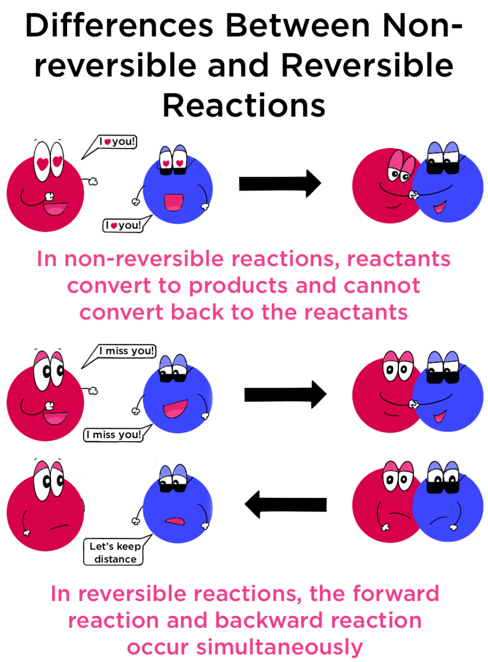
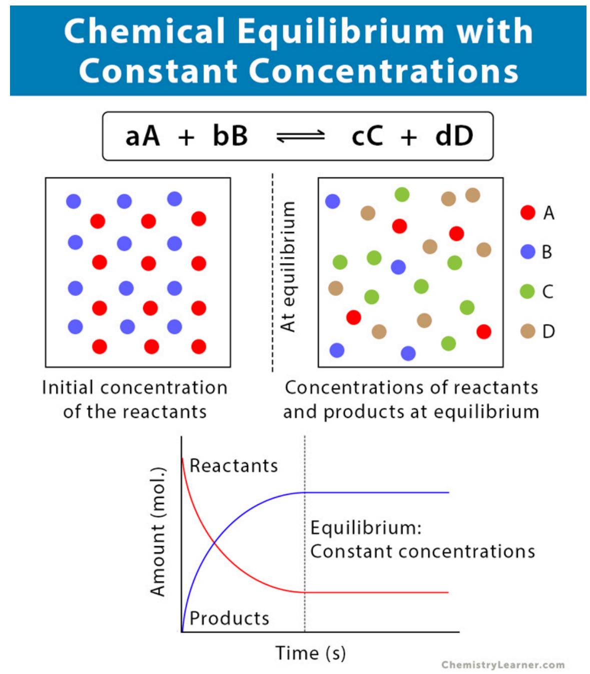
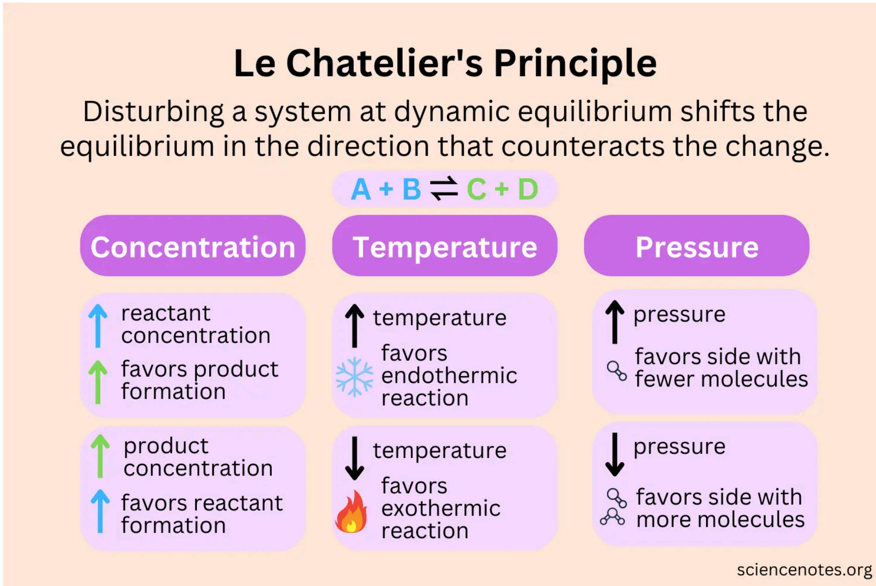
Chemistry Unit 6 Notes





