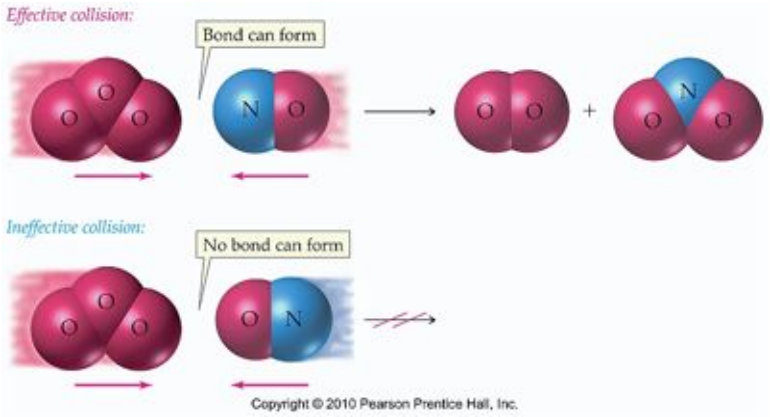
Chapter 7

Goals:

- ✓ Know how to speed the rate of a chemical reaction.
- ✓ Know how to increase the yield of product in a chemical reaction (Le Chatlier's Principle).
- ✓ Understand the general shapes of energy diagrams, and be able to determine if a reaction is endergonic or exergonic from an energy diagram.
- ✓ Know the terms endothermic and exothermic.
- ✓ Understand the values for the equilibrium constant, K.

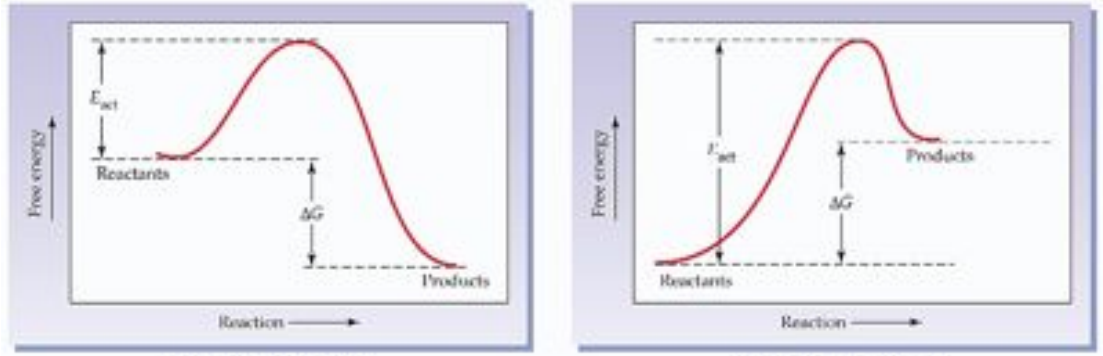
Collision Theory

- Molecules must collide in order to react.
- Molecules must collide with the proper orientation such that the correct atoms can form a bond.
- Molecules must possess a minimum amount of energy in order to collide with enough force to cause a reaction. This minimum amount of energy is known as the activation energy.



