Final Study Guide Chem 2

Chapter 13:

13.3- The Rate Law of Reaction: Rate Law shows the dependence of the rate of a reaction on the concentration of different reactants.

$aA \rightarrow cC+dD$

Rate Law = $k[A]^m$

k=rate constant, specific for each reaction.

m= order of the reaction with respect to A, NOT based on stoichiometric coefficients.

If m=0→ $Rate=k[A]^0=k$

Zero Order Reaction: Rate is independent of concentration of A. (M/s)

If m=1→ $Rate=k[A]^1=k[A]$

First Order Reaction: Rate depends on concentration of A. If [A] doubles, rate doubles. (s^{-1})

If m=2→ $Rate=k[A]^2$

Second Order Reaction: Rate depends on concentration of A. If [A] doubles, rate will be 4 times faster. ($M^{-1}s^{-1}$)

Ex)

[A] (M):

1) .10

2) .20

3) .40

Initial Rate (M/s):

1) .015

2) .030

3) .060

$Rate=k[A]^m$

Rate (2)/Rate (1) = $k[A]_2^m / [A]_1^m$

k's cancel out.

$.015/.030=(.20/.10)^m$

$2=2^m$

ln2=mln2

m=ln2/ln2

m=1

First order reaction.

Rate constant?

$Rate=k[A]^1$

.015 M/s=k(.10M)

k=.015 M/S / .10 M

k=.15 s

Reaction Order for Multiple Reactants:

$aA + bB \rightarrow cC + dD$

Rate= $k[A]^m[B]^n$

m= order of reaction w/ respect to A

n= order of reaction w/ respect to B

Order of reaction= m + n

Ex) $NO_2 + CO \rightarrow NO + CO_2$

$[NO_2]$ (M):

1) .10
2) .20
3) .20
4) .40

[CO] (M):

1) .10
2).10
3) .20
4) .10

initial Rate (M/s):

1) .0021
2) .0082
3) .0083
4) .033

Rate Law?

Rate=$k[NO_2]^m[CO]^n$

m=?

n=?

Determine m:

Choose 2 experiments where $[NO_2]$ is changed, and [CO] is not.

rate (2) / rate (1) = $k[NO_2]_2^m[CO]_2^n$ / $k[NO_2]_1^m[CO]_1^n$

k and [CO] 's both cross out b/c the same.

$.0082/.0021 = .20^m/.10^m$

$4=2^m$

log4=mlog2

m=log4/log2= 2

Second Order Reaction.

Do the same steps to get n=0. Order of Reaction= 2+0= 2= second order reaction

Rate Constant?

Exp (1):

$.0021\ M/s = k\ (.10\ M)^2(.10M)^0$

$k=.0021\ M/s\ /\ .01\ M^2$

$k= 0.21\ M^{-1}s^{-1}$

Effect of Concentration on the Rate:

Rate=$k[A]^2[B]$ (3rd Order)
[A] is doubled? $[2]^2=4$, rate will be 4 times faster.
[B] is doubled, [A] unchanged? $[2]^1= 2$, rate is doubled.
[A] is tripled, [B] doubled? $[3]^2=9$, $[2]^1$
9 x 2= 18
rate is 18 times faster.
If both concentrations change, multiply by each other.

13.4- Integrated Rate Law:
Zero Order:
$[A]_{time}=-kt + [A]_0$
(given)
$[A]_0$= initial concentration
Linear Decreasing Straight Line.
Slope= -k
y-int= $[A]_0$

First Order:
$\ln[A]_t= -kt + \ln[A]_0$
(given)
Linear Decreasing Straight Line (will be curved before ln is put in).
Slope=-k
y-int= $\ln[A]_0$

Second Order:
$1/[A]_t= kt + 1/[A]_0$
(given)
Linear Increasing Straight Line.
Slope= k
y-int= $1/[A]_0$

The Half-Life of a Reaction (t ½):
Time required for concentration of reactant to fall to ½ of its initial value.

Zero Order:
$t_{1/2} = [A]_0 / 2k$
(given, know which half-life goes with which)

First Order:
$t_{1/2} = .693/ k$
(given, know which half-life goes with which order)
Does not depend on initial concentration of reactants

Second Order:
$t_{1/2} = 1 / k[A]_0$