

CHEM 160 – Thermodynamics.

Laws:

- First Law: all of the energy is conserved.
- Second Law: the entropy in the universe is always increasing. $\Delta S_{\text{surr}} = \frac{-\Delta H}{T}$
- Third Law: there is an absolute lowest temperature. $T = 0\text{K} = -273\text{ }^{\circ}\text{C} = -460\text{ }^{\circ}\text{F}$

Formulas:

$$W = -P\Delta V = -\Delta nRT$$

W = Work (J)

P = Pressure (Pa)

ΔV = Change in Volume (L)

Δn = Change in Moles of Gas (mol)

R = Gas Constant (8.34 J/mol•K, if

T = 300 K)

T = Temperature (K)

$$\Delta G = \Delta H - T\Delta S$$

ΔG = Change in Gibbs Free Energy (J/mol)

ΔH = Change in Enthalpy (J/mol)

ΔS = Change in Entropy (J/K•mol)

T = Temperature (K)

$$\Delta H = mC\Delta T$$

m = Mass of System (g)

C = Specific Heat (J/K)

ΔT = Change in Temperature (K)

ΔH = Change in Enthalpy (J/mol)

$$\Delta H = \Delta E + P\Delta V$$

ΔE = System Energy (J)

$P\Delta V$ = Expansion Work

ΔH = Change in Enthalpy (J/mol)

$$E_{\text{mot}} = \frac{1}{2} kT$$

E_{mot} = Motional Energy (J)

k = Boltzmann Constant (1.38 • 10⁻²³ J/K)

T = Temperature (K)

$$S = k \cdot \ln (\#PO)$$

S = Entropy (J/K•mol)

#PO = Number of Possible

Orientations = (# of orientations)^{# of molecules}

ΔH	ΔS	ΔG	<i>Reaction Characteristics</i>
+	+	+ at low T - at high T	Non-spontaneous at low T Spontaneous at high T
+	-	Always +	Non-spontaneous at all T and Reverse reaction is spontaneous
-	+	Always -	Spontaneous at all T
-	-	- at low T + at High T	Spontaneous at low T Non-spontaneous at high T

<i>Energy Type</i>	<i>Symbol</i>	<i>Sign</i>	<i>Interpretation</i>
Change in Enthalpy	ΔH	- +	Exothermic, Heat Released Endothermic, Heat Absorbed
Change in Entropy	ΔS	- +	System has more order System has less order
Change in Free Energy	ΔG	- +	Spontaneous, Compound is unstable Non-Spontaneous, Compound is stable
Work	W	- +	Work done by the system Work done on the system

