التسحيح التوصيلي

الأجهزة

III. 1. Conductometry

The ability for electricity through a body is called its **conductance**. In metallic conductors it is caused by the movement of electrons, while in electrolytic solutions it is caused by ions of electrolyte. The electrolytic conductance, G, of a medium is equal to the reciprocal of its electrical resistance R in ohms:

$$G = \frac{1}{R} \tag{1}$$

Since a solution is a three-dimensional conductor, the exact resistance will depend on the spacing l and area A of the electrodes. The resistance of the solution in such situation is directly proportional to the distance between the electrodes and inversely proportional to the electrode surface area. If we consider the electrolytic shell with two electrodes having a cross-sectional area of A [m^2] and separated by l [m] then the resistance R of the electrolyte solution present between the electrodes is:

$$R = \rho \frac{l}{A} \tag{2}$$

where ρ is the proportionality constant called specific resistivity. It is a characteristic property of material and it is the resistance demonstrated by a conductor of unit length and unit area of cross section.

Substituting the value of R from Eq. (2) in Eq. (1), the expression for the conductance, G, is:

$$G = \frac{1}{\rho(A/l)} = \kappa \frac{A}{l} \tag{3}$$

where κ is the reciprocal of specific resistance called **specific conductance** or **conductivity**. It is measured in [$\Omega^{-1}m^{-1}$]. However, in the SI system, the unit of conductance is "Siemens", S, hence the unit for conductivity will be [S m^{-1}] (1S = 1 Ω^{-1}). It should be remembered that S m^{-1} = 1/100 S cm^{-1}.

In order to compare quantitatively the conductivities of electrolytes, a quantity called molar conductivity is frequently used. The **molar conductivity**, Λ_m, is the conductivity per unit molar concentration of a dissolved electrolyte. It is connected with conductivity, κ, by the relation:

$$\Lambda_m = \frac{\kappa}{c} \tag{4}$$

where c is the concentration in [mol m^{-3}]. The molar conductivity is usually expressed in [S m^2 mol^{-1}] or [S cm^2 mol^{-1}].

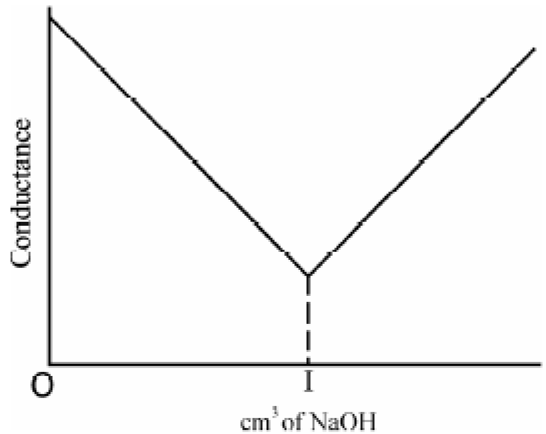

Fig. 6.2: Conductometric titration of a strong acid (HCl) vs. a strong base

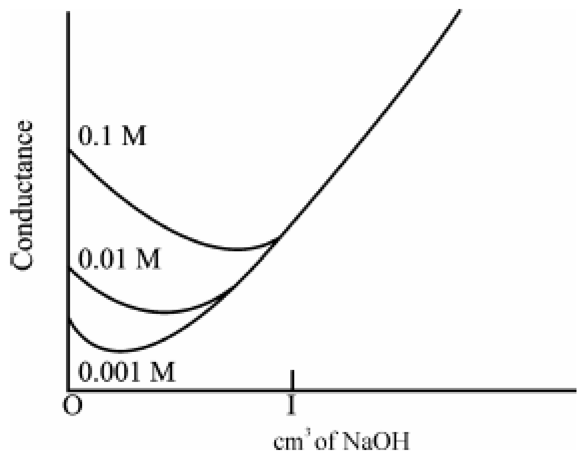

Fig. 6.3: Conductometric titration of a weak acid (acetic acid) vs. a strong base (NaOH)

