Chapter 5: Factors Affecting Reaction Rates

Department of Chemistry

1 Overview

The rate at which chemical reactions proceed can vary widely and is influenced by several key factors. Understanding these allows chemists to control reaction speed for optimal outcomes in research and industry.

2 Effect of Concentration

Increasing the concentration of reactants generally increases the reaction rate, as there are more particles available to collide and react.

3 Effect of Temperature

Raising the temperature increases the kinetic energy of particles, leading to more frequent and energetic collisions. The Arrhenius equation describes this relationship:

$$k = Ae^{-E_a/(RT)}$$

where k is the rate constant, E_a the activation energy, R the gas constant, and T the temperature in Kelvin.

4 Effect of Catalysts

Catalysts lower the activation energy required for a reaction to proceed, increasing the rate without being consumed in the process.

- **Homogeneous Catalysts:** In the same phase as reactants.
- **Heterogeneous Catalysts:** In a different phase (e.g., solid catalyst, gaseous reactants).

5 Example Mechanisms

Decomposition of hydrogen peroxide:

$$2\mathrm{H_2O_2}(aq)\mathrm{MnO_2}2\mathrm{H_2O}(l) + \mathrm{O_2}(g)$$

Manganese dioxide acts as a catalyst.

6 Summary

Chemists can alter concentration, temperature, and catalysts to influence reaction rates. Each factor affects the number and energy of collisions.

References

1. Atkins, P., Jones, L. *Chemical Principles*, 5th Ed.

2. Housecroft, C. *Chemistry*, 4th Ed.