**Unit III     The Mole**

**Lesson            Date                Topic                                                                                       WS**

[1.](http://iannonechem.com/Science/Chemistry/Iannone/Chem11/chem11web/Chem%2011Answers/chem11notes/moleunit/1.molecularmass.ppt)                                             The Molar Mass                                                                      [1](http://iannonechem.com/Sc/workbookanswers/4.answers.htm#b1)

[2.](http://iannonechem.com/Science/Chemistry/Iannone/Chem11/chem11web/Chem%2011Answers/chem11notes/moleunit/2.molechemicalcalculationsA.ppt)                                             Mole Conversions                                                                   [2](http://iannonechem.com/Sc/workbookanswers/4.answers.htm#b2)

[3.](http://iannonechem.com/Science/Chemistry/Iannone/Chem11/chem11web/Chem%2011Answers/chem11notes/moleunit/4.moleEmpirical%20Formula.ppt)                                             Calculating Atoms                                                                   [3](http://iannonechem.com/Sc/workbookanswers/4.answers.htm#b3)

4.                                             Empirical Formula                                                                  [4](http://iannonechem.com/Sc/workbookanswers/4.answers.htm%22%20%5Cl%20%22b4)

[5.](http://iannonechem.com/Science/Chemistry/Iannone/Chem11/chem11web/Chem%2011Answers/chem11notes/moleunit/5.moleMolecularFormula.ppt)                                             Percentage Composition Empirical Formula                           [5](http://iannonechem.com/Sc/workbookanswers/4.answers.htm#b5)

[6](http://iannonechem.com/Science/Chemistry/Iannone/Chem11/chem11web/Chem%2011Answers/chem11notes/moleunit/6.molePercentComposition.ppt).                                             Mole Calculations to Molecular Formula                               [6](http://iannonechem.com/Sc/workbookanswers/4.answers.htm%22%20%5Cl%20%22b6)

[7.](http://iannonechem.com/Science/Chemistry/Iannone/Chem11/chem11web/Chem%2011Answers/chem11notes/moleunit/7.moleWeighingGases.ppt)                                             Identify that Gas                                                                      [7](http://iannonechem.com/Sc/workbookanswers/4.answers.htm#b7)

8.                                             Practice Test 1                                                                        [8](http://iannonechem.com/Sc/workbookanswers/4.answers.htm%22%20%5Cl%20%22b8)

9.                                             Practice Test 2                                                                        [9](http://iannonechem.com/Sc/workbookanswers/4.answers.htm%22%20%5Cl%20%22b9)

**Worksheet # 1           Mole conversions**

Describe each particle as an atom, molecule or a formula unit.

1.         CO2                                        **m**

2.         KCl                                        **fu**

3.         C                                            **at**

4.         AgNO3                                    **fu**

5.         NH4CH3COO                         **fu**

6.         O2                                           **m**

7.         Os                                           **at**

8.         SO3                                         **m**

9.         RbCl                                       **fu**

10.       CaCO3                                    **fu**

11.       Ag                                          **at**

12.       NH3                                        **m**

13.       Cl2                                          **m**

14.       Se                                           **at**

15        The electrolysis of water using H2SO4 as a catalyst is used to generate hydrogen gas. For every 1 electron

consumed 1 atom of hydrogen (exact) is generated. An amp meter is used to measure the rate of electron

consumption.

            1**.00 coulomb = 6.24 x 10 18 electrons.**

            If 1.00 g of hydrogen is generated at a current of 1.50 amps (1 amp = 1 coulomb per second) and over time

period of 17.865 hours, calculate Avogadro’s number (the number of atoms in 1.00g of hydrogen). Use unit

analysis! Start the unitanalysis with 17.865 h and end with atoms H.

**17.865 h      x 3600 s   x   1.5 coulomb  x    6.24 x 1018 e   x   1 atom H     =   6.02 x 1023atoms H**

**1 h                      1s                1 coulomb                 1 e**

16.       State Avogadro's # three different ways describing the number of atoms in a mole, formula units in a mole, and molecules in a mole.

**6.02x  1023 atoms                      =        1  mole**

**6.02x  1023 formula units         =        1 mole**

**6.02  x  1023 molecules              =        1 mole**

Use Unit Analysis to Change from particles to moles or from moles to particles. Note that a particle is an atom, molecule, or formula unit.

17.       Covert 5.44  x  1026 at Co to moles.

**5.44 x 1026atoms Co      x        1 mole                   =        904 moles**

**6.02  x  1023 atoms**

18.       Convert 2.4 moles CO2 to molecules.

**2.4 moles CO2      x        6.02  x  1023 molecules              =  1.4 x 1024 molecules**

**1 mole**

19.       Covert 4.56  x  1024 molecules CO2 to moles.

**4.56 x 1024molecules CO2      x        1 mole                             =        7.57  moles**

**6.02  x  1023 molecules**

20.       Convert 10.9 moles CuSO4 to FUs.

**10.9 moles CuSO4          x        6.02  x  1023 FU’s           =     6.56 x 1024 FU’s**

**1 mole**

21.       Convert 5.33  x  1025 FU to moles NaCl.

**5.33 x 1025FU’s NaCl   x        1 mole                   =        88.5 moles**

**6.02  x  1023 FU’s**

22.       Convert 2.4 moles C to atoms.

**2.4 moles C           x        6.02  x  1023 atoms          =      1.4 x 1024atoms**

**1 mole**

23.       Covert 9.11  x  1025 molecules SO3 to moles.

**9.11 x 1025molecules SO3        x        1 mole                   =        151    moles**

**6.02  x  1023 FU’s**

24.       Convert 2.9 moles CaSO4 to FUs.

**2.9 moles CaSO4      x    6.02  x  1023 FU’s           =     1.7 x 1024 FU’s**

**1 mole**

24.       Convert 5.55  x  1024 FU to moles KF.

**5.55 x 1024FU’s KF       x        1 mole                  =        9.22 moles**

**6.02  x  1023 FU’s**

Draw Electron-dot Diagrams for each of the following. Remember, use brackets for cations or anions. Covalent compounds do not require brackets.

