Problems on Moles solved in Lecture and note clearly visible in Power Point Notes.

Problem 1. How many moles of iron represents in 25.0 g of iron?

Solution . Given-> Molar mass iron = 55.85 g/mol

Set up the calculation using a conversion factor between moles and grams.

$$25.0 \text{ g Fe} \times \frac{1 \text{ mol Fe}}{55.85 \text{ g Fe}} = \mathbf{0.448 \text{ mol Fe}}$$

Problem 2. What is the mass, in grams, of 4.6 mol MgCl2?

Solution. $4.6 \text{ mol } MgCl_2 \times \frac{95.20 \text{ g MgCl2}}{1 \text{ mol MgCl2}} = \mathbf{4.4 \times 10^2 \text{ g } MgCl_2}$

Problem 3. How many MgCl2 formula units are in 4.6 mol MgCl2?

Solution. $4.6 \text{ mol } MgCl_2 \times \frac{6.022 \times 10^{23} \text{ formula units } MgCl_2}{1 \text{ mol of } MgCl_2} = \mathbf{2.8 \times 10^{24} \text{ formula units } MgCl_2}$

Problem 4. How many oxygen molecules are present in 2.00 mol of oxygen molecules?

Solution. Conversion factor needed: $\frac{6.022 \times 10\ 23 \text{ molecules } O_2}{1 \text{ mol } O_2}$

Conversion sequence: moles O_2 → molecules O_2

Solution. $2.00 \text{ mol } O_2 \times \frac{6.022 \times 10^{23} \text{ molecules } O_2}{1 \text{ mol } O_2} = \mathbf{1.20 \times 10^{24} \text{ molecules } O_2}$

Problem 5. How many moles of benzene, C_6H_6, are present in 390.0 grams of benzene?

Solution. The molar mass of C_6H_6 is 78.12 g/mol.

Conversion sequence: grams C_6H_6 → moles C_6H_6

$$390.0\ g\ C_6H_6 \times \frac{1\ mol\ C_6H_6}{78.12\ g\ C_6H_6} = \mathbf{5.000\ mol\ C_6H_6}$$

Problem 6. How many grams of $(NH4)_3PO_4$ are contained in 2.52 moles of $(NH4)_3PO_4$?

Solution. The molar mass of $(NH4)_3PO_4$ is 149.12 g/mol (Calculate from Periodic table).

$$2.52\ mol\ (NH4)_3PO_4 \times \frac{1\ mol\ C_6H_6}{1\ mol\ (NH4)_3PO_4} = \mathbf{376\ g\ (NH4)_3PO_4}$$

Problem 7. 56.04 g of N_2 contains how many N_2 molecules?

Solution. Conversion sequence: g N_2 → moles N_2 → molecules N_2

$$56.04\ g\ N_2 \times \frac{1\ mol\ N_2}{28.02\ g\ N_2} \times \frac{6.022 \times 10^{23}\ molecules\ N_2}{1\ mol\ N_2} = \mathbf{1.204 \times 10^{24}\ molecules\ N_2}$$

EMPIRICAL FORMULA PROBLEM SOLVED IN LECTURE AND NOTES.

Problem 1. The analysis of a salt shows that it contains 56.58% potassium (K); 8.68% carbon (C); and 34.73% oxygen (O). Calculate the empirical formula for this substance.

Step 1 Express each element in grams. Assume 100 grams of compound.

K => 56.58 % = 56.58 g

C => 8.68 % = 8.68 g

O=> 34.73 % = 34.73 g

Step 2 Convert the grams of each element to moles.

$$\text{K} \rightarrow 56.58\ \text{g K} \times \frac{1\ \text{mol K}}{39.10\ \text{g K}} = 1.447\ \text{mol K}$$

$$\text{C} \rightarrow 8.68\ \text{g C} \times \frac{1\ \text{mol C}}{12.01\ \text{g C}} = 0.723\ \text{mol C}$$ smallest mole

$$\text{O} \rightarrow 34.73\ \text{g O} \times \frac{1\ \text{mol O}}{16.00\ \text{g O}} = 2.171\ \text{mol O}$$

Step 3 Identify smallest mole Divide each number of moles by the smallest value.

K = 1.447 mol / 0.723 mol = 2

C = 0.723 mol / 0.723 mol = 1

O = 2.171 mol / 0.723 mol =3

The simplest ratio of K:C:O is 2:1:3

Empirical formula **K_2CO_3**

Problem 2. The percent composition of a compound is 25.94% nitrogen (N), and 74.06% oxygen (O). Calculate the empirical formula for this substance.

Step 1 Express each element in grams. Assume 100 grams of compound.

N => 25.94 % = 25.94 g

O => 74.06 % = 74.06 g

Step 2 Convert the grams of each element to moles.

$$\text{N} \rightarrow 25.94\ \text{g N} \times \frac{1\ \text{mol N}}{14.01\ \text{g N}} = 1.852\ \text{mol N}$$ smallest mole

$$O \rightarrow 74.06\ g\ O \times \frac{1\ mol\ O}{16.00\ g\ O} = 4.629\ mol\ O$$

Step 3 Identify smallest mole Divide each number of moles by the smallest value.

N = 1.852 mol / 1.852 mol = 1

O = 4.629 mol / 1.852 mol = 2.5 → This is not a ratio of whole numbers.

Step 4. To make it a whole number multiply both Nitrogen and Oxygen values by 2

N = 1 x 2 = 2

O = 2.5 x 2 = 5

The simplest ratio of N:O is 2:5

Empirical formula **N_2O_5**

HOW TO CALCULATE MOLECULAR FORMULA FROM EMPIRICAL FORMULA WHEN MOLAR MASS OF THE COMPOUND IS GIVEN. THIS PROBLEM IS SOLVED IN LECTURE AND NOTES.

$$\text{Number of empirical formula units (n)} = \frac{\text{molar mass or molecular formula mass}}{\text{Empirical formula mass}}$$

Problem 1. What is the molecular formula of a compound which has an empirical formula of CH_2 and a molar mass of 126.2 g/ mol?

Calculate the mass of each CH2 unit

1 C = 1(12.01 g) = 12.01g/mol

2 H = 2(1.01 g) = + 2.02g/ mol

14.03g/ mol

$$n = \frac{126.2\ g/mol}{14.03\ g/\ mol} = 9$$

The molecular formula is **$(CH_2)_9 = C_9H_{18}$**