

Titration curve of amino acids



Experiment 1 Titration curves of amino acids General structure of amino acids (amphoteric type): Zwitter ion C^{*} : ? - carbon : ? - amino acid NH₂ : ? - amino group, basic (proton acceptor) COOH : ? - carboxylic group, acidic (proton donor) R : side chain of amino acid Classification of amino acids depending on the nature of side chain: * Neutral * Basic amino acid : with extra amino group (NH₂) in its side chain (histidine, arginine, lysine) * Acidic amino acid : with extra carboxylic acid group (COOH) in its side chain (aspartic acid & glutamic acid) * With phenol group in its side chain (Tyrosine) * With sulfide group in its side chain (Cysteine) Isoelectric point (pI): It is the pH at which the net charge on the molecule in solution is zero (Zwitter ion). Zwitter ion will not migrate in electric field, it is electrically neutral. pI is the average of the closest values of pKa's. The pI for the acidic amino acids is the average of pKa₁ and pKa₂, while the pI for basic amino acids is the average of pKa₂ and pKa₃ pKa range for ? COOH (1. 71 - 2. 63) pKa range for ? - NH₃⁺ (8. 8 - 10. 78) Acidity of neutral amino acid ? - COOH > ? - NH₃⁺ For weak acids : Henderson - Hasslbalch equation : $\text{pH} = \text{pKa} + \log \frac{[\text{A}^-]}{[\text{HA}]}$ When $[\text{A}^-] = [\text{HA}]$ $\text{pH} = \text{pKa}$ Acid- base titration: An experiment in which a measured amount of base (or acid) are added to a measured amount of acid (or base) to calculate something unknown such as molarity, pH..... etc.

Equivalence point: The point at which an acid is exactly neutralized with a base. Inflection point: The point in an acid- base titration at which 0. 5 mole of base has been added to one mole of acid to achieve $[\text{A}^-] = [\text{HA}]$ and then ; $\text{pKa} = \text{pH}$ Example : Inflection points 0. 5 1 1. 5 2 * Alanine is an example

on neutral amino acid which has 2 acidic protons (diprotic acids) H^+ - COOH and H^+ - NH_3^+ , these neutral amino acids have two titration curves.

Net charge +1 0 -1 Zwitter ion Titration curve of Alanine: * aspartic acid is an example on acidic amino acid which has 3 acidic protons (triprotic acids) H^+ - COOH, H^+ - NH_3^+ and R- COOH. Acidic amino acids have three titration curves. Acidity of acidic amino acid H^+ - COOH > R- COOH > H^+ - NH_3^+ Net charge +1 0 -1 -2 Zwitter ion

Titration curve of aspartic amino acid * Lysine is an example on basic amino acid which has 3 basic protons (triprotic acids) H^+ - COOH, H^+ - NH_3^+ and R- NH_3^+ . Basic amino acids have also three titration curves. Acidity of basic amino acid H^+ - COOH > H^+ - NH_3^+ > R- NH_3^+ Net charge +2 +1 0 -1 Zwitter ion Titration curve of Lysine Method : at low pH \sim 1 - 1.3 amino acid is fully protonated.