Notes for Analytical Chemistry

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Notes for analytical chemistry

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There are two main branches for analytical chemistry:-

A. Qualitative analysis

This branch looks for the quality of compounds.

B. **Quantitative analysis**

This branch looks for the quantity of compounds, and it is divided into two sub-branches

B1. **Micro- quantitative analysis** "works on micro quantities of compounds (µg or µl)"

B2. **Macro- quantitative analysis** "works on macro quantities of compounds (mg or ml)"

Different types of quantitative analysis:

1- Alkaline and acidity analysis.
2- Reduction and Oxidation analysis.
3- Precipitation analysis.
4- Gas measurement.
5-Color measurement.
6- Chromatographic analysis.
7- Polarity measurement.

Quantitative analysis‘ s units:-

1- Natural (Physical) units, likes % and PPM

1% means 1 g or ml ⟶ 100g or ml

1 PPM means 1g or ml ⟶ 1000000 g or ml

2- Chemical units, likes N and M

Some chemical expressions:-

Molecular weight (MW)

MW means total weights of each atom in the compound.

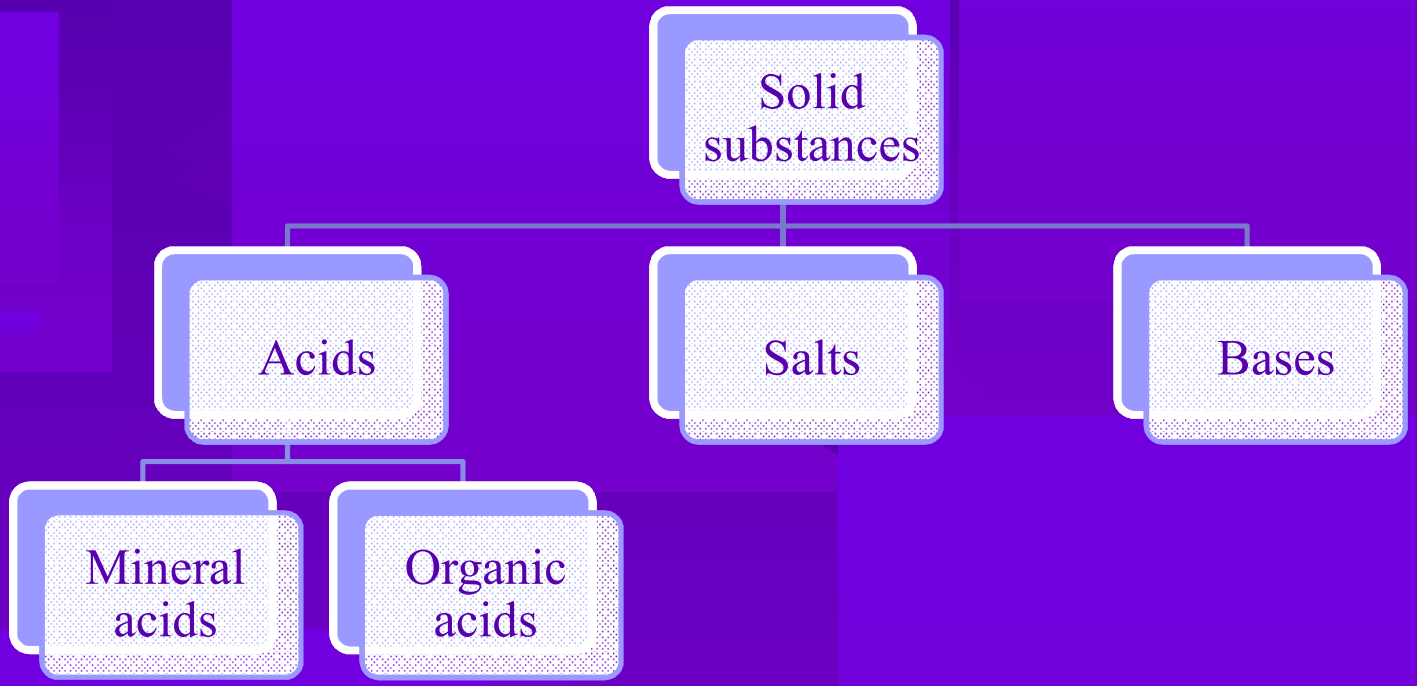
Equivalent weight (Eq.W)

Eq.W means the mass of one equivalent (MW/ Equivalent).

