Che 111: Chapter 9 Practice Problems Key

1. The unit most often used to describe the mass of atoms is the atomic mass unit, whose symbol is u or amu. An atomic mass unit is defined as exactly____1/12_____ the mass of an atom of carbon-12.

2. One _____mole_____ of carbon contains 6.022×10^{23} carbon atoms

3. What is the weighted average mass in grams of 6.022×10^{23} atoms of the elements (a) bromine and (b) nickel?

a) 80 g

b) 59 g

4. A multivitamin tablet contains 40 milligrams of potassium. How many moles of potassium does each tablet contain?

$$40 \text{ mg K}\left(\frac{1 \text{ g}}{1000 \text{ mg}}\right)\left(\frac{1 \text{ mol K}}{39 \text{ g K}}\right) = 1.02 \times 10^{-3} \text{ moles}$$

5. For each of the following ionic substances (a) Co_2O_3 and (b) $Fe_2(C_2O_4)_3$, calculate its formula mass and write a conversion factor that converts between mass in grams and moles of the substance.

a) 2(Co)+ 3(O)= 2(59)+3(16)= $\frac{1.66 \times 10^2 \text{ g } Co_2O_3}{1 \text{ mole } Co_2O_3}$

b) 2(Fe)+ 3[2(C)+4(O)]= 2(56)+3[2(12)+4(16)] = $\frac{3.76 \times 10^2 \text{ g } Fe_2(C_2O_4)_3}{1 \text{ mole } Fe_2(C_2O_4)_3}$

6. A multivitamin tablet contains 5 µg of nickel in the form of nickel(II) sulfate ($NiSO_4$). How many micrograms of $NiSO_4$ does each tablet contain?

$$5 \text{ ug Ni} \left(\frac{1 \text{ g}}{10^6 \text{ ug}}\right)\left(\frac{1 \text{ mol Ni}}{59 \text{ g Ni}}\right)\left(\frac{1 \text{ mol } NiSO_4}{1 \text{ mol Ni}}\right)\left(\frac{155 \text{ g } NiSO_4}{1 \text{ mol } NiSO_4}\right)\left(\frac{10^6 \text{ ug}}{1 \text{ g}}\right)$$

= 13 µg $NiSO_4$

7. A sample of an ionic compound that is used in the semiconductor industry is analyzed and found to contain 53.625 g of indium and 89.375 g of tellurium. What is the empirical formula for this compound?

53.625 g In $\left(\frac{1 \text{ mol In}}{115 \text{ g In}}\right)$ = 0.466 / 0.466 = 1

89.375 g Te $\left(\frac{1 \text{ mol Te}}{128 \text{ g Te}}\right)$ = 0.698 / 0.466 = 1.5

$In_1Te_{1.5} \rightarrow In_2Te_3$

8. Hydralazine is a drug used to treat heart disease. It is 59.99% carbon, 5.03% hydrogen, and 34.98% nitrogen and has a molecular mass of 160.178. What is the molecular formula for hydralazine?

59.99 g C $\left(\frac{1 \text{ mol C}}{12 \text{ g C}}\right)$ = 4.999 / 2.5 = 2

5.03 g H $\left(\frac{1 \text{ mol H}}{1 \text{ g H}}\right)$ = 5.03 / 2.5 = 2

34.98 g N $\left(\frac{1 \text{ mol N}}{14 \text{ g N}}\right)$ = 2.5 / 2.5 = 1

C_2H_2N

Empirical Mass = 2(12) + 2 (1) + 1 (14) = 40 g/mol

Empirical Mass/Molecular Mass = 160/40 = 4

$C_{2x4}H_{2x4}N_{1x4} \rightarrow C_8H_8N_4$

9. Spodumene is a lithium aluminum silicate containing the equivalent of 6.5 % to 7.5 % lithium oxide, Li_2O. Crude ore mined in North Carolina contains 15 % to 20 % spodumene. What maximum mass, in kilograms, of lithium could be formed from 2.538 megagrams of spodumene containing the equivalent of 7.0 % Li_2O?

$$2.538 \text{ Mg Spoudumene} \left(\frac{7 \text{ Mg } Li_20}{100 \text{ Mg Spoudumene}}\right)\left(\frac{10^6 \text{ g}}{1 \text{ Mg}}\right)\left(\frac{1 \text{ mol } Li_20}{30 \text{ g } Li_20}\right)\left(\frac{2 \text{ mol Li}}{1 \text{mol } Li_20}\right)\left(\frac{7 \text{ g Li}}{1 \text{mol Li}}\right)\left(\frac{1 \text{ kg}}{1000 \text{ g}}\right)$$

= 83 kg Li_2O