Chapter 4 Questions

Section 4.1 & 4.2

1) Although pure water is a poor conductor of electricity, we are cautioned not to operate electrical appliances around water. Why?

2) Na_2SO_4 is a strong electrolyte. $HClO_2$ is a weak electrolyte. $C_6H_{12}O_6$ is a nonelectrolye. Draw a picture of each of these materials in solution in terms of the particles floating around in the water after dissolution.

5) Write an equation for each of the following strong electrolytes as they ionize or dissociate into ions upon dissolving in water:
a) $ZnCl_2$
b) HNO_3
c) $Cr(NO_3)_3$
d) $(NH_4)_2CO_3$
e) $FeSO_4$

3) When methyl alcohol, CH_3OH, is dissolved in water, a nonconducting solution results. When acetic acid, $HC_2H_3O_2$ dissolves in water, the solution is weakly conducting and acidic in nature. Describe what happens upon dissolution in the two cases, and account for the different results.

4) Formic acid, $HCHO_2$, is a weak electrolyte. What solute particles are present in an aqueous solution of this compound? Write the chemical equation for the ionization of $HCHO_2$.

6) Write an equation for each of the following weak electrolytes as they ionize or dissociate into ions upon dissolving in water:
a) $HClO$
b) $NaHCO_3$
c) NH_4OH
d) H_2SO_3

Section 4.3

7) Suppose you prepare 500 mL of a 0.10 M solution of some salt and then spill some of it. What happens to the concentration of the solution left in the container?

8) A certain volume of a 0.50 M solution contains 4.5 g of a certain salt. What mass of the salt is present in the same volume of a 2.50 M solution?

9) What is the difference between 0.50 mol HCl and 0.50 M HCl?

10) Which will have the highest concentration of potassium ion: 0.20 M KCl, 0.15 M K_2CrO_4 or 0.080 M K_3PO_4?

11a) Calculate the molarity of a solution that contains 0.0345 mol NH_4Cl in 400 mL of solution.
b) How many moles of HNO_3 are present in 35.0 mL of a 2.20 M solution of nitric acid?
c) How many milliliters of 1.50 M KOH solution are needed to supply 0.125 mol of KOH?
d) Calculate the number of grams of solute in 0.250 L of 0.150 M KBr
e) Calculate the molar concentration of a solution containing 4.75 g of $Ca(NO_3)_2$ in 0.200 L
f) Describe how to make 250 mL of a 0.190 M solution of potassium chromate.
g) Calculate the volume of solution needed to dissolve 19.5 g of sodium thiosulfate to make a 0.100 M solution.

12a) You have a stock solution of 14.8 M NH_3. How many milliliters of this solution should you dilute to make 100.0 mL of 0.100 M NH_3?
b) If you take a 10.0 mL portion of the stock solution (from a) and dilute it to a total volume of 0.250 L, what will be the concentration of the final solution?
c) If you have 10.0 mL of a 3.0 M solution of hydrochloric acid, and you want the solution to be 0.050 M, describe two ways to do it.

Section 4.5 & 4.6

13) Using solubility guidelines, predict whether each of the following compounds is soluble or insoluble in water:
a) $NiCl_2$
b) Ag_2S
c) Cs_3PO_4
d) $SrCO_3$
e) $(NH_4)_2SO_4$
f) K_3PO_4
g) $Pb(C_2H_3O_2)_2$
h) $Ga(OH)_3$
i) NaCN
j) $BaSO_4$

14) Will precipitation occur when the following solutions are mixed? If so, write a balanced chemical equation for the reaction.
a) Na_2CO_3 and $AgNO_3$
b) NaOH and K_2SO_4
c) $FeSO_4$ and $Pb(NO_3)_2$
d) $Hg_2(NO_3)_2$ and KI
e) $(NH_4)_2CO_3$ and $CaCl_2$
f) $NaC_2H_3O_2$ and $CuSO_4$

15) Write the balanced equations and net ionic equations for the reactions that occur when each of the following solutions are mixed.
a) Na_2CO_3 (aq) and $MgSO_4$ (aq)
b) $Pb(NO_3)_2$ (aq) and Na_2S (aq)
c) $(NH_4)_3PO_4$ (aq) and $CaCl_2$ (aq)
d) $Ca(NO_3)_2$ (aq) + $CrCl_3$ (aq) --->
e) $CuBr_2$ (aq) + NaOH (aq) --->
f) $AgNO_3$ (aq) + KI (aq) --->
g) $Pb(NO_3)_2$ (aq) + Na_2SO_4 (aq) --->
h) FeI_3 (aq) + K_3PO_4 -->
i) $Mg(C_2H_3O_2)_2$ (aq) + NH_4OH (aq) -->

Section 4.7

16a) What mass of NaCl is required to precipitate all the silver ions from 20.0 mL of 0.100 M $AgNO_3$ solution?
b) What volume of 0.115 M $HClO_4$ solution is required to neutralize 50.00 mL of 0.0875 M NaOH?
c) What volume of 0.128 M HCl is required to neutralize 2.87 g of $Mg(OH)_2$?
d) What molarity is a solution in which 45.0 mL of silver nitrate solution react all of a 50.0 mL solution of 1.75 M iron (III) iodide?
e) How many milliliters of 0.155 M HCl are needed to neutralize completely 35.0 mL of 0.101 M $Ba(OH)_2$ solution?
f) How many grams of ammonium phosphate are needed to react all of a 400 mL solution of 0.250 M calcium nitrate?

