

Chapter 15 - Terms and Concepts

15.1

Chemical kinetics
Mechanisms
Rate of a chemical reaction
Average rate
Instantaneous rate

15.2

Factors that affect reaction rate
Concentration
Temperature
Catalysis
Nature of chemicals

15.3 - Concentration

Rate equation/rate law
How is it determined? **Initial Rate Method**
Rate constant
Exponents and reaction order

15.4 – Concentration – Time relationships

1st order: $\ln \frac{[R]_t}{[R]_0} = -kt$ Half life: $t_{1/2} = \frac{0.693}{k}$

2nd order: $\frac{1}{[R]_t} - \frac{1}{[R]_0} = kt$

Zero order: $[R]_0 - [R]_t = kt$

Graphical solutions

15.5 – Microscopic view of reaction rates

Concentration – reaction rate – collision theory

What are the collision theory postulates?

Temperature – reaction rates – activation energy

Activation energy

Reaction coordinate plots (p. 714)

What do the bumps mean on an reaction coordinate plot?

Effect of molecular orientation

Arrhenius equation: $k = Ae^{E_a/RT}$ or $\ln k = \ln A - \frac{E_a}{RT}$ (Graphical solution)

Effect of a catalyst on reaction rate

Reaction intermediate

Homogeneous catalyst

Heterogeneous catalyst

- 15.6 – Reaction mechanisms
 - Reaction mechanisms
 - Elementary step
 - Molecularity
 - Uni-molecular process
 - Bi-molecular process
 - Ter-molecular process

Elementary Step	Molecularity	Rate Equation
$A \rightarrow P$	Uni	Rate = $k[A]$
$A + B \rightarrow P$	Bi	Rate = $k[A][B]$
$A + A \rightarrow P$	Bi	Rate = $k[A]^2$
$2A + B \rightarrow P$	Ter	Rate = $k[A]^2[B]$

***Rate equation for any elementary step is defined by the reaction stoichiometry
 ***Molecularity and reaction order are the same for an elementary step
 Rate determining step.

Examples in text

- 15.1 Reaction rates and stoichiometry (coefficients)
- 15.2 Rate of reaction from a graph
- 15.3 Determining a rate equation – rate constant from data
- 15.4 Using rate equations to determine rates
- 15.5 First order rate equations – time
- 15.6 Using first order rate equations – concentration of reactants
- 15.7 Using second order concentration/time equation – concentration
- 15.7.1 *Plotting concentration vs. time to determine reaction order*
- 15.8 Half life of 1st order process
- 15.9 Determine activation energy from Arrhenius equation. Plot $\ln k$ vs. $1/T$
- 15.10 Determine activation energy from temperature dependence of k :

$$\ln\left(\frac{k_2}{k_1}\right) = -\frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$
- 15.11 Elementary steps: molecularities and rate equations
- 15.12 Elementary steps and reaction mechanisms/rate laws
- 15.13 Reaction mechanisms in equilibrium steps

Important tables/charts/blurbs to look at:

Table 15.1 – Characteristic properties of reactions of the type $R \rightarrow$ Products. Page 706

Problem solving tips and ideas 15.1

Using integrated rate laws – Page 706.

Problem solving tips and ideas 15.2

A summary of the principles of rate equations and reaction mechanisms – Page 735.

Problems (Chapter 15, p737)

2, 4, 5, 6, 8, 10, 11, 14, 15, 16, 24, 25, 26, 28, 30, 32, 34, 36, 42, 44, 48, 50, 52, 54, 56, 57