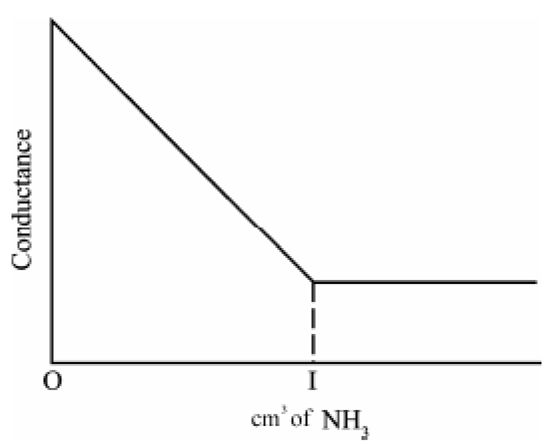

Fig. 6.4: Conductometric titration of a strong acid (H_2SO_4) vs. a weak base (NH_4OH)

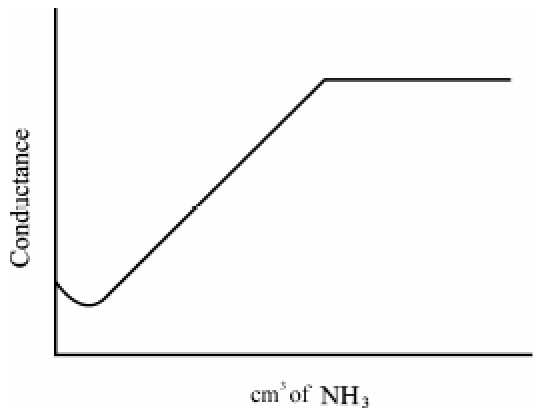

Fig. 6.5: Conductometric titration of a weak acid (acetic acid) vs. a weak base (NH_4OH)

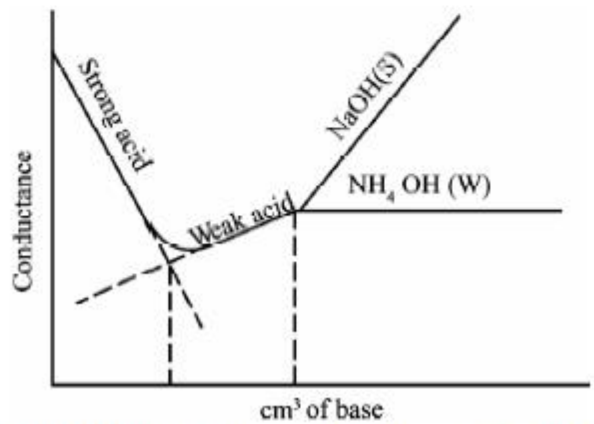

Fig. 6.6 Conductometric titration of a mixture of a strong acid (HCl) and a weak acid (CH_3COOH) vs. a strong base (NaOH) or a weak base (NH_4OH)

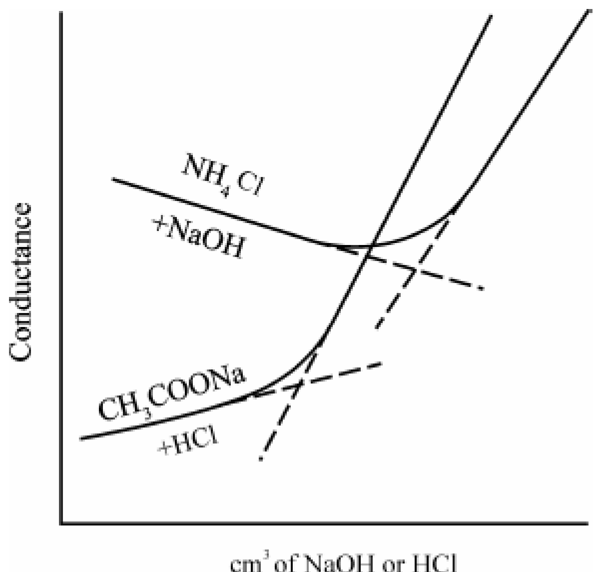

Fig. 6.7: Conductometric titration of a salt of acid (HCl); salt of a weak base (NH_4

Conductance of Cations and Anions in Aqueous Solution at 25 ℃				
Cation	*Conductance*	*Trend*	*Anion*	*Conductance*
H^+	349.8	High	OH^-	198.3
K^+	73.5	↓	Br^-	78.1
NH_4^+	73.5	↓	I^-	76.8
Ag^+	61.9	↓	Cl^-	76.3
Na^+	50.1	↓	NO_3^-	71.5
Li^+	38.7	↓	F^-	55.4