Summary: P811, # 1-14, 16-27

1)
a) $NaCl_{(aq)} \rightarrow Na^{+}_{(aq)} + Cl^{-}_{(aq)}$
b) $K_2SO_{4(aq)} \rightarrow 2K^{+}_{(aq)} + SO_4^{2-}{}_{(aq)}$
c) $NH_4NO_{3(aq)} \rightarrow NH_4^{+}{}_{(aq)} + NO_3^{-}{}_{(aq)}$

2)
a) C = 0.174 mol / 0.250 L = 0.696 mol/L
b) n(NaOH) = 60.0 g / 40.00 g/mol = 1.50 mol
C = 1.50 mol / 0.7500L = 2.00 mol/L
c) n(glucose) = 15.0 g / 180.16 g/mol = 0.0833 mol
C = 0.0833 mol / 0.1250 L = 0.666 mol/L

3) V = 0.09 mol / 0.36 mol/L = 0.3 L

4) $n(Na_2CO_3)$ = 0.12 mol/L X 0.500 L = 0.060 mol
$m(Na_2CO_3)$ = 0.060 mol X 105.99 g/mol = 6.4 g

5)
m(NaCl) = 31.6 g/100mL X 375 mL/100mL = 119 g

6)
$n(KHCO_3)$ = 13.8 g / 100.12 g/mol = 0.138 mol
C = 0.138 mol / 0.354 L = 0.390 mol/L

7)
$Na_2SO_{4(aq)} \rightarrow 2Na^{+}_{(aq)} + SO_4^{2-}{}_{(aq)}$
$n(Na_2SO_4)$ = 0.320 mol
a) $C(Na_2SO_{4(aq)})$ = 0.320 mol / 0.500 L = 0.640 mol/L
b) $C(Na^{+}_{(aq)})$ = 0.320 mol X 2 / 0.500 L = 1.28 mol/L
c) $C(SO_4^{2-}{}_{(aq)})$ = 0.320 mol /0.500 L = 0.640 mol/L

8)
n(NaOH) = 0.200 mol/L X 0.0249L = 0.00498 mol

9)
$M(CuSO_4 \bullet 5H_2O)$ = 249.68 g/mol
n = 0.125 mol/L X 0.1500 L = 0.0188 mol
m = 0.0188 mol X 249.68 g/mol = 4.69 g

10)
When diluting solutions, $C_1V_1 = C_2V_2$
C = 11.6 mol/L X 0.0150 L / 0.5000 L = 0.348 mol/L

11)
V = 2.00 L X 0.215 mol/L / 17.8 mol/L = 0.0242 L

12)
a) m = 1.00 X 10^3 g
b) n = 1.00 X 10^3 g / 18.02 g/mol = 55.5 mol
c) C = 55.5 mol / 1.00 L = 55.5 mol/L
d) The concentration of water will change only when its density changes, which occurs when its temperature changes.

13)
a)
$BaCl_{2(aq)} + Na_2SO_{4(aq)} \rightarrow 2NaCl_{(aq)} + BaSO_{4(s)}$
$Ba^{2+}{}_{(aq)} + SO_4{}^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

b)
$3CuSO_{4(aq)} + 2Al_{(s)} \rightarrow 3Cu_{(s)} + Al_2(SO_4)_3$
$3Cu^{2+}{}_{(aq)} + 2Al_{(s)} \rightarrow 3Cu_{(s)} + 2Al^{3+}{}_{(aq)}$

c)
$Pb(NO_3)_{(aq)} + 2KI_{(aq)} \rightarrow PbI_{2(s)} + 2KNO_{3(aq)}$
$Pb^{2+}{}_{(aq)} + 2I^{-}{}_{(aq)} \rightarrow PbI_{2(s)}$

14)
a) $CuSO_{4(aq)} + Na_2CO_{3(aq)} \rightarrow Na_2SO_{4(aq)} + CuCO_{3(s)}$
b) Product chosen is $CuCO_{3(s)}$
n($CuCO_3$) from $CuSO_4$ = 0.0275 L X .112 mol/L X 1/1 = 0.00308 mol
n($CuCO_3$) from Na_2CO_3 = 0.0450 L X 0.088 mol/L X 1/1 = 0.0040 mol
Therefore, $CuSO_4$ is limiting reactant
c) m($CuCO_3$) = 0.00308 mol X 123.56 g/mol = 0.381 g

16)
a) Dissociation is when two substances separate from each other. Ionization is when a substance loses or gains an electron and becomes an ion in the process.
b) A strong acid complete dissociates in solution. A weak acid only partially dissociates in solution.
c) A strong base complete dissociates in solution. A weak base only partially dissociates in solution.

