PROSPERITY ACADEMY

AS CHEMISTRY 9701

Crash Course

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ACIDS & BASES

COMPLETE NOTES

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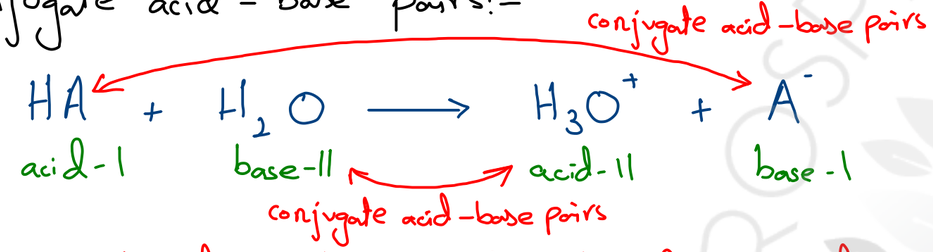
Bronsted Lowry theory of acids and bases:-

- An acid is a H^+ donor (H^+ is only a proton)
- A base is a H^+ acceptor

Conjugate acid - base pairs:-



- H_2O behaved as base, HA behaved as acid.
- A^- is the conjugate base of HA
- H_3O^+ is the conjugate acid of H_2O

- Every base has a conjugate acid → formed by transfer of only 1 H^+
- Every acid has a conjugat base

a) $HCl + H_2O \longrightarrow H_3O^+ + Cl^-$
acid-I, base-II, acid-II, base-I

b) $HNO_3 + H_2O \longrightarrow H_3O^+ + NO_3^-$
acid-I, base-II, acid-II, base-I

c) $CH_3COOH + OH^- \longrightarrow H_2O + CH_3COO^-$
acid-I, base-II, acid-II, base-I

d) $CH_3COOH + NH_3 \longrightarrow NH_4^+ + CH_3COO^-$
acid-I, base-II, acid-II, base-I

e) $HNO_3 + OH^- \longrightarrow H_2O + NO_3^-$
acid-I, base-II, acid-II, base-I

f) $H_2SO_4 + OH^- \longrightarrow HSO_4^- + H_2O$
acid-I, base-II, base-I, acid-II

Strong and weak acids:-

Strong acid:- Fully ionises in aqueous solution e.g Nitric Acid (HNO_3), Sulfuric acid (H_2SO_4), Hydrochloric acid (HCl)

Weak acid:- Partially ionises in aqueous solution e.g. ethanoic acid (CH_3COOH)

- pH of around 3
- does not react vigorously with metals
- bad conductor

- pH of around 1
- does react vigorously with metals
- good conductor

pH of an acid: $0 < x < 7$
pH of neutral: 7
pH of alkali/base: $7 < x < 14$

Strong base:- Sodium hydroxide ($NaOH$), Potassium hydroxide (KOH)
Weak base:- Aqueous ammonia ($NH_3(aq)$)

pH Titration Curves:-

End point:- When indicator changes colour during titration
Equivalence point:- When an acid and base are mixed together in exactly the equation proportions.

- End point and equivalence points are not same ⟶ not all salts formed during titration have pH of 7 at r.t.p
- Titration is complete at equivalence point
- DONOT use the term neutral point!

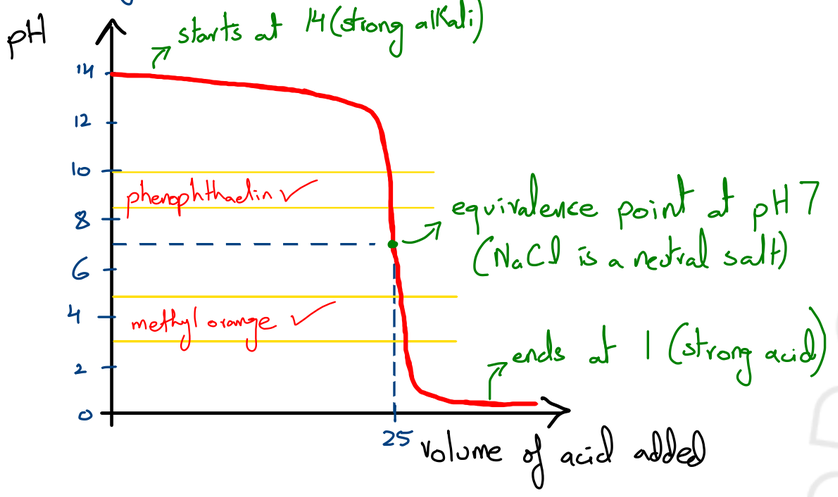
- We will draw titration curves for 1 $moldm^{-3}$ and 25 cm^3 of acid or base already present, and then titrate it with corresponding 1 $moldm^{-3}$ solution