37. CCl4

**..**

**: Cl :**

**..      ..    ..**

**:  Cl  ׃ C ׃ Cl :**

**..     ..     ..**

**: Cl :**

**..**

38. NaCl

       **..**

**[ Na ]+    [ : Cl : ]-**

**..**

39. CO2

**..              ..**

**: O : : C : : O :**

40. Li2SO4

**[ Li: ]+**

**2-**

**..**

**: O :**

**..    ..    ..**

**: O : S : O :**

**..    ..    ..**

**: O :**

             **..**

**[ Li ]+**

41. HCN

                    **..**

**H :  C : : : N :**

42

                                    **-**

**..             ..**

**: O : N :: O :**

**..    ..**

**: O :**

**..**

**Worksheet #2                           The Mole**

Calculate the molecular mass of the following compounds.  Remember to determine the mass of each element and add the mass of the elements together**.**

1.         KI                    **166.0 g/mole**2.         Mg3(PO4)2**262.9 g/mole**

3.         NiO                 **74.7 g/mole**             4.         H2O                             **18.02 g/mole**

5.         BaF2                **175.3 g/mole**           6.         Ti(SO4)2**.6**H2O**348.22 g/mole**

7.         CuS                 **95.6  g/mole**            8.         ZnHCO3**126.41 g/mole**

9.         Li3N                 **34.7  g/mole**            10.       PdSO4**202.5 g/mole**

11.       NaI                  **149.9 g/mole**           12.       K3PO4**212.3 g/mole**

13.       FeO**.6**H2O        **179.92 g/mole**           14.       NaOH                          **40.01  g/mole**

15.       AlF3**.8**H2O       **228.16 g/mole**           16.       Ga2(CO3)3**319.4 g/mole**

17.       CuH2                **65.52  g/mole**            18.       Zn(CH3COO)2**183.46 g/mole**

19.       NiN                 **72.7  g/mole**            20.       BaSO4**.5**H2O                **323.5 g/mole**

Define the following. The first one is done for you.

21.     Atomic massis**the mass of 1 mole of atoms**.

22.     Molecular mass is **the mass of 1 mole of molecules**.

23.     Formula mass is **the mass of 1 mole of formula units**.

24.     Molar mass is **the mass of 1 mole of particles**.

25.   Circle the formula units, square the molecules, and underline the atoms.

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|  |  | val: KCl |  | val: NH4Cl |  |

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| H2O |

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| --- |
| CO2 |

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| P2O5 |

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| **K** |

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| **Au** |

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| C12H24O11 |

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|  |  | val: K2SO4 |  |

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| NH3 |

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| **Cu** |

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| **Br** |

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| **C** |

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Convert from grams to moles.  Show all work using unit analysis

26.      100. g H2O

**100. g H2O            x        1 mole         =        5.55 moles**

**18.02 g**

27.     250. g MgCl2

**250. g MgCl2x1 mole         =        2.62 moles**

**95.3 g**

28.     0.266 g C6H12

**0.266 g C6H12x1 mole         =        0.00316 moles**

**84.12 g**

29.     1.2 x 10-4 g Fe

**1.2 x 10-4 g Fe**       **x1 mole         =        2.2  x  10-6 moles**

**55.8 g**

Convert each quantity to moles.

30.     **500. g H2O      x    1 mole         =        27.7 mole**

**18.02 g**

31.       **0.269 g P2O5****x        1 mole         =        1.89 x10-3 mole**

**142 g**

32.     **135.3 g CaSO4****x        1 mole         =        0.9934 mole**

**136.2 g**

33.       **214.7 g CH4****x        1 mole         =        13.39 mole**

**16.04 g**

34**.     25.3 g C6H12O6****x        1 mole         =        0.141 mole**

**180.12 g**

Convert from atoms, molecules, or formula units **to grams**.

35.

**6.55 x 1024 atoms Ag      x        1 mole             x    107.9 g        =        1.17  x  103 g**

**6.02  x  1023 at      1 mole**

36.

**8.66 x 1026 FU RbCl**       **x        1 mole                   x   121 g      =        1.174  x  105 g**

**6.02  x  1023 FU         1 mole**

37.

**5.00 x 10 32 molecs N2H4****x  1 mole         x                  32.04 g  =    2.66  x  1010 g**

**6.02  x  1023 molecs       1 mole**

38.

**5.3 x 1029 FU KBr  x      1 mole         x        119 g   =      1.0  x  108 g**

**6.02  x  1023 FU**    **1 mole**

39.

**25.3 x 1028 molecules C4H10****x        1 mole                   x                  58.1 g  =         2.44  x  107 g**

**6.02  x  1023 molecules              1 mole**

40.

**1.33 x 1025 atoms Ag      x   1 mole              x        107.9 g   =     2.38  x  103g Ag**

                                            **6.02  x  1023 at            1 mole**

41.

**1.55 x 1016 FU NaCl**       **x   1 mole              x        58.5 g    =     1.51  x  10-6 g NaCl**

                                            **6.02  x  1023 FU          1 mole**

42.

**2.55 x 10 27 molecules NH3  x   1 mole                 x                  17.03 g   =     7.21  x  104g NH3**

                                                  **6.02  x  1023 molecules            1 mole**

43.

**5.3 x 1029 FU KBr          x        1 mole                   x       119 g   =     1.05   x  108 g**

**6.02  x  1023 FU**      **1 mole**

Convert from grams to **atoms, molecules, or formula units**.

44.

**100. g H2O2          x        1 mole         x   6.02  x  1023 molecules         =  1.77  x  1024molecules**

**34.02 g             1 mole**

45.

**2.6 g MgF2x        1 mole         x        6.02  x  1023 FU    =        2.5  x  1022 FU**

**62.3 g                    1 mole**

46.

**0.211 g C5H12****x        1 mole         x        6.02  x  1023 molecules    =   1.76  x  1021molecules**

**72.12g                   1 mole**

47.

**3.33 x 10-2 g Fe     x        1 mole         x        6.02  x  1023 Atoms   =  3.59  x  1020 atoms**

**55.8 g                    1 mole**

48.

**0.126 g Co  x        1 mole    x   6.02  x  1023 at       =        1.29  x  1021 atoms Co**

**58.9 g          1 mole**

**Worksheet #3                           Calculating Atoms**

1.       Measure the mass some Calcium. Calculate the number of atoms. Add 50 mL water to a 250 mL fleaker. Add the calcium to   the beaker and cover with a plastic funnel. Light the funnel after about 12 seconds. Write a balanced chemical equation for the reaction.

**112 g Ca     x        1 mole    x   6.02  x  1023 at       =        1.68  x  1024 at Ca**

**40.1 g          1 mole**

2.       Measure the mass of a Copper cylinder. Calculate the number of atoms in the cylinder.

**112 g Cu     x        1 mole    x   6.02  x  1023 at       =        1.06  x  1024 at Cu**

**63.5 g          1 mole**

3.       Measure the mass of an Iron cylinder. Calculate the number of atoms in the cylinder.

**112 g Fe      x        1 mole    x   6.02  x  1023 at       =        1.21  x  1024 at Fe**

**55.8 g          1 mole**

4.       Measure the mass of a Magnesium cylinder. Calculate the number of atoms in the cylinder.

**112 g Mg    x        1 mole    x   6.02  x  1023 at       =        2.77  x  1024 at Mg**

**24.3 g          1 mole**

5.       Measure the mass of an Aluminum cylinder. Calculate the number of atoms in the cylinder.

**112 g Al       x        1 mole    x   6.02  x  1023 at       =        2.50  x  1024 at Al**

**27.0 g          1 mole**

6.       Measure the mass of a small amount of dry ice (be quick- it won’t last long due to sublimation). Calculate the number of   atoms of CO2.

