**Unit VI    Molarity**

Lesson             Day                  Date                 Topic

[1.](http://iannonechem.com/Sc/notes/unit6/1.introductionmolarity.ppt)                                                                     [Molarity 1](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws1)

[2.](http://iannonechem.com/Sc/notes/unit6/2.solutionsmolarity.ppt)                                                                     [Molarity Lab](http://iannonechem.com/Sc/notes/unit6/Molarity%20Lab%20Procedure.doc)          [Molarity 2](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws2)

[3.](http://iannonechem.com/Sc/notes/unit6/3.molaritystoich.ppt)                                                                     [Stoichiometry](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws3)

[4.](http://iannonechem.com/Sc/notes/unit6/4.titrations.ppt)                                                                     [Titrations lab 1](http://iannonechem.com/Sc/notes/unit6/Titration%20lab.DOC)       [Homework WS # 4](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws4)

[5.](http://iannonechem.com/Sc/notes/unit6/4.titrations.ppt)                                                                     [Titrations Lab 2](http://iannonechem.com/Sc/notes/unit6/Titration%20lab.DOC)      [Homework WS # 5](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws5)

[6.](http://iannonechem.com/Sc/notes/unit6/6.dilutions.ppt)                                                                     [Dilutions](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws6)

7.                                                                     [Spectrophotometry Lab](http://iannonechem.com/Sc/notes/unit6/Spectrophotometry%20lab.DOC)

8.                                                                     [Molarity and Dilutions](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws8)

[9.](http://iannonechem.com/Sc/notes/unit6/9.ionconcentration.ppt)                                                                     [Ion Concentration](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws9)

[10.](http://iannonechem.com/Sc/notes/unit6/10.ICEacidbase.ppt)                                                                   [Molarity Unit Review # 1](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws10)

[11.](http://iannonechem.com/Sc/notes/unit6/11.ChallengeacidbaseICE.ppt)                                                                   [Molarity Unit Review # 2](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws11)

12.                                                                   [Chemistry 11 Calculations Practice Test # 1](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws13)

13.                                                                   [Chemistry 11 Calculations Practice Test # 2](http://iannonechem.com/Sc/workbookanswers/7.answers.htm#ws14)

**Molarity Worksheet # 1**

1.       15.8 g of KCl is dissolved in 225 mL of water. Calculate the molarity.

**15.8 g          x        1 mole**

**Molarity      =                                      74.6 g                    =        0.941 M**

                                                  **0.225 L**

2.       Calculate the mass of KCl required to prepare 250. mL of 0.250 M solution.

          **0.250 L        x        0.250 moles x        74.6 g          =        4.66 g**

                                                  **1 L               1 mole**

3.       Calculate the volume of 0.30 M KCl solution that contains 6.00 g of KCl.

**6.00 g          x        1 mole         x        1 L               =        0.27 L**

**74.6 g                   0.30 mol**

4.       Calculate the volume of 0.250 M H2SO4 that contains 0.250 g H2SO4.

**0.250 g H2SO4      x        1 mole                   x        1 L                         =         0.0102 L**

**98.12 g                            0.250 mole**

5.       1.50 g of NaCl is dissolved in 100.0 mL of water. Calculate the concentration.

**1.50 g            x        1 mole**

**Molarity      =                                      58.5 g                    =        0.256 M**

                                                  **0.1000 L**

6.       How many moles of NaCl are in 250. mL of a 0.200 M solution?

**0.250 L      x        0.200 mole     =     0.0500 moles**

**1 L**

7.       How many litres of a 0.200 M KCl solution contain 0.250 moles?

**0.250 moles x        1 L                         =        1.25 L**

**0.200 moles**

8.       How many millilitres of 0.200 M H2SO4 are required to completely neutralize 250.mL of 0.250 M NaOH?

**H2SO4         +        2NaOH       →      Na2SO4       +        2HOH**

**? mL                     0.250 L**

**0.250 L NaOH  x  0.250 mole  x  1 mole H2SO4    x        1 L     x        1000 mL         =        156 mL**

**1 L          2 mole NaOH            0.200 mole            1 L**

9.       Calculate the mass of CuSO4.5H2O required to prepare 100.0 mL of 0.100 M solution.

**0.100 L        x        0.100 mole            x        249.7 g        =        2.50 g**

**1 L                                   1 mole**

10.     Calculate the mass of Cu(NO3)2.6H2O required to prepare 100.0 mL of 0.200 M solution.

              **5.91 g**

11.     Calculate the mass of CoCl3.6H2O required to prepare 500.0 mL of a 0.200 M       solution.

           **27.4 g**

12.     50.0 g of NaCl is dissolved in 200.0 mL of water, calculate the molarity.

 **4.27 M**

13.     25.0 g of CuSO4.8H2O is dissolved in 25.0 mL of water, calculate the molarity.

 **3.29 M**

14.     Calculate the mass of NaCl required to prepare 500.0 mL of a 0.500 M solution.

**14.6 g**

15.     Calculate the volume of 0.500 M NaCl solution required to contain 0.0500 g of NaCl.

       **0.00171 L**

16.     Calculate the volume of 0.200 M NaCl solution required to contain

          0.653 g of NaCl.

         **0.0558L**

17.     Calculate the mass of NaCl required to prepare 256 mL of a 0.35 M solution.

         **5.2 g**

18.     25.2 g of NaCl is dissolved in 365 mL of water, calculate the molarity.

         **1.18 M**

19.     56.3 g of CuSO4.8H2O is dissolved in 30. mL of water, calculate the molarity.

         **6.2 M**

**Worksheet # 2      Molarity**

1.       Calculate the mass of CuSO4.6H2O required to prepare 200.0 mL of 0.300 M solution.

**0.200 L        x        0.300 moles x        267.72 g      =        16.1 g**

                              **1 L                         1 mole**

2.       Calculate the mass of CoCl3.8H2O required to prepare 300.0 mL of a 0.520 M solution.

**0.300 L        x        0.520 moles x        309.56 g      =        48.3 g**

                              **1 L                         1 mole**

3.       150.0 g of NaCl is dissolved in 250.0 mL of water, calculate the molarity.

**150.0 g        x        1 mole**

**Molarity      =                                      58.5 g (3sig figs)                    =        10.3 M**

                                        **0.250 L**

4.       25.2 g of CuSO4.6H2O is dissolved in 28.0 mL of water, calculate the molarity.

          **25.2 g          x        1 mole**

**Molarity      =                                      267.72 g      =        3.36 M**

                                        **0.0280 L**

5.       Calculate the mass of NaCl required to prepare 565.0 mL of a 0.450 M solution.

**0.5650 L      x        0.450 moles           x        58.5 g          =        14.9 g**

                              **1 L                                   1 mole**

6.       Calculate the volume of 0.250 M NaCl solution required to contain

          0.0300 g of NaCl.

**0.0300 g NaCl       x        1 mole         x        1 L               =        0.00205 L**

**58.5 g                    0.250 mole**

7.       Calculate the volume of 0.500 M NaCl solution required to contain 0.52 g of NaCl.

**0.52 g NaCl x        1 mole                   x        1 L                         =        0.018 L**

**58.5 g                              0.500 mole**

8.       Calculate the mass of NaCl required to prepare 360.0 mL of a 0.35 M solution.

**0.3600 L      x        0.35 moles             x        58.5 g          =        7.4 g**

                              **1 L                                   1 mole**

9.       55.6 g of NaCl is dissolved in 562 mL of water, calculate the molarity.

          **55.6 g          x        1 mole**

**Molarity      =                                      58.5 g                    =        1.69 M**

                                        **0.562 L**

10.     78.9 g of CuSO4.8H2O is dissolved in 500.0 mL of water, calculate the molarity.

          **78.9 g          x        1 mole**

**Molarity      =                                      303.76 g                =        0.519 M**

                                        **0.5000 L**

**Stoichiometry Worksheet # 3**

1.       Excess sodium hydroxide solution is added to 20.0 mL of 0.184 M ZnCl2,calculate the mass of zinc hydroxide that will           precipitate.

          NaOH(aq)      +        ZnCl2(aq)       →      Zn(OH)2(s)    +       2NaCl(aq)

                                        **0.0200 L                ? g**

**0.0200 L ZnCl2  x   0.184 mole   x  1 mole Zn(OH)2  x   99.42 g        =          0.366 g Zn(OH)2**

                                        **1 L               1 mole ZnCl2         1 mole**

2.       How many millilitres of 1.09 M HCl are required to react with a solution formed by dissolving 0.775 g of sodium        carbonate?