17) 25.0 mL of 0.450 M iron (III) nitrate react with 15.0 mL of 0.600 M lithium carbonate. How many grams of precipitate should be produced?

18) Some aqueous sulfuric acid is spilled on a lab bench. It can be neutralized by sprinkling solid sodium bicarbonate on it and then mopping up the resultant solution. The reaction produces aqueous sodium sulfate, liquid water and carbon dioxide gas. Sodium bicarbonate is added until the fizzing due to the formation of carbon dioxide gas stops. If 35.0 mL of 6.0 M sulfuric acid was spilled, what is the minimum mass of sodium carbonate that must be added to the spill to neutralize the acid?

**19) A solution of 100.0 mL of 0.200 M KOH is mixed with a solution of 200.0 mL of 0.150 M $NiSO_4$.*
a) Write the balanced chemical equation for the reaction that occurs.
b) What precipitate forms?
c) What is the limiting reactant?
d) How many grams of this precipitate forms?
e) What is the concentration of each ion that remains in the solution?

Section 4.8

20) What is the difference between:
a) a monoprotic add and a diprotic acid?
b) a weak acid and a strong acid?
c) an acid and a base?

21) Classify each of the following as a strong or weak acid or base:

a) $HClO_4$	e) H_2CO_3
b) $HClO_2$	f) $Ca(OH)_2$
c) LiOH;	g) HBr
d) NH_3	h) $HC_7H_5O_2$

22) We use a single arrow in the chemical equation for the ionization of HNO_3 but a double arrow for the ionization of HCN. What do the single and double arrows signify?

23) In net ionic equations, it is possible to remove spectator ions from a reaction. Why would it be impossible to remove F^- from the following reaction:
HF (aq) + KOH (aq) --> KF (aq) + H_2O (l)

24) Complete and balance the following molecular equations, and then write the net ionic equation for each:
a) HBr (aq) + $Ca(OH)_2$ (aq)--->
b) $Cu(OH)_2$ (s) + $HClO_4$ (aq) --->
c) Aqueous acetic acid is neutralized by aqueous potassium hydroxide
d) Solid calcium hydroxide reacts with nitric acid.
e) $Cr(OH)_3$ (s) + HNO_3 (aq) --->
f) Solid iron (III) hydroxide and perchloric acid react.

Section 4.9

25) Determine the oxidation number for the indicated element in each of the following substances:

a) S in SO_3
b) C in $COCl_2$
c) Mn in MnO_4^-
d) Br in HBrO
e) As in As_4
f) O in K_2O_2
g) C in $C_2O_4^{-2}$
h) N in $Ca(NO_3)_2$
i) P in HPO_4^{-2}
j) Co in $CoCl_2$
k) Cr in $Cr(OH)_4^-$
l) Ga in $Ga(OH)_3$

26) Which element is oxidized, and which is reduced in the following reactions?

a) Ni (s) + Cl_2 (g) --> $NiCl_2$ (s)
b) 3 $Fe(NO_3)_2$ (aq) + 2 Al (s) -->
3 Fe (s) + $2Al(NO_3)_3$(aq)
c) Cl_2 (aq) + 2 NaI (aq) --> I_2 (aq) + 2 NaCl (aq)
d) CH_4 (g) + 2 O_2 (g) --> CO_2 (g) + 2 H_2O (g)
e) PbS (s) + 4 H_2O_2 (aq) -->
$PbSO_4$ (s) + 4 H_2O (l)
f) 3 K (s) + $CrCl_3$ (aq) --> 3 KCl (aq) + Cr (s)

27) Write balanced molecular and net ionic equations for the reactions of

a) hydrochloric acid with nickel;
b) sulfuric acid with iron
c) hydrobromic acid with zinc
d) perchoric acid with magnesium
e) manganese with sulfuric acid
f) chromium with hydroiodic acid

28) Which of the following reactions are redox reactions? For those that are, indicate which element is oxidized and which one is reduced. For those that are not, indicate whether they are precipitation or acid-base reactions.

a) $NaHCO_3$ (s) --> NaOH (s) + CO_2 (g)
b) Fe_2O_3 (s) + 3 CO (g) --> 2Fe (s) + 3 CO_2 (g)
c) $Sr(NO_3)_2$ (aq) + H_2SO_4 (aq) -->
$SrSO_4$ (s) + 2 HNO_3 (aq)
d) Ca (s) + Cl_2 (g) --> $CaCl_2$ (s)
e) $Cu(OH)_2$ (s) + 2 HNO_3 (aq) -->
$Cu(NO_3)_2$ (aq) + 2 H_2O (l)
f) 4 Zn (s) + 10 H^+ (aq) +2 NO_3^- (aq) -->
4 Zn^{+2} (aq) + N_2O (g) + 5 H_2O (l)

29) Based on the activity series (Table 4.5), what is the outcome of each of the following reactions?

a) Al (s) + $NiCl_2$ (aq) -->
b) Ag (s) + $Pb(NO_3)_2$ (aq) -->
c) Cr (s) + $NiSO_4$ (aq) -->
d Zinc metal is added to a solution of silver nitrate
e) iron metal is added to a solution of aluminum sulfate
f) hydrochloric acid is added to cobalt metal
g) Mn (s) + HBr (aq) -->
h) H_2 (g) + $CuCl_2$ (aq) -->
i) hydrogen gas is bubbled through an aqueous solution of $FeCl_2$
j) lithium metal is added to water