**112 g CO2   x        1 mole    x   6.02  x  1023 molecules   =        1.53  x  1024 molecules CO2**

**44.0 g          1 mole**

7.       Calculate the mass of 4.56 x 1025 atoms of Sr.

**4.56 x 1025 at Sr   x        1 mole                   x        87.6 g          =        6.64  x  103 g Sr**

**6.02  x  1023 at                1 mole**

8.       Calculate the mass of 6.33 x 1020 molecules of CO2.

**6.33 x 1020 molecule CO2         x        1 mole         x                  44.0 g   =          4.63  x 10-2 g CO2**

**6.02  x  1023 molecs        1 mole**

9.       Calculate the mass of 8.66 x 1026 FU of SrO.

**8.66 x 1026 FU SrO        x        1 mole                   x        103.6 g        =          1.49  x  105g SrO**

**6.02  x  1023 FU              1 mole**

10.     Calculate the mass of 2.3 x 1028 FU of SrCO3.H2O.

**2.3 x 1028 FU SrCO3.H2O        x        1 mole         x        165.62 g      =          6.3  x  106 g SrCO3.H2O**

**6.02  x  1023 FU    1 mole**

11.     Calculate the number of H atoms in 5.02g of CH4. There are 4 atoms of H in one molecule of CH4.

**5.02 g CH4     x     1 mole    x   6.02  x  1023 molecules CH4  x  4 atoms H      =     7.54 x  1023 at H**

**16.04 g        1 mole                                       molecule CH4**

12.     Calculate the number of O atoms in 200. g Al2(SO4)3. There are 12 atoms of O in one formula unit of Al2(SO4)3.

**200 g Al2(SO4)3  x 1 mole    x   6.02  x  1023 FU Al2(SO4)3  x    12 atoms O    =     4.22 x  1024 at O**

**342.3 g        1 mole                                      FU Al2(SO4)3**

13.     Calculate the mass of CaCO3 that contains 2.00 x 1028 atoms of O. There are 3 atoms of O per one FU of CaCO3.

**2.00  x  1028 at O   x   1 FU CaCO3x        1mole                    x        100.1 g   =       1.11  x  106 g**

**3 at O                    6.02  x  1023                     1 mole**

14.     Calculate the mass of Al2(SO4)3 that contains 2.00 x 1028 atoms of O.

**2.00  x  1028 at O  x  1 FU Al2(SO4)3x        1mole                    x        342.3 g   =       9.48  x  105 g**

**12 at O                        6.02  x  1023 FU              1 mole**

15.     Calculate the mass of Al2(SO4)3 that contains 2.00 x 1020 atoms of Al.

**2.00  x  1020 at Al   x  1 FU Al2(SO4)3  x      1mole                    x        342.3 g   =       0.0569 g**

**2 at Al                        6.02  x  1023 FU              1 mole**

16.     Calculate the number of Al atoms in 500.g Al2(SO4)3.

**500. g Al2(SO4)3    x   1 mole    x   6.02  x  1023 FU Al2(SO4)3  x  2 atoms Al  =     1.76 x  1024 at Al**

**342.3 g        1 mole                                      FU Al2(SO)3**

Draw Electron-dot Diagrams for each of the following. Remember, use brackets for cations or anions. Covalent compounds do not require brackets.

17.     C2F6

               **..      ..**

**: F :  : F :**

**..     ..      ..    ..**

**: F :   C :   C : F :**

**..      ..     ..    ..**

**: F:  : F :**

**..     ..**

18.     KClO4

**[ K ]  +**

                        **-**

**..**

**: O :**

**..     ..     ..**

**: O : Cl  : O :**

**..    ..     ..**

**: O :**

**..**

19.     NH3

**..**

**H : N : H**

**..**

**H**

20.     Li2CO3

21.     N2

      **: N ׃׃׃ N :**

22.     PO33-

                              3**-**



**..     ..     ..**

**: O : P  : O :**

**..   ..      ..**

**: O :**

**..**

**Worksheet #4                           Empirical Formula**

Use a calculation to determine the empirical formula of each of the following compounds. Show all of your work.

1.       A compound is found to be 6.353 g Ag, 0.823 g N, and 2.824 g of O. Calculate the empirical formula of the compound.

**6.353 g Ag   x        1 mole         =        0.05888 moles       =        1**

**107.9 g                  0.05879 moles       ←      smallest number**

**0.823 g N    x        1 mole         =        0.05879 moles       =        1                  AgNO3**

**14.0 g                    0.05879 moles**

**2.824 g O    x        1 mole         =        0.1765 moles         =        3**

**16.0 g                    0.05879 moles**

2.       A compound is found to be 6.25g Pb, 0.846g N, and 2.90g of O. Calculate the empirical formula of the above compound.

**6.25 g Pb   x          1 mole         =        0.03016 moles       =        1**

**207.2 g                  0.03016 moles       ←      smallest number**

**0.846 g N    x        1 mole         =        0.06049 moles       =        2        PbN2O6          or     Pb(NO3)2**

**14.0 g                   0.03016 moles                           3 marks                     4 marks     only do this for ionic!**

**2.90 g O      x        1 mole         =        0.1813 moles         =        6**

**16.0 g                    0.03016 moles**

3.       A compound is found to be 1.00g Ca, 0.700g N, and 2.40 g O.  Calculate the empirical formula of the above compound.

                    **Ca(NO3)2**

4.       A compound is found to be 27.91% Fe, 24.08% S, and 48.0% O. Calculate the empirical formula.

**27.91 g Fe   x        1 mole         =        0.5002 moles         =        1        x 2     =          2**

**55.8 g                    0.5002 moles**

**24.08 g S     x        1 mole         =        0.7502 moles         =        1.5     x 2     =          3**

**32.1 g                    0.5002 moles**

**48.0 g O      x        1 mole         =        3.000 moles           =        6        x 2     =          12**

**16.0 g                    0.5002 moles**

          **Fe2S3O12               Fe2(SO4)3**

5.       A compound is found to be 15.38% Co, 40.74% Cr, and 43.88% O. Calculate the empirical formula.

          **Co2(Cr2O7)3**

6.       A compound is found to be 63.65% C, 10.71% H, 18.56% N, and 7.072% O. Calculate the empirical formula.

          **C12H24N3O**

7.       Change 5.0 x 1026 formula units CoCl2**.**6H2O to grams.

**5.0 x 1026 FU CoCl2.6H2O  x    1 mole                   x        238.02 g  =  2.0  x  105 g CoCl2.6H2O**

**6.02  x  1023 FU              1 mole**

8.       Convert 2.36 g FeSO4**·**5H2O to formula units.

**2.36 g FeSO4·5H2O** **x   1 mole   x   6.02  x  1023 FU FeSO4·5H2O =  5.87  x  1021 FU FeSO4·5H2O**

**242g            1 mole**

9.       Change 3.65 x 1022 molecules CO2 to grams.

          **2.67 g**

10.     Convert 2.36 g grams P2O5 to molecules.

          1**.00  x  1022  molecules P2O5**

**Worksheet # 5      Percentage Composition, Molecular and Empirical Formula**

Complete the following chart.

