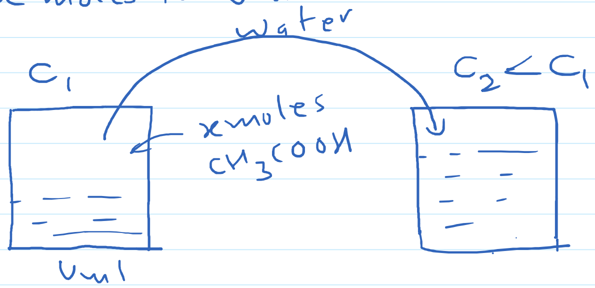
Variation of conductance / conductivity / molar conductivity with dilution

1. Conductance

a) weak electrolyte

eg: CH_3COOH

x moles in V ml



$\alpha_1 = \sqrt{\frac{K_a}{C_1}}$ $\alpha_2 = \sqrt{\frac{K_a}{C_2}}$

$\alpha_2 > \alpha_1$

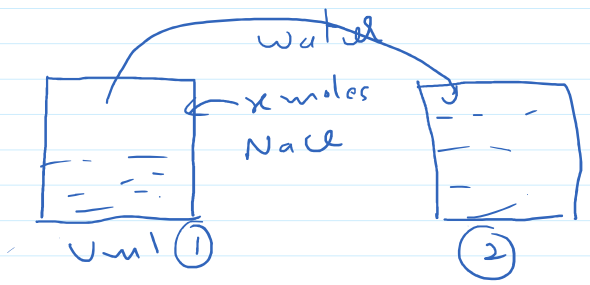
On dilution, degree of dissociation for weak electrolyte increases, thus, number of charge carriers increase, thus conductance increase

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

b) strong electrolytes

eg: NaCl

x moles in V ml

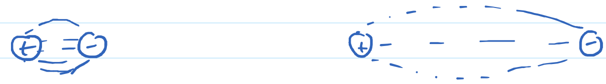


Number of charge carriers in both is same.

But in case (2) solute - solute interaction is lesser, thus resistance is lesser, conducance is more.

(1) (2)

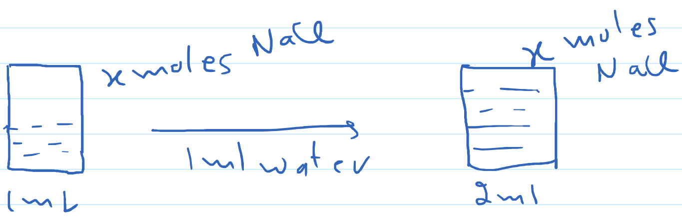
Na^+ Cl^-

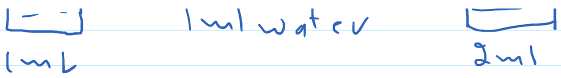


less solute-solute interaction

Thus for strong as well as weak electrolyte conductance increases with dilution.

2. Conductivity





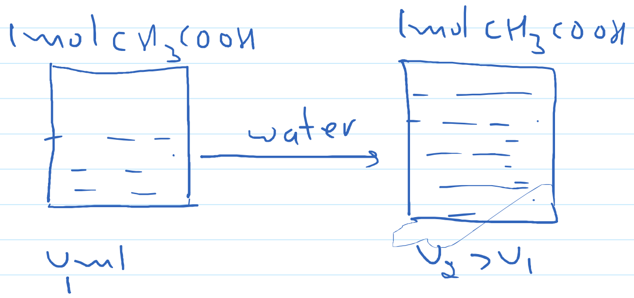
x moles NaCl in 1ml — $\frac{x}{2}$ moles NaCl in 1ml

On dilution number of ion per unit volume decreases, thus conductivity decreases for strong as well as weak electrolytes

2. Molar conductivity

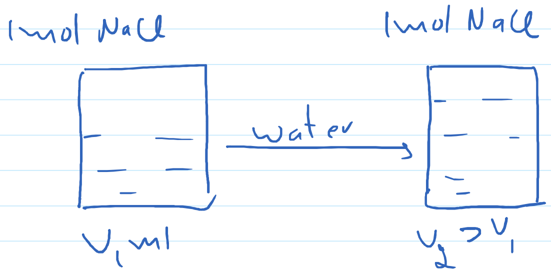
a) weak electrolyte

CH_3COOH



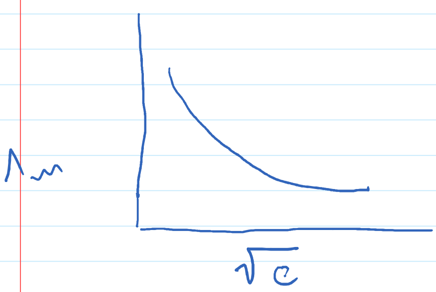
b) strong electrolyte

NaCl



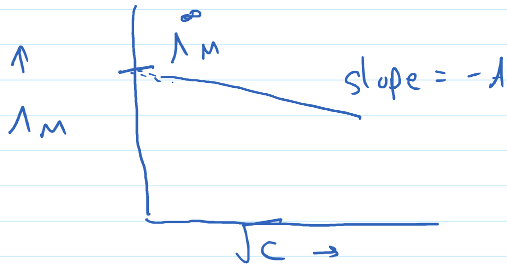
Molar conductivity for both strong as well as weak electrolytes increase on dilution.

weak electrolyte:



$$\alpha = \frac{\Lambda_M}{\Lambda_M^\infty}$$

strong electrolytes:



Debye-Huckel Onsager equation:

$$\Lambda_M = \Lambda_M^\infty - A\sqrt{c}$$

$\Lambda_M^\infty \rightarrow$ Molar conductivity at infinite dilution

$c \rightarrow$ concentration

A → constant

The value of A for a given solvent and temperature depends on the type of electrolyte i.e the charges on the cation and anion produced on the dissociation of the electrolyte in solution

Thus NaCl, $CaCl_2$, $MgSO_4$ are known as 1-1, 2-1, 2-2 electrolytes respectively.

All electrolytes of a particular type have the same value for 'A'