Statistical Molecular Thermodynamics

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Video 12.8

Review of Module 12

Critical Concepts from Module 12

- The reaction extent is a single variable that through stoichiometry indicates the change dn for all compounds in a balanced chemical reaction.
- The free energy of reaction is the change in free energy for a reaction extent change of one mole.
- The standard-state free energy of reaction is the change in free energy for changing one mole (reaction extent) of unmixed (i.e., pure) reactants into unmixed (pure) products.
- The Gibbs free energy provides a means to evaluate the position of equilibrium for chemical reactions; if the free energy of reaction is postive, the reaction proceeds towards reactants; if the free energy of reaction is negative, the reaction proceeds towards products; zero is equilibrium.

Critical Concepts from Module 12

- The Gibbs free energy allows one to understand how chemical systems respond when displaced from equilibrium; for example, changes in pressure and in temperature lead the system to re-establish equilibrium; these various responses are summarized as Le Châtelier's Principle.
- The equilibrium constant is the reaction quotient when the system is at equilibrium, e.g., for standard-state units of pressure

$$K_P(T) = \left(\frac{P_Y^{\nu_Y} P_Z^{\nu_Z}}{P_A^{\nu_A} P_B^{\nu_B}} \right)_{eq} \qquad \nu_A A(g) + \nu_B B(g) \rightleftharpoons \nu_Y Y(g) + \nu_Z Z(g)$$

- To have meaning, an equilibrium constant must be associated with a balanced chemical equation, as above.

Critical Concepts from Module 12

- The relationship between the standard-state free energy of reaction and the equilibrium constant is given by (in pressure, concentration, or activity units i)

$$\Delta_r G^\circ(T) = -RT \ln K_i(T)$$

- The equilibrium constant can be obtained directly from the partition functions of all compounds in a reacting system.

Next: An Exam!

Then: Electrochemistry