          Na2CO3(aq)    +        2HCl(aq)        →      2NaCl(aq)     +     H2O(l)     +     CO2(g)

          **0.775g                   ? mL**

**0.775 g Na2CO3      x      1 mole  x   2 mole HCl        x      1 L     x        1000 mL         =  13.4 mL**

                                        **106 g       1 mole Na2CO3         1.09 moles             1 L**

3.       Calculate the number of grams barium carbonate that can be precipitated by     adding 50.0 mL of 0.424 MBa(NO3)2.

          Ba(NO3)2(aq)  +      K2CrO4(aq)    →       BaCrO4(s)        +     2KNO3(aq)

**0.0500 L Ba(NO)2   x     0.424 mole  x    1 mole BaCO3    x     253.3 g   =          5.37 g BaCrO4**

                                        **1 L                     1 mole Ba(NO)2        1 mole**

4.       Determine the number of millilitres of 0.246 M AgNO3 required to precipitate all the phosphate ion in a solution containing 2.10 g of sodium phosphate.

          3AgNO3(aq)    +    Na3PO4(aq)     →    Ag3PO4(s)      +     3NaNO3(aq)

**156 mL**

5.       How many grams of silver nitrate must be used in the preparation of 150. mL of 0.125 M solution.

          **3.19 g**

6.       What volume of SO2 is generated by the complete reaction of 35.0 mL of 0.924 M Na2SO3?

          Na2SO3(aq)    +        2NaOH(aq)     →      2NaCl(aq)    +          H2O(l) +     SO2(g)

          **0.724 L**

7.       How many milliliters of 6.2 M NaOH must react to liberate 2.4 L of hydrogen at STP?

          2Al(s)  +        6NaOH(aq)     →        2Na3AlO3(aq)+         3H2(g)

          **35 mL**

8.       Calculate the weight of H2C2O4**.**2H2O required to make 750.0 mL of a 0.480 M solution.

          **45.4 g**

9.       25.4 L of HCl gas at STP are dissolved in 2.5 L of water to produce an acid solution. What volume of 0.200 M Ba (OH)2 will this solution neutralize?

**2HCl           +        Ba(OH)2     →      BaCl2          +        2HOH**

**25.4 L HCl  x        1 mole         x        1mole Ba (OH)2   x            1L            =      2.8 L**

                                        **22.4 L                    2 mole HCl                      0.200 mol**

10.     8.25 L at STP of HCL gas is dissolved in 500 ml of water to produce an acid solution. What volume of 0.200 M Ca    (OH) 2 will this solution neutralize?

**Ca (OH)2    +        2HCl           →      CaCl2          +        2H2O**

**8.25 L HCL     x   1 mole    x   1 mole Ca (OH)2x        1 L                  =       0.921L**

**22.4 L          2 mole HCL                              0.200 mol**

11.     250 mL of water is added to 100 mL of 0.0200M H2SO4. What volume of 0.100M KOH will it neutralize?

          **H2SO4                   +        2KOH         →      2K2SO4                 +          2HOH**

**0.1 L H2SO4    x   0.0200mol       x    2 mole KOH    x   1 L   x          1000 mL**

**1L                          1 mole H2SO4       0.100 mol    1 L**

**=        40ml**

12.     What volume of 0.924 M Na2SO3is required for the production of 350.0 mL of SO2 at STP?

          2HCl   +   Na2SO3(aq)       +  2NaOH(aq)          →      2NaCl(aq)    +          H2O(l)+     SO2(g)

**1.69 x 10-2L**

13.     How many milliliters of hydrogen at   STP  can be generated by 500.0 mL 6.2 M NaOH completely reacting with excess Al.

          2Al(s)  +        6NaOH(aq)    →        2Na3AlO3(aq)+         3H2(g)

**3.5  x 104 mL**

14.     64.5 L of HCl gas at STP are dissolved in water to produce an acid           solution. What volume of 0.200 M Ba (OH)2 will this solution neutralize?

**7.20 L**

**Titration Calculations    Worksheet # 4**

1.       In a titration 12.5 mL of 0.200 M NaOH ia required to neutralize 10.0 mL of H2SO4.

          Calculate the concentration of the acid ?

**H2SO4               +        2NaOH         →      Na2SO4                   +          2HOH**

**0.0100 L                     0.0125 L**

**? M                             0.200 M**

**Molarity    =    0.0125 L NaOH   x      0.200 moles   x      1 mole H2SO4**

**1 L                 2 mole NaOH**

**0.0100 L**

**=        0.125 M**

2.       In a titration 22.5 mL of 0.100 M HCl ia required to neutralize 20.0 mL of Ba(OH)2 .

          Calculate the concentration of the base ?

**2HCl               +        Ba(OH)2         →      BaCl2                  +          2HOH**

**0.0225 L                     0.0200 L**

**0.100 M                           ? M**

**Molarity    =    0.0225 L HCl   x      0.100 moles   x        1 mole Ba(OH)2**

**1 L               2 mole HCl**

**0.0200 L**

**=        0.0563 M**

3.       A burette filled with 1.52 M nitric acid solution reads 33.10 mL initially. After titrating a 25.00 mL sample of

          barium hydroxide the endpoint was reached and the burette showed 46.30 mL. What is the barium hydroxide

          concentration?

**46.30  -  33.10   =  13.20 mL  =  0.01320 L**

**2HNO3         +          Ba(OH)2         →      Ba(NO3)2                  +          2HOH**

**0.01320 L                0.02500 L**

**1.52 M                     ? M**

                    **0.0132L HNO3      x  1.52 mole   x  1 mole Ba(OH)2**

**Molarity      =                                                1 L            2 mole HNO3            =         0.402 M**

                                                               **0.02500 L**

4.       A burette filled with 2.557 M sodium hydroxide solution reads 15.62 mL initially. After titrating a 25.00 mL sample of phosphoric acid the endpoint was reached and the burette now showed 39.22 mL. What is the [phosphoric acid]?

          **39.22  -  15.62   =  23.60 mL  =  0.02360 L**

**3NaOH       +        H3PO4                   →      Na3PO4       +        3H2O**

**0 .02360 L                0.02500 L**

**2.557 M                ? M**

                    **0.02360 L NaOH  x  2.557 mole  x   1 mole H3PO4**

**Molarity      =                                                1 L             3 mole NaOH                 =       0.8046 M**

                                                               **0.02500 L**

5.       A 10.00 mL sample of 2.120 M sodium hydroxide solution is placed in a 250.0 mL Erlenmeyer flask. An indicator called       bromothymol blue is added to the solution. The solution is blue. Hydrochloric acid was added from a burette until there was a green color (endpoint had been reached). Determine the concentration of hydrochloric acid given the following           burette readings:

                                        **Burette final                   =        22.04 mL**

**Burette initial                 -         12.08 mL**

**Difference                       =          9.96 mL              Beware subtraction!!!! One sig fig is lost!!!**

**NaOH         +        HCl             →      NaCl  +        H2O**

**.01000 L                .00996 L**

**2.120 M                ? M**

                    **0.01000 L NaOH   x   2.1220 mole      x      1 mole HCl**

**Molarity      =                                                  1 L                      1 mole NaOH    =   2.13 M HCl**

                                                               **0.00996 L**

6.       The following data was obtained during the titration of 1.0097 M sodium hydroxide with a 25.00 mL aliquot of hydrofluoric acid:

                                                                      Trial 1                   Trial 2                    Trial 3

                    Burette Final Reading                 34.56 mL                39.42 mL               44.20 mL

                    Burette Initial Reading               14.94 mL                19.86 mL               24.66 mL

                    Vol. of NaOH Added

          Use the above information to determine the concentration of the acid.

**NaOH         +        HF               →      NaF   +        H2O**

**0 .01955 L                0 .0250 L**

**1.0097 M                ? M**

                    **0.01955 L NaOH   x   1.0097 mole      x      1 mole HF**

**[HF]            =                                                  1 L                      1 mole NaOH          =       0.7896 M**

                                                               **0.0250 L**

7.       The following data was obtained during the titration of 0.0998 M sodium hydroxide with a

10.00 mL aliquot of sulphuric    acid:

                                                            Trial 1                   Trial 2                    Trial 3

                    Burette Final Reading               26.05 mL      48.52 mL      33.78 mL

                    Burette Initial Reading               2.46 mL       34.94 mL      20.22 mL

                    Vol. of NaOH added

          Use the above information to determine the concentration of the acid.