If acid & base react in 1:1 ratio then 25 cm^3 should be needed to neutralize

Strong acid + Strong base:- ($HCl + NaOH$)

$HCl + NaOH \longrightarrow NaCl + H_2O$

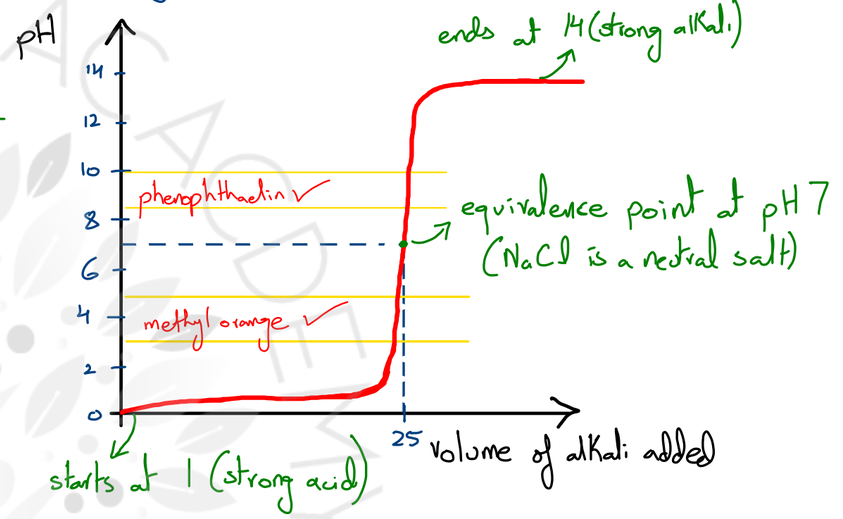
Running acid into the alkali:-



pH change only happens for narrow domain

steep point covers alkaline and acidic pHs

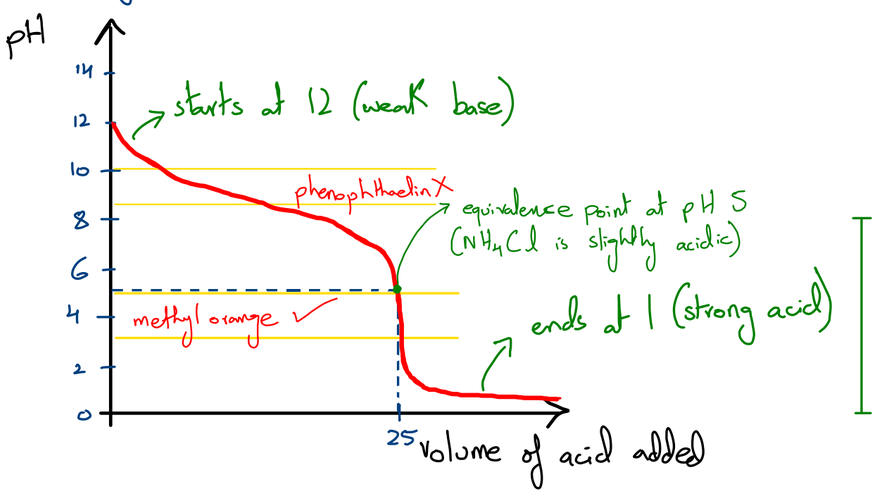
Running alkali into the acid



Strong acid and weak base:- ($HCl + NH_3$)

