Chemical Kinetics

Where does the word kinetic come from? What are its roots?

Time

Rate

Chemical Kinetics

Reaction Rates

Equations

What is an "Effective Molecular Collision"?

What factors play a role in creating "effective collisions"?

The six factors that affect reaction rate

Temperature

Concentration

Agitation

Surface Area

Catalysts

Nature of the Reactants

Energy Profiles

Exothermic Reactions

Endothermic Reaction

Reactant

Product

Activation Energy

Reaction Rates

Time

Rate

Reaction Rates

We love graphs!

Equations

Mole Ratios

1) The concentration of a substance in a reaction changes from 2.0 M to 1.0 M in 20. min.
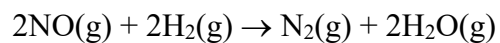
Express the rate of this reaction in M/min.

2) Dinitrogen pentoxide decomposes into nitrogen dioxide and oxygen according to the following equation:

$$2N_2O_5 \text{ (g)} \rightarrow 4NO_2 \text{ (g)} + O_2 \text{ (g)}$$

If the change in oxygen concentration was found to be 1.0 M/s, what is the reaction rate in terms of dinitrogen pentoxide?

Rate Laws

For the reaction:
$$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$$
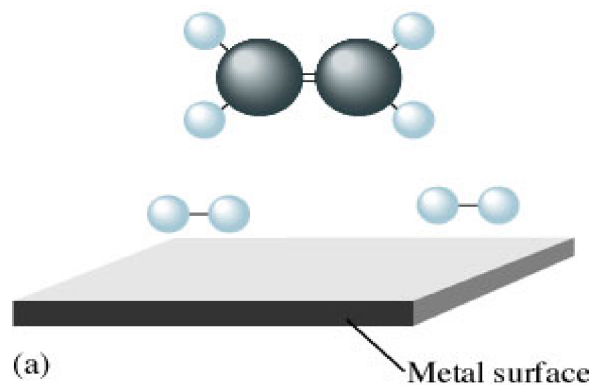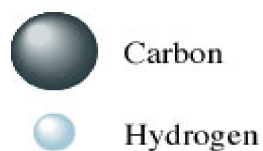
The experimental rate law is:
$$R = k[NO]^2 [H_2]$$

Catalysts

Promoter

Inhibitor

How Does it work?

Graphs

Carbon

Hydrogen

(a)   Metal surface   (b)

Adsorption   Migration
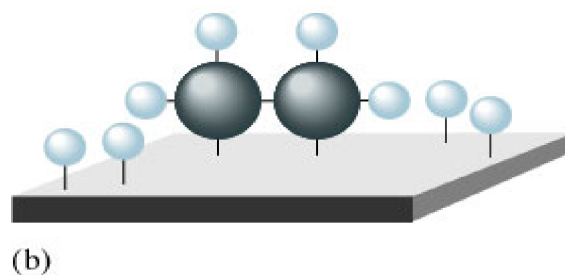
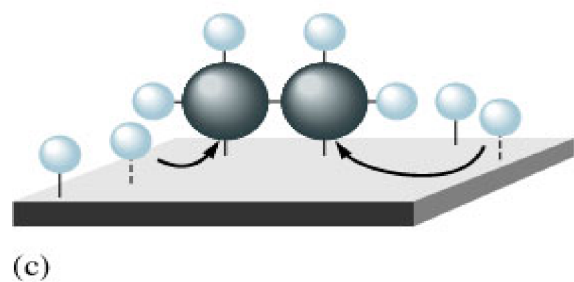(c)   (d)
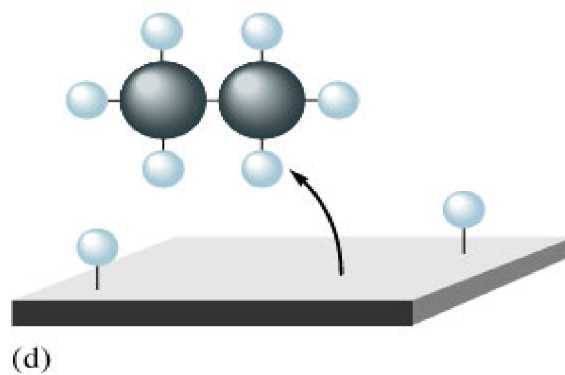
Reaction   Escape

Reaction Mechanisms

Two restrictions!

1)

2)

Example:

Intermediate

Elementary Steps

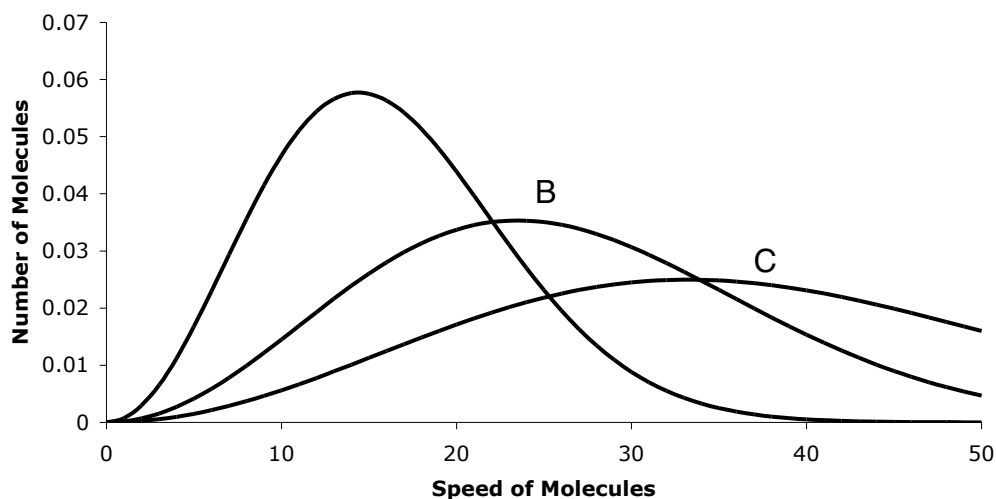Molecularity

Unimolecular   Bimolecular   Termolecular

Rate Determining Step

The Kinetic Molecular Theory

The Ice Cream Graph Returns!

Distribution of Moleclular Speeds

A = Low Temperature, Cold
B = Medium Temperature, Luke-Warm
C = High Temperature, Hot!