          **6.77  x  10-2 M**

8.       The following data was obtained during the titration of 2.0554 M hydrochloric acid with a 25.00 mL aliquot of barium hydroxide:

                                                                      Trial 1                   Trial 2                    Trial 3

                    Burette Final Reading                22.92 mL                25.32 mL                41.30 mL

                    Burette Initial Reading                 0.06 mL                 2.58 mL                18.54 mL

                    Volume of Acid Added

          Use the above information to determine the concentration of the barium hydroxide.

          **0.9352 M**

9.       What volume of 2.549 M NaOH is needed to fully titrate 50.0 mL of 1.285 M HCl solution ?

**HCl   +        NaOH                   →**

**0.0500 L HCl  x   1.285 mol   x   1 mole NaOH      x   1L          =       0.0252 L**

**1 L                1 mole HCl            2.549 mole**

10.     What volume of 1.146 M KOH is needed to fully titrate 20.8 mL of 0.557 M H2SO4 solution ?

**H2SO4         +        2KOH                   →**

**0.0208 L H2SO4   x   0.557 mol   x   2 mole KOH      x     1L      =        0.0202 L**

**1 L                   1 mole H2SO4         1.146 mole**

**Titrations Worksheet # 5**

1.       Calculate the mass of H2C2O4.2H2O required to prepare 500.0 mL of a 0.200M solution.

          **12.6 g**

2.       Calculate the mass of Cu2SO4.6H2O required to prepare 200.0 mL of a 0.300M solution.

          **19.9 g**

3.       In a titration 0.200 M NaOH is used to neutralize 10.0 mL of H2SO4. In three runs, the following data was collected. Calculate the concentration of the acid.

                                                            Volume of 0.20 M NaOH (mL)

          Initial Burette Reading               12.90            15.70            18.50

          Final Burette Reading15.70            18.50            21.50

**0.028 M**

4.       In a titration 0.250 M KOH is used to neutralize 25.0 mL of H3PO4. In three runs, the following data was collected. Calculate the concentration of the acid.

                                                            Volume of 0.250 M KOH (mL)

          Initial Burette Reading                         2.90              15.70            28.70

          Final Burette Reading15.70            28.70            42.70

                                                                    **12.80            13.00           ~~14.00~~**

                                                  **Use 12.90 mL**

**0.0430 M**

5.       Calculate the volume of 0.500M H3PO4 required to neutralize 25.0 mL of

          0.200M NaOH.

          **0.00333L**

6.       Calculate the volume of 0.50 M NaOH required to neutralize 35.0 mL of

          0.100M H2C2O4.

          **0.014L**

7.       In a titration 35.7 mL of 0.250 M H3PO4 is used to neutralize 25.0 mL of KOH. Calculate the molarity of the base.

          **2.08 M**

8.       In a titration 35.2 mL of 0.20 M H2C2O4 is used to neutralize 10.0 mL of NaOH. Calculate the molarity of the base.

**1.4 M**

9.                                     2 Al    +                  3 I2               →      2 AlI3

          Initial                     12.0 mol                 15.0 mol                    0

          Change:

End:                       **2.0 mol                  0mol                      10.0 mol**

10.                                   C        +        2Cl2              →                CCl4

          Initial                     16.0 mol       34.0 mol                            0

          Changes:

End:                       **0 mol           2.0 mol                            16.0 mol**

11.                                   4 Fe     +      3 O2             →                2 Fe2O3

          Initial                     12.0 mol       8.0 mol                            0

          Change:

End:                       **1.3 mol        0 mol                               5.33 mol**

12.                         2 NO            +                  O2                          →                2 NO2

                              100. g   x  1 mole             100. g   x  1 mole                        0

                                              30.0 g                               32.0 g

Init:              **3.333                               3.125                                         3.333**

Change:       **3.333                               1.667                                         3.333**

End:             **0                                      1.458 mol  x  32.0 g                  3.333  x  46.0g**

                                                                                          **1 mole                               1 mole**

Grams:         **0 g                                   46.7 g                                        153 g**

13.     Calculate the volume of H2 gas produced at STP by the reaction of 300. mL of 0.500 M HCl with excess Zn.

                              Zn    +    2HCl    →   H2    +     ZnCl2

**0.300 L         x   0.500 moles   x    1 mole H2      x       22.4 L     =   1.68 L**

                              **1 L                 2 mole HCl             1 mole**

14.     Calculate the volume of 0.30 M KCl solution that contains 9.00 g of KCl.

          **0.40 L**

**Dilutions Worksheet # 6**

1.       20.0 mL of 0.200 M NaOH solution is diluted to a final volume of 100.0 mL, calculate the new concentration.

**M1V1           =        M2V2**

**(20.0)(0.200)         =        M2(100.0)**

          **M2     =**        **0.0400 M**

2.       15.0 mL of a solution of NaOH is diluted to a final volume of 250.0 mL and the new molarity is 0.0500 M. Calculate the original molarity of the base.

**M1V1           =        M2V2**

**(15.0) M1    =        (250.0) (0.0500)**

          **M1     =**        **0.833 M**

3.       50.0 mL of 0.025 M NaOH solution is added to 150.0 mL of water. Calculate the new molarity.

          V2      =        50.0 mL  +  150.0 mL       =        200.0

**M1V1           =        M2V2**

**(0.025)(50.0)         =        M2 (200.0)**

          **M2     =**        **0.0063M**

4.       45.0 mL of a solution of NaOH is diluted by adding 250.0 mL of water to produce a new molarity of 0.0500 M. Calculate the molarity of the base.

          **0.328 M**

5.       A 0.125 M solution is concentrated by evaporation to a reduced final volume of 100.0 mL and a molarity of 0.150 M. Calculate the original volume.

          **120. mL**

6.       850.0 mL of 0.280 M KOH solution is diluted to a final volume of 1000.0 mL, calculate the new concentration.

          **0.238 M**

7.       95.0 mL of a solution of NaOH is diluted to a final volume of 135 mL and the new molarity is 0.0500 M. Calculate the   original molarity of the base.

          **0.0711 M**

**Molarity Review # 7**

1.       Convert 250. g AgNO3 to formula units and then to atoms of O.

          **2.66  x  1024 at O**

2.       Convert 5.9 x1025 H2 molecules to grams.

          **2.0  x  102 g H2**

3.       Calculate the percentage composition of MgSO4.

**20.2 % Mg           26.7 % S               53.2 % O**

4.       A compound is 42.3 % C, 5.94 % H, 32.9 % N, and18.8 % O and has a molecular    mass of 425.25 g/mol. Calculate the empirical and molecular formula.

          **C3H5N2O              C15H25N10O5**

5.       How many grams O2 are required to consume 56.3 g Al?

4Al      +         3O2       →      2Al2O3

          **50.0 g O2**

6.       25.5 mL of 0.100 M HCl reacts with excess Zn to produce 25.3 mL of H2 gas at STP. Calculate the theoretical yield in mL and the percentage yield of H2 gas.

          Zn      +   2HCl       →    H2     +           ZnCl2.

          **0.0255 L    x    0.100 mole     x    1 mole H2      x      22.4 L    =   0.0286 L                88.6 %**

                                        **1 L               2 mole HCl            1 mole**

7.       Calculate the energy produced by the complete reaction of 150. g H2.

          2H2+        O2→         2H2O   +   130. KJ

          **4.83  x  103 KJ**

8.       84.0 g of Al reacts with 122 g O2 to produce Al2O3.  How many grams of Al2O3are produced?  Determine the mass of the reactant in excess and the limiting reactant.

                    **4Al               +                  3O2                        →                2Al2O3**

**84.0 g  x  1 mole             122 g  x  1 mole**

**27 g                                 32 g**

**I         3.111 mole                                3.8125 mole                                        0**

**C       3.111 mole                                2.333 mole                                          1.5555 mole**

**E        0                                                1.4795 mole                                        1.5555 mole**

**47.3 g                                                  159 g**

9.       15.2 g of Al reacts with 14.3 g O2 to produce Al2O3.  How many grams of Al2O3are produced?  Determine the mass of the reactant in excess and the limiting       reactant.

