SAS
S07

BAE 103
Energy in Biological Systems

Equations

Force, Work and Power

$$F = ma \qquad F = \frac{Gm_1m_2}{R^2} = mg$$

$$W = F \cdot d \qquad H = \frac{F \cdot d}{t} = F \cdot v$$

Heat Engines

$$e = \frac{T_h - T_l}{T_h}$$

Fluid Statics

$$p = \frac{F}{A} \qquad p_{abs} = p_{atm} + p_{guage} \qquad p = \rho gh$$

$$\rho = \frac{m}{v} \qquad s.g. = \frac{\rho_{fluid}}{\rho_{H_2O}}$$

Friction Loss

$$\dot{m} = \rho vA \qquad q = vA$$

$$N_R = \frac{\rho vD}{\mu} = \frac{vD}{\upsilon}$$

$$N_r < 2000 \qquad f = \frac{64}{N_R}$$

$$N_R > 2000 \qquad f = \frac{0.316}{N_R^{0.25}}$$

$$p_1 = p_2 + \rho g\left(\Delta z + f\,\frac{L}{D}\frac{v^2}{2g}\right)$$

Heat Capacity

$$Q = mc\Delta T \qquad Q = mh$$

Heat Transfer

$$Q = \frac{-kA}{t}(T_h - T_l) \qquad Q = hA(T_s - T_f) \qquad Q = \sigma A \varepsilon T^4$$

$$\sigma = 0.173\times10^{-8}\ \frac{Btu}{hr\cdot ft^2\cdot{}^\circ R^4} \qquad \sigma = 5.67\times10^{-8}\ \frac{W}{m^2\cdot K^4}$$

Heat Loss

$$Q = \frac{A}{R_t}(T_{inside} - T_{outside}) \qquad R_t = R_{inside} + R_1 + R_2 + ... + R_n + R_{outside}$$

COP

$$COP = \frac{Q_h}{W} \qquad COP = \frac{Q_l}{W}$$

$$COP = \frac{Q_h}{Q_h - Q_l} \qquad COP = \frac{Q_l}{Q_h - Q_l}$$

Gibb's Free Energy

$$\Delta G_{rx} = \Delta H_{rx} - T(\Delta S_{rx})$$