# Topic 6F - Autoprotolysis and pH

## Very Dilute Solutions of Strong Acids and Bases

If the concentration of a strong acid or base is less than $\sim 10^{-6}$ M, the concentrations of $H_3O^+$ and $OH^-$ resulting from the autoprotolysis of $H_2O$ must be taken into account. For the reactions

$$HA\ (aq) + H_2O\ (l) \rightleftarrows A^-\ (aq) + H_3O^+\ (aq) \qquad \text{(Strong)}$$

$$H_2O\ (l) \rightleftarrows H_3O^+\ (aq) + OH^-\ (aq) \qquad \text{(Autoprotolysis)}$$

the aqueous species present are $A^-$, $H_3O^+$, and $OH^-$. Thus, three equations are needed to determine the three concentrations:

Charge Balance:    $[A^-] + [OH^-] = [H_3O^+]$

Material Balance:    $[A^-] = [HA]_i \Rightarrow [HA]_i + [OH^-] = [H_3O^+]$

Autoprotolysis:    $[H_3O^+][OH^-] = K_w = [H_3O^+]([H_3O^+] - [HA]_i)$

Re-arranging the last equation,

$$[H_3O^+]^2 - [HA]_i\,[H_3O^+] - K_w = 0$$

Thus, as $[HA]_i$ decreases, $[H_3O^+]$ approaches that resulting from autoprotolysis alone.