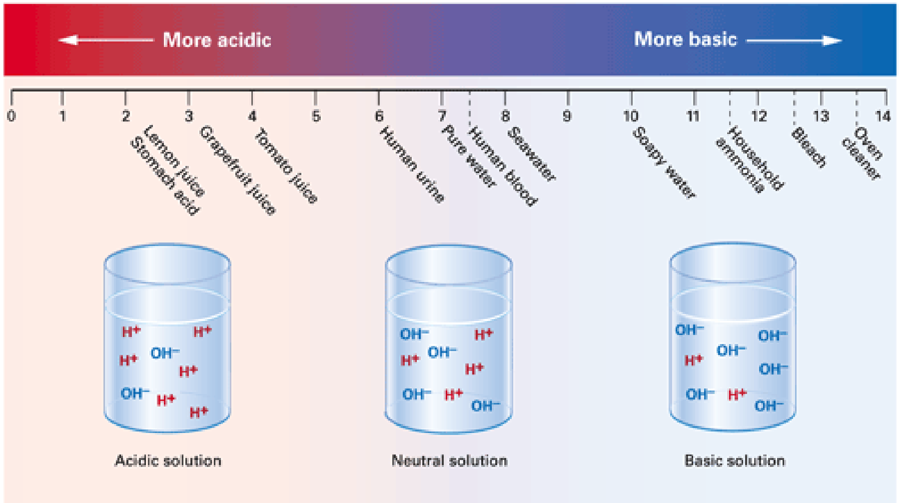
CHARACTERISTICS OF EQUILIBRIUM

1. Reaction must take place in a closed system- no reactant or product can enter or leave
2. Temperature must remain constant.
3. All reactants and products present are in constant dynamic motion.



Properties

ACIDS	BASES
• electrolyte	• electrolyte
• sour taste	• bitter taste
• sticky feel	• slippery feel
• turn litmus red	• turn litmus blue
• react with bases to form water and a salt (ionic compound)	• react with acids to form water and a salt (ionic compound)



