Review of Chemistry 11

HCl C_3H_8 SO_2 NH_4Cl KOH H_2SO_4 H_2O $AgNO_3$ $PbSO_4$ H_3PO_4 $Ca(OH)_2$ $Al(OH)_3$ P_2O_5 $Ba(OH)_2$ CH_3COOH

1. Classify the above as ionic or covalent by making two lists. Describe the difference between an ionic and covalent compound.

Ionic **NH_4Cl KOH $AgNO_3$ $PbSO_4$ $Ca(OH)_2$ $Al(OH)_3$ $Ba(OH)_2$**

Covalent **C_3H_8 SO_2 H_2O P_2O_5 H_3PO_4 CH_3COOH H_2SO_4**

2. Classify the above as acids, bases, salts and molecular (covalent compounds) by making four lists.

Acids **HCl H_2SO_4 CH_3COOH H_3PO_4**

Bases **KOH $Ca(OH)_2$ $Ba(OH)_2$ $Al(OH)_3$**

Salts **NH_4Cl $AgNO_3$ $PbSO_4$**

Molecular **C_3H_8 SO_2 H_2O P_2O_5**

3. Describe how you can identify each of the four categories by the formula of the compound.

Acids **The formula starts with H or ends in COOH except H_2O.**

Bases **The formula starts with a metal or NH_4 and ends in OH.**

Salts **The formula starts with a metal or NH_4 and does not end in OH.**

Molecular **The formula starts with a nonmetal other than H.**

4. Describe how each of the four categories would react with litmus and conduct electricity when aqueous.

	Litmus	**Conductivity**
Acids	**Red**	**Yes**
Bases	**Blue**	**Yes**
Salts	**Neutral**	**Yes**
Molecular	**Neutral**	**No**

5. For each compound that conducts electricity, write a dissociation equation to show how it ionizes in water.

$NH_4Cl_{(s)} \rightarrow NH_4^+ + Cl^-$

$KOH_{(s)} \rightarrow K^+ + OH^-$

$AgNO_{3(s)} \rightarrow Ag^+ + NO_3^-$

$PbSO_{4(s)} \rightarrow Pb^{2+} + SO_4^{2-}$

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

$Al(OH)_{3(s)} \rightarrow Al^{3+} + 3OH^-$

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

$C_3H_{8(g)} \rightarrow C_3H_{8(aq)}$

$SO_{2(g)} \rightarrow SO_{2(aq)}$

$H_2SO_{4(l)} \rightarrow 2H^+ + SO_4^{2-}$

$H_2O_{(l)} \rightarrow H_2O_{(l)}$

$H_3PO_{4(l)} \rightarrow 3H^+ + PO_4^{3-}$

$P_2O_{5(s)} \rightarrow P_2O_{5\ (aq)}$

$CH_3COOH_{(l)} \rightarrow CH_3COO^- + H^+$

6. Calculate the molar mass of $FeSO_4 \cdot 5H_2O$ and $Co_3(PO_4)_2 \cdot 6H_2O$.

241.9 g/mol 474.7 g/mol

7. 0.300 moles of NaCl is dissolved in 250.0 ml of water, calculate the molarity.

Molarity = $\frac{0.300 \text{ moles}}{.250 \text{ L}}$ = 1.20 M

8. 500. g of $FeSO_4 \cdot 6H_2O$ is dissolved in 600. ml of water, calculate the molarity.

Molarity = $\frac{500g \times \frac{1 \text{ mole}}{259.9g}}{.600 \text{ L}}$ = 3.21 M

9. How many grams of NaCl are required to prepare 100.0 ml of a 0.200 M solution?

$.100L \times \frac{0.200 \text{ mole}}{1 \text{ L}} \times \frac{58.5 \text{ g}}{1 \text{ mole}}$ = 1.17g

10. 20. g of $MgCl_2$ are dissolved in 250. ml of water, calculate the concentration of each ion.

