Unit 6 Problem Set

1) a. Double displacement
b. Combination
c. Single displacement
d. Decomposition
e. Combination

2) In both reactions you have to have at least two reactants. In a combination reaction, the reactants react to form a more complex molecule. However, in a single displacement, a new molecule is formed that may not be complex. In addition, an element remains as a product.

3)
a. Salt
b. Strong base
c. Weak base
d. Strong acid
e. Weak acid
f. Weak base

4)

Strong acids		Strong bases	
hydrochloric acid	(HCl)	lithium hydroxide	$LiOH$
hydrobromic acid	(HBr)	sodium "	$NaOH$
hydroiodic acid	(HI)	potassium "	KOH
Nitric acid	(HNO_3)	rubidium "	$RbOH$
Perchloric acid	$(HClO_4)$	cesium "	$CsOH$
Sulfuric acid	(H_2SO_4)	magnesium "	$Mg(OH)_2$
		calcium "	$Ca(OH)_2$
		strontium "	$Sr(OH)_2$
		barium "	$Ba(OH)_2$

5) a. Ag^+, Hg_2^{2+} or Pb^{2+}

b. Sr^{2+}, Ba^{2+}, Pb^{2+}, Ag^+, or Ca^{2+}

c. None

d. Li^+, Na^+, K^+, or NH_4^+ ([illegible])

e. Ca^{2+}, Sr^{2+}, or Ba^{2+} ([illegible])

f. Li^+, Na^+, K^+, or NH_4^+ ([illegible])

6) $\longrightarrow$ Reaction goes to completion to the formation of product.

$\rightleftarrows$ Reaction goes in both directions

7) a. $K_3PO_4(aq) + Ca(NO_3)_2(aq) \rightarrow KNO_3(aq) + Ca_3(PO_4)_2(s)$ Not balanced

$2PO_4^{3-}(aq) + 3Ca^{2+}(aq) \rightarrow Ca_3(PO_4)_2(s)$ balanced.

Precipitation reaction

b. $K_2CO_3(s) + H_2O(l) \rightleftarrows$

$CO_3^{2-}(aq) + H_2O(l) \rightleftarrows HCO_3^-(aq) + OH^-(aq)$

Neutralization reaction.

c. $HBr(aq) + HNO_2(aq) \rightarrow$ No reaction

d. $Na_2S(aq) + HI(aq) \rightarrow$

$S^{2-}(aq) + 2H^+(aq) \rightarrow H_2S(g)$ gas forming reaction

8) a. $NaOH_{(aq)} + NH_4NO_{3(aq)} \rightarrow$

$OH^-_{(aq)} + NH_4^+{}_{(aq)} \rightarrow H_2O_{(l)} + NH_{3(g)}$

Gas evolving reaction + neutralization

b. $NiSO_{4(aq)} + NaOH_{(aq)} \rightarrow$

$Ni^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Ni(OH)_{2(s)}$

Precipitation reaction

c. $MgSO_{3(aq)} + HCl_{(aq)} \rightarrow$

$SO_3^{2-}{}_{(aq)} + H^+_{(aq)} \rightarrow SO_{2(g)} + H_2O_{(l)}$

9) a. 1 y 4 Precipitation Rxn.

$KBr_{(aq)} + AgNO_{3(aq)} \rightarrow AgBr_{(s)} + KNO_{3(aq)}$

$Br^-_{(aq)} + Ag^+_{(aq)} \rightarrow AgBr_{(s)}$

b. 2 y 3 Neutralization Rxn.

$LiOH_{(aq)} + HC_2H_3O_{2(aq)} \rightarrow LiC_2H_3O_{2(aq)} + H_2O_{(l)}$

$OH^-_{(aq)} + HC_2H_3O_{2(aq)} \rightarrow C_2H_3O_2^-{}_{(aq)} + H_2O_{(l)}$

c. 5 y 6 Precipitation Rxn.

