29:011 Exam 4 Constants and Formulas

$1\ \text{u} = 1.6605 \times 10^{-27}\ \text{kg}$ $\quad N_A = 6.022 \times 10^{23}$

$R = 8.31\ \text{J/(mol K)}$ $\quad k_B = R/N_A = 1.38 \times 10^{-23}\ \text{J/K}$

$c_{water} = 4186\ \text{J/(kg °C)}$ $\quad c_{ice} = 2000\ \text{J/(kg °C)}$

$L_{f,water} = 33.5 \times 10^4\ \text{J/kg}$ $\quad L_{v,water} = 22.6 \times 10^5\ \text{J/kg}$

$$T_F = \frac{9}{5}T_C + 32 \qquad T_C = \frac{5}{9}(T_F - 32) \qquad T_K = T_C + 273.15$$

$$\Delta L = \alpha L_o \Delta T \qquad Q = mc\Delta T \qquad Q = mL_f \qquad Q = mL_v$$

$$\left(\frac{Q}{t}\right)_{conduction} = k\frac{A\Delta T}{L} \qquad \left(\frac{Q}{t}\right)_{radiation} = e\sigma T^4 A \qquad \sigma = 5.67\times10^{-8}\ J\Big/\left(s\cdot m^2\cdot K^4\right)$$

$$m = \rho V \qquad n = \frac{N}{N_A} \qquad m_{particle} = \frac{\text{mass per mole}}{N_A} \qquad PV = nRT = Nk_BT$$

$$\overline{KE} = \frac{1}{2}mv_{rms}^2 = \frac{3}{2}k_BT \qquad U_{\substack{ideal\\gas}} = \frac{3}{2}N\,k_BT = \frac{3}{2}nRT \qquad v_{rms} = \sqrt{\frac{3k_BT}{m}}$$

$$\Delta U = U_f - U_i = Q - W \qquad W = P\Delta V = P(V_f - V_i) \qquad W_{\substack{engine\\in\ cycle}} = Q_H - Q_C$$

$$\text{engine efficiency } e \equiv \frac{W}{Q_H} = 1 - \frac{Q_C}{Q_H} \qquad \left(\frac{Q_C}{Q_H}\right)_{\substack{\text{Carnot}\\\text{engine}}} = \frac{T_C}{T_H} \qquad e_{\substack{\text{Carnot}\\\text{engine}}} = 1 - \frac{T_C}{T_H}$$

$$f = \frac{1}{T} \qquad v = \lambda f = \frac{\lambda}{T} \qquad v_{string} = \sqrt{\frac{F}{\mu}} \qquad \mu = \frac{m}{L}$$

$$v_{sound} = \sqrt{\frac{\gamma k_BT}{m}} \qquad \gamma = \frac{5}{3}\ \text{(ideal monatomic gas)} \qquad v_{\substack{\text{sound,}\\\text{air at 20°C}}} = 343\ m/s$$

$$\text{sound intensity: } I = \frac{\text{Power (W)}}{\text{Area } (\text{m}^2)} \qquad \text{Power (W)} = \frac{\text{Energy (J)}}{\text{time (s)}} \qquad \textit{Area of a sphere} = 4\pi r^2$$

$$\text{sound intensity level: } \beta = (10\ dB)\log\left(\frac{I}{I_0}\right) \qquad I_0 = 1.00\times10^{-12}\ \frac{W}{m^2}$$