Assign 18.1 p 547 1-5

Name Sturmona (key)

# 18.1 CHEMICAL KINETICS

**Chemical kinetics** looks at: the rate at which reactions occur.

**Reaction rate** is: how fast a chem. reax. will occur.

- Change in concentrations of reactants & products in a certain amt of time.

avg reax rate = $\frac{\Delta \text{reactant}}{\Delta \text{time}}$ or $\frac{\Delta \text{product}}{\Delta \text{time}}$ units: M/s

see transparency (from data p. 723).

*A reaction rate cannot be determined by a balanced equation because:

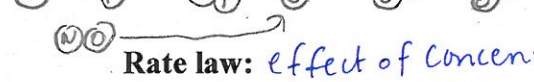
there are intermediate steps in reax. All you see is the first step & the last in a balanced equation. The intermediate steps occur take different times. (elementary steps)

The rearrangement of the atoms is complicated.

A rate determining step is: the slowest step.

use magnets to show this!

Consider: $2NO_{(g)} + F_{2(g)} \rightarrow 2NOF_{(g)}$



Step 1: $NO_{(g)} + F_{2(g)} \rightarrow NOF_{2(g)}$

Step 2: $NOF_{2(g)} + NO_{(g)} \rightarrow 2NOF$

See practice problems p. 726

**Rate law:** effect of concentration on reax. rate.

(see back for examples & practice probs p. 730) Rate = $k[A]^x[B]^y$ *x & y determined experimentally!

k is proportionality constant & if fixed at a certain temp.

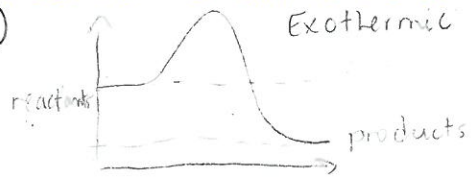
**Collision Theory** is important in reaction rates because:

Molecules must collide in order to react & they must have enough energy so bonds will break & new bonds will form. They must also have the proper orientation. The KE from the moving particles transfers to PE to break bonds. deform bonds,

Activation Complex: unstable arrangement of atoms that forms momentarily at peak of act-energy barrier. = transition state. Lasts ≈ $10^{-13}$ sec.

**Activation Energy** is: the energy needed to start a reaction.

(see transparency graphs p. 735)


Slow, slow, slow reax rate between C+O at room temp. Collisions too slow to break C–C + O–O bonds.

***Summary: Why do different reactions occur at different rates?***

Energy! Every reaction has particles which must have sufficient energy to overcome the barrier at any given time during the reax. Each reaction has its own activation energy.

**FACTORS AFFECTING REACTION RATES**

Name and describe the five factors that affect reaction rates.

1) Nature of Reactants

- some reactants require a lot of atom rearranging before the products are formed. - these will be slow at room temp.
- these usually have many covalent bonds to break.

i.e. portland cement takes weeks to harden. It sets up a complex 3-D lattice w/ alternating silicon & $O_2$ atoms.

2) Temperature

- increases the fraction of particles that collide w/ sufficient KE to form the activation ~~complex~~ energy-complex.

* Cyalume light sticks * (Call Party Ox)

- usually a ↑10°C will double or triple reax rate.
- ↑ freq of collisions
- ie. starter flame touches ~~carbon~~ charcoal ∴ atoms of C & O collide w higher energy & frequency. Some high enough to form $CO_2$.

3) Concentration

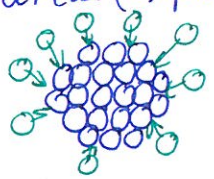
- more reactants molecules = more collisions

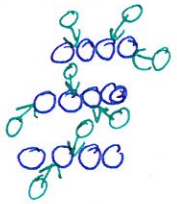
4) Surface Area

Lycopodium demo!

- the greater the surface area (exposed molecules) the better the chance of reacting.

Coal chunks - okay coal dust - explosive





5) Catalysts

- speed up chem reax w/o being used up.

Combustion of $H_2$ & $O_2$ @ rm temp negligible but w/ platinum (Pt) $2H_{2(g)} + O_{2(g)} \xrightarrow{Pt} 2H_2O_{(l)}$

Body uses Catalysts since if ↑temp it could be deadly! cool example in back-