$3NiSO_{4(aq)} + 2Na_3PO_{4(aq)} \rightarrow Ni_3(PO_4)_{2(s)} + 3Na_2SO_{4(aq)}$

$3Ni^{2+}_{(aq)} + 2PO_4^{3-}{}_{(aq)} \rightarrow Ni_3(PO_4)_{2(s)}$

d. 1 y 3

$KBr_{(aq)} + LiOH_{(aq)} \rightarrow$ No reaction

e. 6 y 1

$Na_3PO_{4(aq)} + KBr_{(aq)} \rightarrow$ No reaction

f. 3 y 4 Precipitation reaction

$LiOH_{(aq)} + AgNO_{3(aq)} \rightarrow LiNO_{3(aq)} + AgOH_{(s)}$

$OH^-_{(aq)} + Ag^+_{(aq)} \rightarrow AgOH_{(s)}$

10) a. $Na_2S_{(aq)} + 2AgNO_{3(aq)} \rightarrow 2NaNO_{3(aq)} + Ag_2S_{(s)}$

Filter the solid Ag_2S and wash with water.

b. $HCl_{(aq)} + KOH_{(aq)} \rightarrow H_2O_{(l)} + KCl_{(s)}$

Evaporate the water to get the salt.

c. [redacted]

$Fe_2(SO_4)_{3(aq)} + 6KOH_{(aq)} \rightarrow 2Fe(OH)_{3(s)} + 3K_2(SO_4)_{(aq)}$

Filter the solid $Fe(OH)_3$ and wash with water.

d. $Na_2S_{(aq)} + Fe_2(SO_4)_{3(aq)} \rightarrow Na_2SO_{4(aq)} + Fe_2S_{3(s)}$

Filter the solid. Then evaporate the water to get Na_2SO_4.

e. Fe_2S_3

Same as d. Filter the solid and wash with water.

11) 1. Precipitate formation. The solid product does not redissolve

2. Gas formation. The gas product escapes.

3. Formation of a weak electrolyte. For instance, when water forms during a neutralization reaction it will not ionize.

12) a. Weak
b. Strong
c. Strong
d. Nonelectrolyte
e. Weak
f. Nonelectrolyte

13) a. Non electrolyte
b. Weak
c. Strong
d. Strong
e. Nonelectrolyte
f. Strong

14) $Al(NO_3)_{3(aq)} \rightarrow Al^{3+}_{(aq)} + 3NO_3^-{}_{(aq)}$

1 mol $Al(NO_3)_3$ → 1 mol Al^{3+} : 3 mol NO_3^-

∴ 0.10M Al^{3+}

0.30M NO_3^-

15) $CaI_{2\,(aq)} \rightarrow Ca^{2+}_{(aq)} + 2I^-_{(aq)}$

$0.300\,\cancel{L}_{CaI_2} \times \frac{0.170\,mol\,CaI_2}{\cancel{L}} \times \frac{2\,mol\,I^-}{1\,mol\,CaI_2} = 0.102\,mol\,I^-$

Total volume: 400.0mL (6)

16) $CaCl_2\ (aq) \rightarrow Ca^{2+}\ (aq) + 2Cl^-\ (aq)$ $[Cl^-] = 0.600M$

$NaCl\ (aq) \rightarrow Na^+\ (aq) + Cl^-\ (aq)$ $[Cl^-] = 0.400M$

$$[Cl^-] = \frac{(0.150L \times 0.600\ \frac{mol}{L}\ Cl^-) + (0.250L \times 0.400\ \frac{mol}{L}\ Cl^-)}{0.4000L}$$

$= 0.475\ M\ Cl^-$

17)

a. $0.060M\ Na_3PO_4$

$Na_3PO_4\ (aq) \rightarrow 3Na^+\ (aq) + PO_4^{3-}\ (aq)$

$\therefore [Na^+] = 0.180M$

b. $0.150M\ NaMnO_4$

$NaMnO_4\ (aq) \rightarrow Na^+\ (aq) + MnO_4^-\ (aq)$

$\therefore [Na^+] = 0.150M$

c. $0.095\ M\ Na_2SO_4$

$Na_2SO_4\ (aq) \rightarrow 2Na^+\ (aq) + SO_4^{2-}\ (aq)$

$\therefore [Na^+] = 0.190\ M$