                    **4Al               +                  3O2                        →                2Al2O3**

**15.2 g  x  1 mole             14.3 g  x  1 mole**

**27 g                                 32 g**

**I         0.5630 mole                              0.4469 mole                                        0**

**C       0.5630 mole                              0.4222 mole                                        0.2815 mole**

**E        0                                                0.247 mole                                          0.2815 mole**

**0.790 g                                                28.7 g**

10.     15.8 g of KCl is dissolved in 225 mL of water. Calculate the molarity.

**[KCl]           =        15.8 g          x        1 mole         =        0.941 M**

**74.6 g**

**0.225 L**

11.     Calculate the mass of KCl required to prepare 250.0 mL of 0.250 M solution.

**0.2500L       x        0.250 mole            x        74.6 g          =        4.66 g KCl**

                              **1 L                                   1 mole**

12.     Calculate the volume of 0.30 M BaCl2 solution that contains 6.00 g of KCl.

**6.00 g          x        1 mole         x        1 L               =        0.27 L**

**74.6 g                    0.30 mole**

13.     Calculate the volume of 0.250 M H3PO4 that contains 0.250 g H2SO4.

**0.250 g        x        1 mole         x        1 L               =        0.0102 L**

**98.03 g              0.250 mole**

14.     1.5 g of BaCl2 is dissolved in 100.0 mL of water. Calculate the concentration.

          **0.072 M**

15.     How many moles of BaCl2 are in 250.0 mL of a 0.200 M solution?

          **0.0500 moles**

16.     How many litres of a 0.200 MBaCl2 solution contain 0.250 moles?

          1.25 L

17.     Calculate the volume of H2 gas produced at STP by the reaction of 400.0 mL of 0.800 M HCl with excess Zn.

                              Zn    +    2HCl    →   H2    +     ZnCl2

          **3.58 L**

18.     Calculate the volume of 0.250 M H3PO4 required to neutralize 25.5 mL of  0.200M NaOH.

          **H3PO4         +        3NaOH             Na3PO4       +        3HOH**

          **? L                         0.0255 L**

**0.0255 L NaOH    x        0.200 mole     x     1 mole H3PO4       x        1 L                 =        0.00680 L**

                                                  **1 L                         3 mole NaOH                 0.250 mole**

19.     Calculate the volume of 0.500 M KOH required to neutralize 45.3 mL of  0.320 M H2SO4 .

**H2SO4         +        2KOH               K2SO4         +        2HOH**

**0.0453 L                ? L**

          **0.0453 L H2SO4    x        0.320 mole     x     2 mole KOH      x        1 L                 =        0.0580 L**

                                                  **1 L                         1 mole H2SO4              0.500 mole**

20.     Calculate the mass of CoCl3.6H2O required to prepare 500.0 mL of a 0.200 M solution.

          **27.4 g**

**Worksheet # 8 Dilutions and Molarity**

1.       40.0 mL of 0.400 M NaOH solution is diluted to a final volume of 200.0 mL,   calculate the new concentration.

**M1V1           =        M2V2**

**(0.400)(40.0)         =        M2(200.0)**

          **M2     =**        **0.0800 M**

2.       85.0 mL of a solution of NaOH is diluted to a final volume of 290.0 mL and the new molarity is 0.0500 M. Calculate the original molarity of the base.

          **M1V1           =        M2V2**

**M1(85.0)     =        (0.0500)(290.0)**

                    **M1               =**        **0.171 M**

3.       150.0 mL of 0.025 M NaOH solution is added to 150.0 mL of water. Calculate the new molarity.

          **M1V1                     =        M2V2**

**(0.025)(150.0)       =        M2(300.0)**

          **M2     =**        **0.013 M**

4.       220.0 mL of a solution of NaOH is diluted by adding 250.0 mL of water to produce a new molarity of 0.0500 M. Calculate the molarity of the base.

          **M1V1           =        M2V2**

**M1(220.0)             =        (0.0500)(470.0)**

                    **M1                         =        0.107 M**

5.       A 0.350 M solution is concentrated by evaporation to a reduced final volume of 100.0 mL and a molarity of 0.825 M. Calculate the original volume.

          **V1     =        236 mL**

6.       850.0 mL of 0.280 M KOH solution is diluted to a final volume of 1000.0 mL, calculate the new concentration.

**M2     =        0.238 M**

7.       28 g of KCl is dissolved in 225 mL of water, calculate the molarity.

          **1.7 M**

8.       Calculate the mass of KCl required to prepare 125 mL of 0.450 M solution.

          **4.20 g**

9.       Calculate the volume of 0.40 M KCl solution that contains 8.00 g of KCl.

          **0.27 L**

10.     Calculate the volume of 0.400 M H2SO4 required to neutralize 25.0 mL of 0.200 M NaOH.

          **0.00625 L**

11.     Calculate the volume of H2 gas produced at STP by the reaction of 250.0 mL of 0.600 M HCl with excess Zn.               Zn    +    2HCl    →   H2    +     ZnCl2

          **1.68 L**

12.     8.5 L of HCl gas at STP is dissolved in 325 mL of water, calculate the molarity of the acid solution.

          **1.2 M**

13.     How many moles of NaCl are in 350.0 mL of a 0.400 M solution?

**0.140M**

14.     How many litres of a 0.300 M KCl solution contain 0.350 moles?

          **1.17 L**

15.     Calculate the mass of 8.25 x 105 mL of H2 gas at STP.

          **74.4 g**

16.     Calculate the number of formula units of KCl in 200.0 mL of 0.300 M solution.

**3.61  x  1022 FU**

**Worksheet # 9     Ion Concentration**

1.       What is the concentration of each ion in a 10.5 M sodium sulphite solution?

           **Na2SO3     →      2 Na+          +        SO32-**

**10.5 M                  21.0M                   10.5M**

2.       What is the concentration of each ion in the solution formed when 94.5 g of nickel (III) sulphate is dissolved into 850.0 mL of water?

**Ni2 (SO4) 3             →      2Ni3+            +        3S042-**

**0.274 M                          0.548M                 0.822M**

**Molarity =   94.5 g          x        1 mole**

**405.7 g                  =        0.274M**

**0.8500L**

3.       If 3.78 L of 0.960 M calcium fluoride solution is added to 6.36 L of water, what is the resulting concentration of each ion?

**M1V1 = M2V2CaF2           →                Ca2+         +        2F-**

**(0.960) (3.78) = M2 (10.14)                0.358 M                          0.358 M                    0.716 M**

**M2= 0.358 M**

4.       What is the concentration of each ion in a 5.55 M zinc phosphate solution?

                    **Zn3 (PO4)2            →      3Zn2+          +        2PO43-**

**5.55 M                            16.7                       11.1 M**

5.       What is the concentration of each ion in the solution formed when 94.78 g of iron (III) sulphate

          is dissolved into 550.0 mL of water?

                              **Fe2 (SO4)3   →      2Fe3++        3SO42-**

**0.4309 M              0.8619 M              1.293 M**

**94.78 g        x        1 mol**

**[Fe2 (SO4)3]          =                                    399.9 g          = 0.4309 M**

**0.5500 L**

6.       If 6.25 L of 0.560 M sodium bromide solution is added to 3.45 L of water, what is the resulting

          Concentration of each ion?

**M1V1 = M2V2NaBr           →                    Na+         +            Br-**

**(0.560) (6.25) = M2(9.70)**        **0.361 M                              0.361 M                0.361 M**

**M2= 0.361 M**

7.       50.0 mL of 0.200 M Na3PO4 solution is mixed with 150.0 mL of 0.400 M Na2CO3.

         Calculate all ion concentrations.

                    **Na3PO4             →      3 Na+           +        PO43-**

**50.0          0.200 M                     0.150 M                0.0500 M**

     **200.0**

            **Na2PO4             →      2 Na+           +        CO32-**

**150.0       0.400 M                      0.600 M                   0.300 M**

     **200.0**

**[Na+] = 0.600 M + 0.150 M = 0.750 M**

8.       What is the concentration of each ion in the solution formed when 16.5 g of Aluminum sulphate is

          dissolved into 600.0 mL of water?

                                          **16.5 g                  x        1 mol**

**[Al2 (SO4)3] =                                               342.3 g        =   0.0803 M**

**0.600 L**

**Al2 (SO4)3   →      2Al3++         3SO42-**

                    **0.0803 M              0.161 M      0.241M**

9.       If 1.78 L of 0.420 M barium fluoride solution is added to 2.56 L of water, what is the resulting

          concentration of each ion?