Empirical Formula                     Molar Mass            Molecular Formula           Molecular Mass

1.       CH                                   **13.01 g/mole         C6H6**                              78 g/mole

2.       C3H2O                              **54.02 g/mole         C9H6O3**                           162 g/mole

3.        **C4H7NO**                        **85 g/mole**              C12H21N3O3                       **255 g/mole**

4.       C4H8O                              **72.08 g/mole**         **C12H24O3**                         216 g/mole

5.       C2H4NO                           **58.04 g/mole**         **C6H12N3O3**                      174 g/mole

6.       **C5H11NO**                        **101.11 g/mole**       C15H33N3O3                       **303.33 g/mole**

7.       C2H2O                              **42.02 g/mole**         **C10H10O5**                         210 g/mole

8.       C3H7NO                           **73.07 g/mole**         **C12H28N4O4**                    292 g/mole

9.       **C2H4NO**                          **58.04 g/mole**         C4H8N2O2                         **116.08 g/mole**

10.     CCl3                                 **118.5 g/mole**         **C2Cl6**                               237 g/mole

11.     If the empirical formula for a compound is C2H3O and its molecular mass is 129 g/mole, what is the molecular formula.

**Empirical formula                    C2H3O                   Empirical Mass              43.03 g/mole       x 3**

**Molecular Formula                  C6H9O3                 Molecular Mass             129 g/mole**

**129/43.03  =  3x**

12.     A compound is 49.2% P and 50.8% O, calculate the empirical formula. If the molecular mass is 126 g/mole, calculate the        molecular formula.

**49.2 g P   x            1 mole         =        1.587 moles =        1**

**31.0 g                    1.587 moles**

**50.8 g O      x        1 mole         =        3.175 moles =        2                  PO2**

**16.0 g                    1.587 moles**

**Empirical formula                    PO2                              Empirical Mass          63.0 g/mole     x 2**

**Molecular Formula                  P2O4                                Molecular Mass          126 g/mole**

**126/63.0  =  2x**

13.     A compound is 62.54% Pb, 8.46% N, and 29.0% O, calculate the empirical formula.

          **Pb(NO3)2**

14.     A compound is 46.08 % C, 27.0% N, and 27.0 % O.  Calculate the empirical formula. If the molecular mass is 832 g/mole,     calculate the molecular formula.

**46.08 g C   x         1 mole         =        3.84 moles   =        2.2749         x          7   =  16**

**12.0 g                    1.688 moles**

**27.0 g N      x        1 mole         =        1.929 moles =        1.1428         x           7    = 8**

**14.0 g                    1.688 moles**

**27.0 g O      x        1 mole         =        1.688 moles =        1                  x          7    = 7        C16N8O7**

**16.0 g                    1.688 moles**

**Empirical formula                    C16N8O7                    Empirical Mass              416 g/mole     x 2**

**Molecular Formula                  C32N16O14                       Molecular Mass             832 g/mole**

**832/416  =  2x**

15.     Oil of citronella is a mosquito repellent is 87.8% C and 12.2% H.  Calculate the empirical formula. If the molecular mass is   205 g/mole, calculate the molecular formula.

**87.8 g C   x           1 mole         =        7.3167 moles         =        1        x  3    =            3**

**12.0 g                    7.3167 moles**

**12.2 g H      x        1 mole         =        12.079 moles         =        1.651 x  3  =            5**

**1.01 g                    7.3167 moles**

**C3H5**

**Empirical formula                    C3H5                              Empirical Mass              41.05 g/mole     x 5**

**Molecular Formula                  C15H25                             Molecular Mass             205 g/mole**

**205/41.05  =  5x**

Calculate the percentage composition for:

16.      ZnSO4

**1        Zn      =        1        x        65.4   =        65.4 g**

**1        S        =        1        x        32.1   =        32.1 g**

**4        O       =        4        x        16      =        64.0 g**

**161.5 g/mole**

**% Zn           =        65.4 g          x        100%          =        40.5 %**

                                        **161.5 g**

**% S  =                  32.1 g          x        100%          =        19.9 %**

                                        **161.5 g**

**% O            =        64.0 g          x        100%          =        39.6 %**

                                        **161.5 g**

                                                                                                    **100%**

17.     Al2(CO3)3

**2        Al       =        2        x        27.0   =        54.0 g**

**3        C       =        3        x        12.0   =        36.0 g**

**9        O       =        9        x        16.0   =        144.0 g**

**234.0 g/mole**

**% Al            =        54.0 g          x        100%          =        23.1 %**

                                        **234.0 g**

**% C            =        36.0 g          x        100%          =        15.4 %**

                                        **234.0 g**

**% O            =        144 g           x        100%          =        61.5 %**

                                        **234.0 g**

                                                                                                    **100%**

18.     Ca3(PO4)2

**3        Ca     =        3        x        40.1   =        120.3 g**

**2        P        =        2        x        31.0   =        62.0 g**

**8        O       =        8        x        16.0   =        128.0 g**

**310.3 g/mole**

**% Ca          =        120.3 g        x        100%          =        38.8 %**

                                        **310.3 g**

**% P  =                  62.0 g          x        100%          =        20.0 %**

                                        **310.3 g**

**% O            =        128 g           x        100%          =        41.3 %**

                                        **310.3 g**

                                                                                                    **100.1%**

19.     Convert 3.66 Kg CO2to molecules.

**3.66 Kg CO2         x    1000 g  x 1 mole    x   6.02  x  1023 molecules  =  5.01  x  1025molecules CO2**

**1 Kg      44.0 g           1 mole**

20.     Covert 4.0 x 1026 FU of MgCl2 to Kg.

**4.0  x  1026 FU MgCl2  x          1mole                    x        95.3 g          x        1 Kg    =        63 Kg**

**6.03  x  1023 FU              1 mole                   1000 g**

21.     In a propane tank there are 9.0 Kg of C3H8, calculate the number of H atoms. (First calculate molecules and then H atoms).

**9.0 Kg C3H8x 1000 g  x  1 mole  x 6.02  x  1023 molecules  x    8 at H =  9.8  x  1026 H at C3H8**

                          **1 Kg        44.08 g      1 mole                     1 molecule C3H8**

22.     A certain mass of complex Co(NH3)6Cl3 was found to contain 2.65  x  1021 atoms of H, calculate the mass of cobalt III    chloride hexammine. (Change the number of atoms to FU’s first).

**2.65  x  1021 at H  x  1 FU Co(NH3)6Cl3 x   1 mole         x        267.58 g      =          6.54 x  10-2 g**

**18 at H                  6.02  x  1023 at      1 mole**

**Worksheet # 6 Mole Calculations to Molecular Formula**

1        The electrolysis of water using H2SO4 as a catalyst is used to generate hydrogen gas. For every 1 electron consumed

          1 atom of hydrogen (exact) is generated. An amp meter is used to measure the rate of electron consumption.

