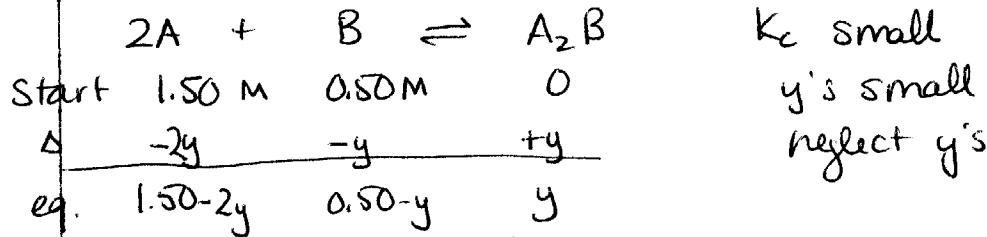
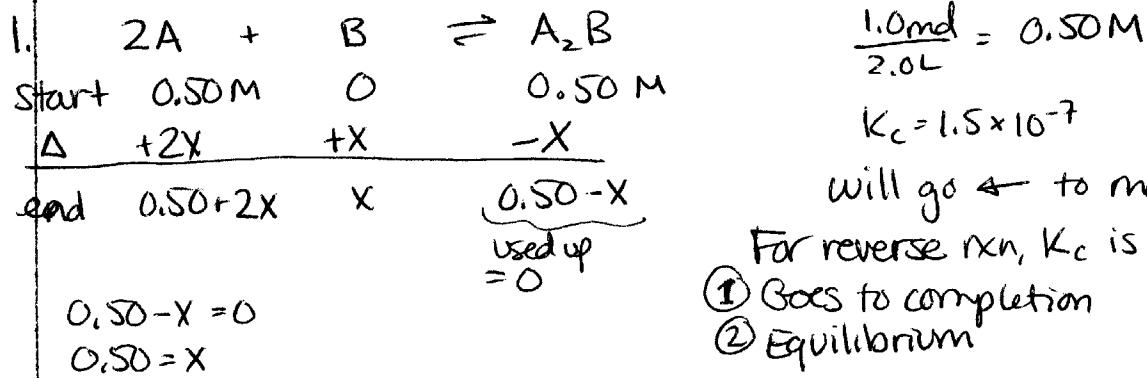


Answers-Review Probs for Exam 1

(1)

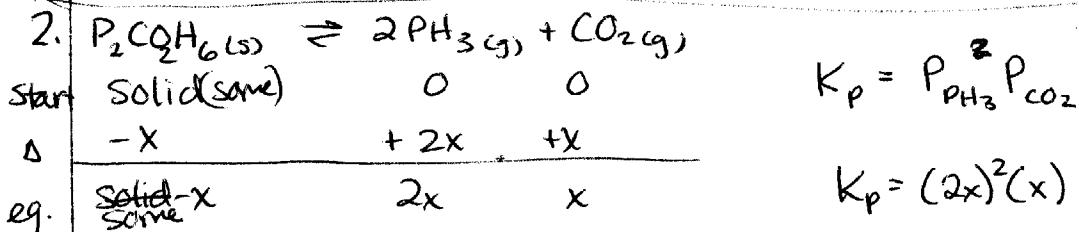


$$K_c = \frac{[A_2B]}{[A]^2[B]} = 1.5 \times 10^{-7} = \frac{y}{(1.50-2y)^2(0.50-y)} = \frac{y}{(1.50)^2(0.50)} = 1.5 \times 10^{-7}$$

reject y's

$$y = 1.5 \times 10^{-7} (1.50)^2 (0.50) = 1.7 \times 10^{-7} \text{ M}$$

$$\text{so: } [A] = 1.50 \text{ M} \quad [B] = 0.50 \text{ M} \quad [A_2B] = 1.7 \times 10^{-7} \text{ M}$$

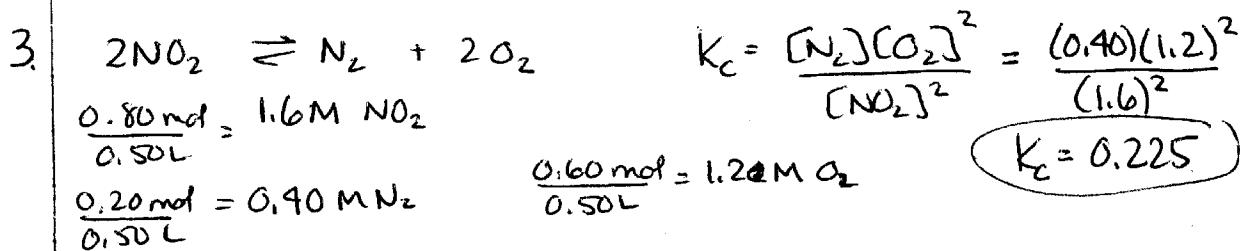


$$\text{total } P = P_{PH_3} + P_{CO_2} = 0.51 \text{ atm} = 2x + x = 3x$$

$$0.51 \text{ atm} = 3x$$

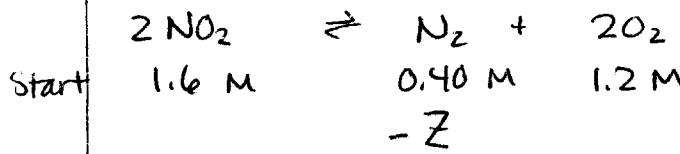
$$x = \frac{0.51 \text{ atm}}{3} = 0.17 \text{ atm}$$

$$K_p = 4(0.17)^3 = 2.0 \times 10^{-2}$$



(2)

