

## Kinetics & Equilibrium

## Chemical Kinetics

- The area of chemistry that is concerned with reaction \_\_\_\_\_ and reaction \_\_\_\_\_ is called **chemical** \_\_\_\_\_ .
- The rate of a reaction depends on the collision \_\_\_\_\_ of the reactants and on the collision efficiency.

## Factors that Affect Reaction Rates

1. Nature of the \_\_\_\_\_
2. \_\_\_\_\_ of the reactants
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

## Nature of Reactants

- The rate of reaction depends on the particular reactants and bonds involved.
- The more \_\_\_\_\_ a reactant, the \_\_\_\_\_ the reaction will proceed

## Concentration

- An \_\_\_\_\_ in rate is expected if the concentration of one or more of the reactants \_\_\_\_\_ .
- This is due to the increased number of \_\_\_\_\_
- Higher concentration = more stuff to hit

## Surface area

- If the surface area is increased, there are more frequent \_\_\_\_\_ leading to a faster reaction

## Temperature

- An increase in temperature increases the \_\_\_\_\_ energy of the particles in a substance resulting in a greater number of effective collisions.

## Catalyst

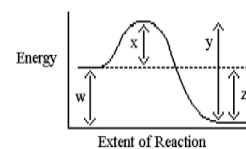
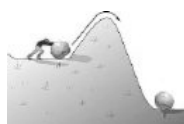
- A \_\_\_\_\_ is a substance that changes the rate of a chemical reaction without itself being permanently consumed.
- An \_\_\_\_\_ slows down a chemical reaction without being used up
- A catalyst works by lowering the activation energy of the reaction

## Collision Theory

- In order for reactions to occur, 3 things must happen:
  1. Atoms or molecules must \_\_\_\_\_
  2. They must collide with the proper \_\_\_\_\_
  3. They must collide with sufficient \_\_\_\_\_

## Activation Energy

- Activation Energy: the minimum amount of energy that particles must collide with to make a reaction occur



## LeChâtelier's Principle

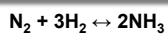
- Le Châtelier's principle states that if a system at equilibrium is subjected to a stress, the equilibrium is shifted in the direction that tends to relieve the stress.

## Concentration



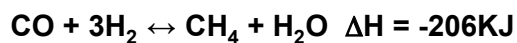
- Which way does the equilibrium shift if [CO] is increased
- Which way does the equilibrium shift if [CH<sub>4</sub>] is increased
- Which way does the equilibrium shift if [H<sub>2</sub>] is increased
- Which way does the equilibrium shift if [H<sub>2</sub>O] is increased

## Concentration



- Add  $\text{N}_2$
- Add  $\text{H}_2$
- Add  $\text{NH}_3$
- Remove  $\text{N}_2$
- Remove  $\text{H}_2$
- Remove  $\text{NH}_3$

## Temperature



- Increase the temperature
- Decrease the temperature

## Volume & Pressure

- When doing volume & Pressure...you look at the number of moles
- $\text{CO} + 3\text{H}_2 \leftrightarrow \text{CH}_4 + \text{H}_2\text{O}$   
4 moles      2 moles
- If you decrease the volume (which is increasing the pressure) you are getting cramped & the molecules will want to go to the side with the fewest # of moles)
- If you increase the volume (which is decreasing the pressure) you have room will want to go to the side with the most # of moles)

## Volume & Pressure

- $\text{CO} + 3\text{H}_2 \leftrightarrow \text{CH}_4 + \text{H}_2\text{O}$
- Increase the pressure
- Increase the volume
- Decrease the volume
- Decrease the pressure

## Volume & Pressure

- If the number of moles are the same...there will be no change when to the system when volume & pressure are changed.
- $\text{H}_2 + \text{I}_2 \leftrightarrow 2\text{HI}$
- Volume & pressure  $\rightarrow$  no change