## 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 <u>standard-state</u> 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

$$K_{P}(T) = \left(\frac{P_{Y}^{v_{Y}} P_{Z}^{v_{Z}}}{P_{A}^{v_{A}} P_{B}^{v_{B}}}\right)_{eq} \qquad v_{A}A(g) + v_{B}B(g) \Longrightarrow v_{Y}Y(g) + v_{Z}Z(g)$$

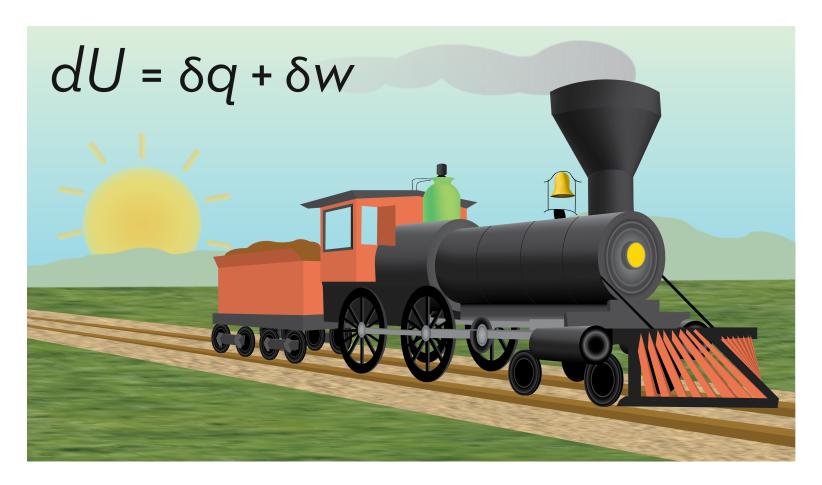
 To have meaning, an equilibrium constant must be associated with a balanced chemical equation, as above.

## 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)

$$\Delta_{\rm r} G^{\circ}(T) = -RT \ln K_i(T)$$

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



Next: An Exam!

Then: Electrochemistry