3 continued want 0.70 mol NO₂ at eq. $\frac{0.70 \text{ mol}}{0.50 \text{ L}} = 1.4 \text{ M}$ NO₂ at eq.



Let Z = ~~0.275~~ M N₂ to remove
eq. will shift →

Δ	-2x	+x	+2x
eq.	1.6 - 2x	0.40 - Z + x	1.2 + 2x
	= 1.4 M at eq.	0.40 + 0.1 - Z	1.2 + 2(0.1)

$$1.6 - 2x = 1.4$$

$$-1.4 + 2x = -1.4 + 2x$$

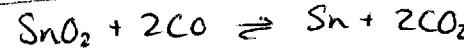
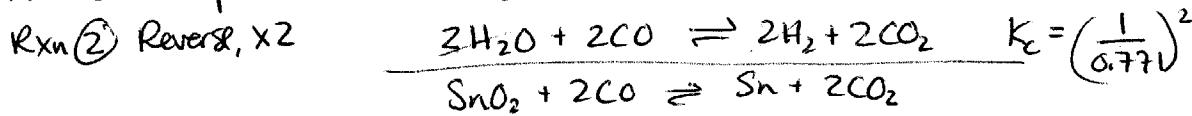
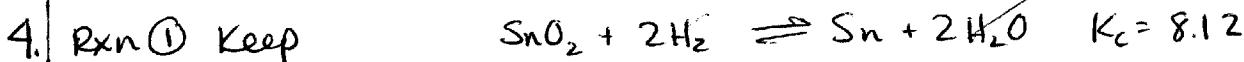
$$\frac{0.2}{2} = \frac{2x}{2} \quad x = 0.1$$

$$K_c = \frac{[\text{N}_2][\text{O}_2]^2}{[\text{NO}_2]^2} = \frac{(0.50 - Z)(1.4)^2}{(1.4)^2} = 0.225$$

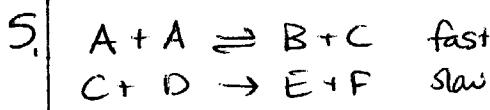
$$\begin{array}{cccc} 0.50 - Z & = 0.225 \\ -0.225 + Z & -0.225 & +Z \\ 0.275 & = Z \end{array}$$

$$Z = 0.275 \text{ M N}_2 \text{ to add}$$

$$(0.275 \frac{\text{mol}}{\text{L}})(0.50 \text{ L}) = 0.1375 = 0.14 \text{ moles N}_2 \text{ to add}$$



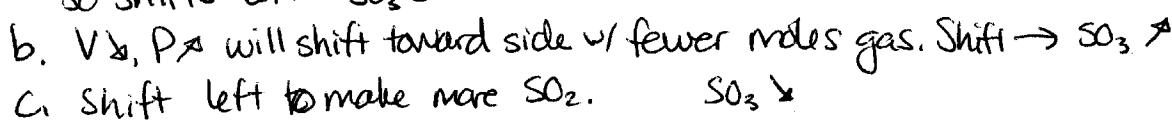
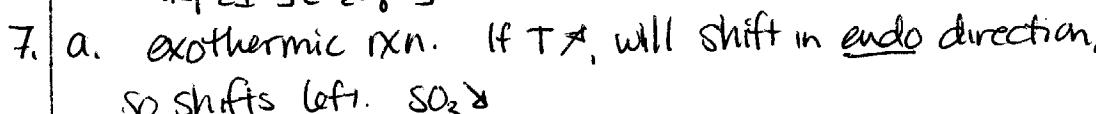
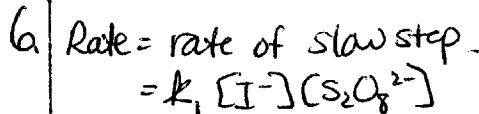
$$K_{\text{overall}} = \frac{8.12}{(0.771)^2} = 13.66 = 13.7$$



$$\text{overall rate} = k_2[C][D] \quad C \text{ is intermed.}$$

$$k_1[A]^2 = k_{-1}[B][C]$$

$$[C] = \frac{k_1[A]^2}{k_{-1}[B]} \quad \text{so overall rate} = \frac{k_1 k_2 [A]^2 [D]}{k_{-1}[B]}$$



(3)