          **M1V1 = M2V2BaF2          →Ba2+            +          2F-**

**(0.420)(1.78) = M2 (4.34)                   0.172 M                0.172 M               0.345 M**

**M2 =0.172 M**

10.     What is the concentration of each ion in a 1.22 M zinc acetate solution?

                    **Zn (CH3COO) 2    → Zn 2+       +        2CH3COO-**

**1.22 M                       1.22M              2.44M**

11.     What is the concentration of each ion in the solution formed when 94.78 g of cobalt (III) sulphate

          is dissolved into 400.0 mL of water?

**[Co2(SO4)3]           =        94.78 g        x        1 mole**

**406.1 g        =        0.5835 M**

**0.4000 L**

**Co2(SO4)3             →                2Co3+          +        3SO42-**

**0.5835 M                                  1.167 M                1.750 M**

12.     If the chloride concentration in 2.00 L of solution is 0.0900 M, calculate the [Al3+] and the molarity of the AlCl3 solution.

**AlCl3            →      Al3+              +                  3Cl-**

**0.0300 M              0.0300 M                        0.0900 M**

13.     If the [Ga3+] concentration in 2.00 L of solution is 0.0300 M, calculate the [SO42-] and the molarity of the Ga2(SO4)3 solution.

**Ga2(SO4)3   →      2Ga3+          +        3SO42-**

**0.0150 M              0.0300 M              0.0450 M**

14.     In a titration 12.5 mL of 0.200 M NaOH is needed to neutralize 10.0 mL of H3PO4, calculate the acid concentration.

**H3PO4         +        3NaOH       →      Na3PO4       +        3HOH**

**0.0100 L                0.0125 L**

**? M                       0.200 M**

**[H3PO4]       =        0.0125 L NaOH    x      0.200 mole    x       1 moles H3PO4**

**1 L                         3 mole NaOH     =        0.0833 M**

**0.0100 L**

15.     What volume of 0.200 M H2SO4 is required to neutralize 25.0 mL of 0.300 M NaOH?

**H2SO4         +        2NaOH       →      Na2SO4       +        2HOH**

**? L                         0.0250 L**

**0.200 M                0.300 M**

**0.0250 L NaOH    x        0.300 mole    x      1 moles H2SO4      x        1 L             =    0.0188 L**

**1 L                        2 NaOH                           0.200 mole**

16.     The [Cl-]    =  0.600 M in 100.0 mL of a AlCl3 solution. How many grams AlCl3are in the solution?

**AlCl3                  Al3+    +        3Cl-**

**0.200 M                                    0.600 M**

**0.1000 L     x    0.200 mole   x   133.5 g       =        2.67 g**

**1 L                1 mole**

17.     The [SO42-]   =  0.600 M in 100.0 mL of a Al2(SO4)3 solution. How many gramsAl2(SO4)3are in the solution?

                    **6.85 g**

**Worksheet # 10              Molarity Unit Review # 1**

1.       200.0 mL of 0.200 M H2SO4 reacts with 250.0 mL of 0.40 M NaOH, calculate the concentration of the excess base.

**H2SO4                   +                  2NaOH                 →      Na2SO4         +        2HOH**

**0.2000 L  x  0.200 mole            0.250 L  x  0.40 mole**

**1 L                                             1 L**

**I                   0.0400 mole                              0.100 mole**

**C                 0.0400 mole                              0.0800 mole**

**E                  0                                                0.020                               Note the loss of one sig fig!**

**[NaOH]       =        0.020 mole  =        0.044 M**

**0.4500 L                                    Note that the final volume is 250.0 + 200.0 mL**

2.       100.0 mL of 0.100 M H2SO4 reacts with 50.0 mL of 0.20 M NaOH, calculate the concentration of the excess acid.

**H2SO4                   +                  2NaOH                 →      Na2SO4         +        2HOH**

**0.1000 L  x  0.100 mole            0.050 L  x  0.20 mole**

**1 L                                             1 L**

**I                   0.0100 mole                              0.010 mole**

**C                 0.0050 mole                              0.010 mole**

**E                  0.0050 mole                              0**

**[H2SO4]       =        0.0050 mole          =        0.033 M**

**0.1500 L**

**Note that the final volume is 100.0 + 50.0 mL**

3.       500.0 mL of 0.100 M H2SO4 reacts with 400.0 mL of 0.400 M NaOH, calculate the concentration of the excess base.

**H2SO4                   +                  2NaOH                 →      Na2SO4         +        2HOH**

**0.5000 L x  0.100 mole             0.4000 L x  0.40 mole**

**1 L                                             1 L**

**I                   0.0500 mole                                0.160 mole**

**C                 0.0500 mole                                 0.100 mole**

**E                  0 mole                                        0.060 mole**

**Note the loss of sig figs!**

**[NaOH]       =        0.06 mole  =        0.067 M**

**0.900 L**

**Note that the final volume is 500.0 + 400.0 mL**

4.       100.0 mL of 0.200 M MgCl2 reacts with 300.0 mL of 0.400 M AlCl3, calculate all ion concentrations.

                    **MgCl2             →      Mg2+           +        2Cl-**

**100.0       0.200 M                     0.0500 M               0.100 M**

     **400.0**

            **AlCl3             →        Al3+           +          3Cl-**

**300.0       0.400 M                      0.300 M                 0.900 M**

     **400.0**

**[Cl-] = 0.100 M + 0.900 M = 1.000 M**

5.       Change 2.66 moles of H2O to molecules.

          **1.60 x 1024 molecules**

6.       Change 9.7x1019 atoms Fe to moles.

          **1.6 x 10-4 mole**

7.       Convert 88.3 g AgNO3 to formula units and then to atoms of O.

**88.3 g   x   1 mol       x    6.02 x 1023 FU      x        3 atoms O   =        9.39 x  1023 atoms O**

**169.9 g                        1 mol                 1 FU**

8.       Convert 3.8 x 1025 H2 molecules to grams.

          **1.3 x 102 g**

9.       Calculate the empirical formula of a compound that is 62.2 % Pb, 8.454 % N, and 28.8 % O.

          Is this compound ionic or covalent?

**Pb (NO3)2**

10.     A compound is 42.3 % C, 5.94 % H, 32.9 % N, and 18.8 % O and has a molecular mass of 425.25 g/mol. Calculate the empirical and molecular formula.

          **C15H25N10O5**

11.     How many moles of Al2O3 are produced by the reaction 200. g Al?

4Al       +      302→     2Al2O3

**3.70 mole**

12.     How many moles Al are required to produce 300. g Al2O3?

                    4Al       +      302→     2Al2O3

**5.88 mole**

13.     100. g Al reacts with excess O2 to produce 150. g Al2O3 according to

          Calculate the theoretical and percentage yield. 4Al  +  302→      2 Al2O3.

          **79.4 %**

14.     Calculate the energy produced by the complete reaction of 150. g H2.

          2H2+        O2→      2H2O  +  130. KJ

       **4.83 x 103 kJ**

15.     How many grams of H2 would be needed to produce 260. KJ of energy?

          2H2+  O2→  2H2O  +  130. KJ

          **8.08 g**

16.     20. mol H2 reacts with 8.0 mol O2 to produce H2O.  Determine the number of grams reactant in excess and number of grams H2O produced.  Identify the limiting reactant.

          **8 g H2,         2.9 x 102 g H2O**

17.     How many litres of O2 gas are required to produce 100. g Al2O3?

                    4Al       +      302→     2Al2O3

**32.9 L**

18.     15.8 g of KCl is dissolved in 225 mL of water. Calculate the molarity.

          **0.941 M**

19.     Calculate the mass of KCl required to prepare 250.0 mL of 0.250 M solution.

          **4.66 g**

20.     Calculate the volume of 0.30 M KCl solution that contains 6.00 g of KCl.

**0.27 L**

21.     Calculate the volume of 0.250 M H2SO4 required to neutralize 20.0 mL of 0.100 M NaOH.

**0.00400 L**

22.     Calculate the volume of H2 gas produced at STP by the reaction of 150.0 mL of 0.500 M HCl with excess Zn.

                    Zn    +    2HCl    →   H2    +     ZnCl2

**0.840 L**

23.     1.5 L of HCl gas at STP is dissolved in 225 mL of water, calculate the molarity of  the acid solution.

**0.30 M**

24.     How many moles of NaCl are in 250. mL of a 0.200 M solution?

          **0.0500 moles**

25.     How many litres of a 0.200 M KCl solution contain 0.250 moles?

**1.25 L**

26.     Calculate the mass of 2.25 x 105 mL of H2 gas at STP.

**20.3 g**

27.     Calculate the number of formula units of KCl in 100.0 mL of 0.200 M solution.

**1.20 x 1022 FU**

28.     40.6g of KBr is dissolved in 500.0 mL of water, calculate the molarity.

