CH. 14 Kinetics

27) $A + B \rightarrow C$

Rate $= k[B]^2$

a) A is a zero order reactant, so <u>NO</u> <u>CHANGE</u> in the rate!

$[A]^0 = 1$

* [k is also constant. Only a change in temp. can change k!]

b) $B \rightarrow 2^{nd}$ order

$A \rightarrow 0$ order

overall rxn order $\rightarrow 2^{nd}$ order

c) $k = \frac{Rate}{[B]^2} = \frac{M s^{-1}}{M^2} = M^{-1} s^{-1}$

29) $2 N_2O_5 \rightarrow 4 NO_2 + O_2$

Rate $= k[N_2O_5]$

$k = 4.82 \times 10^{-3} s^{-1}$

a) Rate $= 4.82 \times 10^{-3} s^{-1} [N_2O_5]$

b) Rate $= 4.82 \times 10^{-3} s^{-1} (.0240 M)$

$= 1.16 \times 10^{-4} M s^{-1}$

c) If double $[N_2O_5]$, rate doubles.

d) If half $[N_2O_5]$, rate is halved.

} N_2O_5 is 1^{st} order reactant.

31) $CH_3Br + OH^- \rightarrow CH_3OH + Br^-$

Rate = $k[CH_3Br][OH^-]$

a) $k = \dfrac{.0432\ \cancel{M}\,s^{-1}}{(5.0\times10^{-3}\ \cancel{M})(.050M)} = 170\ M^{-1}s^{-1}$

b) $1.7\times10^{2}\ M^{-1}s^{-1}$

c) If $[OH^-]$ is tripled, rate will triple.

d) If $[OH^-]$ is tripled & $[CH_3Br]$ is tripled, rate will be 9x faster.

33) $OCl^- + I^- \rightarrow OI^- + Cl^-$

a) Rate = $k[OCl^-]^x[I^-]^y$

- when $[OCl^-]$ doubles, rate doubles, ∴ OCl^- is 1st order
- when $[I^-]$ doubles, rate doubles, ∴ I^- is 1st order

* Rate = $k[OCl^-][I^-]$

b) $k = \dfrac{1.36\times10^{-4}\ \cancel{M}\,s^{-1}}{(1.5\times10^{-3}\ \cancel{M})(1.5\times10^{-3}M)} = 60\ M^{-1}s^{-1}$

$6.0\times10^{1}\ M^{-1}s^{-1}$

c) Rate = $6.0\times10^{1}\ \cancel{M^{-1}}s^{-1}(2.0\times10^{-3}\ \cancel{M})(5.0\times10^{-4}M)$

$= 6.0\times10^{-5}\ M s^{-1}$

35) $BF_3 + NH_3 \rightarrow F_3BNH_3$

* NH_3 is 1st order (T 1 + 2)
* BF_3 is 1st order (T 4 + 5)

a) Rate = $k[BF_3][NH_3]$

b) 2nd order overall

c) $k = \dfrac{.2130\ M s^{-1}}{(.250\ M)^2} = 3.41\ M^{-1}s^{-1}$

d) Rate = $3.41\ M^{-1}s^{-1}(.100\ M)(.500\ M)$
= $.171\ M s^{-1}$

36.) $2NO + O_2 \rightarrow 2NO_2$

$Rate = k[NO]^x[O_2]^y$

NO is 2^{nd} order

O_2 is 1^{st} order

a) $Rate = k[NO]^2[O_2]$

b) $k = \frac{\cancel{M}s^{-1}}{(M)^2(\cancel{M})} = M^{-2}s^{-1}$

c) $k_1 = \frac{1.41 \times 10^{-2}}{(.0126)^2(.0125)} = 7105 = 7.11 \times 10^3$

$k_2 = \frac{5.64 \times 10^{-2}}{(.0252)^2(.0125)} = 7105 = 7.11 \times 10^3$

$k_3 = \frac{1.13 \times 10^{-1}}{(.0252)^2(.0250} = 7118 = 7.12 \times 10^3$

Avg $= 7.11 \times 10^3 M^{-2}s^{-1}$

d) $Rate = 7.11 \times 10^3 \cancel{M^{-2}}s^{-1}(.0750\cancel{M})^2(.0100M)$

$= .400\ Ms^{-1}$ → Rate of disappearance of NO

Rate of disappearance of $O_2 = .200\ Ms^{-1}$

38. a) Rate $= k[S_2O_8^{2-}]^x[I^-]^y$

$S_2O_8^{2-}$ is 1^{st} order reactant

I^- is ↴

$$\frac{T3}{T2} \quad \frac{7.8\times10^{-6} = \cancel{k}(.036)^1(.054)^y}{3.9\times10^{-6} = \cancel{k}(.027)^1(.036)^y}$$

$$2 = (1.33)(1.5)^y$$

$$1.5 = 1.5^y \quad \boxed{y = 1}$$

Rate $= k[S_2O_8^{2-}][I^-]$

b) $k = \frac{Rate}{[S_2O_8^{2-}][I^-]} = \frac{M s^{-1}}{M M} = M^{-1}s^{-1}$

$$k_1 = \frac{2.6\times10^{-6}}{(.018)(.036)} = .0040$$

$$k_2 = \frac{3.9\times10^{-6}}{(.027)(.036)} = .0040$$

$$k_3 = \frac{7.8\times10^{-6}}{(.036)(.054)} = .0040$$

$$k_4 = \frac{1.4\times10^{-5}}{(.050)(.072)} = .0039$$

$k_{avg} = .0040 M^{-1}s^{-1}$

c) The rate of disappearance of $S_2O_8^{2-}$ is 1/3 the rate of disappearance of I^-.

d) Rate $= (.0040)(.025)(.050)$

$= 5.0\times10^{-6}\ M s^{-1}$ = rate of disapp. of $S_2O_8^{2-}$.

$1.5\times10^{-5}\ M s^{-1}$ = rate of dissap. of I^-.