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Class 12
Chemistry

Chapter 4

Acid-Base Chemistry

Handwritten Notes

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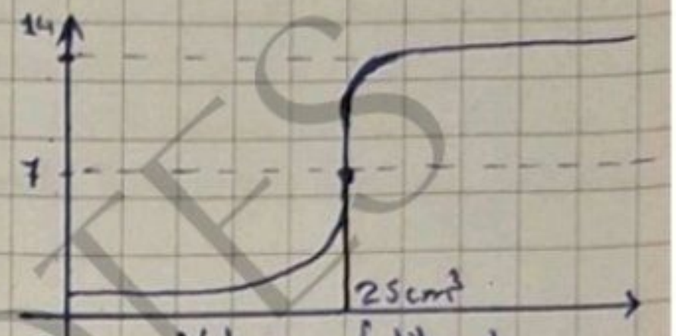
ACID-BASE CHEMISTRY

pH Tritation Curves

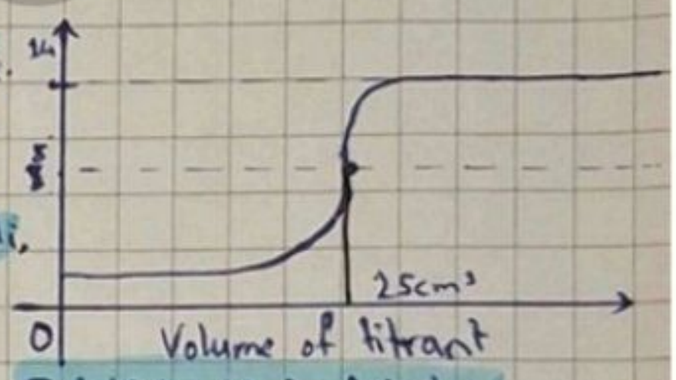
4.1, 4.2, 4,3 not included

Titration is used to find the unknown concentration of an acid or an alkali. In a neutralization titration, a solution of known concentration (titrant) is added from a burette into a conical flask containing a solution of unknown concentration (analyte). An indicator is added to show the end point, where neutralization is complete. Equivalance point is the point where moles of acid = moles of base. It lies at the middle of the steep part of the titration curve.

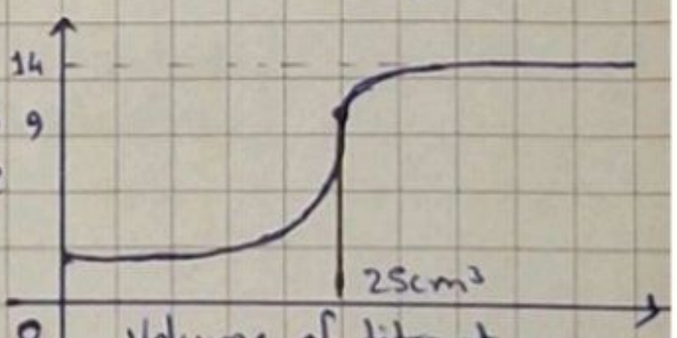
- **Strong Acid - Strong Alkali**: For example HCl and NaOH.
  Initial pH is very low (about 1-2) because of excess H^+ ions. As NaOH is added from a burettet, pH increases slowly. Near the equilvalence point, pH increases very sharply. Equivalence point pH is 7(neutral). After equivalence, excess OH^- makes pH very high (about 13-14). If strong acid is added to a strong base, the curve shape is the same but reversed. The titration curve $1.0 mol dm^{-3}$ HCl with NaOH. Hence $25cm^3$ of titrant (NaOH) is used to neutralise $25cm^3$ of HCl



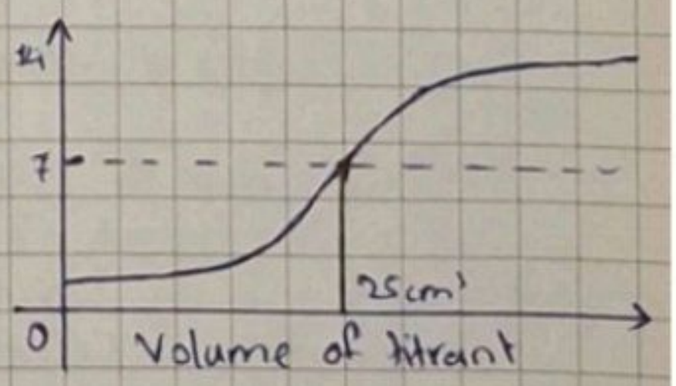
- **Strong Acid - Weak Alkali**: For example HCl and NH_3.
  Initial pH is very low (about 1-2). pH rises slowly as NH_3 is added. The rise near equivalence is less steep (vertical). Equivalance point is acidic (pH about 5.5) because NH_4^+ ions are formed. After equivalence, pH rises but remains lower than with a strong alkali. Curve shape is the same if oreder is reversed, but initial and final pH swap.



