Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (First Year)

Subject: Chemistry

Paper Code: CHC-102

Paper Title: Physical Chemistry

Unit: III

Module Name: Strong, Moderate and Weak Electrolytes, Degree of Ionization and Factors Affecting Degree of Ionization

Module No: 14

Name of the Presenter: Ms. Nikita V. Naik

Notes

STRONG MODERATE AND WEAK ELECTROLYTES

- Michael Faraday classified substances according to their ability to conduct electricity.
- Substances which conduct electricity in aqueous solutions are called **electrolytes**. Example: sodium chloride.
- Substances which do not conduct electricity in aqueous solutions are called **non-electrolytes**. Example: glucose.
- Faraday made a further classification of electrolytes into strong electrolytes and weak electrolytes.

❖ **Strong Electrolytes:** strong electrolytes when dissolved in water ionise almost completely.

Example: sodium chloride is a strong electrolyte, on dissolving it with water, it ionises completely into sodium ions and chloride ions.

❖ **Weak Electrolytes:** weak electrolytes when dissolved in water ionises only partially.

- Example: acetic acid on dissolving in water ionises only partially, to the extent of 5 per cent, to give hydrogen ions and acetate ions.

❖ **Moderate Electrolytes:** Substances that ionise to about 50% in aqueous solutions may be called moderate electrolytes.

IONIC EQUILIBRIUM

- In the case of weak electrolytes, an equilibrium is established between the ionised species and unionised species.
- For example, the ionisation of acetic acid, this may be represented as:

$$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$$

- This type of equilibrium involving ions in aqueous solutions is called ionic equilibrium.

ARRHENIUS THEORY OF IONISATION

(DEGREE OF IONISATION)

Postulates of Arrhenius theory of ionisation

(i) When dissolved in water, an electrolyte splits or dissociates into positively and negatively charged particles called ions. This process is called electrolytic dissociation or ionisation.

$$NaCl \longrightarrow Na^+ + Cl^-$$

$$Al_2(SO_4)_3 \longrightarrow 2Al^{3+} + 3SO_4$$

(ii) On passing electricity, the positive ions migrate towards the cathode and are therefore called the cations. Similarly, negative ions called the anions moves towards the anode.

(iii) The solution of the electrolytes is electrically neutral as a whole. That means total charge carried by the positive ions is equal to the charge carried by negative ions.

(iv) The ions obtained by dissociation of the electrolyte combine back to give the undissociated molecules.

$$NaCl \longrightarrow Na^{+} + Cl^{-}$$

The fraction of the total number of molecules of the electrolyte that dissociates into ions is called the **degree of ionisation or dissociation.**

$$\text{Degree of dissociation } (\alpha) = \frac{\text{No. of molecules dissociated}}{\text{Total No. of molecules taken}}$$

(v) The degree of dissociation increases with dilution and becomes maximum at the infinite dilution.

(vi) The conductance of an electrolytic solution is due to the presence of the ions, produced by the dissociation of the electrolyte.

(vii) The properties of the electrolyte are the properties of its ions. For example, the properties of an acid are due to the H^+ ions furnished by it in the aqueous solution.

(viii) The ions produced by the dissociation of an electrolyte behave like molecules towards colligative properties. For example, each NaCl molecule dissociates to give Na^+ and Cl^-. Hence the observed value of any colligative property is double the expected value.

FACTORS AFFECTING THE DEGREE OF IONISATION

The degree of dissociation of an electrolyte in the solution depends upon the following factors.

(i) **Nature of the solute:** Some electrolytes like mineral acids, alkalis and most of the salts are almost completely ionised in water. These are called strong electrolytes. On the other hand, some electrolyte like organic and inorganic acid and bases ionise only to a small extent. These are called weak electrolytes.

(ii) **Concentration:** Degree of dissociation of an electrolyte increases with dilution and becomes maximum at infinite dilution.

(iii) (iii) **Nature of the solvent:** Every solvent has some definite value of the dielectric constant which is defined as its power to weaken the forces of attraction present between the ions of the electrolyte.

(iv) (iv) **Temperature:** As the temperature is increased, more of the molecules split into ions that is, degree of dissociation increases.

(v) (v) **Presence of common ions:** The degree of dissociation of an electrolyte decreases when another electrolyte is present which furnishes a common ion. This effect is called common ion effect.