Chemistry 172

IΣΠ

Winter 2016

1 General Equations

1.1 Entropy Equations

Table 1: Equations for Entropy

Vary Temperature	Vary Pressure	Vary Volume
$\Delta S = C_{\mathrm{v/p}} \ln \frac{T_f}{T_i}$	$\Delta S = nR \ln \frac{P_i}{P_i}$	$\Delta S = nR \ln \frac{V_f}{V_i}$

$$S = k \ln W$$

$$S_{\mathrm{surr}} = -q_{\mathrm{reaction}}/T$$

1.2 Enthalpy Equations

$$\Delta H = \Delta U + P\Delta V$$
$$\Delta H = \Delta U + \Delta nRT$$
$$\Delta H = \frac{C_p}{\Delta T}$$
$$\Delta U = \frac{C_V}{\Delta T}$$
$$C_p = C_v + nR$$
$$w_{\mathrm{sys}} = -\int_{V_f}^{V_i} PdV$$

Table 2: Equations for Work

Constant Pressure	Constant Temperature	Constant Volume
$w_{\mathrm{sys}} = -P_{\mathrm{ext}}\Delta V$	$w_{\mathrm{sys}} = -nRT \ln \frac{V_{\mathrm{f}}}{V_{\mathrm{i}}}$	0

2 Carnot/Heat Engines

No engine working between two given heat reserviors can be more efficient than a reversible engine working between these two reserviors. The cycle is known as the Carnot cycle. No engine can have the a greater efficiency than a Carnot engine because all steps are reversible.

Table 3: Ideal Molecules

Molecule	Translation	Rotation	C_v	C_p	Internal Energy
Atom	3	0	$\frac{3}{2}R$	$\frac{5}{2}R$	$\frac{3}{2}\ nRT$
Linear	3	2	$\frac{5}{2}R$	$\frac{7}{2}R$	$\frac{5}{2}\ nRT$
Non-Linear	3	3	3R	4R	3 nRT

$$\epsilon = 1 - \frac{Q_\text{c}}{Q_\text{h}}$$

$$Q_\text{h} = W_\text{by gas},\ Q_\text{c} = W_\text{on gas}$$

$$Q_\text{h/c} = nRT_\text{h/c}\frac{V_2}{V_1}$$

$$\epsilon_\text{C} = 1 - \frac{T_\text{c}}{T_\text{h}}\ \text{(Carnot Efficiency)}$$

3 Equilibrium

$$\Delta S_\text{total} = 0$$