Hence

$$\ln\gamma_\pm = \frac{\nu_+}{\nu_-}\ln\gamma_+ + \frac{\nu_-}{\nu_+}\ln\gamma_- \qquad (17)$$

also

$$\nu_+ z_+ = \nu_- z_- \qquad (18)$$

Hence from equation (15), (17) and (18) we have

$$\ln\gamma_\pm = -|z_+ z_-|\frac{e^2 K}{2\epsilon_r KT} \qquad (19)$$

using the definition of ionic strength, μ as

$$\mu = \frac{1}{2}\sum C_i Z_i^2 \qquad (20)$$

and $n_i = \frac{C_i N_A}{1000}$

where N_A is Avagadro's number and $C_i = m_i \rho_0$ (where ρ_0 being the density of the solvent) we obtain,

$$K^2 = \frac{8\pi N_A^2 e^2 \rho_0 \mu}{1000\,\epsilon_r KT}$$

$$\text{or, } K = \left(\frac{8\pi N_A^2 e^2 \rho_0 \mu}{1000\,\epsilon_r KT}\right)^{1/2} \qquad (21)$$

Substituting for K in equation (19) and setting $\rho_0 = 1\ g\,ml^{-1}$ for water, we get,

$$\log\gamma_\pm = -A\,|z_+ . z_-|\,\mu^{1/2}$$

where A is a constant, expressed as.

$$A = \frac{N_A^2 e^3}{2.303\,\epsilon RT}\left(\frac{2\pi}{1000\,\epsilon_r RT}\right)^{1/2}$$

Substituting the value of N_A π and ρ, we get

$$A = \frac{1.8246\times10^6}{(\epsilon_r . T)^{3/2}}$$

At 25°C the dielectric constant (ϵ_r) for water is 78.54 so that the Debye-Huckel constant becomes equal to 0.509, thus

$$\log\gamma_\pm = -0.509\,|z_+ . z_-|\,\mu^{1/2} \qquad (23)$$

This is Debye-Huckel limiting law equation relating the mean ionic activity coefficient to the ionic strength of solution. The negative value for $\log\gamma_\pm$ in equation (23) indicates that the mean ionic activity coefficient ($\gamma_\pm$) is less than unity. The limiting law equation holds good for dilute solution only.