Review worksheets 18.1-18.3 #2.doc

1. Given the reaction: carbon dioxide plus water plus energy to make glucose and oxygen

$6CO_{2(g)} + 6H_2O_{(l)} + ENERGY \rightarrow C_6H_{12}O_{6\,(aq)} + 6O_{2\,(g)}$ is endothermic.

Predict the shift in equilibrium when the following changes are imposed

a. Addition of H_2O RIGHT

b. Decrease the amount of $C_6H_{12}O_6$ RIGHT

c. Increase pressure RIGHT
least # moles

d. Decrease temperature left

e. Add a catalyst No change in equilibrium

f. Write the equilibrium law for the reaction $K_{eq} = \frac{[C_6H_{12}O_6][O_2]^6}{[CO_2]^6[H_2O]^6}$

2. Given the reaction: : $2H_{2\,(g)} + O_{2\,(g)} \rightarrow 2H_2O_{\,(l)}$ + energy is exothermic. Predict the shift in equilibrium when the following changes are imposed

a. Addition of oxygen R

b. Decrease the amount of hydrogen gas L

c. Decrease pressure L

d. Increase temperature L

e. Add a catalyst No change in Equilibrium

f. Write the equilibrium law for the reaction.

$$K_{eq} = \frac{[H_2O]^2}{[H_2]^2[O_2]}$$

g. Given the following concentrations are founf in a 1L solution : $[O_2]$ = 0.24 $[H_2]$ = 0.18 ; $[H_2O]$ = 0.26 mol
Determine the value of Keq. Does the reaction favor the products or reactants(how do you know)?

$$K_{eq} = \frac{(0.26)^2}{(0.18)^2(0.24)} = 8.69$$

favors products because Keq > 1

3 Given the reaction: : $Li_3PO_{4\,(s)} \leftrightarrow 3Li^+_{(aq)} + PO_4^{3-}{}_{(aq)}$.

Predict the shift in equilibrium when the following changes are imposed

a. Addition of PO_4^{3-} ← L

b. Decrease the amount of Li_3PO_4 L

c. What does the addition of a catalyst do to the activation energy? Lowers AE, ∴ making reaction happen faster

d. Addition of $LiCl_{(s)}$ Li^+, Cl^- Left
Common ion effect.

e. Write the equilibrium law for the reaction.

$$K_{eq} = \frac{[Li^+]^3[PO_4^{3-}]}{[Li_3PO_4]}$$

f. Write the solubility product expression, how does it differ from Keq

$$K_{sp} = [Li^+]^3[PO_4^{3-}]$$

g. If the Ksp is 2.37×10^{-4}, determine the concentration of lithium and phosphate ions

$$Li_3PO_4 \rightleftharpoons 3Li^+ + PO_4^{3-}$$

$3x$ x

$$K_{sp} = [Li^+]^3[PO_4^{3-}]$$

$$2.37\times10^{-4} = (3x)^3(x)$$

$$2.37\times10^{-4} = 27x^3 \cdot x$$

$$2.37\times10^{-4} = 27x^4$$

$$\frac{2.37\times10^{-4}}{27} = x^4$$

$$8.78\times10^{-6} = x^4$$

$$(8.78\times10^{-6})^{1/4} = x$$

$x = 0.054$

$[Li^+] = 3x = 3(0.054) = 0.162M$

$[PO_4^{3-}] = x = 0.054M$

$(0.0000087777)^{1/4} = x$

$(0.0000087777\ldots)^{1/4} = x$

4.

$$PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$$

I	$\frac{0.4\text{mol}}{10\text{L}} = 0.04\text{M}$	0	0
C	$0.04 - x$ $(0.04 - 0.025)$	$0 + x$ $0 + 0.025$	$0 + x$ $\frac{0.25\text{mol}}{10\text{L}} = 0.025\text{M}$
E	0.015	0.025	

$0 + x = 0.025$
$x = 0.025$

$$K_{eq} = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{(0.025)(0.025)}{0.015} = 0.0417$$

5. $2NH_{3(g)} \rightleftharpoons 3H_{2(g)} + N_{2(g)}$

	$2NH_{3(g)}$	$3H_{2(g)}$	$N_{2(g)}$
	$1mol/5L$		$0.4mol/5L$
I	$0.2M$	0	$0.08M$
C	$0.2-2x$	$0+3x$	$0.08+x$
		$0+3(0.022)$	$0.08+0.022$
E	$\frac{0.78mol}{5L}$	$0.066M$	$0.102M$
	$0.156M$		