          1.00 coulomb = 6.24 x 10 18 electrons.

          If 1.00 g of hydrogen is generated at a current of 1.50 amps (1 amp = 1 coulomb per second) and over time period

          of 17.865 hours, calculate Avogadro’s number (the number of atoms in 1.00g of hydrogen). Use unit analysis!

          Start the unit analysis with 17.865 h and end with atoms H.

**6.02  x  1023 at**

2.       Convert 500. g NaCl to formula units.

**500 g           x        1 mole         x        6.02  x  1023 FU    =        5.15  x  1024 Fu**

**58.5 g                    1 mole**

3.       Convert 9.8 x 1024 molecules of C2H6 to grams.

**9.8  x  1024molecules      x        1 mole                         x            30.06 g  =          4.9  x 102g**

**6.02  x  1023molecules              1 mole**

4.       Calculate the number of O atoms in 50.0 lb of dry ice CO2.

          (2.21 lb = 1.00Kg)

**50.0 lb    x   1.00 Kg  x   1000 g  x     1 mole  x     6.02 x 10 23 molecules  x  2 at O**

**2.21 lb         1.00 Kg       44.0 g          1 mole                             1 molecules**

**=     6.19 x  1026 atoms O**

5.       Calculate the percentage composition of Al2(SO4)3.  3 significant figures!

**2  Al             2        x        27.0  =        54.0                       % Al            =            15.8 %**

**3   S             3        x        32.1  =        96.3                       % S             =          28.1 %**

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

**342.3 g/mole**

6.       Calculate the molar mass of Co2(SO4)3 . 6H2O

          **514.22 g/mole**

7.       The empirical formula for a compound is C2H5O and its molecular mass is 135g/mol.  The olecular formula is:

**Empirical formula          C2H5Ox 3              Empirical Mass              45.05 g/mole**     **x 3**

**Molecular Formula        C6H15O3                          Molecular Mass                135 g/mole**

**135/45.05  =  3x**

8.       A compound is 24.4% Ca, 17.1% N and 58.5% 0.  Calculate the empirical formula.

          **Ca(NO3)2**

9.       Hydroquinone, a chemical used for photographic developing, is 65.45% C, 5.51% H and 29.09% O.  Calculate the       empirical      and molecular formula.  The molecular mass is 110 g/mol.

**65.45 g C   x         1 mole         =        5.454 moles =        3        =        3**

**12.0 g                    1.818 moles**

**5.51 g H      x        1 mole         =        5.455 moles =        3        =        3**

**1.01 g                    1.818 moles**

**29.09 g O    x        1 mole         =        1.818 moles =        1        =        1**

**16.0 g                    1.818 moles**

**C3H3O**

**Empirical formula                    C3H3O                             Empirical Mass              55.03 g/mole          x 2**

**Molecular Formula                  C6H6O2                           Molecular Mass             110 g/mole**

**110/55.03  =  2x**

10.       A compound is 50.5 %  C, 5.26 % H, and 44.2% N. Calculate the empirical formula. If the molecular mass is 380.2 g/mole, calculate the molecular formula.

**50.5 g C   x     1 mole     =   4.2083   =   1.33 x 3**

**12.0 g           3.1571**

**5.26 g H  x     1 mole     = 5.2079     =    1.65 x 3**

**1.01 g        3.1571**

**44.2 g N  x     1 mole     =  3.1571    =    1**

**14.0g           3.1571**

**Empirical Formula                        Empirical Mass**

**C4H5N395.05 g/mole**

**Molecular Formula                       Molecular Mass**

**C16H20N12                                      380.2 g/mole**

11.     A compound is 50.5% C, 5.26% H, and 44.2% N, calculate the empirical formula. If the molecular mass is **285.15 g/mole**,    calculate the molecular formula.

**50.5 g C   x           1 mole         =        4.208 moles =        1.333           x  3    =            4**

**12.0 g                    3.157 moles**

**5.26 g H      x        1 mole         =        5.208 moles =        1.650           x  3  =            5**

**1.01 g                    3.157 moles**

**44.2 g N      x        1 mole         =        3.157 moles =        1                  x  3  =            3       C4H5N3**

**14.0 g                    3.157 moles**

**Empirical formula                    C4H5N3                    Empirical Mass             95.05 g/mole      x3**

**Molecular Formula                  C12H15N9                         Molecular Mass            285.15 g/mole**

**285.15/95.05  =  3x**

Challenge Problems

12.     When 15.0 g of a compound known to contain C, H, O, and S was burned, 16.2 g of CO2, 6.63 g of H2O, and 15.7 g of SO2 were produced. What is the empirical formula of the compound?

**16.2 g CO2  x        1 mole   x   1 mole C     =        0.3682 mole C      x          12.0 g    =   4.418 g C**

                              **44.0 g          1 mole CO2                                                   1 mole**

**6.63 g H2O  x        1 mole   x   2 mole H     =        0.7358 mole H      x          1.01 g     =  0.7432 g H**

                              **18.02 g        1 mole H2O                                                   1 mole**

**15.7 g SO2  x         1 mole   x   1 mole S      =        0.2449 mole S       x          32.1 g     =  7.862 g S**

                              **64.1 g          1 mole SO2                                                    1 mole**

**Mass of C H S      =        13.023 g**

**Mass of O  =  Total C H S O – Mass of C H S**

**Mass of O  =  15.0 g                 – 13.023**

**Mass of O  =  1.977 g**

**1.977 g O              x        1 mole         =        0.1236 moles O**

                                        **16.0 g**

**Mole Ratio**            **0.3682 mole C      =        3**

**0.1236 moles**

**0.7358 mole H      =        6**

                              **0.1236 moles**

**0.1236 moles O     =        1        Empirical Formula          C3H6OS2**

                              **0.1236 moles**

                              **0.2449 mole S       =        2**

                              **0.1236moles**

13.     When 51.3 g of a compound known to contain C, H, N, and O was burned, 84.2 g of CO2, 20.7 g of H2O, and 10.7 g of N2      were produced. What is the empirical formula of the compound?

**84.2 g CO2  x        1 mole   x   1 mole C     =  1.9136 mole C    x      12.0 g   =        22.96 g C**

                              **44.0 g          1 mole CO2                                         1 mole**

**20.7 g H2O  x        1 mole   x   2 mole H     =  2.2974 mole H  x       1.01 g   =        2.320 g H**

                              **18.02 g        1 mole H2O                                         1 mole**

**10.7 g N2  x           1 mole   x   2 mole N     =  0.7643 mole N    x      14.0 g   =        10.70 g N**

                              **28.0 g          1 mole N2                                            1 mole**

**Mass of C H N     =        35.98 g**

**Mass of O  =  Total C H N O – Mass of C H N**

**Mass of O  =  51.3 g       – 35.98 g**

**Mass of O  =  15.32 g**

**15.32 g O              x        1 mole                   =        0.9575 moles O**

                                        **16.0 g**

**Mole Ratio**            **1.9136 mole C      =        2.50             x        4        =        10**

**0.7643 moles**

**2.2974 mole H      =        3.00             x        4        =        12**

                              **0.7643 moles**

                              **0.7643 mole N      =        1                  x        4        =        4**

                              **0.7643 moles**

**0.9575 moles O     =        1.253           x        4        =        5**

**0.7643 moles**

**Empirical Formula         C10H12N4O5          Wow, finally a challenge!!**

**Worksheet #7                           Identify that Gas**

1.       A volume of a gas weighs 0.256 g. An equal volume of H2 weighs 0.01163g.

Calculate the molecular mass of the gas. Assuming that this gas is a common gas,

what do you think the gas could be? Show some work!

