***Disclaimer**: Although care has been taken to ensure the accuracy and reliability of the information provided, no responsibility is taken for lack of. Information provided is intended to aid rather than be a replacement*

Lecture 23

Acids and bases

Lewis base: electron pair donor
Lewis acid: electron pair acceptor
Bronsted acid: proton donor
Bronsted acid: proton acceptor

- Degree of hydration with acids is uncertain (H_3O^+, $H_5O_2^+$, $H_7O_3^+$…)

Conjugate acid-base pairs

B (base) + HA (acid) ⇌ HB^+ (conjugate acid) + A^- (conjugate base)
HB^+ (acid) + A^- (base) ⇌ B (conjugate base) + HA (conjugate acid)

Water

Self ionizes however position of equilibrium lies towards the left
$K_w = [H^+][OH^-] = 10^{-14}$ at 25℃
In pure water: $[H^+] = [OH^-]$ hence solution is neutral

- $pH = -\log_{10}[H^+]$
- $pOH = -\log_{10}[OH^-]$
- $pH + pOH = 14$

Acid strength

$H_2O_{(l)} + HA_{(aq)} \rightleftharpoons H_30^+{}_{(aq)} + A^-{}_{(aq)}$
$K_a = \frac{[H_3O^+][A^-]}{[HA]}$
$pK_a = -\log_{10}(K_a)$
Strong acids have a high K_a but a small pK_a

Base strength

$H_2O_{(l)} + B_{(aq)} \rightleftharpoons OH^-{}_{(aq)} + BH^+{}_{(aq)}$
$K_b = \frac{[OH^-][BH^+]}{[B]}$
$pK_b = -\log_{10}(K_b)$
Strong bases have high K_b but a small pK_b

Strong acids

- Ionises completely in aqueous solutions
- Anions are very weak bases
- Conjugate base of strong acid is a very weak base

Strong base

- Conjugate acid of strong base is a very weak acid

$K_a \times K_b = [H^+][OH^-]$
$K_a \times K_b = K_w$
$pK_a + pK_b = 14$

Weak acids

- Undergo a small degree of dissociation
- Conjugate base of a weak acid is also a weak base
- $pH = \frac{1}{2}pK_a - \frac{1}{2}\log_{10}[HA]$
- Assumption: initial *[HA]* can be used as only a very small amount dissociates
- If not making assumption: $K_a = \frac{[x]^2}{[initial - x]}$ where $x = [H_3O^+]$
- 5% rule: if dissociation is < 5% ($\frac{[\text{dissociation}]}{[\text{initial}]}$), then approximation/assumption is valid

Weak bases

- Undergo a small degree of protonation
- $pOH = \frac{1}{2}pK_b - \frac{1}{2}\log_{10}[B]$

Amines

- Bases that are like ammonia
- Reacts with water to produce OH^-
- Reacts with acids to form acid salts therefore enhancing its solubility