**CHE1031 Module 3 Quiz: Composition of substances & solutions KEY**

*A periodic table and table of conversion factors are provided.*

*You will be allowed a moment to consult any handwritten notes.*

*Please show all work for full & partial credit.*

**3.1: Formula mass and the mole concept**

**1.** Calculate the molecular or formula mass of each:

(a) P4

(b) Ca(NO3)2

(c) CH3CO2H (acetic acid)

(d) C12H22O11 (sucrose, cane sugar).

(a) 123.88 g/mol

(b) 164.10 g/mol

(c) 60.04 g/mol

(d) 342.23 g/mol

**2.** Which contains the greatest mass of oxygen: 0.75 mol of ethanol (C2H5OH), 0.60 mol of formic acid (HCO2H), or 1.0 mol of water (H2O)? Explain why.  
The answer doesn’t require complete conversion of moles to molecules. Only:  
0.75 mol & 1 atom O/molecule

0.6o mol & 2 atoms O/molecule 🡨

1.0 mol & 1 atom O/ molecule

**3.** Determine the number of moles of the compound and determine the number of moles of each type of atom in 0.1488 g of phosphoric acid, H3(PO4)

0.1488 1 mol = 1.52 E-3 mol X 3 = 4.56 E-3 mol H

97.96 g X 1 = 1.52 E-3 mol P

X 4 = 6.08 E-3 mol O

**4.** Determine the mass of 3.3 E-2 mol Na2(CO3).

3.3 E-2 mol 105.96 g = 3.5 g

1 mol

**3.2: Determining empirical and molecular formulas**

**5.** Determine, to four significant figures, the percent composition of TNT, C6H2(CH3)(NO2)3

MW = 227.09 g/mol C = 84.07(100) = 37.0% H = 5.05 (100) = 2.22%

227.09 227.09

N = 42.03 (100) = 18.5% O = 95.94 (100) = 42.2%

227.09 227.09

**6.** Determine the empirical formulas for a compound with 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen

40.0 g 1 mol = 3.33 mol C 6.7 g 1 mol = 6.63 mol H 53.3 g 1 mol = 3.33 mol O

12.01 1.01 g 15.99 g  
Divide all mol by 3.33 🡪 CH2O

**7.** Dichloroethane, a compound that is often used for dry cleaning, contains carbon, hydrogen, and chlorine. It has a molar mass of 99 g/mol. Analysis of a sample shows that it contains 24.3% carbon and 4.1% hydrogen. What is its molecular formula?

23.4 g 1 mol = 1.95 mol C 4.1 g 1 mol = 4.06 mol Hc7 71.6 g 1 mol = 2.02 mol Cl

12.01 g 1.01 g 35.45 g

C2H4Cl2 = 98.96 g/mol = 1  
 99 g/mol 🡪 So empirical & molecular formulas are C2H4Cl2

**3.3: Molarity**

**8.** What does it mean when we say that a 200-mL sample and a 400-mL sample of a solution of salt have the same molarity? In what ways are the two samples identical? In what ways are these two samples different?  
Both samples have the same ration of moles of solute to liters of solution. So, proportionally the concentration of salt is the same. If we evaporated the solvent, the larger sample would contain more solute.

**9.** Determine the molarity of each of the following solutions:

(a) 1.457 mol KCl in 1.500 L of solution

(b) 0.515 g of H2(SO4) in 1.00 L of solution

(a) 1.457 mol = 0.9713 M

1.500 L

(b) 0.515 g 1 mol = 5.25 E-3 M

98.04 g 1.00 L

**10.** Calculate the number of moles and the mass of the solute in 0.2500 L of 0.1135 M K2(CrO4), an analytical reagent used in iron assays

0.2500 L 0.1135 mol = 2.838 E-2 mol 194.16 g = 5.510 g

1 L 1 mol

**11.** If 4.12 L of a 0.850 M-H3(PO4) solution is be diluted to a volume of 10.00 L, what is the concentration of the resulting solution?

(4.12 L)(0.850 M) = ~~(10.00 L)(~~X M) = 0.350 M

10.00 L