**Gas    X        =        0.256 g        =        22.01           x        2.02 g          =          44.5 g/mole**

**H2                          0.01163 g                                            1 mole**

**Basically, we are just saying that the molar mass of the unknown gas is 22.01 x heavier**

**than a known gas H2 which we know is 2.02 g/mole.**

2.       A volume of a gas weighs 2.12 g. An equal volume of He weighs 0.265 g. Calculate the molecular mass of the gas. Assuming that this gas is a common gas, what do you think the gas could be? Show some work!

**Gas    X        =        2.12 g          =        8.000           x        4.0 g  =        32.0 g/mole**

**He                         0.265 g                                                1 mole**

**Basically, we are just saying that the molar mass of the unknown gas is 8.000 x heavier**

**than a known gas He which we know is 4.0 g/mole.**

3.       A volume of a gas weighs 0.235g. An equal volume of He weighs 0.02043g. Calculate the molecular mass of the gas. This gas is a gas produced by automobile pollution, what do you think the gas could be? Show some work!

**Gas    X        =        0.235 g        =        11.50           x        4.0 g  =        46.0 g/mole**

**He                         0.02043 g                                            1 mole**

**NO2   nitrogen dioxide**

4.       A volume of a gas weighs 0.37216 g. An equal volume of H2 weighs 0.01163 g. Calculate the molecular mass of the gas. Assuming that this gas is a on that is produced by burning matches, what do you think the gas could be? Show some work!

          **64.6 g/mole         SO2**

5.       A volume of a gas weighs 0.02051g. An equal volume of CO2 weighs .02654g. Calculate the molecular mass of the gas. Assuming that this gas is a smelly one that is produced by rotten eggs, what do you think the gas could be? Show some work! This gas is also added to natural gas to make it smell so that leaks can be detected.

          **34.0 g/mole           H2S**

6.       Convert 1.65 g CO2 to molecules.

**1.65 g CO2  x        1 mole         x        6.02  x  1023 molecules    =        2.26  x  1022molecules**

**44.0 g                    1 mole**

7.       Convert 12.5 Kg of SO2 to molecules.

**12.5 Kg SO2          1000 g         x        1 mole    x   6.02  x  1023 molecules  =  1.17  x 1026 molecules**

**1 Kg                      64.1 g          1 mole**

8.       Covert 2.0 x 1026FU of MgCl2 to g.

**2.0 x 1026 FU MgCl2**      **x        1 mole         x        95.3 g          =        3.2  x  104 g**

**6.02  x  1023 FU**    **1 mole**

9.       In a propane tank there are 8.0 Kg of C3H8. Calculate the number of H atoms. (First calculate molecules and then H atoms).

**8.0 Kg C3H8 x  1000 g x 1 mole  x 6.02  x  1023 molecules C3H8 x 8 atoms H = 8.7  x 1026 at H**

**1 Kg         44.08 g      1 mole                                  molecule C3H8**

10.     A certain mass of complex Co(NH3)6Cl3 was found to contain 2.65  x  1025 FU, calculate the mass of cobalt III chloride hexammine.

**2.65  x  1025 FU    x        1 mole                   x        267.58 g      =        1.18  x  104 g**

**6.02  x  1023 FU              1 mole**

11.     The empirical formula of a compound is C3H11O3 and its molecular formula is 380.44 g/mole. Determine the molecular formula.

**C3H11O3                95.11  g/mole**

**C12H44O12             380.44  g/mole**

12.     Calculate the percentage composition of Co(NH3)6Cl3  to three significant figures.

**1 Co  =        1  x  58.9     =        58.9                       22.0 %**

**6 N    =        6  x  14.0     =        84.0                       31.4 %**

**18 H  =        18  x  1.01   =        18.18                     6.79 %**

**3 Cl   =        3  x  35.5     =        106.5                     39.8 %**

**267.58**

13.     A compound is 27.73% Mg, 23.58% P, and 48.69% O, calculate the empirical formula.

          **Mg3(PO4)2**

14.     9, 10-dihydro-6-methylergoline-8-carboxylic acid (LSD) a drug with psychomimetric properties is 71.6 % C, 6.03 % H, 10.4 % N, and 11.9 % O. If the molecular mass of the compound is 268.16 g/mol, calculate the empirical and the molecular formula.

**71.6 g C   x           1 mole         =        5.967 moles =        8**

**12.0 g                    0.7438 moles**

**6.03 g H      x        1 mole         =        5.970 moles =        8**

**1.01 g                    0.7438 moles**

**10.4 g N      x        1 mole         =        0.7429 moles         =        1                           C8H8NO**

**14.0 g                    0.7438 moles**

**11.9 g O      x        1 mole         =        0.7438 moles         =        1                           C4H5N3**

**16.0 g                    0.7438 moles**

**Empirical formula                    C8H8NO                    Empirical Mass             134.08 g/mole     x 2**

**Molecular Formula                  C16H16N2O2                    Molecular Mass            268.16 g/mole**

**268.16/134.08  =  2x**

15.     A volume of a gas containing sulphur and oxygen that is produced by burning coal has a mass of 2.088g. An equal volume of H2 has a mass of 0.0658 g. Calculate the molar mass of the gas and determine its formula.

**Gas    X        =        2.088 g        =        31.73           x        2.02 g          =          64.1 g/mole**

**H2                          0.0658 g                                              1 mole**

**SO2    sulphur dioxide**

16.     Here is the tough one. You can do it- just take it one step at a time! A compound was known to contain C, H, N, O, and S. When a 5.43 g sample was burned the products were 8.43 g CO2, 1.15 g H2O, 0.450 g N2, and 3.07 g of SO2. Determine the empirical formula of the compound. I left you a whole page- I hope that’s enough. Good luck!