- **Weak Acid - Strong Alkali**: For example CH_3COOH and NaOH. Initial pH is higher than a strong acid (about 2-3). pH increases slowly at first. Near equivalance, pH rises sharply. Equivalance point is basic (about 9) due to CH_3COO^- ions. After equivalance, pH becomes very high (about 13-14). Reversing the order gives the same shape with swapped ends.



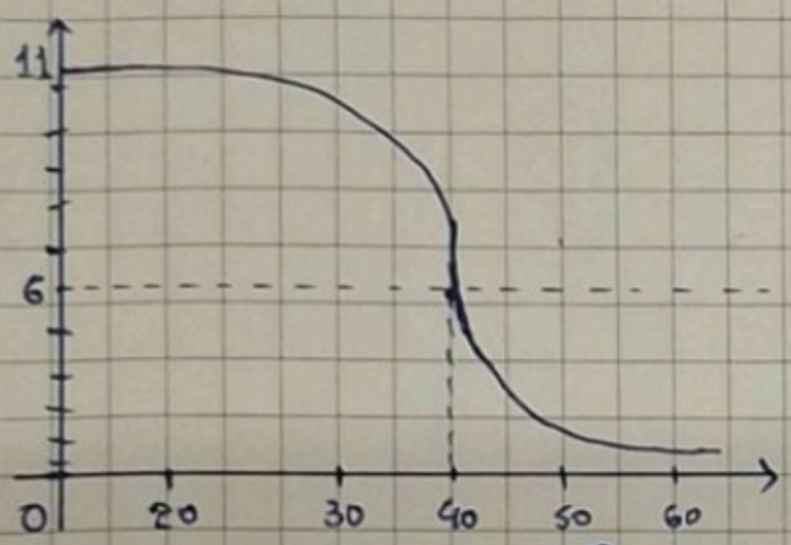
- **Weak acid - Weak Alkali**: Initial pH is about 2-3. No steep vertical region is present. Only a gentle curve with a point of inflection at equivalence. This curve gives very little useful information.



Equivalance point depends on the strength of acid and base.
- Strong - Strong ph 7
- Strong - weak ph < 7
- Weak - strong ph > 7
- Weak - Weak no sharp change

SHORT QUESTIONS

A 20·0cm³ sample of 0·200 moldm⁻³ NH_3 (aq) was titrated with 0·100 moldm⁻³ HCl. Sketch how the pH changes during this titration. Mark clearly where the end point occurs.
Volume of NH_3 = 20·0cm³
Concentration of NH_3 = 0·200 moldm⁻³
Concentration of HCl = 0·100 moldm⁻³
This is a Weak Base — Strong acid titration. $NH_{3(aq)} + HCl_{(aq)} \longrightarrow NH_4^+{}_{(aq)} + Cl^-{}_{(aq)}$
Moles of NH_3 = n = C×V = 0·200 × 0·020 = 0·0040 mol
Volume of HCl needed = V = n/C = 0·0040/0·100 = 0·040 dm³ = 40·0cm³ (equivalance)
Initial pH is basic (10-11). Added HCl reacts with NH_3, pH decreases slowly. At equivilance point all NH_3 is converted into NH_4^+, solution is acidic (pH about 5-6), this is the end point. After this, excess HCl present, pH falls sharply and becomes strongly acidic



CONCEPT ASSESSMENT

In a titration it is found that 25cm³ of 0·1M solution of NaOH is neutralized with 19cm³ of HCl of unknown concentration. Calculate concentration of given HCl solution.
$HCl + NaOH \longrightarrow NaCl + H_2O$
$C_1V_1 = C_2V_2$ ∴valid because the reaction ratio is 1:1
For NaOH, C_1 = 0·100 moldm⁻³ and V_1 = 20cm³
For HCl, C_2 = ? and V_2 = 19cm³
0·100×20 = C_2 × 19
C_2 = 0·100×20/19 = 0·105 moldm⁻³
Draw the pH titration curve when 20cm³ of HCl from the burette is added to 20cm³ of ageous solution of ammonia present in the conical flask.
NH_3 is a weak base so initial pH is about 10-11. Addition of HCl, H^+ ions from HCl react with NH_3 ($NH_3 + H^+ \longrightarrow NH_4^+$) pH decreases gradually. Equivalence point occurs when 20cm³ of HCl has been added. Solution mainly contains NH_4^+. pH is acidic about 5·5, not 7 because NH_4^+ is acidic. After equivalence point excess HCl is present. pH drops and becomes strongly acidic.