(1) * change percents into grams

Empirical and Molecular Formula Practice Problems

1. A compound contains 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen by mass. Determine the empirical formula of the compound.

(2) grams → mol

C $\frac{40.0\ g\ C}{} \left| \frac{1\ mol\ C}{12.011\ g\ C} \right. = \frac{3.33}{3.33} = 1$ (3) ← least number ÷ others

H $\frac{6.7\ g\ H}{} \left| \frac{1\ mol\ H}{1.0079\ g\ H} \right. = \frac{6.6}{3.33} = 1.98 \rightarrow 2$

O $\frac{53.3\ g\ O}{} \left| \frac{1\ mol\ O}{15.999\ g\ O} \right. = \frac{3.33}{3.33} = 1$

CH_2O

2. A sample of an unknown compound is found to contain 2.5 g of nitrogen and 7.1 g of oxygen. Determine the empirical formula.

N $\frac{2.5\ g\ N}{} \left| \frac{1\ mol\ N}{14.007\ g\ N} \right. = \frac{0.18}{0.18} = 1\ (2) = 2$

O $\frac{7.1\ g\ O}{} \left| \frac{1\ mol\ O}{15.999\ g\ O} \right. = \frac{0.44}{0.18} = 2.5\ (2) = 5$

N_2O_5

3. A compound has an empirical formula of CH2O and a molar mass of 180.2 g/mol. Determine the molecular formula.

n (empirical formula) = molar mass / % composition

from periodic table — from given

(1) C (1) = 12.011
H (2) = 2.0158 8 +
O (1) = 15.999
30.025 88 → 30.026 g CH_2O

(2) (isolate n) $n(CH_2O\ g) = 180.2\ g/mol$
$\frac{n(30.026\ g)}{30.026\ g} = \frac{180.2\ g/mol}{30.026\ g}$
$n = 6$ mols

(3) C (1) * 6 = 6
H (2) * 6 = 12
O (1) * 6 = 6

$C_6H_{12}O_6$

Mg = 5.0 g 8.3 MgO − 5.0 g Mg = 3.3 g O

4. A 5.0 g sample of magnesium reacts with oxygen to form 8.3 g of magnesium oxide. Determine the empirical formula of magnesium oxide.

Mg $\frac{5.0\text{ g Mg}}{24.305\text{ g Mg}} \times \frac{1\text{ mol Mg}}{1} = \frac{0.21}{0.21} = 1$

O $\frac{3.3\text{ g O}}{15.999\text{ g O}} \times \frac{1\text{ mol O}}{1} = \frac{0.21}{0.21} = 1$

MgO

* need to solve empirical first *

5. A compound contains 85.6% carbon and 14.4% hydrogen by mass. If its molar mass is 56.1 g/mol, determine its molecular formula.

n (empirical formula) = molar mass / % composition

(1) empirical:

C $\frac{85.6\text{ g C}}{12.011\text{ g C}} \times \frac{1\text{ mol C}}{1} = \frac{7.13}{7.13} = 1$

H $\frac{14.4\text{ g H}}{1.00794\text{ g H}} \times \frac{1\text{ mol H}}{1} = \frac{14.3}{7.13} = 2$

CH_2

molecular

C (1) = 12.011
H (2) = 2.01588 +
14.02688
14.027

$n(14.027\text{ g}) = 56.1\text{ g/mol}$

$\frac{n(14.027\text{ g})}{14.027\text{ g}} = \frac{56.1\text{ g/mol}}{14.027\text{ g}}$

n = 4 C (1) × 4, H (2) × 4 = C_4H_8 final answer

6. A compound contains 27.3% carbon, 72.7% oxygen. Determine the empirical formula. If the ratio comes out as C1O1.5, how would you adjust it to a whole-number empirical formula?

C $\frac{27.3\text{ g C}}{12.011\text{ g C}} \times \frac{1\text{ mol C}}{1} = \frac{2.27}{2.27} = 1$

O $\frac{72.7\text{ g O}}{15.999\text{ g O}} \times \frac{1\text{ mol O}}{1} = \frac{4.54}{2.27} = 2$

CO_2

you would multiply to the nearest whole number. For example, $C_1O_{1.5} * 2 =$

C_2O_3