17)
a) pH = -log(1 X 10^{-2}) = 2.0
b) pH = -log(4.5 X 10^{-11}) = 10.35
c) pH = -log(5.5 X 10^{-3}) = 2.26
d) pH = -log(7.2 X 10^{-10}) = 9.14

18)
a) $[H^+] = 10^{-5.00}$ = 1.0 X 10^{-5} mol/L
b) $[H^+] = 10^{-2.1}$ = 8 X 10^{-3} mol/L
c) $[H^+] = 10^{-9.88}$ = 1.3 X 10^{-10} mol/L
d) $[H^+] = 10^{-7.00}$ = 1.0 X 10^{-7} mol/L

19)
a) $HCl_{(aq)} \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$
b) $[H^+] = 10^{-1.1}$ = 8 X 10^{-2} mol/L
c) $[HCl_{(aq)}]$ = 8 X 10^{-2} mol/L

20)
a) According to the Arrhenius definition, an acid is a source of $H^+_{(aq)}$, while bases are a source of $OH^-_{(aq)}$
b) According to the Bronstead-Lowry defintion, acids are $H^+_{(aq)}$ (or proton) donors, while bases are proton acceptors

21)
a) Acid: H_3O^+, conjugate base is H_2O
Base: NH_3, conjugate acid is NH_4^+
b) Base: OH^-, conjugate acid is H_2O
Acid: HSO_3^-, conjugate base is SO_3^{2-}
c) Base: HPO_4^{2-}, conjugate acid is $H_2PO_4^-$
Acid: HSO_4^-, conjugate base is SO_4^{2-}
d) Base: HS^-, conjugate acid is H_2S
Acid: HCO_3^-, conjugate base is CO_3^{2-}

22)

$HCl_{(aq)} + KOH_{(aq)} \rightarrow KCl_{(aq)} + H_2O_{(l)}$
n(KOH) = n(HCl) = 0.0250 L X 0.125 mol/L = 0.00313 mol
C(KOH) = 0.00313 mol / 0.0214 L = 0.146 mol/L

23)
$H_2SO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$
$n(H_2SO_4)$ = 0.0168 L X 0.250 mol/L X ½ = 0.00210 mol
$C(H_2SO_4)$ = 0.00210 mol / 0.0200 L = 0.105 mol/L

24)
$Ca(OH)_{2(aq)} + 2HNO_{3(aq)} \rightarrow Ca(NO_3)_{2(aq)} + 2H_2O_{(l)}$
$n(Ca(OH)_2)$ = 0.0155 L X 0.100 mol/L X ½ = 0.000775 mol
$C(Ca(OH)_2)$ = 0.000775 mol / 0.0100 L = 0.0775 mol/L

25)
$2H_3PO_{4(aq)} + 3Ca(OH)_{2(aq)} \rightarrow Ca_3(PO_4)_{2(s)} + 6H_2O_{(l)}$
$n(H_3PO_4)$ = 0.0200 L X 0.050 mol/L X 2/3 = 0.00067 mol
$C(H_3PO_4)$ = 0.00067 mol / 0.0178 L = 0.038 mol/L

26)
n(KOH) = 2.00 g / 56.11 g/mol = 0.0356 mol
C(KOH) = 0.0356 mol / 0.250L = 0.142 mol/L
$2KOH_{(aq)} + H_2SO_{4(aq)} \rightarrow K_2SO_{4(aq)} + 2H_2O_{(l)}$
n(KOH neutralized) = 0.0200 L X 0.115 mol/L X 2/1 = 0.00460 mol
V(KOH) = 0.00460 mol / 0.142 mol/L = 0.0324 L

27)
$M((COOH)_2 \bullet 2H_2O)$ = 126.07 g/mol
n(oxalic acid) = 0.118 g / 126.07 g/mol = 0.000935 mol
n(NaOH) = 0.000935 mol X 2/1 = 0.00187 mol
C(NaOH) = 0.00187 mol / 0.0104 L = 0.179 mol/L