Review Section 18.1-18.5 sheet 3

1. Given the reaction: $4J + K \rightarrow 3M + N + 5D$ is endothermic.

   Predict the shift in equilibrium when the following changes are imposed

   a. Addition of N — a) left
   b. Decrease the amount of K — b) left
   c. Increase pressure — c) left
   d. Inc temperature — d) right
   e. Add a catalyst — e) no shift in equilibrium
   f. Write the equilibrium law for the reaction — f) $K_{eq} = \frac{[M]^3[N][D]^5}{[J]^4[K]}$

2. Given the reaction: : $4NH_{3(g)} + 5O_{2(g)} \leftrightarrow 4NO_{(g)} + 6H_2O_{(g)}$ is exothermic.

   Predict the shift in equilibrium when the following changes are imposed

   a. Addition of oxygen — a) right
   b. Decrease the amount of $NH_{3(g)}$ — b) left
   c. Decrease pressure — c) right
   d. Dec temperature — d) right
   e. Add a catalyst — e) no shift in equil.
   f. Write the equilibrium law for the reaction. — (f) $K_{eq} = \frac{[NO]^4[H_2O]^6}{[NH_3]^4[O_2]^5}$
   g. Given the following concentrations are founf in a 1L solution : $[NH_3] = 0.03$ mol $[O_2] = 0.11$ mol ; $[NO] = 0.25$mol ; $[H_2O] = 0.14$mol

      Determine the value of Keq. Does the reaction favor the products or

g) $K_{eq} = \frac{(0.25)^4(0.14)^6}{(0.03)^4(0.11)^5} =$

3. Given the reaction: : $Al_2(CO_3)_{3\,(s)} \leftrightarrow 2Al^{3+}_{(aq)} + 3CO_3^{2-}{}_{(aq)}$.

Predict the shift in equilibrium when the following changes are imposed

a. Addition of $Al_2(SO_4)_3$ (a) left

b. Decrease the amount of CO_3^{2-} (b) right

c. What does the addition of a catalyst do to the activation energy? (c) lower the AE

d. Addition of $FeS_{(s)}$ (d) no change

e. Write the equilibrium law for the reaction. (e) $K_{eq} = \frac{[Al^{3+}]^2[CO_3^{2-}]^3}{[Al_2(CO_3)_3]}$

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

Ksp only includes products (ions) $K_{sp} = [Al^{3+}]^2[CO_3^{2-}]^3$

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

a. Aluminum hydroxide or Calcium hydroxide? Why?

$K_{sp} = 3.0 \times 10^{-34}$ $K_{sp} = 6.5 \times 10^{-6}$

Because it has the larger Ksp.

"Larger Ksp favours ionization"

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

$x \quad 2x$

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

$1.3 \times 10^{-6} = (x)(2x)^2$

$1.3 \times 10^{-6} = x(4x^2$

$1.3 \times 10^{-6} = 4x^3$

$\downarrow$

$0.0069 = x$

$[Ba^{2+}] = x = 0.0069\ M$

$[F^-] = 2x = 2(0.0069)$

$= 0.0138 M$

6. $Fe(OH)_3 \rightleftharpoons Fe^{3+} + 3OH^-$

$x \quad 3x$

$K_{sp} = [Fe^{3+}][OH^-]^3$

$4 \times 10^{-38} = (x)(3x)^3$

$4 \times 10^{-38} = 27x^4$

$\downarrow$

$1.96 \times 10^{-10} = x$

$[Fe^{3+}] = x = 1.96 \times 10^{-10}$

$[OH^-] = 3x = 5.88 \times 10^{-9}$

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

	PCl_5	PCl_3	Cl_2
I	0.5 mol/qL = 0.056 M	0	0
C	0.056 − x	0 + x	0 + x
E	0.056 − 0.039 = 0.017 M	0 + 0.039 = 0.039 M	0.35 mol/qL = 0.039 M

$0 + x = 0.039$, $x = 0.039$

$K_{eq} = \frac{[0.039][0.039]}{[0.017]} = 0.089$ ∴ favors reactants

8. $2NH_{3(g)} \rightleftharpoons 3H_{2(g)} + N_{2(g)}$

	NH_3	H_2	N_2
I	$\frac{1.2\text{ mol}}{5\text{ L}} = 0.24$ M	0	$\frac{0.65\text{ mol}}{5\text{ L}} = 0.13$ M
C	0.24 − 2x	0 + 3x	0.13 + x
E	$\frac{0.78\text{ mol}}{5\text{ L}} = 0.156$ mol/L	3(0.042) = 0.126 M	0.13 + 0.042 = 0.172 M

$0.24 - 2x = 0.156$

$-2x = -0.084$

$x = 0.042$

$K_{eq} = \frac{[H_2]^3[N_2]}{[NH_3]^2} = \frac{(0.126)^3(0.172)}{(0.156)^2} = 0.014$ ∴ favors reactants

9. $Cd(OH)_2 \rightleftharpoons Cd^{2+} + 2OH^-$ $Al_2(CO_3)_3 \rightleftharpoons 2Al^{3+} + 3CO_3^{2-}$

$0.6L \times 0.05\frac{mol}{L}$ 0.03 mol 0.06 mol $0.4L \times 0.02\frac{mol}{L}$ 0.016mol 0.024mol

0.03Mol 0.008mol

TOTAL Vol = 1000mL = 1L

$CdCO_3 \rightleftharpoons Cd^{2+} + CO_3^{2-}$

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

$5.2 \times 10^{-12} = \left(\frac{0.03mol}{1L}\right)\left(\frac{0.024mol}{1L}\right)$

$5.2 \times 10^{-12} < 7.2 \times 10^{-4}$

$\therefore$ yes

10. $BaCl_2 \rightarrow Ba^{2+} + 2Cl^-$ $K_2SO_4 \rightleftharpoons 2K^+ + SO_4^{2-}$

$0.23\frac{mol}{L} \times 0.75L$ 0.1725 mol 0.345 mol $0.25\frac{mol}{L} \times 0.25L$ 0.075 mol 0.0375mol

0.1725mol 0.0375mol

$BaSO_4 \rightleftharpoons 2Ba^+ + SO_4^{2-}$

K_{sp} $[Ba^+]^2[SO_4^{2-}]$

1.1×10^{-10} $\left(\frac{0.1725mol}{1L}\right)^2\left(\frac{0.0375mol}{1L}\right)$

$1.1 \times 10^{-10} < 0.0011$ $\therefore$ yes precipitate will form

11. Entropy will increase

12. $\text{rate} = k[K]^2[B]^3[C]$

13. $\text{rate} = k[A]^2[B]^4$

Solve for k $0.03 = k(0.25)^2(0.70)^4$

TRIAL 1 $1.999 = k$

only need to solve 1

TRIAL 2 $18.75 = k(0.25)^2(35)^4$

$1.999 = k$

TRIAL 3 $0.27 = k(0.75)^2(0.70)^4$

$1.999 = k$