MW ⟶ 1000 ml ⟶ 1M (Molar)

Eq.W ⟶ 1000 ml ⟶ 1N (Normal)

How to calculate the molarity and normality of solid substances



Substance	Molarity	Normality
Mineral acids	MW $\longrightarrow$ 1000ml $\longrightarrow$ 1M	Eq W = MW/ No of substituted H_2 Eq W $\longrightarrow$ 1000ml $\longrightarrow$ 1N
Organic acids	MW $\longrightarrow$ 1000ml $\longrightarrow$ 1M	Eq W = MW/ No of carboxylic group Eq W $\longrightarrow$ 1000ml $\longrightarrow$ 1N
Bases	MW $\longrightarrow$ 1000ml $\longrightarrow$ 1M	Eq W = MW/ No of substituted OH Eq W $\longrightarrow$ 1000ml $\longrightarrow$ 1N
Salts	MW $\longrightarrow$ 1000ml $\longrightarrow$ 1M	Eq W = MW/ one element's equivalent× number of this element atom Eq W $\longrightarrow$ 1000ml $\longrightarrow$ 1N

Substance	Molarity	Normality
Mineral acids (HCl & H_2SO_4)	MW ⟶ 1000ml ⟶ 1M 36 g ⟶ 1000ml ⟶ 1M 98 g ⟶ 1000ml ⟶ 1M	Eq W = MW/ No of substituted H_2 Eq W ⟶ 1000ml ⟶ 1N 36/1 = 36g ⟶ 1000ml ⟶ 1N 98/2=49g ⟶ 1000ml ⟶ 1N
Organic acids (CH_3COOH)	MW ⟶ 1000ml ⟶ 1M 60 g ⟶ 1000ml ⟶ 1M	Eq W = MW/ No of carboxylic group Eq W ⟶ 1000ml ⟶ 1N 60/1=60g ⟶ 1000ml ⟶ 1N
Bases (NaOH)	MW ⟶ 1000ml ⟶ 1M 40 g ⟶ 1000ml ⟶ 1M	Eq W = MW/ No of substituted OH Eq W ⟶ 1000ml ⟶ 1N 40/1=40g ⟶ 1000ml ⟶ 1N
Salts (NaCl)	MW ⟶ 1000ml ⟶ 1M 58g ⟶ 1000ml ⟶ 1M	Eq W = MW/ one element's equivalent× number of this element atom Eq W ⟶ 1000ml ⟶ 1N 58/(1*1)=58 g ⟶ 1000ml ⟶ 1N

For liquid acids

This example will show how to prepare a requested normality or molarity

It is requested to prepare 250 ml HCl solution with 0.1 N concentration, and you have HCl stock 35% (w/v) with density 1.1 g /ml.

For that use this equation

$W \times 1000/Eq.W = V \times N$

W refers to weight (g), V refers to volume (ml) and N refers to normality

$W \times 1000/36 = 250 \times 0.1$ (W= 0.9125 g)

35 g HCl ⟶ 100 ml HCl
0.9 g ⟶ X
X= 2.57 ml ⟶

Take 2.57 ml and complete them to 250 ml with dist. H2O.

If the concentration of HCl is 35% (w/w)

35 g HCl ⟶ 100 g HCl

Weight = Density * Volume or Volume = weight/ Density

So that's mean
35 g ⟶ (w/d)100/1.1 (90.91 ml)
And in this case

35 g ⟶ 90.91 ml
0.9125 g ⟶ X
X= 2.4 ml, this complete into 250 ml with dist.H2O.

Conversion from Normality to Molarity

Use the following equation:-

Normality (N) = Molarity (M) × Equivalent

Moles number = weight (g)/ MW
Equivalent number = weight (g)/Eq.W

Molarity = Moles number/volume (L)
Normality = Equivalent number / volume (L)