

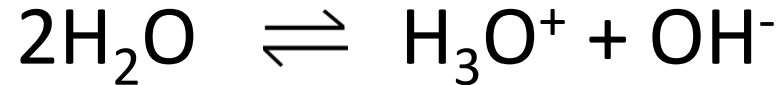
Chemistry 3.6

Aqueous Systems

Acids and Bases

From Level 2

Water dissociation



$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$$

$$\text{“p”} = -\log$$

$$\text{pH} = -\log [\text{H}_3\text{O}^+]$$

$$10^{-\text{pH}} = [\text{H}_3\text{O}^+]$$

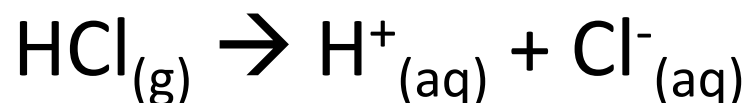
$$\text{pH} + \text{pOH} = 14$$

Dissociating

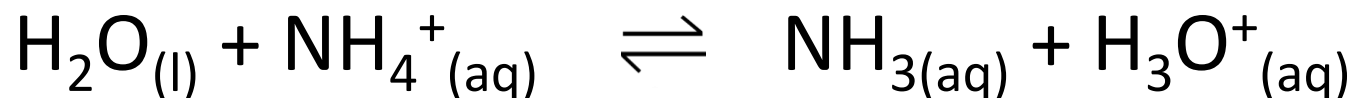
- Once a solid dissolve, each species can further under goes **dissociation** with **water**.
- If it is an **acid** species, it will **donates** a proton (H^+) forming a conjugate base and **H_3O^+ ions**
- If it is a **base** species, it will **accepts** a proton (H^+) forming conjugate acid and **OH^- ions**

Strong acid and weak acid

- Strong acid fully dissociate when it is dissolved



- Weak acid **first dissolve then partially dissociate**



Strong acid Calculation

- Because strong acid fully dissociate, the concentration of H_3O^+ (H^+) ions are the same as displayed in the formula of acid

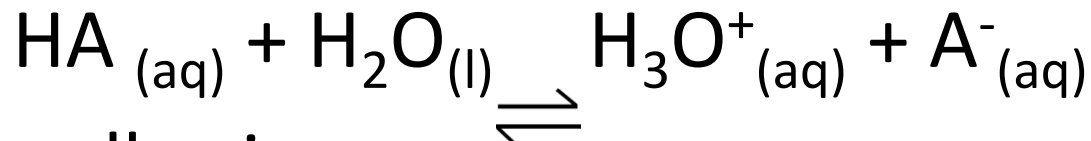
Example

$[\text{H}^+]$ in 0.1 molL^{-1} of $\text{HCl} = 0.1 \text{ molL}^{-1}$

$[\text{H}^+]$ in 0.1 molL^{-1} of $\text{H}_2\text{SO}_4 = 0.2 \text{ molL}^{-1}$

$\text{pH} = -\log[\text{H}^+]$

Weak acid calculation



- K_a is usually given

$$K_a = \frac{[\text{H}_3\text{O}^+][\text{A}^-]}{[\text{HA}]}$$

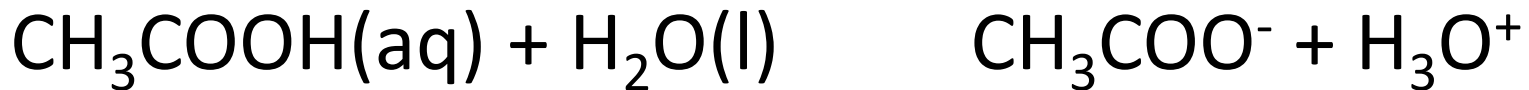
- The assumption is that most of the acid molecules do not dissociate, therefore $[\text{HA}]$ is very similar to the original concentration $c\text{HA}$
- Another assumption is $[\text{H}_3\text{O}^+] = [\text{A}^-]$.

Rearranging the formula gives:

$$[\text{H}_3\text{O}^+] = \sqrt{K_a \times c\text{HA}}$$

Example

Calculate the pH of 0.05 molL^{-1} of ethanoic acid solution. $K_a = 1.74 \times 10^{-5}$



$$K_a = \frac{[\text{H}_3\text{O}^+][\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]} = 1.74 \times 10^{-5}$$

$$[\text{H}_3\text{O}^+] = \sqrt{(1.74 \times 10^{-5}) \times 0.05}$$

$$[\text{H}_3\text{O}^+] = 9.33 \times 10^{-4}$$

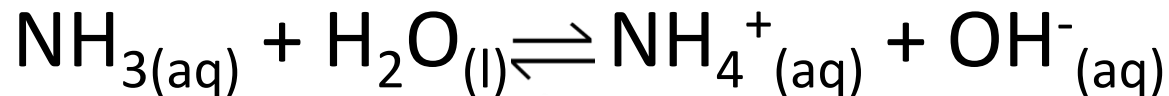
$$\text{pH} = -\log(9.33 \times 10^{-4}) = 3.03$$

Strong base and weak base

- Strong base fully dissociate when it dissolve.



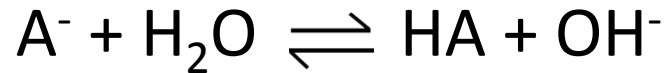
- Weak base first dissolve then dissociate partially.



Strong base calculation

- Calculation the concentration of OH^-
- $10^{-14} \div [\text{OH}^-] = [\text{H}_3\text{O}^+]$
- $-\log [\text{H}_3\text{O}^+] = \text{pH}$

Weak base calculation



- K_b is given in terms of K_a because...

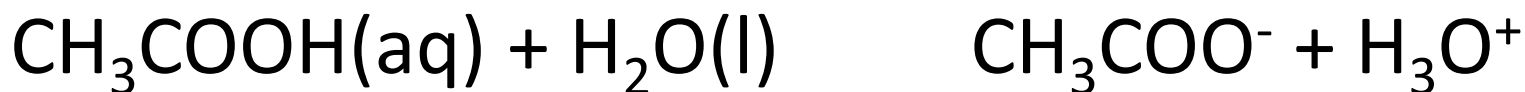
$$K_b = \frac{K_w}{K_a} = \frac{[HA][OH^-]}{[A^-]}$$

- Same assumption with weak acid that the concentration of weak base $[A^-] \approx cA^-$
- $[OH^-] = [HA]$ therefore

$$K_b = \frac{[HA][OH^-]}{[A^-]}$$
$$[OH^-] = \sqrt{K_b \times cA^-}$$

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$$[\text{H}_3\text{O}^+] = \sqrt{(1.74 \times 10^{-5}) \times 0.05}$$

$$[\text{H}_3\text{O}^+] = 9.33 \times 10^{-4}$$

$$\text{pH} = -\log(9.33 \times 10^{-4}) = 3.03$$