7 d. $K_p = K_c(RT)^{\Delta n}$ $\Delta n = 2 - 3$ molar gas = (-1) $1030^\circ C = 1303 K$

$$K_p = 1.98(RT)^{-1} = \frac{1.98}{RT} = \frac{1.98}{(0.08206)(1303)} = 0.0185 = K_p$$

e. must go \rightarrow to make some SO_3

f. must go \leftarrow to make some SO_2

g. Calc Q compare to K. $Q = \frac{[SO_3]^2}{[SO_2]^2(O_2)} = \frac{(1.0)^2}{(1.0)^2(1.0)} = 1$ $Q < K$
must go \rightarrow

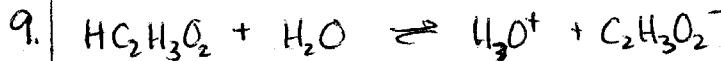
h. $Q = \frac{(2.0)^2}{(1.0)^2(1.0)} = 4.0$

$Q > K$ will go \leftarrow to get to eq.

8. Na^+ neutral HPO_4^{2-} $K_a = K_{a3}$ of $H_3PO_4 = 3.6 \times 10^{-3}$

$$K_b = \frac{K_w}{K_a \text{ of } H_2PO_4^-} = \frac{1.0 \times 10^{-14}}{6.2 \times 10^{-8}} = 1.6 \times 10^{-7}$$

basic $K_b > K_a$



start	0.20 M	lots	0	0	$\frac{HA}{Ka} = \frac{0.20}{1.8 \times 10^{-5}} = 1.1 \times 10^4$
Δ	-x		+x	+x	ok to neglect x.

eq. $0.20 - x \quad x \quad x$

$$Ka = \frac{x^2}{0.20 - x}$$

neglect x

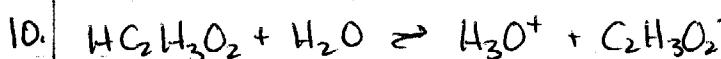
$$Ka = \frac{x^2}{0.20}$$

$$x = \sqrt{Ka(0.20)} = \sqrt{1.8 \times 10^{-5}(0.20)}$$

$$x = 1.9 \times 10^{-3} M \quad H_3O^+$$

$$pH = 2.72$$

% ionization = $\frac{x}{HA} * 100 = \frac{1.897 \times 10^{-3} M}{0.20 M} * 100 = 0.95\%$ ionized



0.0020	lots	0	0
-x		+x	+x

$$\frac{HA}{Ka} = \frac{0.0020}{1.8 \times 10^{-5}} = 111 \text{ not ok to neglect } x$$

$0.0020 - x \quad x \quad x$

$$Ka = \frac{x^2}{0.0020 - x}$$

* use method of successive approx.

① neglect x

$$x_1 = \sqrt{Ka(0.0020)} = 1.897 \times 10^{-4} M$$

$$x_2 = \sqrt{Ka(0.0020 - x_1)} = 1.805 \times 10^{-4} M$$

$$x_3 =$$

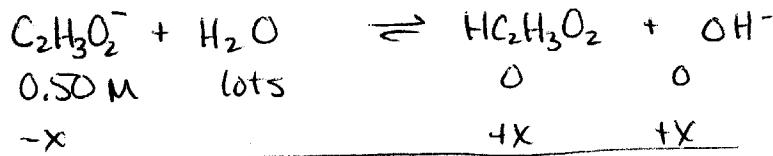
$$1.8097 \times 10^{-4} M$$

close enough

% ioniz.
 $= \frac{1.81 \times 10^{-4}}{0.0020} \times 100 = 9.1\%$

$$pH = 3.74$$

(4)

11. K^+ neutral $C_2H_3O_2^-$ weak base

$$K_b = \frac{K_w}{K_a H C_2H_3O_2} = \frac{1.0 \times 10^{-14}}{1.8 \times 10^{-5}} = 5.556 \times 10^{-10} = \frac{x^2}{0.50-x}$$

neglect x

$$x = \sqrt{K_b(0.50)}$$

$$x = 1.67 \times 10^{-5} \text{ M } OH^-$$

$$pOH = 4.78$$

$$pH = 9.22$$

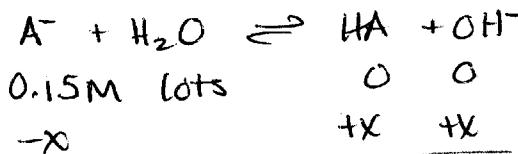
12. $HCP + H_2O \rightleftharpoons H_3O^+ + CP^-$ 

$$K_a = \frac{x^2}{0.095-x} = \frac{(1.148 \times 10^{-3})^2}{(0.095-1.148 \times 10^{-3})}$$

$$= 1.4 \times 10^{-5}$$

$$pH \text{ at eq} = 2.94$$

$$[H_3O^+] \text{ at eq} = 10^{-2.94} = 1.148 \times 10^{-3} \text{ M} = x$$

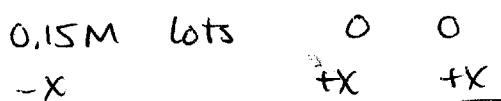
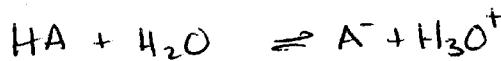
13. Na^+ neutral A^- WB

$$K_b = \frac{x^2}{0.15-x} = \frac{(2.754 \times 10^{-5})^2}{(0.15)} = 5.057 \times 10^{-9} = K_b \text{ of } A^-$$

$$pH = 9.44 \text{ so } pOH = 4.56$$

$$10^{-4.56} = 2.754 \times 10^{-5} \text{ M } OH^- = x$$

$$\text{so } K_a \text{ of HA} = \frac{K_w}{5.057 \times 10^{-9}} = 1.977 \times 10^{-6} = K_a$$



