Collision-Reaction Theory

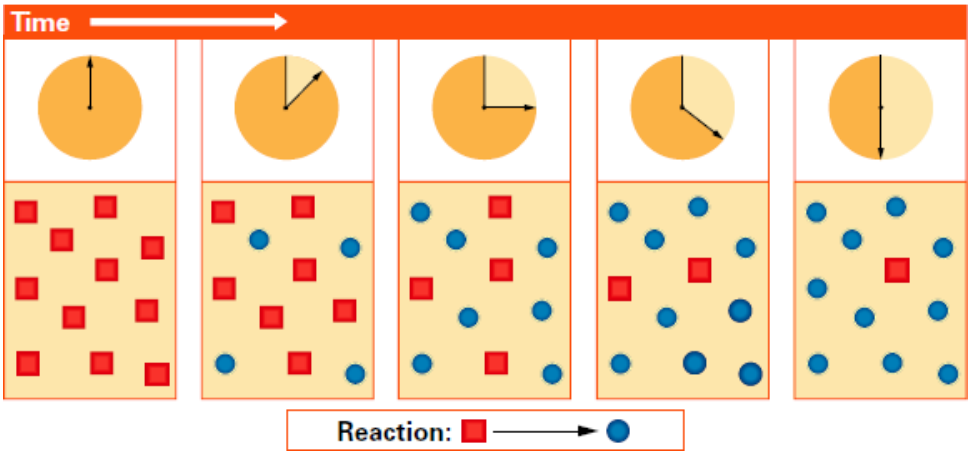
Main principles of the **collision-reaction theory** :
1. all chemical reactions involve collisions between atoms, ions or molecules
2. a certain amount of kinetic energy is required for a reaction to occur
3. a certain orientation of particles is required