**0.682 M**

29.     Calculate the mass of KBr required to prepare 450.0 mL of 0.350 M solution.

          **18.7 g**

30.     Calculate the volume of 0.50 M KCl solution that contains 3.00 g of KCl.

          **0.080 L**

31.     Calculate the volume of 0.250 M H3PO4 required to neutralize 25.5 mL of

          0.200 M NaOH.

          **0.00680 L**

32.     In a titration 22.5 mL of 0.200 M H3PO4 is required to neutralize 10.0 mL of KOH. What is the molarity of the base?

**1.35 M**

**Worksheet # 11    Molarity Unit Review # 2**

1.         100.0 mL of 0.200 M HCl, 200.0 mL of 0.100 M HBr, and 175 mL of 0.100 M Ba(OH)2.

             Calculate the concentration of the excess acid or base.

**0.1000 L  x  0.200 mole   =    0.0200 mole HCl**

**1L**

**0.2000 L  x  0.100 mole   =    0.0200 mole HBr**

**1L**

**=    0.0400 mole HX**

**0.175L  x  0.100 mole   =    0.0175 mole Ba(OH)2**

**1L**

**2HX              +           Ba(OH)2**

**I           0.0400 mole                0.0175 mole**

**C        0.0350 mole           0.0175 mole**

**E         0.0050 mole                0.0000**

**Total Volume =  100.0 mL  +  200.0 mL  +  175 mL   =   475 mL**

**[HX] = 0.0050 mole**

**0.475 L**

**[HX] =  0.011 M**

**2.      150.0 mL of 0.200 M HCl and 250 mL of 0.300 M HNO3react with excess CaCO3.**

**Calculate the theoretical yield of CO2. Start by writing an equation.**

**HCl         +      CaCO3              CO2     +      CaCl2         +    H2O**

**0.1500 L HCl    x   0.200 mole    x    1 mole CO2   x   44.0 g     =    0.660 g**

**1 L                 2 mole HCl        1 mole**

**HNO3        +      CaCO3              CO2     +      Ca(NO3)2             +    H2O**

**0.2500 L HNO3   x   0.300 mole    x    1 mole CO2   x   44.0 g     =    1.65 g**

**1 L                    2 mole HCl        1 mole**

**Total               2.31 g**

3.       Calculate the percentage composition of Al2(SO4)3 to three significant figures.

**2 Al              54.0             %Al =         54.0             x        100%                    =          15.8 %**

**342.3**

**3 S               96.3             %S =           96.3             x        100%                    =          28.1 %**

**342.3**

**12 O            192.0           % O =         192.0           x        100%                    =         56.1%**

**342.3                               342.3**

4.      A compound is 42.3 % C, 5.94 % H, 32.9 % N, and and18.8 % O and has a molecular mass of 850.5g/mol. Calculate the empirical and molecular formula.

          **42.3 g C      x        1 mol           =        3.525 mol    =        3                  C3H5N2O   →      C30H50N20O10**

**12.0 g**

**5.94 g H      x        1 mol           =        5.881 mol    =        5**

**1.01 g**

**32.9 g N      x        1 mol           =        2.350 mol    =        2**

**14.0 g**

**18.8 g O      x        1 mol           =        1.175 mol    =        1**

**16.0 g**

5.       How many grams of 02 are required to consume 56.3 g Al?

          4Al      +         302       →      2Al2O3

          **56.3 g Al      x        1 mol           x        3 mol O2      x        32.0 g                    =       50.0 g O2**

**27.0 g                    4 mol Al                 1 mol**

6.       15.8 g of AlCl3 is dissolved in 225 mL of water, calculate the molarity.

          **Molarity      =        15.8 g          x        1 mol**

**133.5 g        =        0.526 M**

**0.225 L**

7.       Calculate the mass of AlCl3 required to prepare 250.0 mL of 0.250 M solution.

          **0.250 L        x        0.250 mol    x        133.5 g        =        8.34 g**

**L                      1 mol**

8.       Calculate the volume of 0.30 M AlCl3 solution that contains 6.00 g of AlCl3.

          **6.00 g                    x        1 mol           x        1 L               =        0.15 L**

**33.5 g                    0.30 mol**

9.       Calculate the volume of 0.450 M H2SO4 required to neutralize 25.0 mL of

          0.200 M NaOH.

          **H2SO4         +        2NaOH       →      Na2SO4       +        2HOH**

**? L                       0.025 L**

**0.025 L NaOH      x        0.200 mol    x        1 mol H2SO4x           L                 =        0.00556 L**

**L                        2 mol NaOH                   0.450 mol**

10.     Calculate the volume of H2 gas produced at STP by the reaction of 350.0 mL of 0.600 M HCl with excess Zn.

                              Zn    +    2HCl    →   H2    +     ZnCl2

          **0.350 L HCl          x        0.600 mol    x        1 mol H2      x        22.4 L          =       2.35 L**

**L                        2 mol HCl             1 mol**

11.     2.9 L of HCl gas at STP is dissolved in 225 mL of water, calculate the molarity of the acid solution.

          **Molarity      =        2.9 L  x        1 mol           =        0.58 M**

**22.4 L**

**0.225 L**

12.     How many moles of NaCl are in 500.0 mL of a 0.300 M solution?

          **0.500 L        x        0.300 mol    =        0.150 mol**

**L**

13.     How many litres of a .2300 M KCl solution contain 0.250 moles?

          **0.250 mol    x              L                      =        1.09 L**

**0.2300 mol**

14.     Calculate the mass of 560. mL of CO2 gas at STP.

          **0.560 L        x        1 mol           x           44.0 g                 =        1.10g**

**22.4 L                       1 mol**

15.     Calculate the number of formula units of NaCl in 100.0 mL of 0.200 M solution.

          **0.100 L        x        0.200 mol    x        6.02 x 1023FU       =        1.20 x 1022 FU**

**L                         1 mol**

16.     25.5 mL of 0.100 M HCl reacts with excess Zn to produce 25.3 mL of H2 gas at STP.

          Calculate the theoretical yield in mL and the percentage yield of H2 gas.

          Zn  +   2HCl   →  H2     + ZnCl2.

          **0.0255 L      x        0.100 mol    x        1 mol H2      x        22.4 L          =         0.0286 L**

**L                       2 mol HCL            1 mol**

**% Yield       =        25.3   x        100 %         =        88.6 %**

**28.6**

17.     Calculate the energy produced by the complete reaction of 150. g H2.

          2H2+O2→      2H2O  +        130KJ

          **150 g H2      x        1mol            x        130 KJ        =        4.83 x 103 KJ**

**2.02 g                              2 mol**

18.     84.0 g of Al reacts with 122g O2 to produce Al2O3.  How many grams of Al2O3are produced?  Determine the mass of the reactant in excess and the limiting reactant.

**4 Al                        +                            3O2              →                2Al2O3**

**84.0 g          x        1 mol                               122g  x        1mol**

**27.0 g                                                 32.0 g**

**I         3.111 mol                                            3.813 mol                                  0**

**C       3.111 mol                                            2.333 mol                                  1.556**

**E        0                                                          1.48   mol                                1.556**

**Limiting                                                        47.4 g O2 excess                        159 g**

19.     Calculate the percentage composition of Na2SO4.

**2 Na            46.0 g                              % Na                    =        32.4 %**

**1 S               32.1 g                              % S                       =        22.6 %**

**4 O              64.0 g                              % O                      =        45.0 %**

**142.1**

20.     How many litres of O2 gas are required to produce 100. g Al2O3?

                    4Al       +      O2→     2Al2O3

**100. g Al2O3          x        1 mole         x        3 mole O2   x        22.4 L  =   32.9 L**

**102 g                     2 mole Al2O3                   1 mole**

21.     Calculate the molar mass of a gas that weighs 19.43 g and has a STP volume of 9.894 L.

          If the gas is a very funny one containing nitrogen and used by the dentist, determine the

          molar mass and molecular formula for the gas.

          **9.894 L        x        1 mole         =        0.4417 mole**

                                        **22.4 L**

**Molar Mass          =        19.43 g                            =        44.0 g/mole           N2O**

                                                  **0.4417 mole**

Write a balanced formula equation, complete ionic equation, and net ionic equation for each reaction. There are two no reactions.