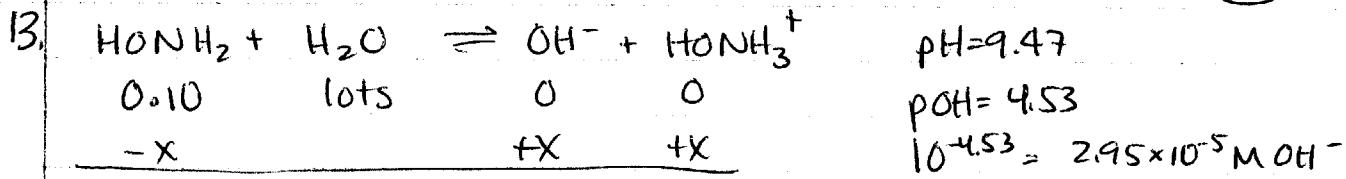
$$K_a = \frac{x^2}{0.15-x} = 2.0 \times 10^{-6}$$

neglect x.

$$x = \sqrt{K_a(0.15)} = 5.5 \times 10^{-4} \text{ M } H_3O^+$$

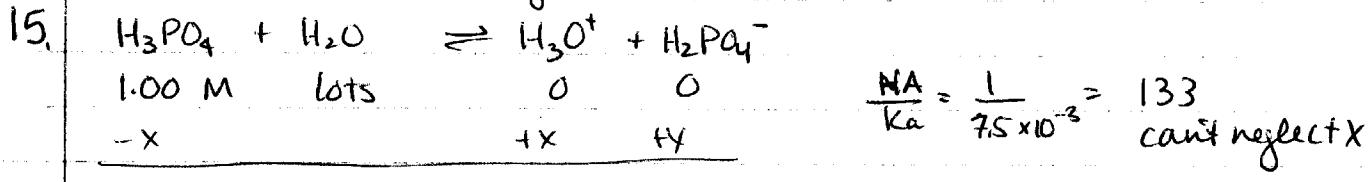
$$pH = 3.26$$

(S)



$$K_b = \frac{x^2}{0.10-x} = \frac{(2.95 \times 10^{-5})^2}{0.10-x} = 8.7 \times 10^{-9} = k_b$$

\uparrow
neglect

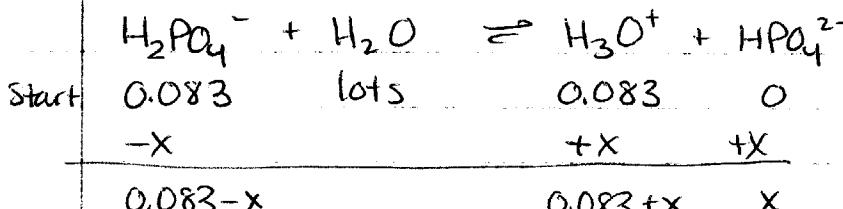


$$K_a = \frac{x^2}{1.00-x} = 7.5 \times 10^{-3} \quad \text{successive approx. } X_1 = \sqrt{K_a(1.00)} = 0.0866$$

\uparrow
neglect x first $X_2 = \sqrt{K_a(1.00-X_1)} = 0.0828$

$X_3 = 0.0829$ close enough.

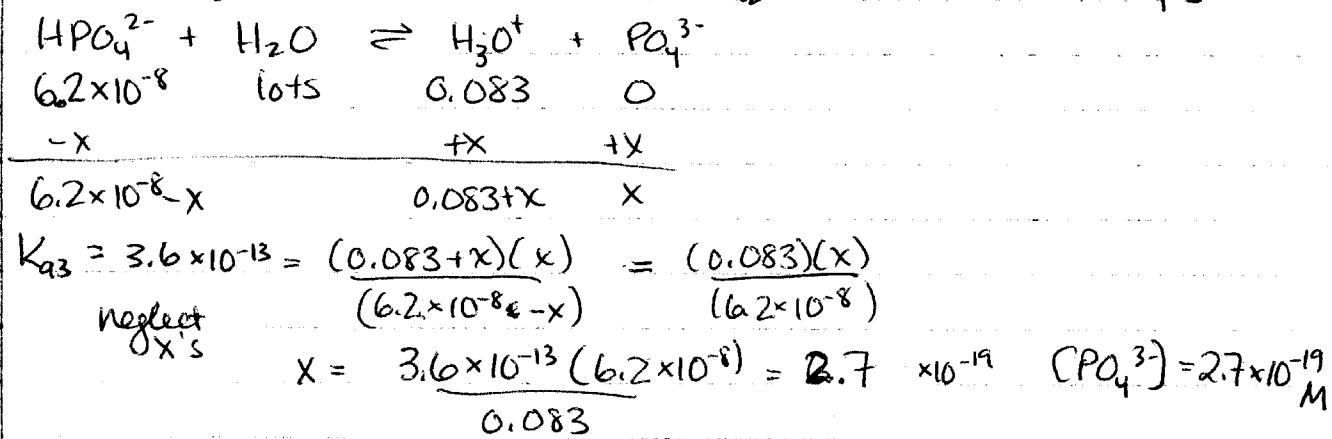
 $[\text{H}_3\text{O}^+] = 0.0829 \quad \text{pH} = 1.08$
 $[\text{H}_2\text{PO}_4^-] = 1.00 - 0.0829 = 0.92 \text{ M}$