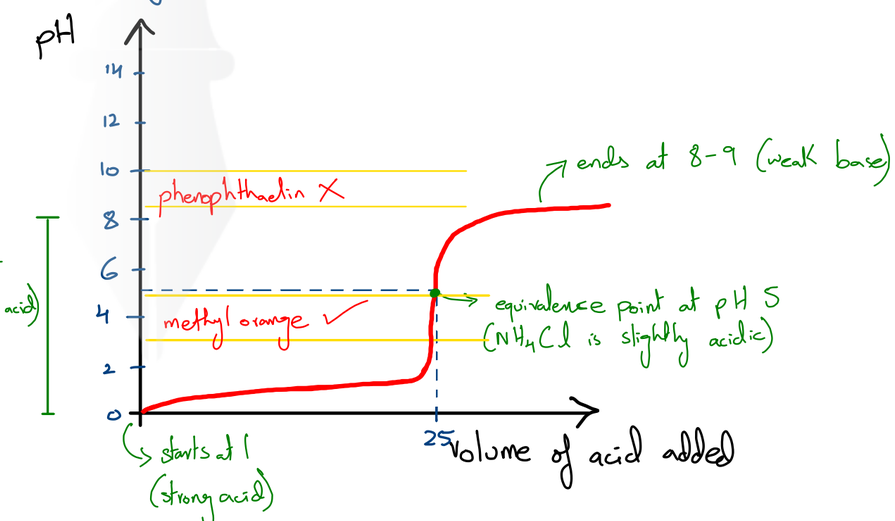
$HCl + NH_3 \longrightarrow NH_4Cl$

Running acid into the alkali:-



steep part lies in acidic pHs (strong acid)

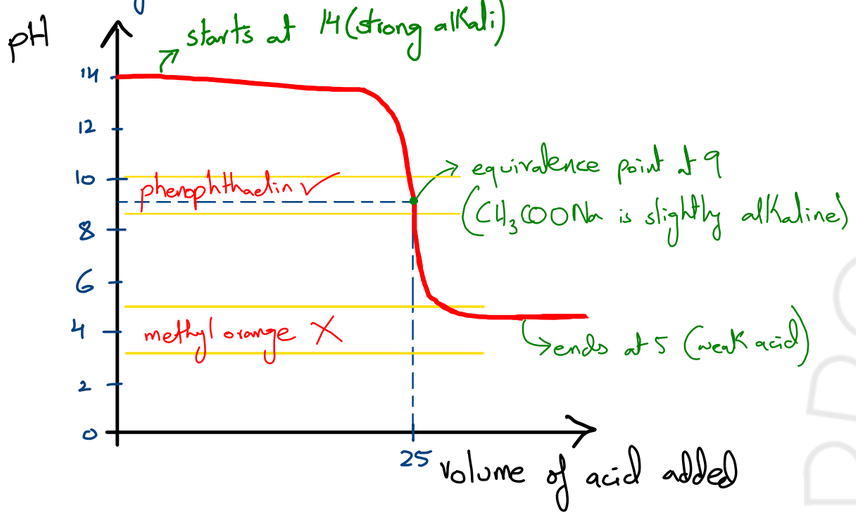
Running alkali into the acid :-



Strong base and weak acid :- ($NaOH + CH_3COOH$)

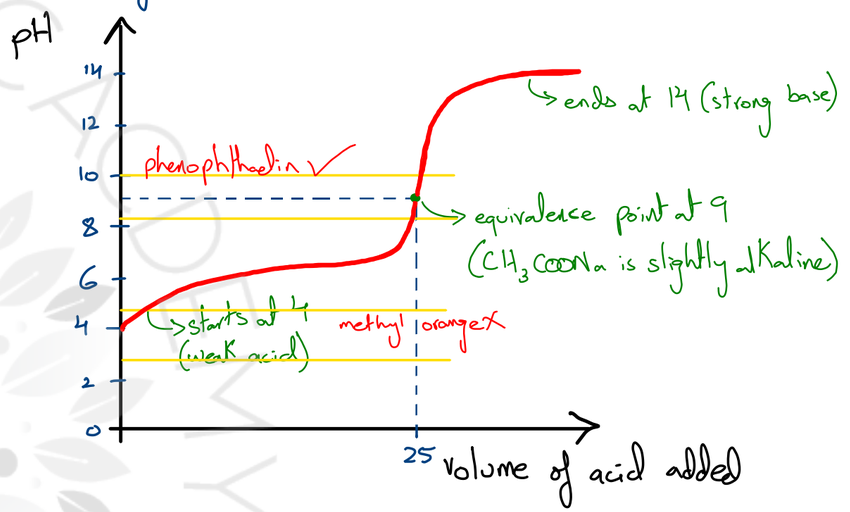
$NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$

Running acid into alkali :-



steep part lies in alkaline pHs (strong base)