Molarity = $\frac{20g \times \frac{1 \text{ mole}}{95.3 \text{ g}}}{0.250 \text{ L}}$ = 0.84 M $MgCl_2$ ---> Mg^{2+} + $2Cl^-$

0.84 M 0.84 M 1.7 M

11. How many liters of 0.300 M NaCl contains 10.0 g of NaCl?

$10.0g \times \frac{1 \text{ mole}}{58.5g} \times \frac{1 \text{ L}}{0.300 \text{ mole}}$ = 0.570 L

12. For each double replacement reaction write the formula equation, the complete ionic equation and the net ionic equation.

a) $H_2SO_{4(aq)} + 2NaOH_{(aq)} \text{-------} > Na_2SO_{4(aq)} + 2HOH_{(l)}$

$2H^+_{(aq)} + SO_4^{2-}{}_{(aq)} + 2Na^+_{(aq)} + 2OH^-_{(aq)} \text{---------} > 2Na^+_{(aq)} + SO_4^{2-}{}_{(aq)} + 2HOH_{(l)}$

$H^+_{(aq)} + OH^-_{(aq)} \text{---------} > HOH_{(l)}$

b) $2H_3PO_{4(aq)} + 3Sr(OH)_{2(aq)} \text{-------} > Sr_3(PO_4)_{2(s)} + 6HOH_{(l)}$

$6H^+_{(aq)} + 2PO_4^{3-}{}_{(aq)} + 3Sr^{2+}_{(aq)} + 6OH^-_{(aq)} \text{---------} > Sr_3(PO_4)_{2(s)} + 6HOH_{(l)}$

$6H^+_{(aq)} + 2PO_4^{3-}{}_{(aq)} + 3Sr^{2+}_{(aq)} + 6OH^-_{(aq)} \text{---------} > Sr_3(PO_4)_{2(s)} + 6HOH_{(l)}$

c) $3Ca(NO_3)_{2(aq)} + 2Na_3PO_{4(aq)} \text{-------} > Ca_3(PO_4)_{2(s)} + 6NaNO_{3(aq)}$

$3Ca^{2+}_{(aq)} + 6NO_3^-{}_{(aq)} + 6Na^+_{(aq)} + 2PO_4^{3-}{}_{(aq)} \text{----------} > Ca_3(PO_4)_{2(aq)} + 6Na^+_{(aq)} + 6NO_3^-{}_{(aq)}$

$3Ca^{2+}_{(aq)} + 2PO_4^{3-}{}_{(aq)} \text{----------} > Ca_3(PO_4)_{2(aq)}$

d) $Zn_{(s)} + 2HCl_{(aq)} \text{---------} > H_{2(g)} + ZnCl_{2(aq)}$

$Zn_{(s)} + 2H^+_{(aq)} + 2Cl^-_{(aq)} \text{---------} > H_{2(g)} + Zn^{2+}_{(aq)} + 2Cl^-_{(aq)}$

$Zn_{(s)} + 2H^+_{(aq)} \text{---------} > H_{2(g)} + Zn^{2+}_{(aq)}$

13. In three runs of a titration 22.8, 22.1 and 22.2 ml of .200 M $Ba(OH)_2$ were required to neutralize 10.0 ml of HCl, calculate the acid concentration.

$2HCl + Ba(OH)_2 \text{----------} > BaCl_2 + 2HO$

0.0100 L **0.02215 L**

? M **0.200 M**

$$[HCl] = 0.02215\ L \times \frac{0.200\ mole}{1\ L} \times \frac{2\ mole\ HCl}{1\ mole\ Ba(OH)_2} \div 0.0100\ L$$

$$= 0.886\ M$$

14. In three runs of a titration 12.1, 12.8, 12.8 ml of 0.200 M HCl were required to neutralize 10.0 ml of $Ca(OH)_2$, calculate the base concentration.

$2HCl + Ca(OH)_2 \text{----------} > CaCl_2 + 2HOH$

0.0128 **0.02215 L**

0.200M

$$\text{Molarity} = 0.0128\ L\ HCl \times \frac{0.200\ mole}{1\ L} \times \frac{1\ mole\ Ca(OH)_2}{2\ mole\ HCl} \div 0.0100\ L$$

= 0.128 M

15. 35.0 ml of 1.00 M H_2SO_4 reacts with 175 ml 0.250M NaOH, calculate the concentration of the excess base.