$$K_{a2} = 6.2 \times 10^{-8} = \frac{(0.083+x)(x)}{(0.083-x)} \quad \text{so} \quad K_{a2} = \frac{(0.083)(x)}{(0.083)}$$

neglect x 's

 $K_{a2} = x = 6.2 \times 10^{-8} = [\text{HPO}_4^{2-}]$



(6)

of reactants

16. conc' changes as time goes on, so rate changes as time goes on

17. It's a constant value - doesn't change as time goes on.

18. (A) vst - can determine average or instantaneous rate.
If straight, zero order. $\ln(A)$ vs t - if straight, it's first order. Slope = $-k$ $[A]$ vs t - if straight, it's 2nd order Slope = k $\ln k$ vs $\frac{1}{T}$ slope = $-E_a/R$ can calc E_a from slope.19. Rate = $k[A]^x$ 2nd order $2^x = 4$

20. $\ln \frac{A_t}{A_0} = -kt$ $\ln \left(\frac{0.12M}{0.50M} \right) = -k(3.41 \text{ hr})$

$$\ln(0.24) = \frac{-1.427}{-3.41 \text{ hr}} = \frac{-k(3.41 \text{ hr})}{-3.41 \text{ hr}}$$

$k = 0.419 \text{ hr}^{-1}$

(b) $\frac{1}{A_t} - \frac{1}{A_0} = kt$ $\frac{1}{0.12M} - \frac{1}{0.50M} = k(3.41 \text{ hr})$

$8.333 \text{ M}^{-1} - 2.00 \text{ M}^{-1} = k(3.41 \text{ hr})$

$6.333 \text{ M}^{-1} = \frac{k(3.41 \text{ hr})}{3.41 \text{ hr}}$

$k = 1.857 \text{ M}^{-1} \text{ hr}^{-1}$

21. a) compare expts 2, 1 NO doubles, H_2 constant, rate $\frac{0.136}{0.0339} = 4 \times$
2nd order in NO.b) Compare expts 2, 3 NO constant H_2 doubles, rate $\frac{0.0678}{0.0339} = 2$ doubles
1st order in H_2

Rate = $k [NO]^2 [H_2]$

b) $k = \frac{\text{rate}}{[NO]^2 [H_2]} = \frac{0.136 \text{ M/sec}}{(0.420M)^2 (0.122M)} = 6.32 \text{ M}^{-2} \text{ sec}^{-1}$

c) Rxns are faster @ higher temps so k at 25°C will be lower

d) Rate = $k [NO]^2 [H_2] = 6.32 \text{ M}^{-2} \text{ sec}^{-1} (0.350M)^2 (0.205M) = 0.159 \text{ M/sec}$

22. a. $\ln \frac{A_t}{A_0} = -kt$ $\ln \frac{1.0}{4.0} = -(0.50 \text{ min}^{-1})t$ $\frac{-1.386}{-0.50 \text{ min}^{-1}} = \frac{-0.50 \text{ min}^{-1}t}{-0.50 \text{ min}^{-1}}$

$t = 2.77 \text{ min}$

b. $\frac{1}{A_t} - \frac{1}{A_0} = kt$ $\frac{1}{1.0 \text{ M}} - \frac{1}{4.0 \text{ M}} = (0.50 \text{ M}^{-1} \text{ min}^{-1})t$ $1.0 \text{ M}^{-1} - 0.25 \text{ M}^{-1} = (0.50 \text{ M}^{-1} \text{ min}^{-1})t$

(7)

