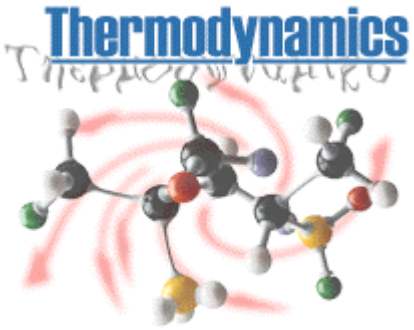
Unit 10B: Thermodynamics Review Sheet



1. What are exothermic processes? Heat is released from the process (chemical or physical), and the "system" loses heat (ΔH is negative).
2. What are endothermic processes? Heat is added to the process, and the "system" gains heat (ΔH is positive).
3. Calculate the enthalpy change for a reaction (ΔH_{rxn}) in three different ways:
   - Using the Heats of formation (ΔH_f)

     $\Delta Hrxn = \Sigma \Delta H_f(products) - \Sigma \Delta H_f(reactants)$
   - Using the Bond Energies:

     $\Delta Hrxn = \Sigma \Delta H(bonds\ broken) - \Sigma \Delta H(bonds\ formed)$
   - Using Hess's Law
4. Express the Heat of the Reaction in one of three ways:
   - As ΔH (positive or negative)
   - In a Thermochemical Reaction
   - In a Potential Energy Diagram
5. Determine the heat transferred for different amounts of reactants & products using Thermochemical reactions and stoichiometry
6. Potential Energy Diagrams:
   - Determine the ΔH and Activation Energies of forward & reverse reactions
   - How does a catalyst affect the potential energy curve? A catalyst reduces the activation energy of both forward and reverse reactions.
7. Define Entropy. Entropy (disorder) increases with the following:
   - Adding Particles

- Adding Energy/Increasing Temperature
- Increasing Volume
- Entropy increases as the phase changes from solid to liquid to gas.
- Entropy increases as ionic solids ionize in solution.

8. Calculate ΔS from a table of thermochemical data:

ΔSrxn = ΣΔS(products) - ΣΔS(reactants)

9. Define free energy as the energy in a system that is available to do useful work.
10. Contrast spontaneous and nonspontaneous reactions: Spontaneous reactions are those with a ΔG that are negative, while nonspontaneous reactions are those with a ΔG that are positive.
11. Calculate Gibb's Free Energy:

$$\Delta G = \Delta H^{\circ}_{sys} - T\Delta S_{system}$$

12. Calculate the Gibb's Free Energy from an unbalanced chemical reaction using the ΔHf, ΔS, and reaction Temperature.
13. Apply the Gibb's Free energy equation to predict how changes in enthalpy and changes in entropy will influence the spontaneity of forward & reverse reactions.

TABLE 19.4 Effect of Temperature on the Spontaneity of Reactions

ΔH	ΔS	$-T\Delta S$	$\Delta G = \Delta H - T\Delta S$	Reaction Characteristics	Example
−	+	−	−	Spontaneous at all temperatures	$2\,O_3(g) \longrightarrow 3\,O_2(g)$
+	−	+	+	Nonspontaneous at all temperatures	$3\,O_2(g) \longrightarrow 2\,O_3(g)$
−	−	+	+ or −	Spontaneous at low T; nonspontaneous at high T	$H_2O(l) \longrightarrow H_2O(s)$
+	+	−	+ or −	Spontaneous at high T; nonspontaneous at low T	$H_2O(s) \longrightarrow H_2O(l)$