Arrhenius Acids and Bases

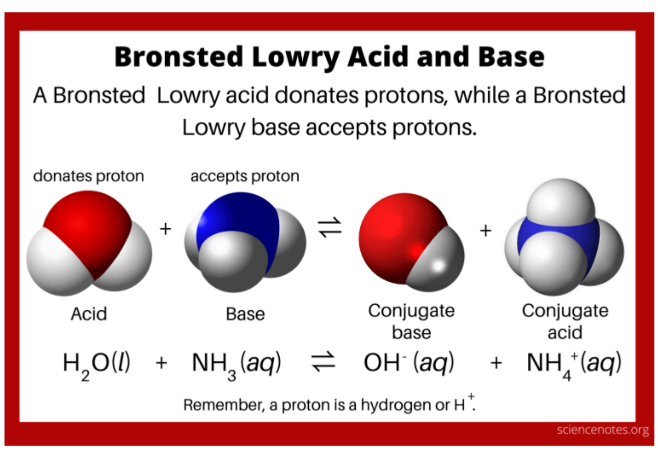
$HCl \longrightarrow H^+ + Cl^-$

Acid - forms H^+ in water

$NaOH \longrightarrow Na^+ + {}^-OH$

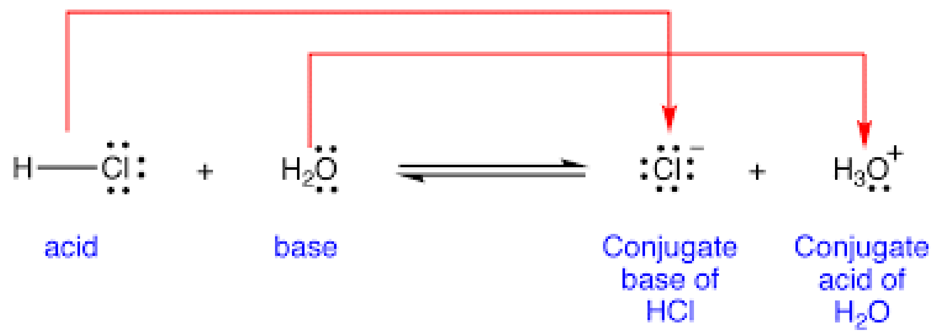
Base - forms ^-OH in water

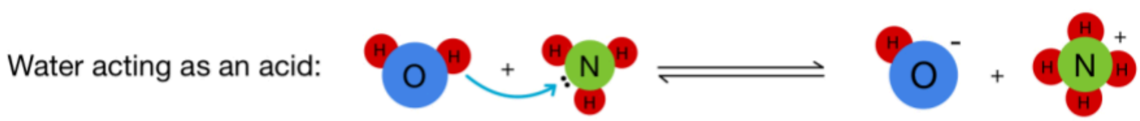
Limitations: Some bases (like NH_3 or Na_2CO_3) don't have an OH group, but DO produce hydroxide ions in solution. According to this model, though, they would not be considered bases.

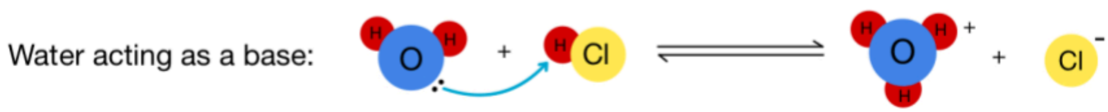


Conjugate acid- formed when base accepts hydrogen ion

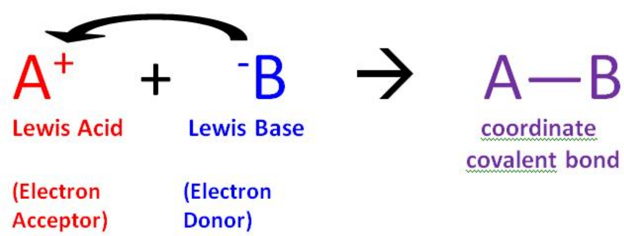
Conjugate base- formed when acid donates hydrogen ion



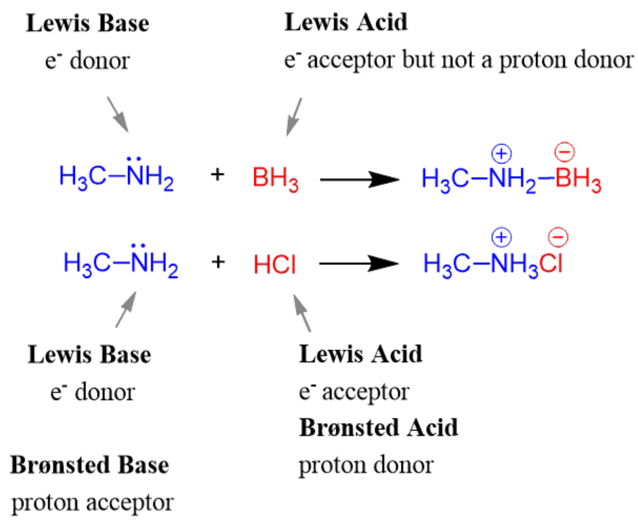




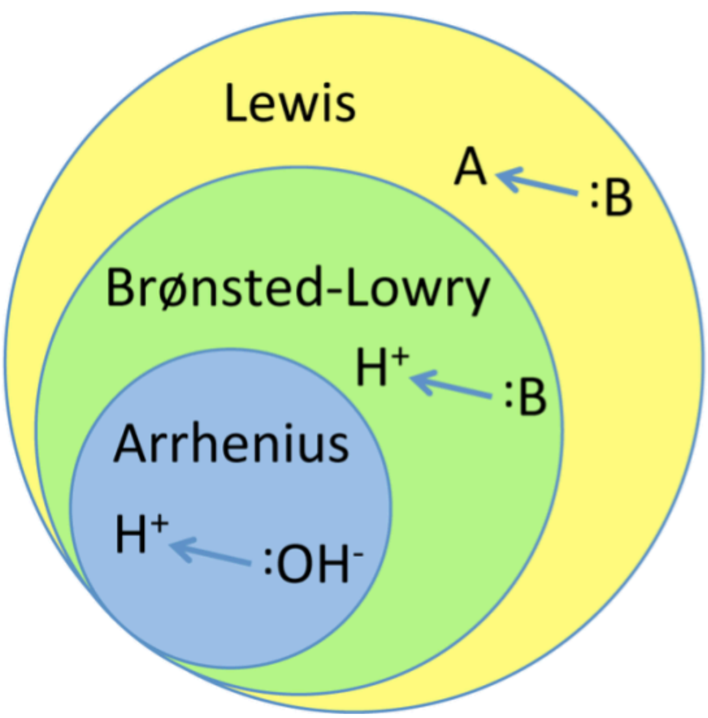
Disadvantages of Bronsted Lowry: can't explain acidic or basic nature of compounds with no tendency to gain or lose hydrogen ion like CO_2.



