Naming:
Charts of prefixes, etc. from textbook
Examples/rules from naming compounds handout
-ate, -ite, ide
Roman numeral names and rules

Example problems from Unit 5 handout
Google title / page / book # or scan it myself

% comp example
Other examples from mole map

Holt Modern Chemistry Review
CHAPTER 7: CHEMICAL FORMULAS AND CHEMICAL COMPOUNDS

The following pages contain the bulk (but not all) of the information for the chapter 7 test.
Focus on this content, but make sure to review class notes, activities, handouts, questions, etc.
If you study this document and NOTHING else, you should at least be able to PASS the test.
******** Test items will be recall, examples, and/or application of this content. ********

OUTCOMES

- Collaborate with peer(s) to understand chemistry content ***(C C)***
- Communicate chemistry content to teacher and peer(s) ***(E C)***
- **7.1:** Name and write formulas for all types of chemical compounds and bonds ***(T & R)***
- **7.3:** Use formula mass to convert between moles and grams ***(F & PK)***
- **7.3:** Calculate the percent composition ***(F & PK)***
- **7.4:** Distinguish among empirical and molecular – definitions and formulas ***(T & R)***
- **7.4:** Determine the empirical formula from the percent composition ***(F & PK)***
- **7.4:** Determine the molecular formula from the empirical formula ***(F & PK)***

7.1: CHEMICAL NAMES AND FORMULAS

- ***Vocabulary***
  - **monatomic ion** -- an ion formed from a single atom
  - **binary compound** -- a compound composed of two different elements
  - **nomenclature** -- a naming system
  - **oxyanion** -- a polyatomic ion that contains oxygen
  - **salt** -- an ionic compound that forms when a metal atom or a positive radical replaces the hydrogen of an acid
- ***Chapter Highlights***
  - A positive monatomic ion is identified simply by the name of the appropriate element. A negative monatomic ion is named by dropping parts of the ending of the element's name and adding -ide to the root.
  - The charge of each ion in an ionic compound may be used to determine the simplest chemical formula for the compound.
  - Binary compounds are composed of two elements.
  - Binary ionic compounds are named by combining the names of the positive and negative ions.
  - The old system of naming binary molecular compounds uses prefixes. The new system, known as the Stock system, uses oxidation numbers.

7.2: OXIDATION NUMBERS

- ***Vocabulary***
  - **oxidation number** -- the number of electrons that must be added to or removed from an atom in a combined state to convert the atom into the elemental form
  - **oxidation state** -- the condition of an atom expressed by the number of electrons that the atom needs to reach its elemental form
- ***Chapter Highlights***
  - Oxidation numbers are useful in naming compounds, in writing formulas, and in balancing chemical equations.
  - Compounds containing elements that have more than one oxidation state are named by using the Stock system.
  - Stock-system names and prefix-system names are used interchangeably for many molecular compounds.
  - Oxidation numbers of each element in a compound may be used to determine the compound's simplest chemical formula.
  - By knowing oxidation numbers, we can name compounds without knowing whether they are ionic or molecular.