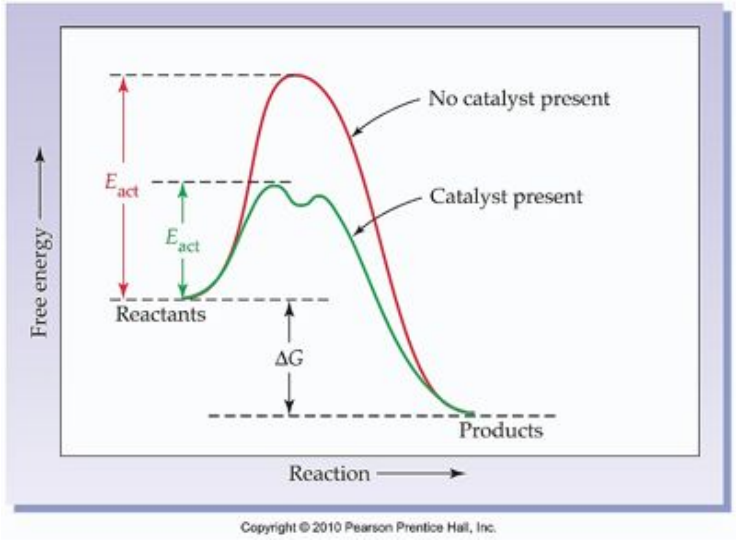
Law of Conservation of Energy

- Energy is neither created nor destroyed, but is only transferred from one form to another.
- Exergonic reaction: a reaction in which the products are lower in energy than the reactants; energy is released.
- Endergonic reaction: a reaction in which the products are higher in energy than the reactants; energy is absorbed.



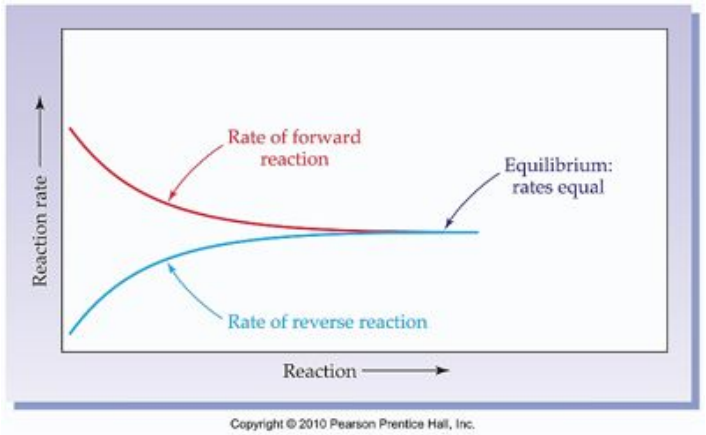
Rate of Reaction

- Temperature: an increase in T will increase the rate of a chemical reaction.
- Concentration: an increase in the C will increase the rate of a reaction.
- Catalyst: addition of a catalyst will increase the rate of a reaction. Note that a biological catalyst is called an enzyme.



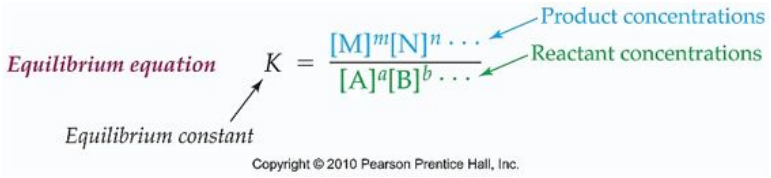
Equilibrium

- Chemical equilibrium occurs when opposing reactions proceed at the same rate, thus there is no change in the overall concentration of the reactants or products. This does not mean that the concentrations are equal!



- Whether a reaction is product favored or reactant favored can be determined mathematically using the following equation:

$$aA + bB \rightarrow mM + nN$$



Le Chatelier's Principle

- In the lab, we strive for as high of a yield of product as possible by:
  - Adjusting T
  - Adjusting P
  - Adjusting C

- Le Chatelier's Principle states that when a change is made in T, P or C to a system at equilibrium, the system will shift it's equilibrium to counterbalance the effect of the change in T, P or C.

Disturbance	**Change as Mixture Returns to Equilibrium**	**Effect on Equilibrium**
Addition of Reactant	Some of added reactant is consumed	Shift to create more product (right)
Addition of Product	Some of added product is consumed	Shift to create more reactant (left)
Decrease V, increase P	Pressure decreases	Shift toward fewer moles of gas
Increase V, decrease P	Pressure increases	Shift toward more moles of gas
Rise in T	Heat energy consumed	Shift in the endothermic direction
Drop in T	Heat energy generated	Shift in exothermic direction

Problems from Ch 7

For the following endothermic reaction, list:

a. All of the changes that you can make to increase the rate of the reaction
b. All of the changes that you can make to increase the yield of product

$$PCl_5\ (g) \rightarrow PCl_3\ (g) + Cl_2\ (g)$$