9/24/2018

Formula Mass + Mole Concept for Compounds

Earlier: av'g mass of atom = atomic mass

6
C
12.01

ex: 1 atom C = 12.01u C

$1 mol = 6.022 \times 10^{23}$ 1 mol C = 12.01g C

Average mass of a compound = formula mass.

ex: C_2Cl_6 $2 \times C = 2 \times 12.01u$

$6 \times Cl = 6 \times 35.45u$

$236.72u$

Just like before, we also can say:

$$1 mol\ C_2Cl_6 = 236.72g\ C_2Cl_6$$

We say the molar mass of C_2Cl_6 is 236.72 g/mol

Counting by weighing!!

Q1. How many moles of C_2Cl_6 molecules are there in a 58.0g sample?

Q2. How many molecules is this?

A1. $58.0g\ C_2Cl_6 \times \frac{1 mol\ C_2Cl_6}{236.72g\ C_2Cl_6} = 0.245 mol\ C_2Cl_6$

A2. $0.245 mol\ C_2Cl_6 \times \frac{6.022 \times 10^{23}\ C_2Cl_6}{1 mol\ C_2Cl_6} = 1.48 \times 10^{23}$ molecules C_2Cl_6

Q1: How many mol of H_2O are there in 0.500 g ?

Q2: How many molecules is this ?

1
H
1.008

8
O
16.00

H_2O

$2 \times H = 2 \times 1.008$

$1 \times O = 1 \times 16.00$

18.02

$1\ mol\ H_2O = 18.02\ g\ H_2O$

guard digits.

A1. $0.500\ g\ H_2O \times \frac{1\ mol\ H_2O}{18.02\ g\ H_2O} = 0.027747\ mol\ H_2O$

A2. $0.027747\ mol\ H_2O \times \frac{6.022 \times 10^{23}\ H_2O}{1\ mol\ H_2O} = 1.67 \times 10^{22}$ molecules H_2O

Composition of compounds

- can calculate mass % of a given element in a cpd.
- can be used to ID + det^n purity.

Ex: Calculate mass % of elements in CCl_2F_2

$1 \times C = 1 \times 12.01 = 12.01$

$2 \times Cl = 2 \times 35.45 = 70.90$

$2 \times F = 2 \times 19.00 = 38.00$

120.91

$\%Cl = \frac{\text{mass Cl}}{\text{mass cpd}} = \frac{70.90\ g/mol}{120.91\ g/mol} \times 100$

$= 58.64\%$

$\%F = \frac{\text{mass F}}{\text{mass cpd}} = \frac{38.00\ g/mol}{120.91\ g/mol} \times 100$

$= 31.43\%$

$\%C = \frac{\text{mass of C}}{\text{mass of cpd}} \times 100 = \frac{12.01\ g/mol}{120.91\ g/mol} \times 100 = 9.933\%$

Determining formulas from % data!

Plan: % elements $\xrightarrow{\times/100}$ g-elements $\xrightarrow{\text{atomic mass}}$ mol-elements $\xrightarrow{\text{simplest ratio}}$ empirical formula

molecular formula $\xleftarrow{\text{by } \times \text{ empirical formula}}$ empirical formula

$$\frac{\text{molar mass cpd}}{\text{molar mass emp. formula.}}$$

Ex: Aspirin is: 60.00% C
4.48% H
35.52% O
$\longrightarrow$ empirical formula.