Any Base is a Lewis Base and Any Acid is a Lewis Acid



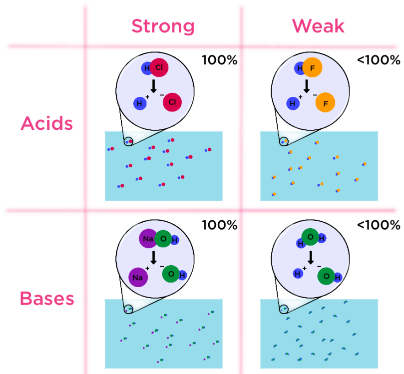
Not every Base is a Brønsted Base and Any Acid is a Brønsted Acid



Summary of 3 Models of Acids & Bases

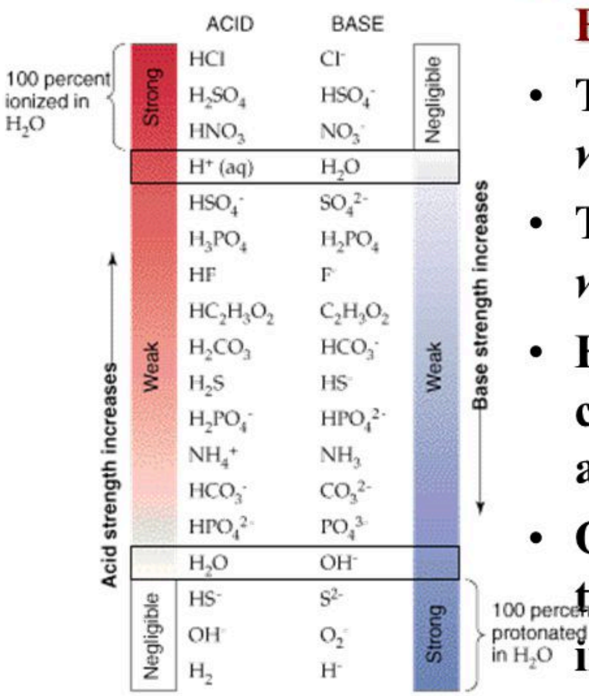
Model	Definition of Acid	Definition of Base
Arrhenius	H^+ producer	OH^- producer
Bronsted-Lowry	H^+ donor	H^+ acceptor
Lewis	Electron-pair acceptor	Electron-pair donor

What are Strong and Weak Acids/Bases



Strong Acids/bases break apart 100% while weak acids/bases do not break apart 100% in aqueous solution

Brønsted-Lowry Acids and Bases



Relative Strengths of Acids and Bases

- The *stronger* the acid, the *weaker* the conjugate base.
- The *stronger* the base, the *weaker* the conjugate acid.
- H^+ is the strongest acid that can exist in equilibrium in aqueous solution.
- OH^- is the strongest base that can exist in equilibrium in aqueous solution.

