Review from Chem. 120 KEY Moles, Stoichiometry, Empirical Formula, Equations

1. Tumeric is commonly used as a spice in Indian and Southeast Asian dishes. Tumeric contains a high concentration of curcumin (C20H18O6), a potential anticancer drug and a possible treatment for cystic fibrosis. Answer the following questions regarding curcumin.
	1. Calculate the molar mass of curcumin.

$$?molar mass$$

$$=20 at C\left(\frac{12.01 amu}{atom C}\right)+18 at H\left(\frac{1.008 amu}{1 atom H}\right)+6 at O\left(\frac{16.00 amu}{1 atom O}\right)$$

$$=240.2 amu C+18.14 amu H+96.00 amu O$$

$$=$$

* 1. Calculate the mass of curcumin that contains 6.297 x 1025 atoms of carbon.

$$?g C\_{20}H\_{18}O\_{6}$$

$$=6.297×10^{25}at C×\frac{1 mole C}{ 6.022×10^{23}atom C}×\frac{1 mol C\_{20}H\_{18}O\_{6}}{20 mol C}×\frac{354.3 g C\_{20}H\_{18}O\_{6}}{1 mol C\_{20}H\_{18}O\_{6}}$$

$$=$$

* 1. Calculate the number of moles of hydrogen in 7.98 moles of curcumin.

$$?mol H=7.98 mol C\_{20}H\_{18}O\_{6}×\frac{18 mol H}{1 mol C\_{20}H\_{18}O\_{6}}=$$

* 1. Calculate the number of molecules of curcumin that contains 792 atoms of oxygen.

$$?molec C\_{20}H\_{18}O\_{6}=793 atom O×\frac{1 molec C\_{20}H\_{18}O\_{6}}{6 atom O}=$$

* 1. Calculate the mass in grams of one molecule of curcumin.

$$?\frac{g C\_{20}H\_{18}O\_{6}}{molecule}=\frac{354.3 g C\_{20}H\_{18}O\_{6}}{1 mol C\_{20}H\_{18}O\_{6}}×\frac{1 mol C\_{20}H\_{18}O\_{6}}{6.022×10^{23}molecule C\_{20}H\_{18}O\_{6}}$$

$$=$$

* 1. If 3.64 g of curcumin is dissolved in ether to make 25.0 mL of solution, what is the concentration of the solution in moles/L?

$$?M=\frac{3.64 g C\_{20}H\_{18}O\_{6}}{0.0250 L soln}×\frac{1 mol C\_{20}H\_{18}O\_{6}}{354.3 g C\_{20}H\_{18}O\_{6}}=0.411 M C\_{20}H\_{18}O\_{6}$$

* 1. If the density of the solution from part f is 0.724 g/mL, what is the mass percent of curcumin in the solution?

$$?\% C\_{20}H\_{18}O\_{6}=\left(\frac{0.411 mol C\_{20}H\_{18}O\_{6}}{1000 mL soln}×\frac{354.3 g C\_{20}H\_{18}O\_{6}}{1 mol C\_{20}H\_{18}O\_{6}}×\frac{1 mL soln}{0.724 g soln}\right)×100=20.1 \% C\_{20}H\_{18}O\_{6}$$

1. A sample contains 70.6% Hg, 12.5% Cl, and 16.9% O. If it has a molar mass of about 568 g/mol

a. What are the empirical and molecular formulas?

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Empirical formula is HgClO3

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Molecular formula is (HgClO3)2 = Hg2Cl2O6 = Hg2(ClO3)2

 b. What is the name of the molecular formula? mercury(I) chlorate

1. Menthol, a strong smelling substance used in cough drops, is a compound of carbon, hydrogen, and oxygen. When 0.1595 g of menthol was subjected to combustion analysis, it produced 0.449 g of CO2 and 0.184 g of H2O. What is menthol’s empirical formula?

$$0.449 g CO\_{2}×\frac{1 mol CO\_{2}}{44.01 g CO\_{2}}×\frac{1 mol C}{1 mol CO\_{2}}=0.0102 mol C×\frac{12.01 g C}{1 mol C}=0.123 g C$$

$$0.184 g H\_{2}O×\frac{1 mol H\_{2}O}{18.02 g H\_{2}O}×\frac{2 mol H}{1 mol H\_{2}O}=0.0204 mol H×\frac{1.008 g H}{1 mol H}=0.0206g H$$

$$?g O=0.1595 g menthol-\left(0.123 g C+0.0206 g H\right)=0.0164 g O$$

$$0.0164 g O×\frac{1 mol O}{16.00 g O}=0.00103 g O$$

$$C\_{\frac{0.0102}{0.00103}}H\_{\frac{0.0204}{0.00103}}O\_{\frac{0.00103}{0.00103}} \rightarrow C\_{10}H\_{20}O$$

1. Write a balanced net ionic equation for the reaction, if any that occurs in each of the following cases. Assume that all soluble reactants are added in the form of aqueous solutions. Indicate gases and precipitates that are formed, as well as insoluble solid reactants. If no reaction occurs, then write **NO RXN**, and do not write a balanced equation. Be sure to **balance** your equations and include your **phase labels** (12 points).
2. zinc bromide + potassium phosphate 🡪

3 ZnBr2 (aq) + 2 K3PO4 (aq) 🡪 6 KBr (aq) + Zn3(PO4)2 (s)

3 Zn2+ (aq) + 6 Br-(aq) + 6 K+(aq) + 2 PO43- (aq) 🡪 6 K+(aq) + 6 Br-(aq) + Zn3(PO4)2 (s)

3 Zn2+ (aq) + 2 PO43- (aq) 🡪 Zn3(PO4)2 (s)

1. nitric acid + barium hydroxide 🡪

2 HNO3 (aq) + Ba(OH)2 (aq) 🡪 Ba(NO3)2 (aq) + 2 H2O (l)

 2 H+ (aq) + 2 NO3- (aq) + Ba2+ (aq) + 2 OH- (aq) 🡪 Ba2+ (aq) + 2 NO3- (aq) + 2 H2O (l)

 H+ (aq) + OH- (aq) 🡪 H2O (l)

1. ammonium nitrate + sodium hydroxide 🡪

NH4NO3 (aq) + NaOH (aq) 🡪 NaNO3 (aq) + NH3 (g) + H2O (l)

NH4+ (aq) + NO3- (aq) + Na+ (aq) + OH- (aq) 🡪 Na+ (aq) + NO3- (aq) + NH3 (g) + H2O (l)

NH4+ (aq) + OH- (aq) 🡪 NH3 (g) + H2O (l)

1. 5.00 g of iron is reacted with 5.00 g of water according to the unbalanced chemical equation shown below. Use an ICE table to answer the following questions (10 points bonus).

3 Fe (s) + 4 H2O (l) 🡪 Fe3O4 (s) + 4 H2 (g)

I 0.0895 mol 0.277 mol 0.000 mol 0.000 mol

C -3x -4x +x +4x

E 0.000 mol 0.277 mol – 4x = x = 0.0298 mol 4(0.0298 mol) =

 0.277 mol – 4(0.0298 mol) = 0.119 mol

 0.158 mol

0.0895 mol – 3x = 0.000 mol

0.0895 mol = 3x

0.0298 mol = x









1. What is the limiting reactant?

 > , therefore there is more water than is needed. So, iron is the limiting reactant.

1. How many grams of Fe3O4 are produced?



1. How many grams of the excess reactant is left over at the end of the reaction?