22 b. $\frac{0.75 \text{ M}^{-1}}{0.50 \text{ M}^{-1} \text{ min}^{-1}} = \frac{0.50 \text{ M}^{-1} \text{ min}^{-1} t}{0.50 \text{ M}^{-1} \text{ min}^{-1}}$ $t = 1.5 \text{ min}$

c. $\ln \frac{A_t}{A_0} = -kt$ $\ln \frac{0.25 \text{ M}}{1.0 \text{ M}} = -(0.50 \text{ min}^{-1})(t)$ $\frac{-1.386}{-0.50 \text{ min}^{-1}} = \frac{-0.50 \text{ min}^{-1} t}{-0.50 \text{ min}^{-1}}$

$$t = 2.77 \text{ min}$$

d. $\frac{1}{A_t} - \frac{1}{A_0} = kt$ $\frac{1}{0.25 \text{ M}} - \frac{1}{1.0 \text{ M}} = (0.50 \text{ M}^{-1} \text{ min}^{-1})t$

$$4.0 \text{ M}^{-1} - 1.0 \text{ M}^{-1} = (0.50 \text{ M}^{-1} \text{ min}^{-1})t$$

$$\frac{3.0 \text{ M}^{-1}}{0.50 \text{ M}^{-1} \text{ min}^{-1}} = \frac{0.50 \text{ M}^{-1} \text{ min}^{-1} t}{0.50 \text{ M}^{-1} \text{ min}^{-1}} \quad t = 6.0 \text{ min}$$

e. Comparing @ and c for a first order rxn: takes the same amt of time for conc to fall from 4.0 M to 1.0 M as to go from 1.0 M to 0.25 M. In both, conc is decreasing to $\frac{1}{4}$ of initial. 2 half lives are passing.

Comparing b and d For 2nd order, amt of time varies.

Compare @ and b) If conc. are above 1 M, 2nd order rxn is faster than 1st order. Comparing c and d, if conc are below 1 M, 2nd order rxn is slower than first order (if rate constant is the same)

f. 2 half lives = 2.77 min. 1 half life = 1.4 min

23. 2nd order. $\frac{1}{A_t} - \frac{1}{A_0} = kt$ $\frac{1}{0.20 \text{ M}} - \frac{1}{0.60 \text{ M}} = k(1.27 \text{ hr})$

$$5.0 \text{ M}^{-1} - 1.6667 \text{ M}^{-1} = kt \quad \frac{3.333 \text{ M}^{-1}}{1.27 \text{ hr}} = \frac{k(1.27 \text{ hr})}{1.27 \text{ hr}} \Rightarrow k = 2.6 \text{ M}^{-1} \text{ hr}^{-1}$$

24. $\ln \frac{k_1}{k_2} = \frac{E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$ $\ln \left(\frac{3.46 \times 10^5 \text{ sec}^{-1}}{1.50 \times 10^3 \text{ sec}^{-1}} \right) = \frac{E_a}{R} \left(\frac{1}{328 \text{ K}} - \frac{1}{298 \text{ K}} \right)$

$$\ln (0.023067) = \frac{E_a}{R} (0.00304878 - 0.003355704)$$

$$E_a = \frac{(-3.769367)(8.314 \text{ J/mol.K})}{-0.000306924 \text{ K}^{-1}}$$

$$-3.769367 = \frac{E_a}{R} (-0.000306924 \text{ K}^{-1})$$

$$= 1.02 \times 10^5 \text{ J/mol} = 1.02 \text{ kJ/mol} = 1.0 \times 10^2 \text{ kJ/mol}$$

(8)

$$25. E_a = 260 \text{ kJ/mol} = 2.60 \times 10^5 \text{ J/mol}$$

$$\ln \frac{k_1}{k_2} = \frac{E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right) \quad \ln \left(\frac{k_1}{0.0315 \text{ sec}^{-1}} \right) = \frac{2.60 \times 10^5 \text{ J/mol}}{8.314 \text{ J/Kmol}} \left(\frac{1}{800 \text{ K}} - \frac{1}{850 \text{ K}} \right)$$

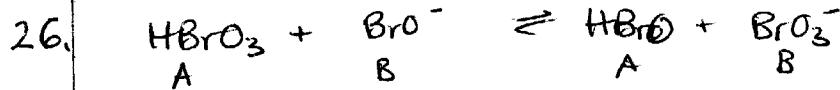
$$\ln \left(\frac{k_1}{0.0315 \text{ sec}^{-1}} \right) = \frac{E_a}{R} (0.00125 - 0.00117647)$$

$$= \frac{2.60 \times 10^5 \text{ J/mol}}{8.314 \times 10^3 \text{ J/Kmol}} (0.000073529 \text{ K}^{-1}) = 2.299$$

$$\ln \left(\frac{k_1}{0.0315 \text{ sec}^{-1}} \right) = 2.299 \quad \text{take } e^x \text{ of both sides}$$

$$\frac{k_1}{0.0315 \text{ sec}^{-1}} = e^{2.299} = 9.9687 \quad (\text{no sig figs!})$$

$$k_1 = 9.9687 (0.0315 \text{ sec}^{-1}) = 0.3 \text{ sec}^{-1}$$



More O's, stronger acid, so HBrO₃ is stronger than HBrO. Eq. lies to side w/weaker acid, so lies to Rt. $K_c > 1$



$$\frac{1.00 \text{ mol}}{4.00 \text{ L}} = 0.250 \text{ M each.}$$

Which way will it go?

$$Q = \frac{P_{\text{N}_2\text{O}_4}}{P_{\text{NO}_2^2}} = \frac{(0.250)}{(0.250)^2} = 4$$