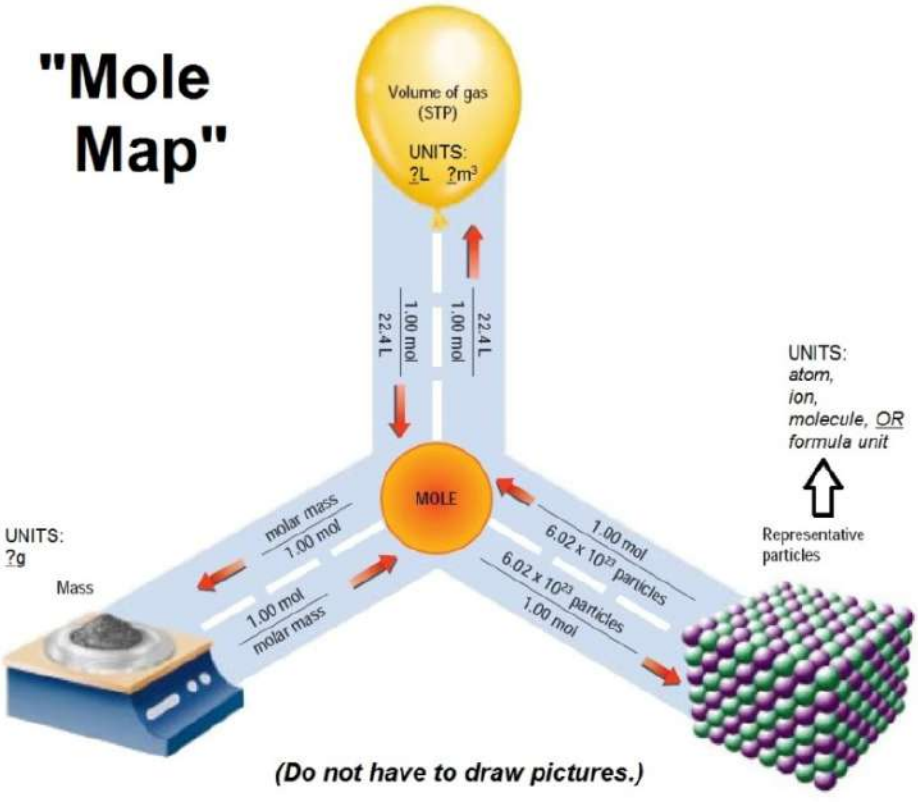
7.3: USING CHEMICAL FORMULAS

- ***Vocabulary***
  - **formula mass** -- the sum of the average atomic masses of all atoms represented in the formula of any molecule, formula unit, or ion
  - **percentage composition** -- the percentage by mass of each element in a compound
- ***Chapter Highlights***
  - Formula mass, molar mass, and percentage composition can be calculated from the chemical formula for a compound.
  - The percentage composition of a compound is the percentage by mass of each element in the compound.
  - Molar mass is used as a conversion factor between amount in moles and mass in grams of a given compound or element.

7.4: DETERMINING CHEMICAL FORMULAS

- ***Vocabulary***
  - **empirical formula** -- a chemical formula that shows the composition of a compound in terms of the relative numbers and kinds of atoms in the simplest ratio
- ***Chapter Highlights***
  - An empirical formula shows the simplest whole-number ratio of atoms in a given compound.
  - Empirical formulas indicate how many atoms of each element are combined in the simplest unit of a chemical compound.
  - A molecular formula can be found from the empirical formula if the molar mass is measured.

"Mole Map"



(Do not have to draw pictures.)

EMPERICAL FORMULA EXAMPLE PROBLEM:

Analysis of a 10.150 g sample of a compound known to contain only phosphorus and oxygen indicates a phosphorus content of 4.433 g. What is the empirical formula of this compound?

SOLUTION

1 ANALYZE

Given: sample mass = 10.150 g
phosphorus mass = 4.433 g
Unknown: empirical formula

2 PLAN

Mass composition ⟶ composition in moles ⟶ smallest whole-number ratio of atoms

3 COMPUTE

The mass of oxygen is found by subtracting the phosphorus mass from the sample mass.

$$\text{sample mass} - \text{phosphorus mass} = 10.150\ \text{g} - 4.433\ \text{g} = 5.717\ \text{g}$$

Mass composition: 4.433 g P, 5.717 g O

Composition in moles:

$$4.433\ \text{g P} \times \frac{1\ \text{mol P}}{30.97\ \text{g P}} = 0.1431\ \text{mol P}$$

$$5.717\ \text{g O} \times \frac{1\ \text{mol O}}{16.00\ \text{g O}} = 0.3573\ \text{mol O}$$

Smallest whole-number mole ratio of atoms:

$$\frac{0.1431\ \text{mol P}}{0.1431} : \frac{0.3573\ \text{mol O}}{0.1431}$$

$$1\ \text{mol P} : 2.497\ \text{mol O}$$

The number of O atoms is not close to a whole number. But if we multiply each number in the ratio by 2, then the number of O atoms becomes 4.994 mol, which is close to 5 mol. The simplest whole-number mole ratio of P atoms to O atoms is 2:5. The compound's empirical formula is P_2O_5.

MOLECULAR FORMULA EXAMPLE PROBLEM:

In Sample Problem M, the empirical formula of a compound of phosphorus and oxygen was found to be P_2O_5. Experimentation shows that the molar mass of this compound is 283.89 g/mol. What is the compound's molecular formula?

SOLUTION

1 ANALYZE

Given: empirical formula
Unknown: molecular formula

2 PLAN

$$x(\text{empirical formula}) = \text{molecular formula}$$

$$x = \frac{\text{molecular formula mass}}{\text{empirical formula mass}}$$

3 COMPUTE

Molecular formula mass is numerically equal to molar mass. Thus, changing the g/mol unit of the compound's molar mass to amu yields the compound's molecular formula mass.

molecular molar mass = 283.89 g/mol
molecular formula mass = 283.89 amu

The empirical formula mass is found by adding the masses of each of the atoms indicated in the empirical formula.

mass of phosphorus atom = 30.97 amu
mass of oxygen atom = 16.00 amu
empirical formula mass of $P_2O_5 = 2 \times 30.97\ \text{amu} + 5 \times 16.00\ \text{amu} = 141.94\ \text{amu}$

Dividing the experimental formula mass by the empirical formula mass gives the value of x. The formula mass is numerically equal to the molar mass.

$$x = \frac{283.89\ \text{amu}}{141.94\ \text{amu}} = 2.0001$$

The compound's molecular formula is therefore P_4O_{10}.

$$2 \times (P_2O_5) = P_4O_{10}$$