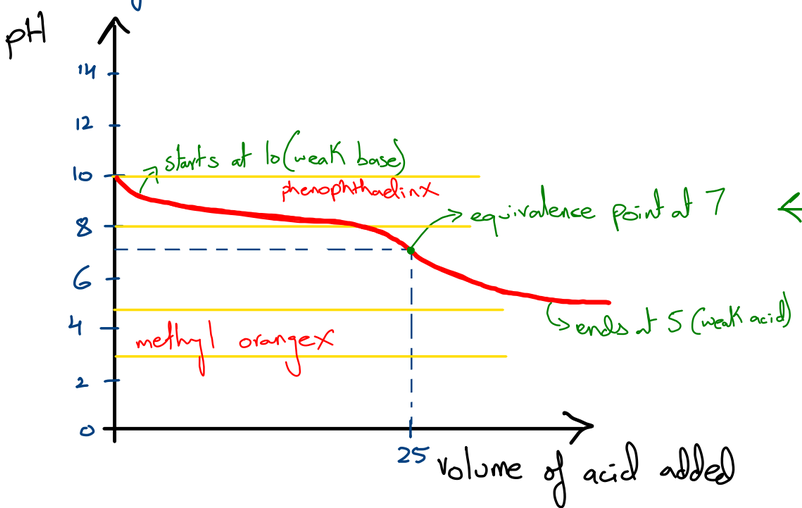
Running alkali into acid :-



Weak acid and weak base :- ($CH_3COOH + NH_3$)

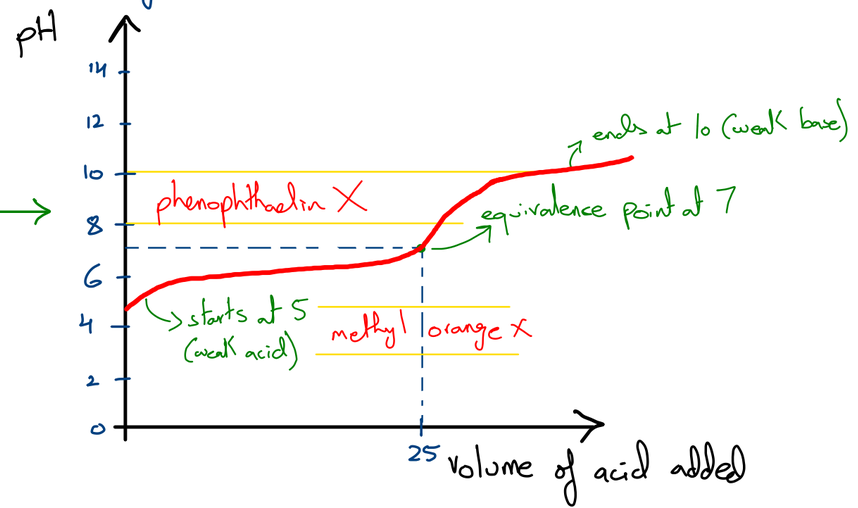
$CH_3COOH + NH_3 \longrightarrow CH_3COO^- + NH_4^+$

Running acid into alkali :-



No clear steep point
No suitable indicator

Running alkali into acid :-

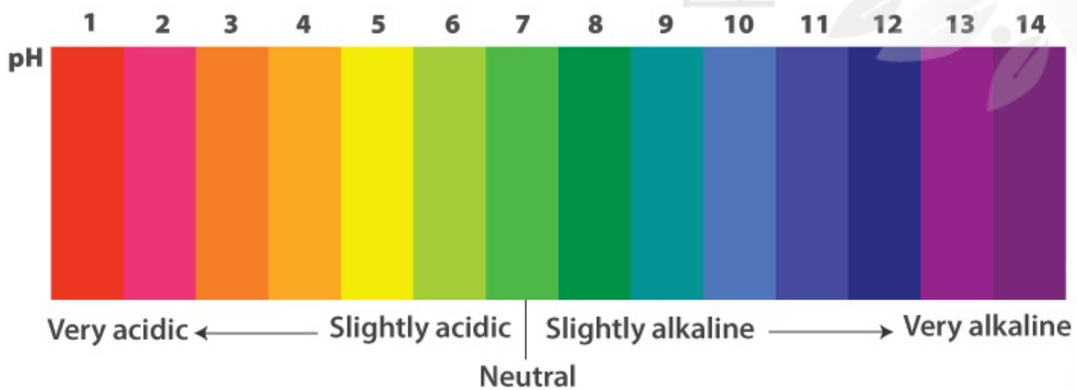


Indicators:-

1) