Entropy & Chemical Reactions

2nd Law of Thermodynamics

- A process will be spontaneous is the entropy of the universe increases
- Now we will look at entropy regarding to chemical reactions

What is the sign for ΔS?

- $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
- First look at the _____
- If all state are the same…then look at # _____

What is the sign for ΔS?

- $4NH3 + 5O_2 \rightarrow 4NO + 6H_2O$

Calculating ΔS

- Calculating ΔS is just like calculating ΔH
- ΔS° of any element or diatomic molecule is NOT zero.
- You must look these up!

Example

- Calculate ΔS for the following reaction:
- $2NiS(s) + 3O_2(g) \rightarrow 2SO_2(g) + 2NiO(s)$

Example

- Calculate ΔS for the following reaction:
- $Al_2O_3(s) + 3H_2(g) \rightarrow 2Al(s) + 3H_2O(g)$

Gibbs Free Energy & Chemical Reactions

- You can calculate ΔG in 3 ways…

1. Like Hess's Law
2. Like ΔH°
3. With the equation $\Delta G = \Delta H - T\Delta S$

Example

- Calculate ΔH, ΔS, & ΔG at 25°C using the following data…
- $2SO_2 + O_2 \rightarrow 2SO_3$

Substance	ΔH (KJ/mol)	ΔS (J/K mol)
SO_2	-297	248
SO_3	-396	257
O_2	0	205

Calculate ΔG

- Using the following data at 25°C
- $C_{diamond} + O_2(g) \rightarrow CO_2(g)$ ΔG = -397KJ
- $C_{graphite} + O_2(g) \rightarrow CO_2(g)$ ΔG = -394KJ
- Calculate ΔG for the reaction:
- $C_{diamond} \rightarrow C_{graphite}$

Calculating ΔG

- Methanol is a high octane fuel used in high performance racing engines. Calculate ΔG for the following reaction
- $2\,CH_3OH(g) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(g)$
- Given the following free energies of formation:

Substance	ΔG°(KJ/mol)
CH_3OH (g)	-163
O_2 (g)	0
CO_2 (g)	-394
H_2O (g)	-229