22.     **Zn(s)  +      2AgNO3(aq)→       2Ag(s)           +        Zn(NO3)2(aq)**

          **Zn(s)  +      2Ag+    +        2NO3-→  2Ag(s)           +        Zn2+             +         2NO3-**

          **Zn(s)  +      2Ag+    →  2Ag(s)           +        Zn2+**

23.     **BaS(aq)        +        2KOH(aq)     →      Ba(OH)2(s)   +        K2S(aq)**

          **Ba2++        S2-      +        2K+    +        2OH-           →      Ba(OH)2(s)   +         2K++S2-**

                              **Ba2+**   **+        2OH-           →      Ba(OH)2(s)**

24.     **2NaCl(aq)     +        F2(g)   →      2NaF(aq)       +        Cl2(g)**

          **2Na+     +     2Cl-    +        F2(g)   →      2Na+    +      2F-     +        Cl2(g)**

          **2Cl-    +        F2(g)   →                2F-     +        Cl2(g)**

25.     **Sr(OH)2 (aq) +        CuSO4(aq)    →      Cu(OH)2 (s)  +        SrSO4(s)**

**Sr2+   +        2OH-           +        Cu2+            +        SO42-           →          Cu(OH)2 (s)  +        SrSO4(s)**

          **Sr2+   +        2OH-           +        Cu2+            +        SO42-           →          Cu(OH)2 (s)  +        SrSO4(s)**

26.     NaCl(aq)        +        Cu(NO3)2(aq)           →

**No reaction, both possible products have high solubility**

27.     NaCl(aq)     +    ZnF2(aq)→

**No reaction, both possible products have high solubility**

28.     100.0 g of an aqueous compound that is 45.49 % Pb, 12.31 % N, and 42.20 % O reacts with another compound that is 28.16 % N, 8.13 % H, 20.79 % P, and 42.91 % O. If the actual yield of the product containing lead is 60.0 g, calculate the        percentage yield.

**60.0 g          Actual Yield**

**3Pb(NO3)4(aq)        +        4(NH4)3PO4(aq)      →      Pb3(PO4)4(s)          +         12NH4NO3(aq)**

**100.0 g                                                                    ? g               Theoretical Yield**

**100.0 g Pb(NO3)4 x  1 mole     x        1 mole Pb3(PO4)4           x        1001.6 g         =        75.3 g**

                                  **455.2 g              3 mole** **3Pb(NO3)4                    1 mole**

**% yield        =        60.0 g                    x        100%                    =          81.8 %**

29.     The following data was obtained during the titration of 2.0554 M hydrochloric acid with a 25.00 mL aliquot of barium hydroxide:

                                                                      Trial 1                   Trial 2                    Trial 3

                    Burette Final Reading                  22.92 mL                25.32 mL               41.30 mL

                    Burette Initial Reading               0.06 mL                 2.58 mL                 18.54 mL

                    Vol. of Acid Added                   **~~22.86 mL~~**             **22.74 mL                22.76 mL**

          Use the above information to determine the concentration of the barium hydroxide.

**2HCl           +        Ba(OH)2     →**

**0.02275 L              0.02500 L**

**2.0554 M              ? M**

**Molarity  Ba(OH)2        =        0.02275 L    x        2.0554 mole          x        1 moleBa(OH)2**

                                                                      **1 L                                   2 mole HCl**

**0.02500 L**

                                                            **=        0.9352 M**

30.       20.0 mL of 0.200 M NaOH solution is diluted to a final volume of 100.0 mL, calculate the new concentration.

**M1V1                     =        M2V2**

**(0.200)(20.0)         =        M2(100)**

**M2     =        0.0400 M**

31.     20.0 mL of 0.300 M AlCl3 is mixed with 20.0 mL of 0.300 CaCl2, calculate all ion concentrations.

                    **ACl3             →          Al3+           +        3Cl-**

**20.0         0.300 M                     0.150 M                0.450 M**

     **40.0**

            **CaF2              →         Ca2+           +        2Cl-**

**20.0         0.300 M                      0.150 M                 0.300 M**

     **40.0**

**[Cl-] = 0.450 M + 0.300 M = 0.750 M**

32.     A burette filled with 2.000 M sodium hydroxide solution reads 20.20 mL initially. After titrating a

25.00 mL sample of phosphoric acid the endpoint was reached and the burette now showed 40.20 mL. What is the    [phosphoric acid]?

**H3PO4         +        3NaOH       →**

**0.02500 L              0.02000 L**

**? M                       2.000 M**

**Molarity  H3PO4                  =        0.02000 L    x        2.000 mole  x          1 mole H3PO4**

                                                                                          **1 L                         3 mole NaOH**

**0.02500 L**

                                                            **=        0.5333 M**

33.     Calculate the volume of 0.500M KOH required to neutralize 45.0 mL of 0.320 M H2SO4.

          **H2SO4                   +        2KOH         →**

**0.0450 L                          ? L**

**0.0450 L H2SO4    x        0.320 moles x        2 mole KOH         x        1 L                  =        0.0576 L**

                                        **1 L                         1 mole H2SO4                 0.500 mole**

34.     100.0 mL of 0.200 M H2SO4 reacts with 150.0 mL of 0.40 M NaOH, calculate the concentration of the excess base.

          **H2SO4                   +                  2NaOH                           →**

**0.1000 L  x  0.200 mole                      0.1500 L   x  0.40 mole**

**1 L                                                       1L**

**I         0.0200 mole                              0.060 mole**

**C       0.0200 mole                              0.0400 mole**

**E        0                                                0.020 mole Note the loss of one sig fig**

**[NaOH]       =        0.020 mole            =        0.080 M**

                                        **0.250 L**

35.     200.0 mL of 0.10 M H2SO4 reacts with 100.0 mL of 0.20 M NaOH, calculate the concentration of the excess acid.

**H2SO4                   +                  2NaOH       →**

**0.2000 L  x  0.100 mole                      0.1000 L   x  0.20 mole**

**1 L                                                         1L**

**I         0.0200 mole                              0.020 mole**

**C       0.010 mole                                0.020 mole**

**E        0.010    loss of one sig fig         0**

**[H2SO4]       =        0.010 mole            =        0.033 M**

                              **0.300 L**

36.       250.0 mL of 0.100 M H2SO4 reacts with 100.0 mL of 0.400 M NaOH and

            200.0 mL of 0.200 M KOH, calculate the concentration of the excess base.

**H2SO4                   +                  2XOH       →**

**0.2500 L  x  0.100 mole                      0.1000 L   x  0.400 mole**    **+     0.2000 L   x 0.200 mole**

**1 L                                                         1L**                                                           **1L**

**I         0.0250 mole                              0.0800 mole**

**C       0.0250 mole                               0.0500 mole**

**E        0                                               0.0300 mole**

**[NaOH]       =        0.0300 mole                    =        0.0545 M**

                              **0.550 L**

**Worksheet # 12   Chemistry 11 Calculations Practice Test # 1**

Pick two formulas that match each classification:

1.   **a                   b**Acid                                 a)  HCl                   e) KOH

2.   **c                   d**Covalent Nonacid            b) CH3COOH          f) NH4Cl

3.   **h                   f**Salt                                  c)  CH4                   g) Ba(OH)2

4.   **e                   g**Base                                 d)  HOH                 h)  AgNO3

5.   Calculate the molarity of the solution formed when 200 g of NaCl is dissolved in

      100 mL of H2O.

**Molarity = 200g   x   1 mole**

**58.5g           =     34.2 M**

**0.100 L**

6.       How many grams of AgCl are required to prepare 150 mL of 0.200 M solution?

**0.150L   x   0.200 mole   x    143.4 g       =    4.30 g**

**1 L              1 mole**

7.       How many litres of 0.200 M AgCl are needed to provide 50 g of AgCl?

**50g   x      1 mole   x           1 L       =    1.7 L**

**143.4g         0.200 mole**

8.       100 g of AlCl3 is dissolved in 200 mL H2O, calculate [Al3+] and [Cl-].

**100 g   x 1 mole**

**Molarity =                     133.5 g           =     3.745 M     AlCl3    →    Al3++       3Cl-**

**0.200 L**

                                          **3.745 M                     3.75 M       11.2M**

9.       In three runs of a titration 36.9, 34.4 and 34.3 mL of 0.200 M NaOH was required to neutralize a 25.0 mL sample of H2CO3. Calculate the molarity of the acid.