**8.43 g CO2  x        1 mole   x   1 mole C     =        0.1916 mole C      x          12.0 g   =    2.299 g C**

                              **44.0 g          1 mole CO2                                                   1 mole**

**1.15 g H2O  x        1 mole   x   2 mole H     =        0.1276 mole H      x          1.01 g    =   0.1289 g H**

                              **18.02 g        1 mole H2O                                                   1 mole**

**0.450 g N2  x         1 mole   x   2 mole N     =        0.03214 mole N    x          14.0 g     =  0.4500 g N**

                              **28.0 g          1 mole N2                                                      1 mole**

**3.07 g SO2  x         1 mole   x   1 mole S      =        0.04779 mole S     x          32.1 g      = 1.537 g S**

                              **64.1 g          1 mole SO2                                                    1 mole**

**Mass of C H N S =        4.4149 g**

**Mass of O  =  Total C H N S O         –        Mass of C H N S**

**Mass of O  =  5.43 g                          –        4.4149**

**Mass of O  =  1.0151 g**

**1.0151 g O            x        1 mole                   =                  0.06344 moles O**

                                        **16.0 g**

**Mole Ratio**                      **0.1916 mole C      =        6                  x        2        =          12**

**0.03214 moles**

**0.1276 mole H      =        4                  x        2        =          8**

                                        **0.03214 moles**

**0.03214 mole N    =        1                  x        2        =          2**

**0.03214 moles**

**0.06344 moles O   =        2                  x        2        =         4**

                                        **0.03214 moles**

                                        **0.04779 mole S     =        1.5               x        2        =          3**

                                        **0.03214 moles**

**Empirical Formula         C12H8N2O4S3**

**Thank goodness that one is finished!!!!**

**Worksheet #8                           Review of Mole Calculations**

1.       Convert 2.59 g of SO3 to molecules.

**2.59 g of SO3**        **x        1 mole                   x        6.02  x  10 23          =          1.95  x  1022molecules**

                                        **80.1 g                              1 mole**

2.       Convert 3.56 x 1025 FU  of  CoCl4 to Kg.

                    **11.9 Kg**

3.       In a propane tank there are 26.5 Kg. of C2H6. Calculate the number of H atoms.

**26.5 Kg C2H6 x 1000 g  x  1 mole  x  6.02  x  1023 molecs C2H6 x  6 atoms H =   3.18 x  1027 at H**

**1 Kg         30.06 g        1 mole                                molecule C2H6**

4.       Describe each atom as an atom, molecule, anion, cation, or a formula unit:

CO2              **molecule**

                    Co                **atom**

                    AgNO3**FU**

                    KCl              **FU**

                    Cr2O72-**anion**

                    NH4+            **cation**

5.       Convert 568 g of H3PO4to moles.

**568 g           x        1 mole         =        5.79 moles**

**98.03 g**

6.       Convert 3.25 x 105g Rh into atoms.

**3.25  x  105 g         x        1 mole         x        6.02  x  1023 at      =        1.90  x  1027 at**

**102.9 g                  1 mole**

7.  Calculate the molar mass of the following compounds:

Hg3(PO4)2**791.8 g/mole**CuI2          **317.3 g/mole**

Pb2SO4**510.5 g/mole**Li2SO3          **93.9 g/mole**

8.       What is the percent composition of C2H6

          **% C  =        79.8 %**

**% H  =        20.2 %**

9.       What is the percent composition of CaCl2**.** 2H2O

          **1  x  40.1  =           40.1 g**                              **% Ca          =          27.3 %**

**2  x  35.5  =           71.0 g                                        % Cl           =          48.3 %**

          **4  x  1.01 g  =        4.04 g**                                        **% H            =          2.75 %**

**2  x  16.0     =        32.0 g**                              **% O            =          21.7 %**

**147.14**

10.     The empirical formula of a compound is SiH3.  If 0.0275 mol of the compound has a mass of 1.71g, what is the compounds molecular formula?

**Empirical Formula         SiH3Empirical Mass                                  =         31.13 g/mole**

**Molecular Formula        Si2H6           Molar Mass          =        1.71 g          =          62.18 g/mole**

                                                                                                    **0.0275 mole**

11.     A compound is 27.73% Mg, 23.58% P, and 48.69% O, calculate the empirical formula.

**27.73 g Mg x        1 mole      =           1.141 moles =        1.5     x        2          =       3**

**24.3 g                    0.7606 moles**

**23.58 g P     x        1 mole      =           0.7606 moles         =        1        x          2       =        2**

**31.0 g                    0.7606 moles**

**48.69 g O    x        1 mole      =           3.043 moles =        4        x       2          =       8**

**16.0 g                    0.7606 moles**

          **Mg3P2O8Mg3(PO4)2**

12.     Find the empirical formula for a compound containing 46.3% Li and 53.7% O.

**46.3 g Li      x        1 mole      =           6.710 moles =        2**

**6.9 g                      3.356 moles**

**53.7 g O      x        1 mole      =           3.356 moles =        1**

**16.0 g                    3.356 moles**

**Li2O**

13.     Convert 5.65  x 1017 atoms of Fe into grams.

          **5.24  x  10-5 g**

14.     A compound contains C, H and O.  A 5.90 g sample is burned to yield 11.18 g of CO2 and 3.66 g H2O.  What is the empirical formula of the compound?

**11.18 g CO2  x    1 mole   x   1 mole C     =   0.2541 mole C    x     12.0 g     =       3.0491 g C**

                          **44.0 g         1 mole CO2                                       1 mole**

**3.66 g H2O  x      1 mole   x   2 mole H     =   0.4062 mole H    x     1.01 g     =       0.4103 g H**

                           **18.02 g       1 mole H2O                                       1 mole**

**Mass of C H         =        3.4594 g**

**Mass of O  =  Total C H O      –        Mass of C H**

**Mass of O  =  5.90 g       –        3.4594**

**Mass of O  =  2.441 g**

**2.441 g O    x        1 mole         =        0.1525 moles O**

                              **16.0 g**

**Mole Ratio**                      **0.2541 mole C      =        1.666           x        3        =          5**

**0.1525 moles**

**0.4062 H               =        2.664           x        3        =          8**

                                        **0.1525 moles**

**0.1525 moles O     =        1                  x        3        =          3**

**0.1525 moles**

**Empirical Formula         C5H8O3**

15.     A volume of a gas weighs 2.12 g.  An equal volume of He weighs 0.265g. Calculate the molecular mass of the gas. Assuming that this gas is a common diatomic gas, what do you think the gas could be?  Show your work.

