



Al-Mustaqbal-College University
Chemical Engineering and Petroleum
Industry Department
Analytical chemistry
First class / first term
Lecture one part 2

By

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Lecture one

General principles to calculate the equivalent weight :

a) for acids :

$$\text{eq.wt of acid} = \frac{\text{M.wt of acid}}{\text{no.of H}^+ \text{ active}}$$

There are many types of acids :

- 1) mono basic acid : HCl , HNO₃ , HF, ect.
- 2) di basic acid : H₂SO₄ , H₂S , H₂SO₃,ect.
- 3) tri basic acid : H₃PO₄,ect.

يعتمد حساب الوزن المكافئ على التفاعل الذي يدخل به المركب الكيميائي ، فقد يحدث ان يفقد الحامض H⁺ واحدة اثناء التفاعل لذلك يقسم الوزن الجزيئي على ١ ، او قد يستهلك 2H⁺ في التفاعل فيقسم الوزن الجزيئي على ٢ او قد يستهلك 3H⁺ فيقسم على ٣ .

اذن يعتمد الحساب على معادلة التفاعل الكيميائي وكم يستهلك من H⁺ في التفاعل

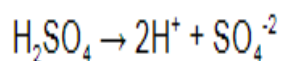
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1. Sulphuric Acid (H_2SO_4)

For acids, X (valency factor) is the basicity

Basicity- basicity is the number of hydrogen ions or hydronium ions released by an acid.

In the case of sulphuric acid (H_2SO_4)



The number of hydrogen ion released by sulphuric acid is 2. Therefore, its valency factor or X value will be two.

The molecular weight of sulphuric acid is 98.

As we know, Equivalent weight = molecular weight / X

The equivalent weight of sulphuric acid = $98 / 2 = 49$

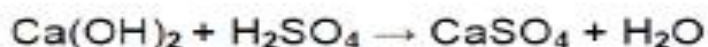
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b) for base :

$$\text{eq. wt of acid} = \frac{\text{M.wt of base}}{\text{no. of OH- active}}$$



$$\text{eq. wt. of NH}_4\text{OH} = \frac{\text{M.wt of NH}_4\text{OH}}{\text{no. of OH- active}} = \frac{35}{1} = 35$$



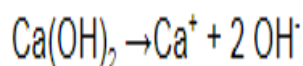
$$\text{eq. wt. of Ca(OH)}_2 = \text{-----}$$

1. Calcium Hydroxide Ca(OH)_2

For the base, X (valency factor) is the acidity

Acidity- Acidity is the number of hydroxyl ions or hydroxide ions released by a base.

In the case of calcium hydroxide base Ca(OH)_2



The number of hydroxyl ions released by the calcium hydroxide base is 2. Therefore, its valency factor or X value will be two.

The molecular weight of the calcium hydroxide base is 74.

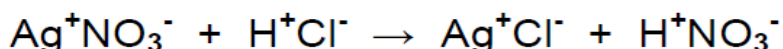
As we know, Equivalent weight = molecular weight / X

The equivalent weight of calcium hydroxide base = $74 / 2 = 37$

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d) for salts :

$$\text{eq.wt of salt} = \frac{\text{M.wt of salt}}{\text{No. of positive charge of salt}}$$



$$\text{eq.wt. of } \text{Ag}^+\text{NO}_3^- = \frac{\text{M.wt of Ag+NO}_3^-}{1}$$

$$\text{eq.wt. of } \text{Ag}_2^+\text{O}^{-2} = \frac{\text{M.wt}}{2}$$

$$\text{eq.wt. of } \text{Al}^{+3}\text{PO}_4^{-3} = \frac{\text{M.wt}}{3}$$

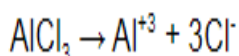
$$\text{eq.wt. of } \text{Ca}_3^{+2}(\text{PO}_4)_2^{-3} = \frac{\text{M.wt}}{6}$$

1. Aluminium Chloride

Step by Step Calculation for Finding the Equivalent Weight of Aluminium Salts

For the metals, X (valency factor) is the total positive charge on the positive ion (cation).

In the case of aluminium chloride salt $\text{Al}(\text{Cl})_3$



The number of positive charge on aluminium cation is three. Therefore, its valency factor or X value will be three.

The molecular weight of the calcium hydroxide base is 133.34 g/mol.

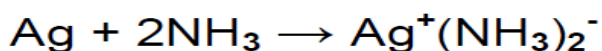
As we know, Equivalent weight = molecular weight / X

The equivalent weight of aluminium chloride salt = $133.34 / 3 = 44.44$.

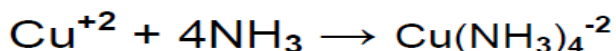
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f) for complex ion :

$$\text{eq.wt. of complex ion} = \frac{\text{M.wt}}{\text{no.of charges}}$$



$$\text{eq.wt. of } \text{Ag}^+(\text{NH}_3)_2^- = \frac{\text{M.wt}}{1}$$



$$\text{eq.wt. of } \text{Cu}(\text{NH}_3)_4^{-2} = \frac{\text{M.wt}}{2}$$

Formula Weight (F_w) :

It is the sum of the atomic weights of the atoms that make up the formula, and is denoted by the symbol F_w . The formula weight is used for compounds that exist in the form of ions or molecules in nature, and examples of compounds that contain ions are: Ionic compounds such as table salt (sodium chloride) NaCl

(هو مجموع الأوزان الذرية للذرات المكونة للصيغة، ويرمز له بالرمز F_w . ويستخدم وزن الصيغة للمركبات التي توجد على هيئة أيونات أو جزيئات في الطبيعة، ومن الأمثلة على المركبات التي تحتوي على أيونات: المركبات الأيونية مثل مركب ملح الطعام (كلوريد الصوديوم) (NaCl))

Example\ Find the weight of the formula F_w for the following :



Atomic Weights: ($\text{Cl} = 35.5$, $\text{S} = 32$, $\text{Na} = 23$, $\text{O} = 16$)

$$F_{w\text{NaCl}} = 23 + 35.5 = 58.5$$

$$F_w(\text{Na}_2\text{SO}_4) = (2 \times 23) + 32 + (4 \times 16) = 142$$