H_2SO_4 + 2NaOH ----------> Na_2SO_4 + 2HOH

0.0350L x $\frac{1.00\ mole}{1\ L}$ = 0.0350 mole **0.175L x $\frac{0.250\ mole}{1\ L}$ = 0.04375 mole**

I	**0.0350 mole**	**0.04375 mole**
C	**0.02188 mole**	**0.04375 mole**
E	**0.01312 mole**	**0 mole**

Total Volume = 210 mL = 0.210 L

Molarity = $\frac{0.01312\ mole}{0.210L}$ = 0.0625 M

16. 350.0 ml of 0.200 M HCl reacts with 175 ml 0.125 M $Ca(OH)_2$, calculate the concentration of the excess acid.

2HCl + $Ca(OH)_2$ ----------> $CaCl_2$ + 2HOH

0.350L x $\frac{0.200\ mole}{1\ L}$ = 0.0700 mole **0.175L x $\frac{0.125\ mole}{1\ L}$ = 0.02188 mole**

I	**0.0700 mole**	**0.02188 mole**
C	**0.0438 mole**	**0.02188 mole**
E	**0.0262 mole**	**0.000 mole**

Total Volume = 525 mL = 0.525 L **Molarity = $\frac{0.0262\ mole}{0.525L}$ = 0.0499M**

17. 25.0 g of sodium reacts with water, how many grams of hydrogen are produced? How many grams of sodium hydroxide are produced?

$2Na_{(s)}$ + $2HOH_{(l)}$ ---------> $H_{2(g)}$ + $2NaOH_{(aq)}$

25.0 g Na x $\frac{1\ mole}{23.0\ g}$ x $\frac{1mol\ H_2}{2mol\ Na}$ x $\frac{2.02\ g}{1\ mole}$ = 1.10 g

25.0 g Na x $\frac{1\ mole}{23.0\ g}$ x $\frac{2mol\ NaOH}{2mol\ Na}$ x $\frac{40.0\ g}{1\ mole}$ = 43.5 g

18. 25.0 g of calcium reacts with water, how many grams of hydrogen are produced? How many grams of calcium hydroxide are produced?

$Ca_{(s)} + 2HOH_{(l)} \text{ ---------> } H_{2(g)} + Ca(OH)_{2(aq)}$

$25.0\text{ g Ca} \times \frac{1\text{ mole}}{40.1\text{ g}} \times \frac{1\text{mol } H_2}{1\text{mol Ca}} \times \frac{2.0\text{ g}}{1\text{ mole}} = 1.25\text{ g}$

$25.0\text{ g Ca} \times \frac{1\text{ mole}}{40.1\text{ g}} \times \frac{1\text{mol } Ca(OH)_2}{1\text{mol Ca}} \times \frac{74.1\text{ g}}{1\text{ mole}} = 46.2\text{ g}$

19. How many millilitres of 0.200M NaOH is required to neutralize 25.0 ml of 0.100 M H_2SO_4 ?

$H_2SO_4 + 2NaOH \text{ ----------> } Na_2SO_4 + 2HOH$

0.025 L ? L

0.100 M 0.200 M

$0.0250\text{ L NaOH} \times \frac{0.100\text{ mole}}{1\text{ L}} \times \frac{2\text{ mole NaOH}}{1\text{ mole } H_2SO_4} \times \frac{1\text{ L}}{0.200\text{mole}} \times \frac{1000\text{ mL}}{1\text{L}} = 25.0\text{ mL}$

20. How many millilitres of 0.200M H_2SO_4 is required to neutralize 25.0 ml of 0.100 M NaOH ?

$H_2SO_4 + 2NaOH \text{ ----------> } Na_2SO_4 + 2HOH$

? mL 0.0250 L

0.200 M 0.100 M

$0.0250\text{ L NaOH} \times \frac{0.100\text{ mole}}{1\text{ L}} \times \frac{1\text{ mole } H_2SO_4}{2\text{ mole NaOH}} \times \frac{1\text{ L}}{0.200\text{mole}} \times \frac{1000\text{ mL}}{1\text{L}} = 6.25\text{ mL}$

21. If the $[F^-] = 0.600$ M in a AlF_3 solution, calculate the $[Al^{+3}]$ and the number of grams required to make 1.00 L of the solution.

