Standard: #3- 5

Honors Chemistry

Ratios of atoms: covalent molecules vs. ionic crystals

What is the difference between formulas and the percent mass of a substance.

a. Student should be able to determine the percent mass of a compound.

b. Student will be able to determine the percent composition ionic and covalent substances.

1. What is the difference between an empirical formula and a molecular formula?

simplest ratios only | Covalent may or may not be simplest ratios

I or C

2. For each of the following:

   a. Indicate an I or C for bond type.

   b. Indicate an E or a M if formula is an empirical or molecular ratio

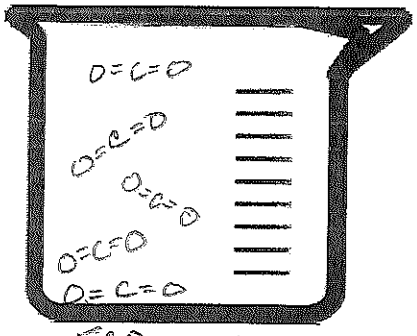
   c.

C	NO_2 E+M	C	CH_4 E+M	I+C	$NaNO_3$ E
C	$C_6H_{12}O_6$ M	C	C_2H_6 M	I+C	$C_2O_4^{-2}$ M
I	$AlCl_3$ E	C	C_2H_5OH E+M	C	C_6H_{14} M

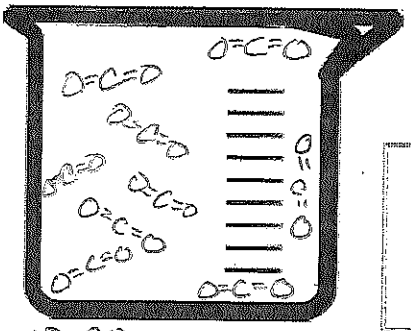
   d. Is it possible for an ionic compound to be molecular?

   e. Is it possible for a covalent compound to be empirical?

3. In the beakers below, draw the pictures requested and answer the questions below.



5 CO_2 Beaker 1



10 CO_2 beaker 2

Percentage = number of items / total items

In beaker 1 draw 5 CO_2 molecules, in beaker 2 draw 10 CO_2 molecules

   a. In a single molecule of CO_2

      i. 1 C atoms

      ii. 2 O atoms

   b. beaker 1

      i. 5 C atoms

      ii. 10 O atoms

   c. Beaker 2

      i. 10 C atoms

      ii. 20 O atoms

   d. Imagine you had a beaker with 100 carbon dioxide molecules.

In a pure sample of CO_2 what is the percent C atoms and what is the percent O atoms?

33.3% C 66.7% C

Does the sample size matter? Why or why not? Explain

No - always same ratio

Always C:O in at 2:1 ratio

100 CO_2

i. 100 C atoms
ii. 200 O atoms

e. Imagine you had a beaker with 1,000,000 carbon dioxide molecules.
   i. 1,000,000 C atoms
   ii. 2,000,000 O atoms

4. Glucose, $C_6H_{12}O_6$, what is the percent of all the particles are:
   a. Carbons 25% $6/24 \times 100 = 25\%$ C
   b. Hydrogen: 50% $12/24 \times 100 = 50\%$ H
   c. Oxygen: 25% $6/24 \times 100 = 25\%$ O

5. If you had 100 molecules that you thought were glucose but were not sure. When analyzed
   a. What should be the simplest ratio of carbon: Hydrogen: Oxygen?
      1:2:1
   b. What should be the actual number of each element found in the 100 molecule sample?
      600 C : 1200 H : 600 O

Read: We have seen from above that the number of atoms is in a fixed ratio, and each of those atoms also has its own fixed mass. Therefore the ratios of mass should also be fixed! Think about this!

6. A carbon atom has a mass of 12 amu and an oxygen atom has the mass of 16 amu. What is the mass of a single CO_2 molecule? 44 amu
   C $1 \times 12 = 12$
   O $2 \times 16 = 32$
   44 amu
7. What is the percent of C by mass: $\frac{12}{44} \times 100 = 27.3\%$ C
8. What is the percent of O by mass: $\frac{32}{44} \times 100 = 72.7\%$ O
9. If you have a 100g sample of CO_2; how much of that 100 grams is due to C 27.3g ?
10. If you have a 50 gram sample of CO_2; How much of that is due to C 13.7g ?
    $\frac{27.3}{100} = \frac{x}{50}$ $x = 13.7$g
11. CH_4: (C: 12 amu; H 1 amu)
    a. What are the percent ratios of particles between C and H
       $\frac{1C}{5} \times 100 = 20\%$ C
       $\frac{4H}{5} \times 100 = 80\%$ H
    b. What are the percent ratios of mass between these two particles:
       C $1 \times 12.0 = 12.0$
       H $4 \times 1.0 = 4.0$
       16.0 amu
       $\frac{12}{16} \times 100 = 75\%$ C
       $\frac{4}{16} \times 100 = 25\%$ H
       } by mass
    c. If I have 50 CCl_4 molecules, use appropriate ratio above to determine number of chlorine atoms
       Carbon atoms: 50
       Cl atoms : 200
    d. If I have 50 grams of CCl_4, use the appropriate ratio above to determine the mass of chlorine atoms.
       C $1 \times 12.0 = 12.0$
       Cl $4 \times 35.5 = 142.0$
       154.0
       $\frac{12}{154} \times 100 = 7.8\%$ C
       $\frac{142}{154} \times 100 = 92.2\%$ Cl
       $\frac{7.8}{100} = \frac{x}{50}$ 3.9g C
       $\frac{92.2}{100} = \frac{x}{50}$ 46.1g Cl
    e. What can you say about the connection between the percent particles and percent mass of this substance? Not the same!
       Percent particles is based on amount
       percent mass is based on mass
       & each element has a different mass