$Q < K$ rxn will go \rightarrow to reach eq.
Q must increase.

i	0.250 M	0.250 M
c	-2x	+x
e	0.250-2x	x

$$K_c = 171$$

$$K_c = \frac{(0.250+x)}{(0.250-2x)^2}$$

$$K_c (0.250-2x)^2 = 0.250+x$$

$$K_c (0.0625 - 0.5x - 0.5x + 4x^2) = 0.250+x$$

$$\frac{10.6875 - 171x + 684x^2}{-0.250 - x} = 0.250+x$$

$$\frac{10.4375 - 172x + 684x^2}{c - b} = \emptyset$$

9

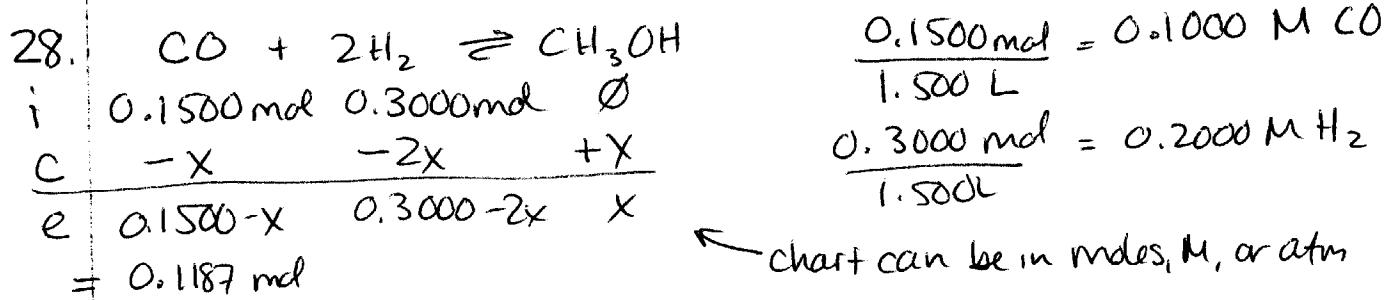
27 continued $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{+172 \pm \sqrt{172^2 - 4(684)(10.4378)}}{2(684)}$

 $x = \frac{172 \pm 32.0468}{1368} = \textcircled{0.149} \text{ or } \textcircled{0.1023} \leftarrow x$

not possible. $0.250 - 2(0.149) = \text{negative}$

$\begin{aligned} [\text{NO}_2] &= 0.250 - 2x = 0.250 - 2(0.1023) = 0.045 \text{ M NO}_2 \\ [\text{N}_2\text{O}_4] &= 0.250 + x = 0.250 + 0.1023 = 0.352 \text{ M N}_2\text{O}_4 \end{aligned}$

check: $\frac{[\text{N}_2\text{O}_4]}{[\text{NO}_2]} = \frac{0.352}{(0.045)^2} = 174 \text{ close. ok}$



$0.1500 - x = 0.1187$

$x = 0.1500 - 0.1187 = 0.0313 \text{ mol}$

$0.3000 - 2x = 0.3000 - 2(0.0313) = 0.2374 \text{ mol H}_2$

$x = 0.0313 \text{ mol CH}_3\text{OH}$

chart can be in moles, M, or atm

$\frac{0.1500 \text{ mol}}{1.500 \text{ L}} = 0.1000 \text{ M CO}$

$\frac{0.3000 \text{ mol}}{1.500 \text{ L}} = 0.2000 \text{ M H}_2$

$\frac{0.1187 \text{ mol}}{1.500 \text{ L}} = 0.07913 \text{ M CO}$

$\frac{0.2374 \text{ mol H}_2}{1.500 \text{ L}} = 0.15827 \text{ M H}_2$

$\frac{0.0313 \text{ mol CH}_3\text{OH}}{1.500 \text{ L}} = 0.020867 \text{ M CH}_3\text{OH}$

$K_c = \frac{[\text{CH}_3\text{OH}]}{[\text{CO}][\text{H}_2]^2}$

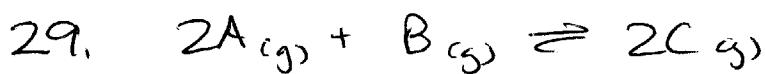
$K_c = \frac{(0.020867)}{(0.07913)(0.15827)^2} = 10.527 \quad 3 \text{ sf}$

$K_c = 10.5$

$K_p = K_c (RT)^{\Delta n} \quad \Delta n_{\text{gas}} = \text{prod} - \text{react} = 1 - 3 = -2$

$K_p = 10.527 (RT)^{-2} = \frac{10.527}{(RT)^2} = \frac{10.527}{(0.08206)(500 \text{ K})^2} = 6.25 \times 10^{-3}$

(10)



a. start 0.500 M 0.500 M

A	$-2x$	$-x$	$+2x$
end	$0.500 - 2x$	$0.500 - x$	$2x$

$$\text{LR} = 0 \quad 0.500 - 2x = 0 \quad 0.500 - 2x = 0$$

$$0.500 = 2x$$

$$0.250 \text{ M} = x$$

$K_c = 3.7 \times 10^8$ huge.
goes to completion

then back a little
to eq.

