# Topic: Chemical calculation (cont.)

**Fighting! ^^**

**Contents:**

Molar mass

Empirical Formula

Molecular Formula

# Intro to Molar Mass

- ***The mass of one mole of any substance.***

- **<u>Example 1:</u>**
- Find the molar mass of Carbon.
- **Solution**
- *Ar of carbon= 12*

❖ *Molar mass = 12g*

❖ *12 g = 1 mole of carbon atoms.*

# Further examples

**Example 2:**

Find the molar mass of water.

**Solution**

*Mr of carbon= 18*

- *Molar mass = 18g*
- *18 g = 1 mole of water molecules.*

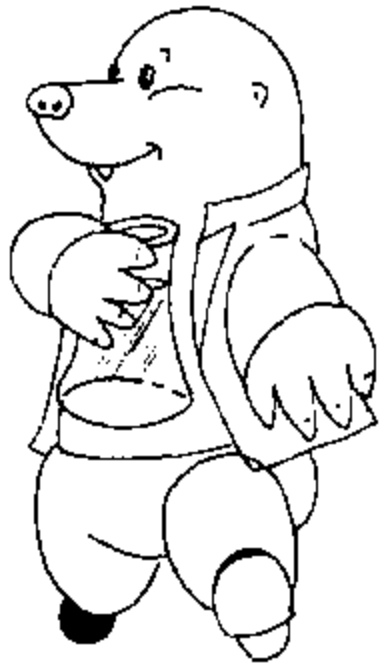
**Example 3:**

Find the molar mass of Sodium chloride.

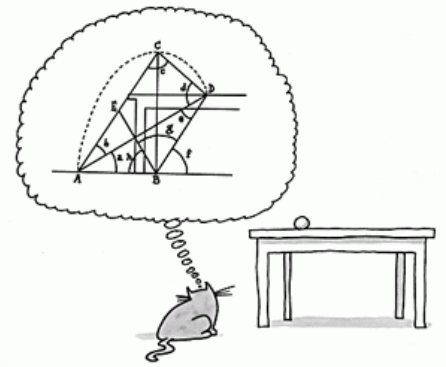
**Solution**

*Mr of carbon= 58.5*

- *Molar mass = 58.5g*
- *58.5 g = 1 mole of NaCl ions.*



# Complex Molar Mass



**Example 1:**

***How many moles of atoms are there in 8g of helium?***

***Solution*** – Step 1

Find the molar mass of the element in grams. (Ar of He = 4)

The molar mass of helium, He = 4 g

`Step 2

Use the formula to calculate the number of moles.

$$\text{No. of moles of He atoms} = \frac{\text{Mass (in g)}}{\text{Molar mass (in g)}}$$

$$= \frac{8\text{g}}{4\text{g}}$$

$$= \textbf{\textit{2 mol.}}$$

# Further example:

**Example 2:**

***What is the mass of 0.4 moles of iron atoms?***

***Solution*** – Step 1

Find the molar mass of the element in grams. (Ar of iron = 56 )
The molar mass of iron, Fe = 56g

Step 2

$$\text{No. of moles of iron} = \frac{\text{Mass (g)}}{\text{Molar mass (g)}}$$

Mass of iron = No. of moles X Molar mass
= 0.4 mol X 56 g = ***22.4g***.

# Empirical formula

It shows the ***simplest*** or the ***smallest*** number ratio of all the different atoms present in a compound.

## Example 1: Calculating the empirical formula of a compound.

A sample of an oxide of copper contains 8g of copper combined with 1g of oxygen. Find the empirical formula of the compound.

***Solution***

| | | |
|---|---|---|
| **Step 1:** elements present | Copper (Cu) | Oxygen (O) |
| **Step 2:** Mass (g) | 8g | 1g |
| **Step 3:** Molar Mass / Ar / Mr | 64g | 16g |
| **Step 4:** No. of moles | $\frac{8}{64}$ = 0.125 mol | $\frac{1}{16}$ = 0.0625 mol |
| **Step 5:** Divide by the smallest number. | $\frac{0.125}{0.0625}$ = 2 | $\frac{0.0625}{0.0625}$ = 1 |
| Empirical formula is | $Cu_2O_1 \rightarrow Cu_2O$ | |

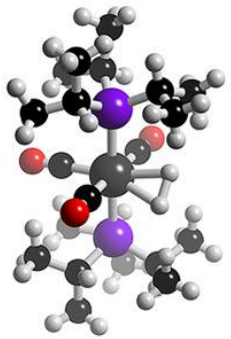
**Example 2: Calculating the empirical formula from percentage composition.**

An oxide of sulphur contains 40% sulphur and 60% oxygen by mass. Find the empirical formula.

***Solution***

| | | |
|---|---|---|
| **Step 1:** elements present | Sulphur (S) | Oxygen (O) |
| **Step 2**: % Mass | 40 | 60 |
| **Step 3:** Molar Mass / Ar / Mr | 32g | 16g |
| **Step 4**: No. of moles | $\frac{40}{32}$ = 1.25 mol | $\frac{60}{16}$ = 3.75 mol |
| **Step 5:** Divide by the smallest number. | $\frac{1.25}{1.25}$ = 1 | $\frac{3.75}{1.25}$ = 3 |
| Empirical formula is | $S_1O_3 \rightarrow SO_3$ | |

# Molecular Formula



- It is the ***actual*** or ***exact*** number of each atom present in a molecule of a compound.
- Sometimes the number ratio cannot be made any simpler than the actual number of atoms in the molecule. Then the empirical formula and molecular formula will be the **same**.

**Example 1:**

Propene has the empirical formula $CH_2$. The relative molecular mass of propene is 42. Find the molecular formula of propene.

***Solution***

Empirical formula = $CH_2$

Mr given = 42

X ($CH_2$) = 42

X (1C + 2H) = 42

X (12 + 2) = 42

X (14) = 42

X = 42/14 = 3

- Molecular formula = X($CH_2$)
  = 3($CH_2$)
  = $C_3H_6$.