Equations for Exam 1

Chapter 19

$\Delta L = \alpha L \Delta T$ $\Delta V = \beta V \Delta T$ $\beta = 3\alpha$ (when applicable)

$PV = nRT = Nk_BT$ $1\text{ atm} = 1.01 \times 10^5 \frac{\text{N}}{\text{m}^2}$ $R = 8.314\text{ J/mol}\cdot\text{K}$

$0\text{ K} = -273^\circ\text{C}$ $m = nM,$ $N = N_A n,$ $N_A = 6.02 \times 10^{23}$

Chapter 20

1 cal = 4.186 J, 1 atm L = 101 J. $Q = mc\Delta T$ $Q = \pm mL$

Water: $c = 1\frac{cal}{g^oC} = 4.186\frac{\text{J}}{\text{g}^\text{o}\text{C}},$ $L_f = 79.7\frac{\text{cal}}{\text{g}} = 333\frac{\text{J}}{\text{g}},$ $L_v = 539\frac{\text{cal}}{\text{g}} = 2260\frac{\text{J}}{\text{g}}$

Ice: $c = 0.50\frac{\text{cal}}{\text{g}^\text{o}\text{C}} = 2.090\frac{\text{cal}}{\text{g}^\text{o}\text{C}},$ Steam: $c = 0.48\frac{\text{cal}}{\text{g}^\text{o}\text{C}} = 2.010\frac{\text{cal}}{\text{g}^\text{o}\text{C}}$

$W = -\int PdV$ $\Delta E_{\text{int}} = Q + W$ $\Delta T = 0 \Longrightarrow W = nRT\ln(V_i/V_f)$

$\mathcal{P} = kA\frac{dT}{dx}$ or $\frac{kA\Delta T}{L}$ $\mathcal{P} = \sigma AeT^4$ or $\sigma Ae(T^4 - T_0^4)$ with $\sigma = 5.67 \times 10^{-8}\frac{\text{J}}{\text{m}^2\cdot\text{K}^4}$

Chapter 21

$E_{\text{int}} = nC_\text{V}T,$ $C_\text{V} = \frac{3}{2}R$ (monatomic) or $\frac{5}{2}R$ (diatomic), $C_\text{P} = C_\text{V} + R$

$\text{Q} = 0 \Longrightarrow P_fV_f^\gamma = P_iV_i^\gamma$ and $T_fV_f^{\gamma-1} = T_iV_i^{\gamma-1}$ with $\gamma = C_\text{P}/C_\text{V}$

Process	Definition	ΔE_{int}	Q	W
isovolumetric	$\Delta V = 0$	$nC_\text{V}\Delta T$	$nC_\text{V}\Delta T$	0
isobaric	$\Delta P = 0$	$nC_\text{V}\Delta T$	$nC_\text{P}\Delta T$	$-P\Delta V$
isothermal	$\Delta T = 0$	0	$nRT\ln(V_f/V_i)$	$nRT\ln(V_i/V_f)$
adiabatic	$Q = 0$	$nC_\text{V}\Delta T$	0	$nC_\text{V}\Delta T$

Chapter 22 (sec. 1 – 5)

$e = \frac{W}{Q_H} = 1 - \frac{Q_C}{Q_H}$ $W = Q_H - Q_C$ $\text{CoP} = \frac{Q_C}{W}$ or $\frac{Q_H}{W}$

Carnot cycle: $\frac{Q_C}{Q_H} = \frac{T_C}{T_H},$ In general: $e \le e_\text{C},$ $\text{CoP} \le \text{CoP}_\text{C}$