LR used up.

Need $\frac{2A}{B}$ have $\frac{0.5A}{0.5B} = \frac{1A}{1B}$

not enough A. A is LR



i \emptyset 0.250 M 0.500 M

c $+2y$ $-y$ $-2y$

e $2y$ $0.250 - y$ $0.500 - 2y$

goes back a little
(K small)

y's are small
neglect.

$$K_c = \frac{[C]^2}{[A]^2[B]} = \frac{(0.500 - 2y)^2}{(2y)^2(0.250 - y)} = \frac{(0.500)^2}{(2y)^2(0.250)} = 3.7 \times 10^8$$

$$\sqrt{\frac{(0.500)^2}{4(0.250)(3.7 \times 10^8)}} = y = 2.6 \times 10^{-5} \text{ M}$$

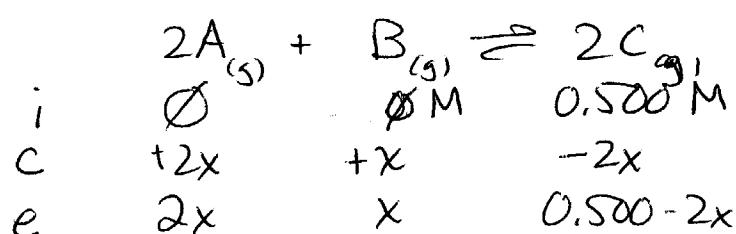
$$[A] = 2y = 5.2 \times 10^{-5} \text{ M}$$

$$[B] = 0.250 - y = 0.250 \text{ M}$$

$$[C] = 0.500 - 2y = 0.500 \text{ M}$$

11

29 b



$K_c = 3.7 \times 10^8$
 will go reverse.
 K for reverse rxn
 is ~~f_g~~ tiny.
 x is very small!
 neglect x .

$$K_c = \frac{[C]^2}{[A]^2[B]} = \frac{(0.500 - 2x)^2}{(2x)^2(x)} \approx \frac{(0.500)^2}{4x^2 \cdot x} = \frac{(0.500)^2}{4x^3} = 3.7 \times 10^8$$

$$x = \sqrt[3]{\frac{(0.500)^2}{4 \cdot 3.7 \times 10^8}} = 5.53 \times 10^{-4} M$$

$$[A] = 2x = 1.1056 \times 10^{-3} M = 1.1 \times 10^{-3} M$$

$$[B] = x = 5.5 \times 10^{-4} M$$

$$[C] = 0.500 - 2x = 0.500 - 2(5.5 \times 10^{-4}) = 0.49889 M = 0.499 M$$

~~Equilibrium Problem of the Week - #1~~~~Due 2/18/10 at 7:00 pm~~

(It's OK to talk about this with other students, but no copying or both papers get a zero.)

#30

Given the equilibrium:



If you combine substances so the initial partial pressures are 0.100 atm A, 0.400 atm B, and 0.500 atm C, determine the partial pressures of all gases at equilibrium.

	A	+ 3B	\rightleftharpoons	C	+ 2D	+ E _(s)	
Start	0.100 atm	0.400 atm		0.500 atm	0	0	
Δ	-x	-3x		+x	+2x	+x	

	end	0.100-x	0.400-3x	0.500+x	2x	x	
		= 0	0.400-3(0.100)				
so x = 0.100			0.100	0.600	0.200	0.100	

Rxn goes \rightarrow
K is huge. Goes to completion.
2 charts.

① LR gets used up
Need $\frac{3B}{1A}$ Have $\frac{0.4B}{0.1A} = \frac{4B}{1A}$
extra B, so A is LR - gets used up

Step 2 - goes to equilibrium

	A	+ 3B	\rightleftharpoons	C	+ 2D	+ E _(s)	
i	0	0.100 atm		0.600 atm	0.200 atm	0.100 ?? atm	
c	+y	+3y		-y	-2y	-y	
eq	y	0.100+3y		0.600-y	0.200-2y	0.100-y	

omit E - solid
neglect y, since K reverse is
very small.

$$K_p = 3.5 \times 10^9 = \frac{P_C P_D^2}{P_A P_B^3}$$

$$K_p = \frac{(0.600-y)(0.200-2y)^2}{(y)(0.100+3y)^3} \approx \frac{(0.600)(0.200)^2}{(y)(0.100)^3} \approx K_p = 3.5 \times 10^9$$

$$y = \frac{(0.600)(0.200)^2}{(0.100)^3(3.5 \times 10^9)} = 6.857 \times 10^{-9} = 6.9 \times 10^{-9} \text{ atm}$$

$$P_A = 6.9 \times 10^{-9} \text{ atm} \quad P_B = 0.100 \text{ atm} \quad P_C = 0.600 \text{ atm} \quad P_D = 0.200 \text{ atm}$$