Acid Ionization Constant

- **Acid Ionization Constant** (K_a): the equilibrium constant for the ionization reaction of an acid with water
  - $HA + H_2O \rightleftharpoons A^- + H_3O^+$

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

- Large K_a = Strong acid
- Small K_a = Weak acid

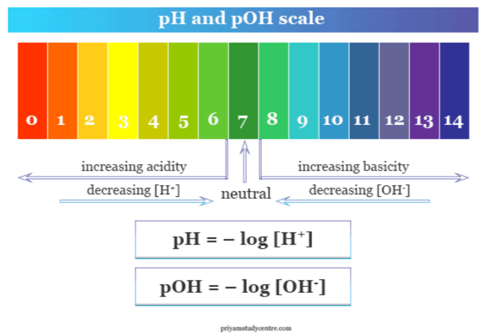
Base Ionization Constant

- **Base Ionization Constant** (K_b): the equilibrium constant for the ionization reaction of a base with water
  - $B + H_2O \rightleftharpoons OH^- + BH^+$

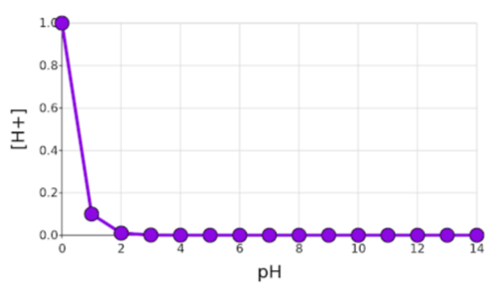
$$K_b = \frac{[BH^+][OH^-]}{[B]}$$

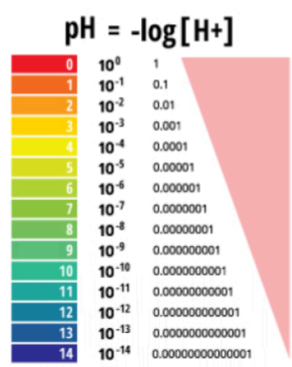
- Large K_b = Strong base
- Small K_b = Weak base

$$K_w = [H^+][OH^-]$$
$$= (1\times10^{-7})(1\times10^{-7})$$
$$= 1\times10^{-14}$$

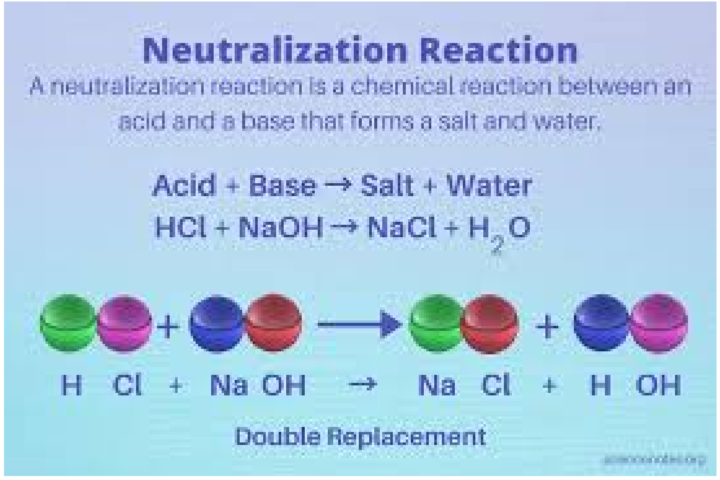


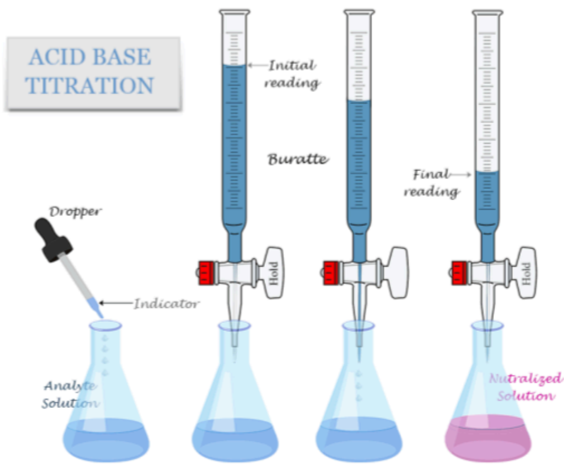
$$pH + pOH = 14.00$$

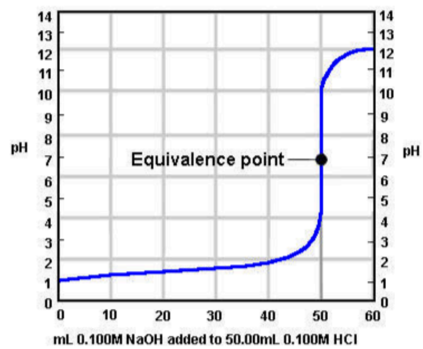




$$K_a = \frac{[H^+][A^-]}{[HA]}$$







BUFFERS

1. Definition

- Buffers are solutions which can resist changes in pH when acid or alkali is added.