$0.2-2x=0.156$

$-2x=0.156-0.2$

$-2x=-0.044$

$x=0.022$

$K_{eq}=\frac{[N_2][H_2]^3}{[NH_3]^2}$

$=\frac{(0.102)(0.066)^3}{(0.156)^2}=0.0012$ ∴ favour reactants

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

	$\frac{1.75\text{ mol}}{2\text{ L}}$	$\frac{1.2\text{ mol}}{2\text{ L}}$	0	
I	0.875 M	0.6 M	0	$0+2x=0.71$, $x=0.355$
C	$0.875-2x$	$0.6-x$	$0+2x$	
	$0.875-2(0.355)$	$0.6-0.355$		
E	0.165 M	0.245 M	0.71 M	

$$K_{eq} = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{(0.71)^2}{(0.165)^2(0.245)} = 75.58$$

∴ favors products

b $2NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$

	$2NO_{2(g)}$	$N_2O_{4(g)}$
I	2.5 M	0
	$2.5-2x$	$0+x$
	$2.5-2x=1.8$	
	$-2x=-0.7$	
	$x=0.35$	
E	1.8M	0.35M

$K_{eq} = \frac{[N_2O_4]}{[NO_2]^2}$

$= \frac{0.35}{(1.8)^2}$

$= 0.108$

7 Which substance is more soluble in water at 25°C.

a. Lead (II) sulfate or Lead (II) hydroxide? Why?

Ksp = 2.53×10^{-8} Ksp = 1.43×10^{-20}

Because Ksp is larger

Larger Ksp is more soluble!

8. What is the concentration of barium ions and nitrate ions in a saturated solution of Barium nitrate at 25°C.
(Ksp = 4.63×10^{-3})

Ba^{2+} NO_3^-

$Ba(NO_3)_2 \rightleftharpoons Ba^{2+} + 2\,NO_3^-$

x $2x$

$K_{sp} = [Ba^{2+}][NO_3^-]^2$

$4.63\times10^{-3} = (x)(2x)^2$

$4.63\times10^{-3} = x(4x^2)$

$4.63\times10^{-3} = 4x^3$

$\frac{4.63\times10^{-3}}{4} = x^3$

$\left(\frac{4.63\times10^{-3}}{4}\right)^{1/3} = x$

$0.105 = x$

$[Ba^{2+}] = x$
$= 0.105\,M.$

$[NO_3^-] = 2x$
$= 2(.105)$
$= 0.21\,M$

9. What is the concentration of copper (II) ions and phosphate ions in a saturated solution of copper(II) phosphate at 25°C. ($K_{sp} = 1.40 \times 10^{-37}$)

$$Cu_3(PO_4)_2 \rightleftharpoons 3\,Cu^{2+} + 2PO_4^{3-}$$

$3x$ $2x$

$K_{sp} = [Cu^{2+}]^3[PO_4^{3-}]^2$

$1.40\times10^{-37} = (3x)^3(2x)^2$

$= (27x^3)(4x^2)$

$1.40\times10^{-37} = 108x^5$

$1.67\times10^{-8} = x$

$[Cu^{2+}] = 3x$

$= 3(1.67\times10^{-8})$

$= 5.01\times10^{-8}$

$[PO_4^{3-}] = 2x$

$= 2(1.67\times10^{-8})$

$= 3.34\times10^{-8}$

$CaCO_3$

10. Will a precipitate of calcium carbonate 750 ml of 0.52 M calcium chloride, $CaCl_2$, is mixed with 250 ml of 0.35M iron (II) carbonate, $FeCO_3$?
(Ksp $CaCO_3 = 5.2 \times 10^{-6}$)

$CaCl_2 \rightleftharpoons Ca^{2+} + 2Cl^-$

$0.75L \times 0.52\frac{mol}{L} = 0.39mol$ $0.39M$ $0.78M$

$FeCO_3 \rightleftharpoons Fe^{2+} + CO_3^{2-}$

$0.25L \times 0.35\frac{mol}{L} = 0.0875mol$ $0.0875M$ $0.0875M$

$CaCO_3 \rightleftharpoons Ca^{2+} + CO_3^{2-}$

K_{sp} $Q = [Ca^{2+}][CO_3^{2-}]$

$= (0.39)(0.0875)$

$5.2 \times 10^{-6} < 0.034125$

Yes precipitate will form

11. Will a precipitate of barium fluoride form if 500ml of 0.0025 M aluminum fluoride AlF_3 is mixed with 500 ml of 0.001 M Barium hydroxide , $Ba(OH)_2$, (Ksp BaF_2 = 1.84×10^{-7})

$AlF_3 \rightleftharpoons Al^{3+} + 3F^-$

$0.5L \times 0.0025\frac{mol}{L} = 0.00125mol$

$0.00125mol$ $0.00375M$

$= 0.00125\frac{mol}{L}$

$Ba(OH)_2 \rightleftharpoons Ba^{2+} + 2OH^-$

$0.5L \times 0.001\frac{mol}{L} = 0.0005mol$ $0.001M$

$= 0.0005\frac{mol}{L}$

$BaF_2 \rightleftharpoons Ba^{2+} + 2F^-$

$Ksp \bigcirc [Ba^{2+}][F^+]^2$

$1.84 \times 10^{-7} > (0.0005)(0.00375)^2 = 7.03 \times 10^{-9}$ NO

12)

