_1\right)$$
$$c_p = c_v + R$$
$$\dot{Q} - \dot{W} + \sum_{inlets} \dot{m}_i\left(h_i + \frac{{V_i}^2}{2} + gz_i\right) - \sum_{outlets} \dot{m}_o\left(h_o + \frac{{V_o}^2}{2} + gz_o\right) = \frac{\mathrm{d}E}{\mathrm{d}t}$$
$$q - w = \Delta u + \Delta\text{ke} + \Delta\text{pe}$$
$$Q - W = \Delta U + \Delta\text{KE} + \Delta\text{PE}$$
$$\oint \frac{\partial Q}{T} \leq 0 \quad \text{Clausius Inequality}$$
$$dS = \frac{\partial Q}{T} \quad \text{reversible}$$
$$T\ ds = du + P\ d\nu$$
$$T\ ds = dh - \nu\ dP$$
$$\Delta s = s_2^\circ - s_1^\circ - R\ln\frac{P_2}{P_1}$$
$$\Delta s = c_p\ln\left(\frac{T_2}{T_1}\right) - R\ln\left(\frac{P_2}{P_1}\right)$$
$$\Delta s = c_v\ln\left(\frac{T_2}{T_1}\right) + R\ln\left(\frac{\nu_2}{\nu_1}\right)$$
$$\Delta s = c_p\ln\left(\frac{T_2}{T_1}\right) \quad \text{incompressible}$$
$$W = \frac{P_2V_2 - P_1V_1}{1-n} \quad \text{for } n \neq 1$$
$$W = P_1V_1\ln\frac{V_2}{V_1} \quad \text{for } n = 1$$

Ideal Gas Constant

$$R_u = 0.083\,14\,\mathrm{bar\,m^3\,kmol^{-1}\,K^{-1}}$$
$$R_u = 8.314\,\mathrm{kJ\,kmol^{-1}\,K^{-1}}$$
$$R_u = 1.986\,\mathrm{BTU\,lbmol^{-1}\,R^{-1}}$$
$$R_u = 1545\,\mathrm{lb_f\,feet\,lbmol^{-1}\,R^{-1}}$$