Moles and Matter Review Sheet

Solve the following moles problems and take care to have the math show how you got your answer. Try solving the first couple of problems in each section, check your answers and then complete the packet.

If the mass of one mole of water (H20) is 18 grams (2x hydrogen's mass of 1g plus oxygen's mass of 16g equals 18 g) then give the masses of the following compounds:

1) H_3PO_4
   3+31 + 4x16 = 98g
2) CO_2
   12+32 = 44g
3) $Mg(SCN)_2$
   24.3+(2x(32+12+14)) = 140.3g
4) C_3H_8OH
   3x12 + 8+16+1 = 61g
5) $PbCr_2O_7$
   207.2+52x2 + 7x16 = 423.2g

If one mole of ANYTHING is 6.02×10^{23} parts or units of what ever you are dealing with, solve the following quantity problems.

1) Determine the number of particles in the following:
   a. 5.75 moles of Munchkins (that's a lot of Munchkins)

   5.75 moles x 6.02 x 10^{23} parts/mole
   34.62 x 10^{23} = 3.46×10^{24} parts

   b. 14.5 moles of $CaCO_3$

   14.5 moles x 6.02 x 10^{23} parts/mole
   87.3 x 10^{23} parts = 8.73×10^{24}

   c. 1.23×10^{-3} moles of NaCl

   ~~1.23 x 6.02~~ 1.23 x 10^{-3} moles x 6.02 x10^{23} parts/mole
   7.40×10^{20} parts

   d. Three quarters of a mole of water

   3/4 mole x 6.02 x10^{23}
   0.75 mole x 6.02 x10^{23} parts/mole

   4.52×10^{23} parts

Be careful of the units! ALWAYS!!! The mass of any number of moles is equal to the number of moles times the mass of one mole of the compound. Solve the following problems:

2) Determine the mass in grams of the following:

a. 4.25 kg of NaCl

4250 g   23 g/mol   35.5 g/mol

b. Half a mole of C_2H_5OH

2x12 + 5x1 + 16+1 = 46 g/mol x 0.5 mol = 23 g

c. 78.9 mg of Aspirin

78.9 mg x 1 g / 1000 mg = ~~7.9x10~~ 7.89 x 10^-2

or

0.0789

d. 0.045 moles of Sulfur

0.045 mol x 32 g/mol = 1.44 g

Going from grams to moles, you want to see how many times the molar mass of the compound or substance fits into the mass you have or how many times the mass you have can be divided into the molar mass of the compound..

3) Determine the moles in the following:

a. 71.4g of Titanium

71.4 g / 47.87 g/mol = 1.49 moles

b. 217g of water

18 g/mol   217 g / 18 g/mol = 12.1 moles

c. 415g of aluminum phosphate $AlPO_4$

415 g / 122 g/mol = 3.4 mol   27 31 4x16 = 122

d. 9.51×10^2g of Lead

951 g / 207 g/mol = 4.59 mol

Going from particles to moles, you want to see how many times Avogadro's number fits into the number of particles you have or how many times the number of units you have can be divided into integers plus the remainder of Avogadro's number. Any number of moles greater than 10,000 (10^4) should be suspicious.

4) Determine the moles in the following:

a. 1.23×10^{23} particles of CO_2

$\frac{}{6.02 \times 10^{23} \text{ parts/mole}} = 0.2$ moles

b. 8.43×10^{22} particles of sugar

$\frac{}{6.02 \times 10^{23} \text{ parts/mole}} = 1.4 \times 10^{-1}$ moles

c. 4.79×10^{24} particles of $N_2C_8 H_2O_3$

$\frac{}{6.02 \times 10^{23} \text{ parts/mol}} = 0.796 \times 10^{1} = 7.96$ moles

d. 5,000 trillion molecules of dihexyldoorknob

$5 \times 10^3 \times 10^{12} = \frac{5 \times 10^{15} \text{ molecules}}{6.02 \times 10^{23} \text{ parts/mol}} = 0.831 \times 10^{-8} \text{ mol} = 8.31 \times 10^{-9}$

Percent composition asks you to determine the mass of each type of element in a compound expressed as a percentage of the total mass of the compound. Simply divide the total mass of each element in the compound by the molar mass of the compound and express this number in the form of a percent

5) Determine percent by mass of each element in NH_4SCN

a. N

$\frac{14+14}{76} \times 100 = 36.8\%$ $\quad 14+4+32+12+14 = 76$

b. H

$\frac{4}{76} \times 100 = 5.3\%$

c. K

$\frac{0}{76} = 0\%$

d. S

$\frac{32}{76} \times 100 = 42\%$

e. C

$\frac{12}{76} \times 100 = 15.8\%$

f. Based on the percentages of the previous compound, how much nitrogen would you get if you were able to break down 756.3 grams of the compound?