Rate of Reaction

$A + B \rightleftharpoons C$

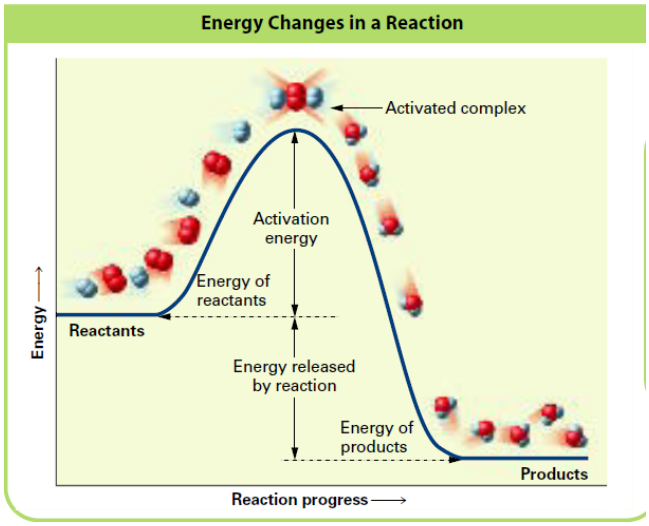
Reaction Rate

Amount of reactant changing per unit time



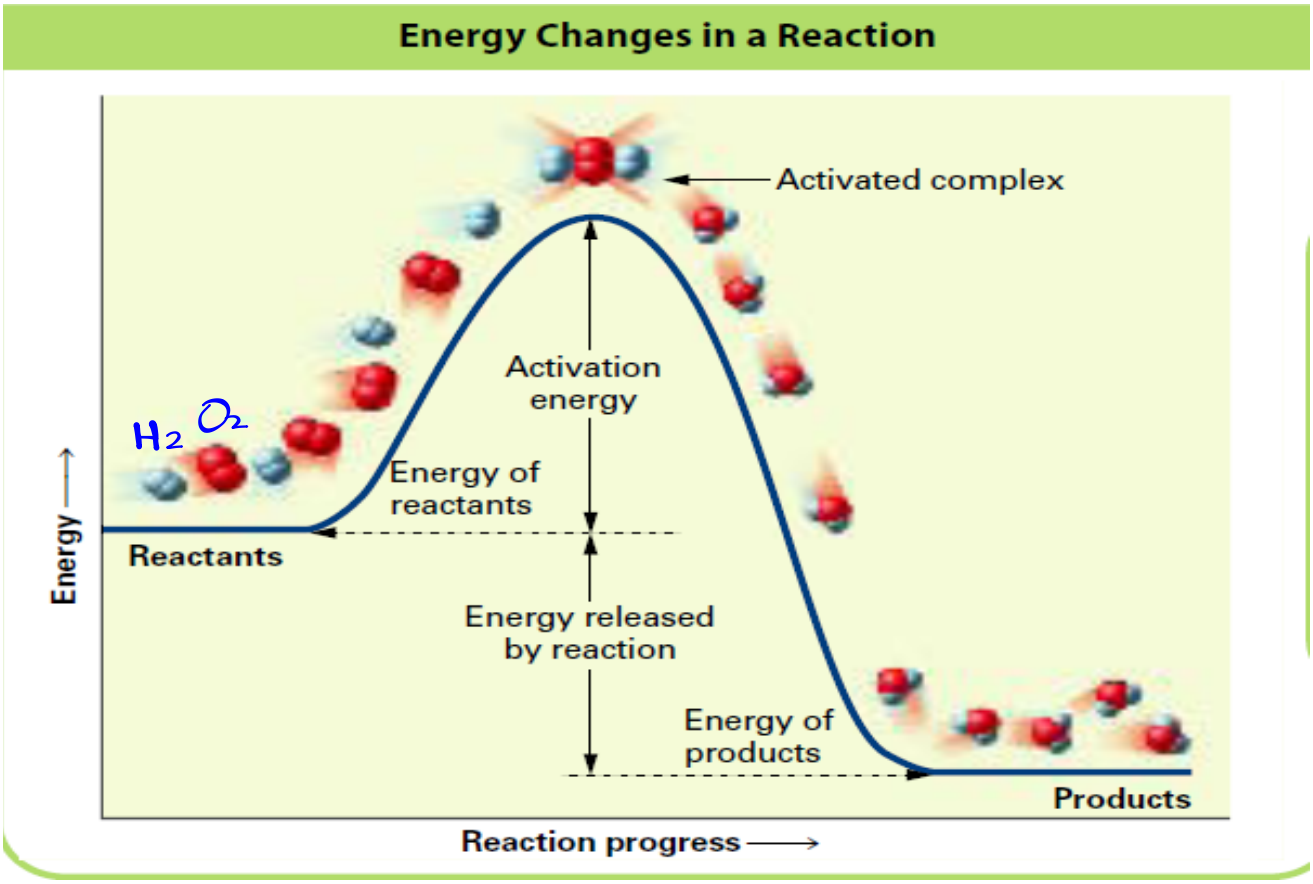
Activation Energy

Minimum amount of energy that colliding particles must have in order to react



Activated Complex (Transition State)

Unstable arrangement of atoms that forms at the peak of the activation-energy barrier



http://www.youtube.com/watch?v=VbIaK6PLrRM

http://www.youtube.com/watch?v=rl50M-wNVcs

Factors Affecting Reaction Rates

Temperature
Raising the temperature speeds up the rate of reaction
- More collisions, and more particles with enough kinetic energy to overcome activation energy barrier

Ex. burning of charcoal

Concentration
Increased concentration increases rate of reaction
- More particles, more collisions, higher rate of reaction

Ex. glowing splint in pure oxygen

Particle Size
Larger the particle, slower the rate of reaction
- Larger particle, less surface area, less reactant available for collision

