Chm.2.2.5 Analyze quantitatively the composition of a substance (empirical formula, molecular formula, percent composition, and hydrates) *(questions 1, 2, 3, 4, 5, 6, 7, 8)*

- Calculate empirical formula from mass or percent using experimental data. *(questions 13, 14, 15, 16)*
- Calculate molecular formula from empirical formula using molecular weight. *(questions 17, 18, 19, 20)*
- Determine percentage composition by mass of a given compound. *(questions 9, 10, 11, 12)*
- Perform calculations based on percent composition. *(questions 13, 14, 15, 16, 17, 18, 21)*
- Determine the composition of hydrates using experimental data. *(question 21)*

## Molar Mass/2-Step MOLE Conversions: Must show *DIMENSIONAL ANALYSIS* set up!

1. How many moles of water are there if you have $2.52 \times 10^{25}$ molecules of water?

2. How many moles of aluminum sulfite are there in 25.5 grams of aluminum sulfite?

3. Calculate the mass in grams for 0.250 moles of sodium chloride.

4. Calculate the number of moles in 100. grams of sodium chloride.

## 3-Step MOLE Conversions: Must show *DIMENSIONAL ANALYSIS* set up!

5. How many grams of calcium nitrate are in $3.24 \times 10^{23}$ formula units (f.u.) of calcium nitrate?

6. How many grams of sulfur dioxide are in $3.15 \times 10^{23}$ molecules of sulfur dioxide?

7. How many atoms of mercury are in 84.6 grams of pure mercury?

8. **CHALLENGE:** You collect 26.5 grams of carbon tetrafluoride. How many atoms of fluorine are present?

## Percent (%) Composition: Must show ALL work for full credit!

9. Determine the percent composition for each of the elements in copper (II) sulfate.

10. What is the percent composition of calcium in the compound calcium phosphide?

11. Determine the percent composition for each of the elements in ammonium hydroxide.

12. Determine the percent composition for each of the elements in carbon tetrachloride.

## Empirical Formulas (E.F.): Must show ALL work for full credit!

13. Determine the empirical formula (E.F.) of a compound containing 24.7% potassium, 34.8% manganese, and 40.5% oxygen.

**14.** Quantitative analysis shows that a compound contains 32.4% Na, 22.7% S, and 45.0% O. Determine the empirical formula (E.F.) of this compound.

**15.** Determine the empirical formula (E.F.) of a compound containing 67.6% mercury, 10.8% sulfur, and 21.6% oxygen.

**16.** A very flammable gas contains 60.0% carbon and 40.0% hydrogen. Determine its empirical formula.

## Molecular Formulas (M.F.): Must show ALL work for full credit!

**17.** The compound methyl butanoate smells like apples.  Given its percent composition as 58.8% carbon, 9.80% hydrogen, and 31.4% oxygen and a molecular mass of 102 g/mol, what is the molecular formula (M.F.) for methyl butanoate?

**18.** Determine the molecular formula (M.F.) of a compound containing 43.6% P and 56.4% O, if the molecular mass is 284 g/mol.

**19.** The empirical formula of a compound is $C_3H_7$, with a molecular mass of 86.0 g/mol. Determine the molecular formula (M.F).

**20.** The empirical formula of a compound is CH, with a molecular mass of 26.0 g/mol. Determine the molecular formula (M.F.).

## Hydrates: Must show ALL work for full credit!

**21.** Hydrated sodium tetraborate, commonly called borax has the general formula $Na_2B_4O_7 \bullet nH_2O$. Chemical analysis indicates that this hydrate is 52.8% sodium tetraborate and 47.2% water. Determine the formula and name the hydrate.

**22.** During lab, 1.62 grams of $CoCl_2$ x **n** $H_2O$ was heated. After heating, only 0.880 grams of $CoCl_2$ remained. What was the formula of the original hydrate? What was the name of the original hydrate?