Chemical Equilibrium Review

1. D 2. A 3. D 4. C 5. B

6. - temperature would remain constant
   - heat required for forward reaction would equal the heat released by the reverse reaction

7.

	$3H_2$	+ N_2	$\rightleftharpoons 2NH_3$
I	x		0
C	−2.25	−0.75	+1.5
E	3.0	2.0	1.5

$x - 2.25 = 3.0$

$[H_2] = 5.25$ mol/L

it is a 1 L container

∴ 5.25 mol

8,9 I - increase in [B]

II - increase in temperature

III - increase in [C]

IV - decrease in temperature

10. $K_{eq} = \frac{[B][C]^2}{[A]^3} = \frac{(2)(4)^2}{(3)^3} = 1.19$

11. $3A + B \rightleftharpoons 2C$

12. $K_{eq} = \frac{[NaHSO_4][HI]}{[NaI][H_2SO_4]}$

$7.3 \times 10^{-4} = \frac{(3.2 \times 10^{-2} \text{ mol/L})(4.6 \times 10^{-4} \text{ mol/L})}{(x)(2.1 \times 10^{-1} \text{ mol/L})}$

$[NaI] = 10.4$ mol/L

13. $2N_2O \rightarrow 2N_2 + O_2$

	$2N_2O$	$2N_2$	O_2
I	0.8 mol/L	0	0
C	−.780	+.780	+.39
E	.02	.780 mol/L	.39

$$k_c = \frac{[N_2]^2[O_2]}{[N_2O]^2} = \frac{(.780)^2(.39)}{(.02)^2} = \underline{593}$$

14. (a) - increase the volume of the container
- increase the temperature

(b) - it will allow the system to reach equilibrium faster

15. $Fe(OH)_{2(s)} \rightleftharpoons Fe^{2+}_{(aq)} + 2OH^-_{(aq)}$

	Fe^{2+}	OH^-
I	0	0
C	$+1.25\times10^{-5}$	$+2.5\times10^{-5}$
E	1.25×10^{-5}	2.5×10^{-5}

$$K_{sp} = [Fe^{2+}][OH^-]^2 = (1.25\times10^{-5})(2.5\times10^{-5})^2 = \underline{7.81\times10^{-15}}$$

16. $BaCO_{3(s)} \rightleftharpoons Ba^{2+}_{(aq)} + CO_3^{2-}_{(aq)}$

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

$5.1\times10^{-9} = (x)(x)$

$x = 7.14\times10^{-5}$ mol/L

1 mol $BaCO_3$ = (137.3) + (12) + 3(16) = 197.3 g

$[BaCO_3] = \frac{mol}{L}$

$7.14\times10^{-5} = \frac{x}{1.2L}$ $\quad x = 8.57\times10^{-5}$ mol

$mol = \frac{mass}{Molar\ mass}$

$8.57\times10^{-5}\ mol = \frac{x}{197.3g}$

$\underline{x = 0.017\ g}$

17. $BiI_{3(s)} \rightleftharpoons Bi^{3+}_{(aq)} + 3I^-_{(aq)}$

$K_{sp} = [Bi^{3+}][I^-]^3$

18. (a) insoluble (b) insoluble (c) insoluble

19. $MgCl_{2(aq)} + 2KOH_{(aq)} \rightarrow Mg(OH)_{2(s)} + 2KCl_{(aq)}$

$[MgCl_2] = \frac{mol}{L}$ $[KOH] = \frac{mol}{L}$

$.2 = \frac{x}{.015L}$ $.18 = \frac{x}{.025L}$

$x = 0.003$ mol $x = 0.0045$ mol

- If the reaction goes to completion, either all of the $MgCl_2$ or KOH will be used up.
- We need twice as much KOH as $MgCl_2$
- If we use 0.003 mol of $MgCl_2$, we need $2(.003) = .006$ mol of KOH, we don't have that much. so that doesn't happen
- If we use 0.0045 mol of KOH, we need $\frac{(0.0045)}{2} = 0.00225$ mol of $MgCl_2$, this works.
- if we use 1 mol of $MgCl_2$, 1 mol of $Mg(OH)_2$ is produced.

Therefore, since we use 0.00225 mol of $MgCl_2$ we produce 0.00225 mol of $Mg(OH)_2$

20. $Pb(NO_3)_{2(aq)} + 2KBr_{(aq)} \rightarrow PbBr_{2(s)} + 2KNO_3$

$Pb^{2+} + 2NO_3^- + 2K^+ + 2Br^- \rightarrow PbBr_{2(s)} + 2K^+ + 2NO_3^-$

$Pb^{2+}_{(aq)} + 2Br^-_{(aq)} \rightarrow PbBr_2(s)$

21. $AgCl_{(s)} \rightleftharpoons Ag^+_{(aq)} + Cl^-_{(aq)}$

$AgNO_{3\,(aq)} \rightleftharpoons Ag^+_{(aq)} + NO_3^-{}_{(aq)}$

	Ag^+	Cl^-
I	6.5×10^{-3}	0
C	$+x$	$+x$
E	$(6.5\times10^{-3} + x)$	(x)

$K_{sp} = [Ag^+][Cl^-]$

$1.6\times10^{-10} = (6.5\times10^{-3} + x)(x)$

↑ ignore this x

$1.6\times10^{-10} = (6.5\times10^{-3})x$

$x = 2.46\times10^{-8}$ mol/L

1 mol AgCl = (107.9) + (35.45) = 143.35 g

2.46×10^{-8} mol (143.35 g) = 3.53×10^{-6} g

Solubility of AgCl in this situation is 3.53×10^{-6} g/L

22. Nitric Acid = HNO_3

in water: $ZnS_{(s)} \rightleftharpoons Zn^{2+}_{(aq)} + S^{2-}$

nitric acid dissociates as follows: $HNO_{3\,(aq)} \rightleftharpoons H^+_{(aq)} + NO_3^-{}_{(aq)}$

The H^+ from the nitric acid will combine with the S^{2-} from the zinc sulfide causing that reaction to go to the right, causing more ZnS to be dissolved.