%N = 36.8%

756.3g x 0.368 = 278 gr

g. Again, from the previous compound, what total mass of ~~oxygen~~ Sulfur and carbon would you need to make 4 kilograms of the chemical?

4,000g x 0% for Oxygen   4,000 x 0.158 carbon

4,000g x 0.42 = 1680g Sulfur   = 632g C

Percent composition can also give you the ratio of moles of each element in a compound if you convert the percent straight to grams, then those grams to moles, and then compare the amount of moles to each other. The empirical formula for a compound is not always the molecular formula though. If the molar mass of the compound is the same as the empirical formula, then they are the same. If the molecular formula's mass is a multiple of the empirical formula, then you must multiply the amount of elements in the empirical formula by how many times bigger the molecular formula' mass is than the empirical formula's.

6) (a simple problem) If 1 mole of a compound breaks up into 72 grams of carbon, 12 grams of hydrogen, and 96 grams of oxygen, what is it's empirical and molecular formula?

1 mole = 180g

72g / 12g/mol C = 6 mol C / 6 = 1 C   96g / 16g/mol O = 6/6 O = 1 O

12g / 1g/mol H = 12 mol H / 6 = 2 H

CH2O = 30g   180/30 = 6

6 x CH2O = C6H12O6

7) If an unknown gas has an empirical formula of C_2H_5 could it be butane if butane has a formula of C_4H_{10}?

Yes, they are in the same ratio of moles

8) If this gas has a molar mass of 87g, what is the formula for this gas?

C2H5 = 24 + 5 = 29

87g / 29g = 3   3 x C2H5 = C6H15

9) If a compound is found to be made of 158.25g Xenon and 91.75g of Fluorine, what is it's empirical formula?

$\frac{158.25g\ Xe}{131.3\ g/mol\ Xe} = \frac{1.2\ mol}{1.2} = 1$ XeF_4

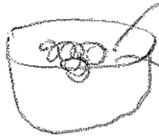
$\frac{91.75g\ F}{19\ g/mol\ F} = \frac{4.83\ mol}{1.2} = 4$

10) If this gas has a molar mass of 621.6g, what is it's molecular formula?

$XeF_4 = 207.3$ $\frac{621.6}{207.3} = 3$ Xe_3F_{12}

Compounds that are surrounded by water molecules are called hydrates. Since water molecules can't be divided and still be water, the ratio of water to the central compound (called the anhydrous compound) is always a whole number ratio. The number of water molecules is reflected in the name of the coumpound, mono for one, di for two, tri for three, etc. Heat is used to separate the water from the anhydrous compound and from the masses you can calculate the moles of each and then the formula for the hydrated compound.

11) If 25.0 grams of $NiCl_2 \cdot ?H_2O$ are heated and 11.37 grams of water are driven off, what is the formula for the hydrate?



$H_2O = 11.37g / 18\ g/mol =$ ~~0.71~~ 0.63

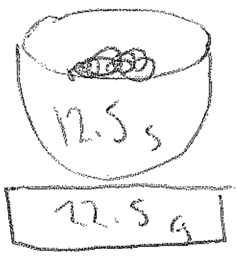
$NiCl_2 = 25.0 - 11.37g = 13.63g / (58.7\ g/mol + 71\ g/mol) = 0.105$

129.7 g/mol

about 1 to 6

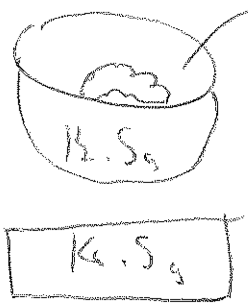
so $NiCl_2 \cdot 6H_2O$

12) If a crucible has a mass of 12.5 grams and full of $FeCl_3$ hydrate it weighs 22.5 grams calculate the formula for the hydrate if after heating the crucible and anhydrous compound weigh 18.5 grams.



$FeCl_3 \cdot ?\, H_2O$

22.5 g − 12.5 g = 10 g of $FeCl_3 \cdot ?H_2O$



H_2O = ~~18.5 g − 12.5 g~~ 10 g − 6 g = ~~6 g~~ 4 g

$FeCl_3$ = 18.5 − 12.5 g = 6 g

55.8 + ~~71~~ 106.5 = ~~126.8~~ 162.3 g

$\frac{4\text{ g}}{18\text{ g/mol } H_2O}$ = 0.22 mole / ~~0.047~~ 0.037 = ~~4.7~~ 6

$\frac{6\text{ g}}{\text{~~126.8~~ } 162.3\text{ g/mol}}$ = 0.0~~47~~37 mol / 0.047 mol = 1

$FeCl_3 \cdot 6\, H_2O$