                                               **H2SO4              +             2NaOH    →         Na2SO4     +              2HOH**

**0.0250 L                          0.3435 L**

**? M                                 0.200 M**

**[ H2SO4]                =        0.03435 L   x   0.200 mole   x  1 mole H2SO4       =    0.137 M**

**1 L               2 mole NaOH**

**0.0250 L**

**=        0.137 M**

10.    Calculate the [NaOH] due to excess NaOH in the new solution produced by mixing 100. mL

0.200 M HCl and 100. mL 0.300 M NaOH.

**HCL            +                  NaOH         →      NaCl      +                 HOH**

**0.100L   x   0.200 mole  =   0.0200 mol         0.100L x 0.300 mol  =   .030 mole**

**1 L                                                         1 L**

**I                                    0.0200 mole                    0.0300 mole**

**C                                  0.0200 mole                    0.0200 mole**

**E                                   0  mole                            0.0100 mole**

**Total Volume = 200 mL = 0.200 L           Molarity     =         0.0100 mole           = 0.0500 M**

**0.200 L**

11.    A empty beaker has a  mass of 29.86 g. The same beaker is filled with 0.250 L with a solution of CaCl2 and weighs 87.26 g. The solution is evaporated to dryness and the mass of the beaker and solid is 62.31 g. Calculate the molarity of the solution.

**Mass of CaCl2 = 62.31 – 29.86 = 32.45g**

**Molarity = 32.45g   x   1 mole**

**111.1g           =     1.17 M**

**.250 L**

12.     Complete the reaction equations.

      i) Formula Equation/Chemical Equation

**2AgNO3 (aq)  +  Na2SO4 (aq)  →      Ag2SO4(s)+      2NaNO3(aq)**

      ii) Total Ionic Equation

**2Ag+(aq)+     2NO3-    +    2Na+(aq)+  SO42-    →     Ag2SO4(s)+      2Na+(aq)+      2NO3-(aq)**

      iii) Net Ionic Equation

**2Ag+(aq)+  SO42-        →     Ag2SO4(s)**

13. Complete the formula equation:

**2H3PO4(aq)    +    3Sr(OH)2(aq)     →    Sr3(PO4)2(s) +        6HOH(l)**

Complete the complete ionic equation:

**6H+(aq)+     2PO43-     +    3Sr2+(aq)+    6OH-  →   Sr3(PO4)2(s)         +       6HOH(l)**

Complete the net ionic equation:

**6H+(aq)+     2PO43-     +    3Sr2+(aq)+    6OH-      →        Sr3(PO4)2(s)   +       6HOH(l)**

14. Complete the formula equation:

**Fe3(PO4)2(aq)    +    3Zn(s)     →           3Fe(s)     +     Zn3(PO4)2(s)**

Complete the complete ionic equation:

**3Fe2+(aq)+    2PO43-**    **+    3Zn(s)     →        3Fe(s)     +     Zn3(PO4)2(s)**

Complete the net ionic equation:

**3Fe2+(aq)+    2PO43-**    **+    3Zn(s)     →        3Fe(s)     +     Zn3(PO4)2(s)**

**Worksheet # 13              Chemistry Calculations Practice Test # 2**

1.       Calculate the number of formula units in 250. g  CaCl2.

          **1.35 x 1024   FU**

2.       Calculate the mass of 2.35 x 1020  molecules of CO2.

          **0.0172 g**

3.       Calculate the STP volume of 10.0 g of CO2 gas.

          **5.09 L**

4.       Calculate the number of grams CaCl2 in 350. mL of a 0.250M solution.

          **9.72g**

5.       Calculate the volume of 0.250 M NaCl solution that would contain 0.17 g NaCl.

          **0.012L**

6.       1.26 g of AlCl3 are dissolved in 160.0 ml of water. Calculate the molarity of the solution.

          **0.0590M**

7.       12.5 ml of CO2 gas at STP are dissolved in 250.0 ml of water. Calculate the molarity of the solution.

          **0.00223M**

8.       10.0 g of Al2(SO4)3 is dissolved in 155 ml of water. Calculate the two ion concentrations.

          **0.377 M**

**0.565 M**

9.       200.0 ml of 0.200M H3PO4 reacts with 200.0 ml of 0.300M KOH. Calculate the molarity of the excess acid in the new solution formed.

**0.0500M**

10.     16 g of Ca react with water. Calculate the volume of H2 gas produced at STP.

          Ca   +   2H2O      H2   +   Ca(OH)2

          **8.9L**

11.     In a titration 0.200 M NaOH is used to neutralize 10.0 mL of H2SO4. In three runs the following data was collected. Calculate the concentration of the acid.

          Volume of 0.200 M NaOH         25.3 mL       25.8 mL       25.6 mL

**0.256 M**

12.     60.0 g of Al react with 60.0 g of O2. Calculate the amount of excess reactant.

          4Al      +       3O2   →      2Al2O3

          **6.66 g O2**

13.     Calculate the percentage composition of the elements in Ga2 (SO4)3 to three significant digits.

                    **32.6%         ,           22.5%       ,          44.9%**

14.     What volume of 0.300 M solution must be diluted to a final volume of 1200.0 mL and have a molarity of 0.2500M.

          **1.00L**

15.     Calculate the number of grams NaCl produced by the complete reaction of

          520 g Cl2.               2Na              +        Cl2    →    2NaCl

**857g**

16.     If the actual yield of NaCl in the last question was 200. g, calculate the percentage yield of NaCl.

          **23.3%**

17.     200.0 ml 0.200 M HCl reacts with 400.0 ml  0.150M NaOH. Calculate the molarity of excess base.

          HCl   +         NaOH   →    NaCl    +      H2O

          **0.0333M**

18.     100.0 mL of 0.250 M HCl solution is diluted by adding 250.0 mL of water, calculate the new concentration.

**0.0714M**

19.     65.5 mL of 0.300 M is diluted to a new molarity of 0.0600 M, how much water was added?

**262mL**

20.     56.0 mL of 0.100 M HCl reacts with 0.250 M Ba (OH)2, calculate the volume of base required to completely neutralize the acid.

          **0.0112L**

21.     Write the formula, complete, and net ionic equation for each.

          H3PO4 (aq)and NaOH(aq).

          **H3PO4 (aq)+ 3NaOH (aq)→ Na3PO4 (aq) + 3HOH(l)**

**3H+ (aq) + PO4-3 (aq) + 3Na+ (aq) + 3OH- (aq) → 3Na+ (aq) + PO4-3 (aq) + 3HOH(l)**

**H+ (aq) + OH- (aq)→ HOH (l)**

22.     Write the formula, complete, and net ionic equation for each.

          Na3PO4(aq)and Ca (NO3)2(aq).

          **2Na3PO4 (aq) + 3Ca(NO3)2 (aq) → Ca3 (PO4)2 (s) + 6NaNO3 (aq)**

**Na+ (aq) + 2PO43- (aq) +3Ca2+ (aq) + 6NO3- (aq) → Ca3 (PO4)2 (s) + 6Na+ (aq)+6NO3- (aq)**

**3Ca2+ (aq) + 2PO43- (aq)→ Ca3 (PO4)2 (s)**

23.     Write the formula, complete, and net ionic equation for each.

          Cu (NO3) 2(aq) and Ag(s).

          **Ag (s) + Cu (NO3)2 (aq) → No Reaction**

24.     A empty beaker has a mass of 25.86 g. The same beaker is filled with 0.250 L with a solution of Cl2 and weighs 87.26 g. The solution is evaporated to dryness and the mass of the beaker and solid is 36.31 g. Calculate the molarity of the solution.

          **0.376 M**

25.     125.0 g of an aqueous compound that is 3.091 % H, 31.62  % P, and 65.29 % O reacts with another compound that is 80.14 % Ba, 18.68 % O, and 1.179 % H. If the actual yield of the solid product is 350. g, calculate the percentage yield of the solid.

**91.2%**

  26.        **0.0250 M**

  27.        **0.0091 M**

  28.       **[Ca2+]   =    0.0714 M         [Al3+]  =  0.193 M          [Cl-]  =    0.722M**

  29        **[Na+]   =    0.333 M         [PO43-]  =  0.0667 M          [SO42-]  =   0.0667 M**

  30.        **0.0827 M**

31.      150.0 mL of 0.200 M HCl and 250.0 mL of 0.300 M HNO3react with excess CaCO3.

           Calculate the theoretical yield of CO2. Start by writing an equation.

          **2.31 g**