$AlF_3 \text{ -------> } Al^{3+} + 3F^-$

0.200 M 0.200 M 0.600M

$1.00\text{L} \times \frac{0.200\text{ mole}}{1\text{ L}} \times \frac{84.0\text{ g}}{1\text{ mole}} = 16.8\text{ g}$

22. If the $[Na^+] = 0.250$ M in a Na_3P solution, calculate the $[P^{-3}]$ and the number of grams required to make 1.50 L of the solution.

$Na_3P \text{ -------> } 3Na^+ + P^{3-}$

0.250 M 0.08333M

1.50L x 0.08333 mole x 100 g = 12.5 g

1 L 1 mole

23. A beaker of mass = 25.36g contains 2.00 L of a solution of $BaCl_2$ and is evaporated to dryness mass = 28.59 g. Calculate the molarity of the solution.

28.59g – 25.36 =3.23g

Molarity = 3.23g x 1 mole

208.3g = 0.00775 M

2.00 L

23. A beaker has a mass of 25.36 g. A solution that contains 2.00 L of a solution of $BaCl_2$ has a mass of 163.59 g. The solution is evaporated to dryness and it then has a mass of 28.59 g. Calculate the molarity of the solution.

62.31 – 55.66 =6.65g

Molarity = 6.65g x 1 mole

84.0g = 0.0792M

1.00 L

25. A titration was performed by adding 0.175 M $H_2C_2O_4$ to a 25.00 mL sample of NaOH. The following data was collected. Calculate the molarity of the base.

	Trial #1	Trail # 2	Trial #3
Final volume of $H_2C_2O_4$ (mL)	23.00	39.05	20.95
Initial volume of $H_2C_2O_4$ (mL)	4.85	23.00	5.00

18.15 mL 16.05 mL 15.95 mL

Average 16.00 mL

$H_2C_2O_4$ + 2NaOH ----------> $Na_2C_2O_4$ + 2HOH

0.0160 L 0.0250 L

0.175 M ?M

[NaOH] = 0.0160 L x 0.175 mole x 2 mole NaOH

1 L 1 mole $H_2C_2O_4$

0.0250 L

= 0.224 M

26. 2HCl + $Ba(OH)_2$ ----------> $BaCl_2$ + 2 H_2O

When 3.16 g samples of $Ba(OH)_2$ were titrated to the endpoint with HCl solution. 37.80mL, 35.49mL, 35.51 mL of HCL was required. Calculate the HCl concentration.

$2HCl$ + $Ba(OH)_2$ ----------> $BaCl_2$ + $2\ H_2O$

0.03500 L 3.16g

? M 171.3g/mole

$$[HCl] = 3.16\text{g} \times \frac{1\text{ mole}}{171.3\text{ g}} \times \frac{2\text{ mole HCl}}{1\ Ba(OH)_2} \times \frac{1}{0.03500\text{ L}}$$

= 1.05 M

27. A 0.960 g sample of impure Na_2CO_3 is dissolved in water and then completely reacted with 0.200 M HCl requiring 65.3 mL. Calculate the percentage by mass of Na_2CO_3 in the sample.

Na_2CO_3 + 2HCl $\rightarrow$ CO_2 + 2NaCl + H_2O

0.00653 L

? g 0.200 M

$$0.0653\text{ L HCl} \times \frac{0.200\text{ moles}}{1\text{ L}} \times \frac{1\text{ mole } Na_2CO_3}{2\text{ moles HCl}} \times \frac{106\text{ g}}{1\text{ mole}} = 0.069218\text{g}$$

$$\% = \frac{0.069218\text{ g}}{0.960\text{ g}} \times 100\ \% = 7.21\ \%$$