Chemical Equilibrium

For
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Physical Chemistry
Paper-IA
Lecture-01

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Law of Mass action

- Law state that the rate of any chemical reaction is proportional to the product of the masses of the reacting substances, with each mass raised to a power equal to the coefficient that occurs in the chemical equation
- The rate of the chemical reaction is directly proportional to the product of the activities or concentrations of the reactants.
- It explains and predicts behaviors of solutions in dynamic equilibrium.
- A chemical reaction mixture that is in equilibrium, the ratio between the concentration of reactants and products is constant in a reaction equilibrium mixture.

Two aspects are involved in the initial formulation of the law:

Equilibrium aspect ,composition of a rxn mix. at equilibrium

Kinetic aspect,concerning the rate equations for elementary reactions

Kinetic derivation for law of mass action

Rate law:

It is an equation that shows the dependence of the reaction rate on the concentration of each reactant.

$$aA + bB \longrightarrow \text{Products}$$

$$\text{rate} \ \alpha \ [A]^m [B]^n$$

$$\text{rate} = k[A]^m [B]^n$$

where k is the rate constant

Rate law for elementary reaction

- Law of mass action applies

Rate of reaction α Product of active masses of reactants

Active mass molar concentration raised to power of number of species

Examples:

$$A \longrightarrow P+Q \quad rate=K_1[A]$$

$$A \longrightarrow P+Q \quad rate=K_2[A]^1[B]^2$$

$$2A + B \longrightarrow E+F+G \quad rate=K_3[A]^2[B]^1$$