1.12 ACIDS AND BASES

Determination of pH

- Ionic product of water, Kw
  - $K_w = [H^+][OH^-]$
    - Used to find pH of strong base
    - Kw varies with temperature
- pH is a measure of hydrogen ion concentration
- Weak acids and bases
  - Weak acids and bases only dissociate slightly in aqueous solution
- Acid dissociation constant: Ka
  - $K_a = \frac{[H^+][A^-]}{[HA]}$
    - $pK_a = -\log_{10}(K_a)$ or $K_a = 10^{-pK_a}$
  - $K_a = \frac{[H^+]^2}{[HA]}$
    - For Ka of weak acids you can assume $[H^+] \approx [A^-]$
- $pH = -\log_{10}[H^+]$ or $[H^+] = 10^{-pH}$
  - For strong monoprotic acid X: $[H^+] = [X]$
    - Monoprotic: Donates one proton
  - For strong diprotic acid X: $[H^+] = 2[X]$
    - Diprotic: Donates two protons

Acid–Base Equilibria

- Acids are proton donors
  - Release hydrogen ions
- Bases are proton acceptors
  - Produce hydroxide ions
- Involves the transfer of protons

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Titrations

- **pH curves**
  - Various strong and weak monoprotic acid and bases
  - Plots pH against volume of acid/base added
    - Equivalence point is the vertical part of the curve
- **Indicator**
  - Identifies the end point of the reaction by a clear colour change
    - Methyl orange
      - Red in acid
        Yellow in alkali
    - Phenolphthalein
      - Colourless in acid
        Pink in alkali
- **Titrate acids with bases**
  - A solution of known concentration is used to determine the concentration of an unknown solution
  - Burette and pipette
    - Accurate
    - Meniscus readings

Buffer Action

- **Buffers resist changes in pH**
  - Position of equilibrium moves to counteract the change in concentration of OH^- or H^+
    - Le Chatelier's principle
  - Acidic buffers are made up of a weak acid and one of its salts
    - Calculate pH of acidic buffer solutions using Ka
  - Basic buffers are made up of a weak base and one of its salts
    - E.g. a solution of ammonia with ammonium chloride is a basic buffer
- **Applications**
  - Blood buffer system to keep pH at 7.4
  - Maintain slightly acidic pH of shampoo
  - Maintain correct pH in biological washing powders

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