2. Composition of a buffer

Buffers are 2 types:

a, Mixtures of weak acids with their salt with a strong base or

b, Mixtures of weak bases with their salt with a strong acid.

- **A few examples are given below:**

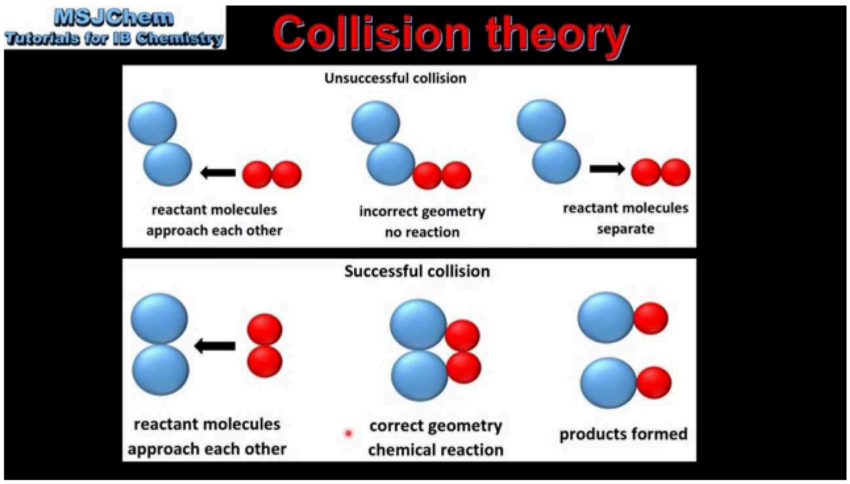
i. Bicarbonate buffer

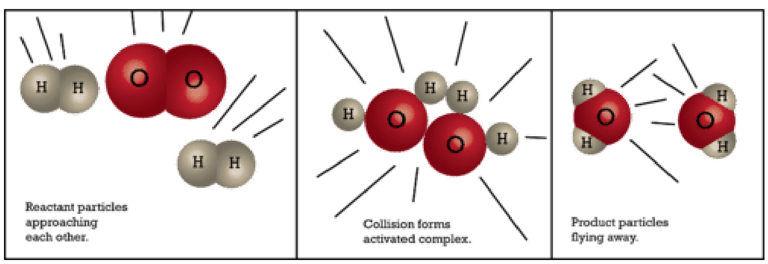
ii. Acetate buffer

iii. Phosphate buffer.

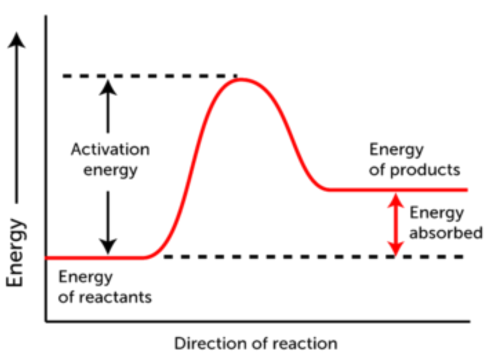
Buffer Capacity

$$\text{REACTION RATE} = \frac{\text{CHANGE IN MASS OF REACTANT OR PRODUCT}}{\text{TIME}}$$