$LiF \rightleftharpoons Li^+ + F^-$

$2.30\times10^{-4}\ \frac{mol}{L} \times 0.25L = 5.75\times10^{-5}\ mol$

$5.75\times10^{-5}\ mol$ $\quad$ $5.75\times10^{-5}\ mol$

$Na_3PO_4 \rightleftharpoons 3Na^+ + PO_4^{3-}$

$1.8\times10^{-3}\ \frac{mol}{L} \times 0.175L = 3.15\times10^{-4}\ mol$

$9.45\times10^{-4}\ mol$ $\quad$ $3.15\times10^{-4}\ mol$

? $Li_3PO_4 \rightleftharpoons 3Li^+ + PO_4^{3-}$

Total Volume

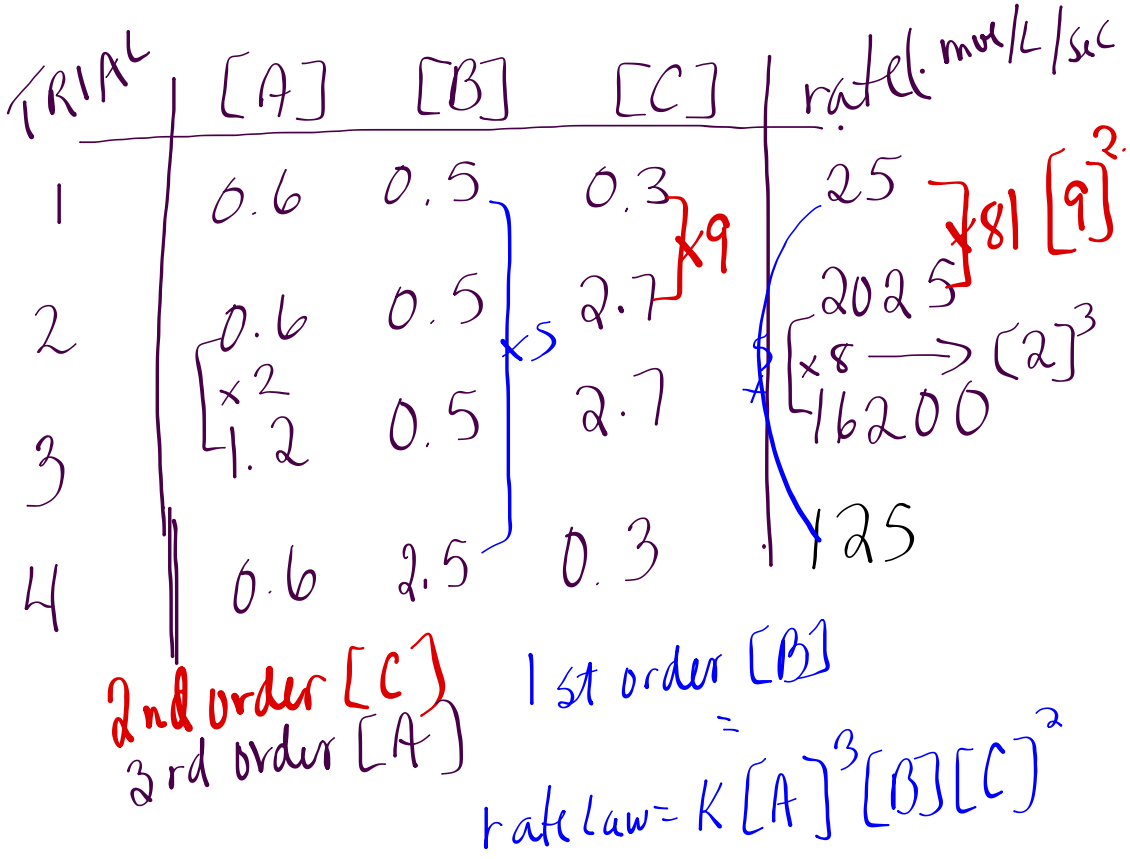
250mL
+ 175mL
425mL
0.425L

$K_{sp} \square [Li^+]^3 [PO_4^{3-}]$

$K_{sp} \square \left(\frac{5.75\times10^{-5}\ mol}{0.425L}\right)^3 \left[\frac{3.15\times10^{-4}\ mol}{0.425L}\right]$

$K_{sp} \square 1.84\times10^{-15}$

$2.37\times10^{-4} > 1.84\times10^{-15}$ No precipitate forms


TRIAL
[A]
[B]
[C]
rate (mol/L/sec
1
0.6
0.5
0.3
25
2
0.6
0.5
2.7
225
3
×2
1.2
0.5
2.7
×8
1800
4
0.6
2.5
0.3
125
×9
×81
[9]²
×5
[2]³
2nd order [C]
3rd order [A]
1st order [B]
=
rate law = K[A]³[B][C]²

Attachments

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