KINETICS

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Chapter 17 (Pauling 16)

Rate Influencing Factors

-Nature of Reactants (reactivity/redox potential does not equal rate!)

Lithium for example does not equal rate. You can't predict it.

-Surface Area

more area exposed means faster rate and less time

-Temperature

10K doubling (rule of thumb) $R=2^n$ where $n=\Delta T/10$

typically rate increases with temperature

-Concentration (most important)

How molarity [x]. $R=\Delta[x]/\Delta t$

-Catalysts and Inhibitors (energy threshold)

catalyst - less energy required to create activated complex

inhibitor - more energy required to create activated complex

Differential Rate Law

-rate depends on concentration

- "Rate Law" ... ("write the rate law")

Integrated Rate Law

-concentration depends on time

(graphs from lecture)

-equimolar when the rate of consumption equals the rate of production, A->B

-nonequimolar when rate of consumption is not equal to rate of production, A->2B

-single step rxn if $R=k[x]^n$ with n = molar coefficient

Rates of Consumption vs. Production

-consumption rate: $R_c=-\Delta[x]/\Delta t = k[x]^n$

-production rate is the same as the consumption rate only non negative (rate is always +)

RDS and Rates

-the RDS (rate determining step) is the slowest rate (small k) or the step in a chemical rxn

Method of Initial Rates

-comparison of concentration with rates (looking at exponents)
-$\Delta[x]^n = \Delta R$

Order of the Reactions

-exponent
-when the order matches the coefficient, it's single step

Method of Linearizing Plots

	ORDER		
	0	1	2
Diff. Rate Law	$R = k$	$R = k[x]$	$R = k[x]^2$
Int. Rate Law	$[x] = -kt + [x]_0$	$\ln([x]) = -kt + \ln([x]_0)$	$1/[x] = kt + 1/[x]_0$
Linear	[x] vs. time	ln([x]) vs. time	1/[x] vs. time
Relationship betw/ rate constant to gradient of plot	gradient = -k	gradient = -k	gradient = k
Half life	$t_{1/2} = [x]_0/2k$	$t_{1/2} = \ln 2 / k$	$t_{1/2} = 1 / k[x]_0$

-use when you can't use "method of initial rates"
-$t_{1/2} = [x]/2^n$ with n = number of half lives
- all radioactive decay is first order!!!
$R \propto k \quad R \propto 1/t_{1/2}$
-overall order of a reaction: add exponents in the rate law

Chemical Equilibrium

-change is minimized within any system (stability, balanced, opposed)
-chemical equilibrium occurs when **Rates are equal, opposite and unchanging!**

Equilibrium Condition

Law of Mass Action

-Concentration of pure liquids and solids do not change!!! (don't include them in the equilibrium expression. Only include gasses and aqueous phases)
-dependent on temperature and reaction

Le Chatalier's Principle
-any system in equilibrium will react in a manner that reduces the effects of any stress placed on that system
-action and reaction are equal, but <u>not</u> opposite!!!

Pressure
-only for gas - number of mols count
-shift equilibrium, not equilibrium constant
-only reacting products/gases count

Concentration (amount)
-increases rate
-shifts equilibrium, not equilibrium constant
-pure substances don't count

Temp
-depends on endo/exo direction
-shifts equilibrium <u>and</u> equilibrium constant
-K values change depending on direction

Catalysts/Inhibitors
-have equal influences
-shift nothing
-accelerates/decelerates the time in which equilibrium is reached

Common Ion Effect
-if you have a solution, and you added something, if a common ion is present, something will probably precipitate because of LeChetalier's Principle

Solubility Product Equilibrium (K_{sp})
treat each thing like x, or multiply by the coefficient to find the concentration. Just go in reverse if Ksp is given.