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 :

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

There are many types of acids :

1) mono basic acid : HCl , HNO_3 , HF, ... ect.
2) di basic acid : H_2SO_4 , H_2S , H_2SO_3, ...ect.
3) tri bacic acid : H_3PO_4, ...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 .

Lecture one

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)

$H_2SO_4 \rightarrow 2H^+ + SO_4^{-2}$

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 94.

As we know, Equivalent weight = molecular weight / X

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

Lecture one

b) for base :

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

$$HCl + NH_4OH \rightarrow NH_4Cl + H_2O$$

$$\text{eq.wt. of } NH_4OH = \frac{\text{M.wt of NH4OH}}{\text{no.of OH} - \text{active}} = \frac{35}{1} = 35$$

$$Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + H_2O$$

eq.wt.of $Ca(OH)_2$ = ----------

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

$Ca(OH)_2 \rightarrow Ca^+ + 2\ OH^-$

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

Lecture one

d) for salts :

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

$$Ag^{+}NO_3^{-} + H^{+}Cl^{-} \rightarrow Ag^{+}Cl^{-} + H^{+}NO_3^{-}$$

$$\text{eq.wt. of } Ag^{+}NO_3^{-} = \frac{\text{M.wt of Ag+NO3}-}{1}$$

$$\text{eq.wt. of } Ag_2^{+}O^{-2} = \frac{\text{M.wt}}{2}$$

$$\text{eq.wt. of } Al^{+3}PO_4^{-3} = \frac{\text{M.wt}}{3}$$

$$\text{eq.wt. of } Ca_3^{+2}(PO_4)_2^{-3} = \frac{\text{M.wt}}{6}$$

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 $Al(Cl)_3$

$AlCl_3 \rightarrow Al^{+3} + 3Cl^{-}$

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.

Lecture one

f) for complex ion :

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

$$Ag + 2NH_3 \longrightarrow Ag^{+}(NH_3)_2^{-}$$

$$\text{eq.wt. of } Ag^{+}(NH_3)_2^{-} = \frac{\text{M.wt}}{1}$$

$$Cu^{+2} + 4NH_3 \longrightarrow Cu(NH_3)_4^{-2}$$

$$\text{eq.wt. of } Cu(NH_3)_4^{-2} = \frac{\text{M.wt}}{2}$$

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 Fw. 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 Fw. 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 :

NaCl, Na_2SO_4 ?

Atomic Weights: (Cl = 35.5, S = 32, Na = 23, O = 16)

$Fw_{NaCl} = 23 + 35.5 = 58.5$

$Fw\ (Na_2SO_4) = (2 \times 23) + 32 + (4 \times 16) = 142$