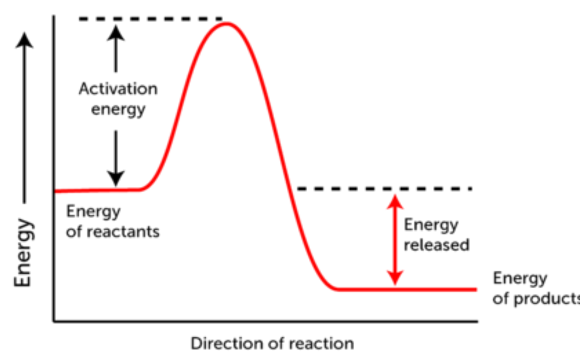


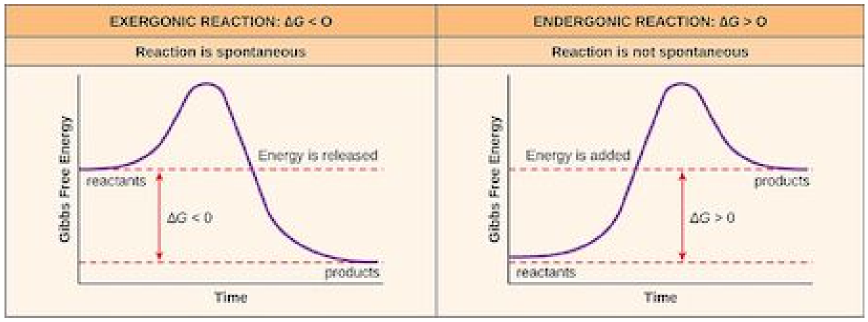


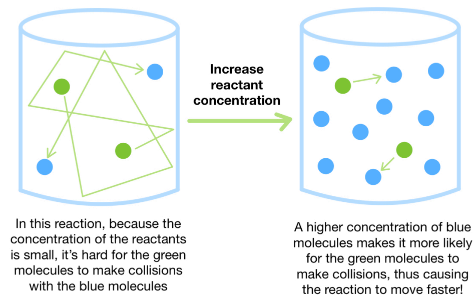
Endothermic Reaction

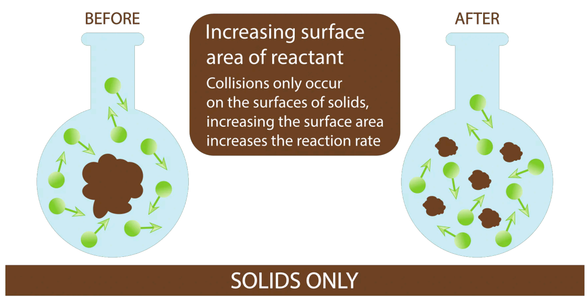


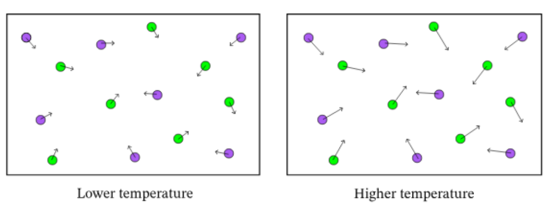
Exothermic Reaction

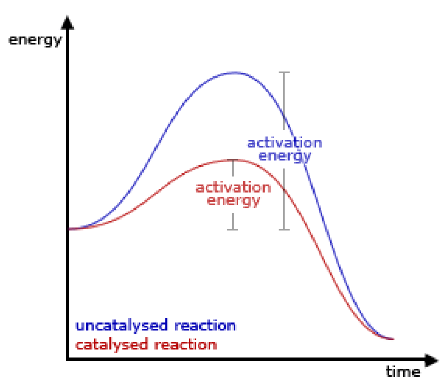



EXERGONIC REACTION: ΔG < 0
Reaction is spontaneous
Gibbs Free Energy
Energy is released
reactants
ΔG < 0
products
Time
ENDERGONIC REACTION: ΔG > 0
Reaction is not spontaneous
Gibbs Free Energy
Energy is added
products
ΔG > 0
reactants
Time


Increase reactant concentration
In this reaction, because the concentration of the reactants is small, it's hard for the green molecules to make collisions with the blue molecules
A higher concentration of blue molecules makes it more likely for the green molecules to make collisions, thus causing the reaction to move faster!


BEFORE
Increasing surface area of reactant
Collisions only occur on the surfaces of solids, increasing the surface area increases the reaction rate
AFTER
SOLIDS ONLY


Lower temperature
Higher temperature


energy
activation energy
activation energy
uncatalysed reaction
catalysed reaction
time