SCH 4U Unit 5

Equilibrium - An Introduction

Students will be able to:

Objective 1

- organize data from experiments, make generalizations from a set of data, predict the results of both experiments done in class and experiments similar to those done in class and realize that theories and principles can help to explain chemical equilibrium

Objective 2

- define and use the following terms: steady state, open and closed systems, reactions that have gone to completion, reversible reactions, macroscopic property, microscopic activity, dynamic equilibrium and equilibrium reactions

Objective 3

- list the conditions that are necessary for chemical equilibrium to occur
- define chemical equilibrium as taking place in a closed system with constant macroscopic properties and constant molecular activity (rate forward = rate reverse)
- identify the factors that determine the state of equilibrium for various systems

Objective 4

- realize that there can be reactants and products can be present at the same time during a chemical reaction

Objective 5

- recognize a system that is in equilibrium

Objective 6

- define the following: homogeneous system, heterogenous system, Le Chatelier' s principle

Objective 7

- apply Le Chatelier' s principle to predict the direction of equilibrium shift for changes of pressure and volume to systems that are at equilibrium

Objective 8

- apply Le Chatelier' s principle to predict the direction of equilibrium shift for changes of temperature to systems that are at equilibrium

Objective 9

- apply Le Chatelier' s principle to predict the direction of equilibrium shift for changes of concentration and for the addition of solid and liquid reactants to systems at equilibrium

Objective 10

- apply Le Chatelier' s principle to predict the direction of equilibrium shift for the addition of catalysts and non-reacting gases to systems that are at equilibrium

Objective 11

- give the meaning of the law of chemical equilibrium (the law of mass action)
- using square brackets to indicate concentration, write the equilibrium constant expression (law of mass action expression) for both homogeneous and heterogeneous systems

Objective 12

- define the equilibrium constant (Kc) and interpret the numerical value of the equilibrium constant in terms of the relative concentrations of reactants and products, the relative extent that the reaction proceeds forward and the effect of temperature change (Kc changes)

Objective 13

- determine initial and/or equilibrium concentrations given a balanced chemical equilibrium equation and an initial and an equilibrium concentration

Objective 14

- calculate the value of the equilibrium constant given the equilibrium concentrations of both reactants and products (type 1 calculations)

Objective 15

- calculate the value of the equilibrium constant given all initial concentrations and one equilibrium concentration or the initial concentrations of reactants (or products) and the % dissociation of the reactants (type 1 calculations)

Objective 16

- determine the equilibrium concentrations of a reactant or product given a balanced equilibrium equation, the equilibrium constant and the equilibrium concentrations of the other reactants and products

Objective 17

- determine the equilibrium concentrations of all reactants or products given a balanced chemical equation, the equilibrium constant and the initial concentrations of the reactants and products (or vice versa) (type 2 calculations)

Objective 18

- define entropy,
- identify the factors that increase entropy and use these factors to select:
    - a. The system having the greatest entropy and
    - b. The reaction that increases its entropy the most

Objective 19

- know that reactions "want" to achieve minimum potential energy and maximum entropy

Objective 20

- understand that equilibrium is a compromise between the tendency of reactions to achieve minimum potential energy and maximum entropy

Objective 21

- discuss the meaning and importance of Gibb' s free energy equation (/\G = /\H - T/\S)