**Gas    X        =        2.12 g          =        8        x        4.0 g  =        32 g/mole**

**He                         0.265 g                                      1 mole**

**O2      oxygen**

**Worksheet # 9      Moles Practice Test # 1**

1.       Convert 5.65 g of SO2 to molecules.

**5.65 g          x        1 mole         x        6.02  x  1023  molecules   =        5.31  x  1022molecules**

**64.1 g                    1 mole**

2.       Convert 3.56 x 1025 FU of CuCl2 to Kg.

**3.56 x 1025 FU of CuCl2 x        1 mole         x        134.5 g        x        1 Kg            =       7.95 Kg**

**6.02  x  1023 FU    1 mole                   1000 g**

3.       In a lighter there are 0.52 g. of C4H10. Calculate the number of H atoms.

**0.52 g    x    1 mole         x        6.02  x  1023 molecules    x        10 at H        =          5.4 x  1022 at H**

**58.1 g                    1 mole                                       1 molecule C4H10**

4.       Describe each atom as an atom, molecule, or a formula unit:

**CO2                                 molecule**

**Zn                                    atom**

**Ca(NO3)2                    FU**

**NaCl  ­­­­­                        FU**

**CH3COOH        molecule**

5.       Convert 572 g of HNO2to moles.

**572 g HNO2          x        1 mole         =        12.2 mole**

**47.01 g**

6.       Convert 3.25 x 105g Ru into atoms.

**3.25  x  105 g         x        1 mole         x        6.02  x  1023 at      =        1.94  x  1027 at**

**101.1 g                  1 mole**

7.       Calculate the molar mass of the following compounds:

Au3(PO4)3**876 g/mole**CuBr2           **223.3 g/mole**

Pb3(PO4) 2**811.6 g/mole**Li2CO3         **73.8 g/mole**

8.       What is the percent composition of C3H10

**% C  =        78.1 %**

**% H  =        21.9 %**

9.       What is the percent composition of SrCl2**.**3H2O

**% Sr           =        41.2 %**

**% Cl           =        33.4 %**

**% H            =        2.85 %**

**% O            =        22.6 %**

10.     The empirical formula of a compound is C3H8.  If 2.00 mol of the compound has a mass of 264.48 g, what is the compounds molecular formula? Hint: first calculate the molar mass by dividing grams by moles.

**Molar Mass          =        264.48 g      =        132.24 g/mole       132.24         =          3 x**

**2.00 mole                                            44.08**

**C9H24**

11.     Find the empirical formula for a compound containing 24.45  % Ca, 17.07 % N and 58.53 % O.

          **Ca(NO3)2**

12.     Find the empirical formula for a compound containing 74.40  % Ga and 25.60  % O.

          **Ga2O3**

13.     Convert 5.55 x 1017 atoms of Co into grams.

**5.55  x  1017 at Co x        1 mole                   x        58.9 g                    =          5.43  x  10-5g Co**

**6.02  x  1023at                 1 mole**

14.     A volume of a gas weighs 3.0475 g.  An equal volume of He weighs 0.265g.        Calculate the molecular mass of the gas.  Assuming that this gas causes acid rain, what do you think the gas could be?  Show your work.

**Gas x           =        3.04475       =        11.489  x  4.0 g/mole      =        46 g/mole                   NO2**

**He                         0.265**

15.     Methamphetamine, MDMA, or commonly called ecstasy is an illegal drug from the family called “entactogens” which literally means in Greek “touching within”. It is considered to be a mood elevator that is 59.506 % C, 8.0135 % H, 6.9424 % N, 7.934 % O, and 17.604 % Cl. Calculate the empirical formula for MDMA.

**C10H16NOCl**

16.     Brodifacoum, a Coumarin derivative used to poison rats, is also used a blood thinner in small doses. An antidote for this poison is vitamin K, a blood-clotting agent. This compound contains C, H, Br and O.  A 10.00 g sample is burned to yield 25.633 g of CO2, 3.894 g H2O, and 1.502 g of Br2. What is the empirical formula of the compound? The structural formula is shown below.

**25.633 g CO2  x   1 mole   x     1 mole C     =   0.5826 mole C    x     12.0 g           =       6.991 g C**

                              **44.0 g          1 mole CO2                                        1 mole**

**3.894 g H2O  x      1 mole   x   2 mole H     =   0.4322 mole H     x    1.01 g           =       0.4365 g H**

                              **18.02 g        1 mole H2O                                       1 mole**

**1.502 g Br2  x        1 mole   x   2 mole Br   =   0.01880 mole Br   x   79.9 g           =       1.502 g Br**

                              **159.8 g        1 mole Br2                                         1 mole**

**Mass of C H Br    =        8.930 g**

**Mass of O  =  Total C H Br O           –        Mass of C H Br**

**Mass of O  =  10.00 g                        –        8.930**

**Mass of O  = 1.071 g**

**1.071 g O              x        1 mole         =        0.06691 moles O**

                                        **16.0 g**

**Mole Ratio**            **0.5826 moles C     =        31                x        2        =        62**

**0.01880 moles**

**0.4321 mole H      =        23                x        2        =        46**

                              **0.01880 moles**

**0.01880 mole Br   =        1                  x        2        =        2**

**0.01880 moles**

**0.06691 moles O   =        3.56             x        2        =        7**

                              **0.01880 moles**

**Empirical Formula         C62H46Br2O7**

**That’s all folks!!!!-**

**Worksheet # 10                     Moles Practice Test 2**

1. Convert 3.567 x 1023molecules of C4H10to g.

**34.4 g**

1. Convert 1.547 kg of Fe2(CO3)3 to FU’s.

**3.19 x 1024 FU**

1. What is the percent composition of Cr(C2H3O2)2 ? Three significant figures.

**Cr = 30.6%**

**C = 28.2%**

**H = 3.56%**

**O = 37.6%**

1. The empirical formula of a compound is SiH3.  If 1.5 moles of the compound have a mass of 139.95g, what is the compound's molecular formula?  (Hint: calculate molecular mass first.)

**Si3H9**

1. A compound has an empirical formula of ClCH2 and a molecular weight of 99.0 g/mol. What is its molecular formula?

**Cl2C2H4**

1. Aspirin has a chemical formula of C9H8O4.  A sample of aspirin has 9.70 x 1012 atoms of carbon.  How many atoms of hydrogen does this sample contain?

**8.62 x 1012 atoms H**

1. A volume of a gas weighs 2.647 g.  An equal volume of O2 weighs 3.025 g.  Calculate the molecular mass of the gas.  Assuming that this gas is an element, what is the gas?

**N2 (atomic mass 28.0 g/mole)**

1. Find the empirical formula for the oxide that contains 42.05 g of nitrogen and 95.95 g of oxygen.

**NO2**

1. A compound is 75.46% carbon, 4.43% hydrogen, and 20.10% oxygen by mass. It has a molecular weight of 318.31 g/mol. What is the molecular formula for this compound?

**C20H14O4**

1. 0.487 grams of quinine (a compound made C, H, N and O with a molar mass = 324 g/mol) is combusted and found to produce 1.321 g CO2, 0.325 g H2O and 0.0421 g of N2. Determine the empirical and molecular formulas.

**Emperical C10H12NO             Molecular C20H24N2O2**

1. If 0.500 g of hydrogen was generated at a current of 0.750 amps and over time period of 17.865      hours, calculate Avogadro’s number (the number of atoms in 1.00 g of hydrogen). Use unit analysis! Start the unit analysis with 17.865 h and end with atoms H.

1.00 coulomb = 6.24 x 10 18 electrons           1 electron = 1 H atom             1 amp = 1 coulomb per

            **17.865 h  x  60 min  x 60 s       x   0.750 coul   x   6.24x1018 el   x   1H atom    =    3.01x1023 H atoms**

**h              min                   s                             coul          1 el**

**3.01 x 1023 H atoms               =   6.02x1023 H atoms/g**

**0.5 g**