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2025-2026

((Analytical Chemistry))

Stage (-1-)

LEC- ((3))

Chemical Equilibria

By

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Introduction

Chemical Equilibrium

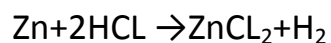
Chemical equilibrium occurs in reversible reactions when the forward and backward reactions proceed at the same rate, so the concentrations of reactants and products remain constant.

Reaction Types

1-Irreversible Reaction

Reaction proceeds only in one direction.

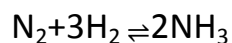
Example:



2-Reversible Reaction

Reaction occurs in both forward and backward directions.

Example:

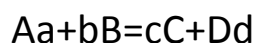




Dynamic Equilibrium

$$\text{Rate}_{\text{forward}} = \text{Rate}_{\text{backward}}$$

Equilibrium Constant (K_c)



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

$K_c > 1 \rightarrow$ Products favored

$K_c < 1 \rightarrow$ Reactants favored

Reaction Rate

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

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

Problem 1 – Irreversible reaction

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

Calculate the rate.



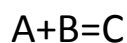
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Solution:

$$\text{Rate} = \frac{\Delta(A)}{\Delta t}$$
$$\text{Rate} = \frac{0.8 - 0.4}{20}$$
$$\text{Rate} = 0.02\text{M/S}$$

Problem 2 – Reversible reaction, reactants greater



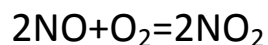
Calculate Kc and predict side favored

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

Solution:

$$K_c = \frac{[C]}{[A][B]}$$
$$K_c = \frac{[0.2]}{[0.5][0.5]} = 0.8$$

Problem 3 – Reversible reaction, products greater



Question: Calculate Kc

Giving: $\text{NO}_2=0.3$ $\text{NO}=0.1$ $\text{O}_2=0.05$

Solution /

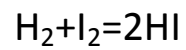
$$K_c = \frac{[\text{NO}_2]^2}{[\text{NO}]^2[\text{O}_2]}$$



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Problem 4 – Unknown product



Where: $K_c = 4$ $[\text{H}_2] = [\text{I}_2] = 0.2$

Find $[\text{HI}]$

Solution /

$$[\text{HI}] = 0.4 \text{ M} \cdot$$