Department of biology

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((Analytical Chemistry))

Stage (-1-)

LEC- ((3))

Chemical Equilibria

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Introduction

Chemical Equilibrium

Chemical equilibrium occurs in reversible reactions when the forward and backward reactions proceed at the same rate, so the concentrations of reactants and products remain constant.

Reaction Types

1-Irreversible Reaction

Reaction proceeds only in one direction.

Example:

$Zn+2HCL \rightarrow ZnCL_2+H_2$

2-Reversible Reaction

Reaction occurs in both forward and backward directions.

Example:

$N_2+3H_2 \rightleftharpoons 2NH_3$

Dynamic Equilibrium

$Rate_{forward}=Rate_{backward}$

Equilibrium Constant (Kc)

Aa+bB=cC+Dd

$$kc = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

Kc > 1 → Products favored

Kc < 1 → Reactants favored

Reaction Rate

$$\text{Rate} = \frac{\Delta(\text{A})}{\Delta\text{t}}$$

Where: $\Delta(\text{A})$ =[A]initial-[A]final

Problem 1 – Irreversible reaction

[A]decreases from 0.80 M to 0.40 M in 20 s

Calculate the rate.

Solution:

$$\text{Rate} = \frac{\Delta(\text{A})}{\Delta \text{t}}$$

$$\text{Rate} = \frac{0.8 - 0.4}{20}$$

$$\text{Rate} = 0.02\text{M/S}$$

Problem 2 – Reversible reaction, reactants greater

A+B=C

Calculate Kc and predict side favored

Giving [A]=[B]=0.5, [C]=0.2

Solution:

$$kc = \frac{[\text{C}]}{[A]\ \ [B]}$$

$kc = \frac{[0.2]}{[0.5]\ \ [0.5]}$=0.8

Problem 3 – Reversible reaction, products greater

$2NO+O_2=2NO_2$

Question: Calculate Kc

Giving: No_2=0.3 NO=0.1 O_2=0.05

Solution /

$$kc = \frac{[\text{NO2}]^2}{[NO]^2[O2]}$$

Problem 4 – Unknown product

$H_2+I_2=2HI$

Where:$K_C=4$ $[H_2]=[I_2]=0.2$

Find [HI]

Solution /

[HI] = 0.4 M ·