Ex. Burning log in a fire

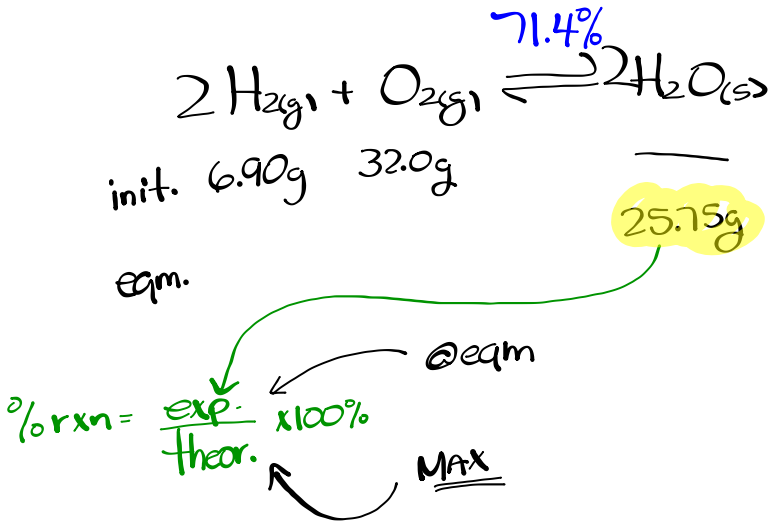
Catalyst
Lowers the activation energy for a reaction, increasing rate of reaction
- Not consumed in chemical reaction

Ex. Enzymes in digestive tract

Inhibitor - substance that interferes with the action of a catalyst, often by reacting with the catalyst

SAMPLE PROBLEM : % REACTION

Find the % reaction and write the expression if 6.90 g of $H_{2(g)}$ and 32.0 g of $O_{2(g)}$ react to form 25.75 g of ice at - 70 C°.



Find max. product

If H_2 is L.R.:

$$6.90\text{g } H_2 \times \frac{1\text{mol } H_2}{2.02\text{g } H_2} \times \frac{2\text{mol } H_2O}{2\text{mol } H_2} \times \frac{18.02\text{g } H_2O}{1\text{mol } H_2O} = 61.55\text{g } H_2O$$

If O_2 is L.R.:

$$32.0\text{g } O_2 \times \frac{1\text{mol } O_2}{32.00\text{g } O_2} \times \frac{2\text{mol } H_2O}{1\text{mol } O_2} \times \frac{18.02\text{g } H_2O}{1\text{mol } H_2O} = 36.04\text{g } H_2O$$

O_2 is L.R.

$$\%\text{rxn} = \frac{\text{exp.}}{\text{theor}} \times 100\%$$

PRODUCTS - FAVOURED

$$\%\text{rxn} = \frac{25.75\text{g}}{36.04\text{g}} \times 100\%$$

%rxn = 71.4%

SAMPLE PROBLEM : % REACTION

Find the % reaction and write the expression if 6.90 g of $H_{2(g)}$ and 32.0 g of $O_{2(g)}$ react to form 25.75 g of ice at - 70 C°.

$$2H_{2(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(s)}$$

init. 6.90g 32.0g —

25.75g

eqm.

$$\%\,rxn = \frac{exp.}{theor.} \times 100\%$$

Find max. product

If H_2 is L.R.:

$$6.90g\,H_2 \times \frac{1\,mol\,H_2}{2.02g\,H_2} \times \frac{2\,mol\,H_2O}{2\,mol\,H_2} \times \frac{18.02g\,H_2O}{1\,mol\,H_2O} = 61.55g\,H_2O$$

If O_2 is L.R.:

$$32.0g\,O_2 \times \frac{1\,mol\,O_2}{32.00g\,O_2} \times \frac{2\,mol\,H_2O}{1\,mol\,O_2} \times \frac{18.02g\,H_2O}{1\,mol\,H_2O} = 36.04g\,H_2O$$

O_2 is L.R.

$$\%\,rxn = \frac{exp.}{theor.} \times 100\%$$

$$\%\,rxn = \frac{25.75g}{36.04g} \times 100\%$$

$\%\,rxn = 71.4\%$

Worksheet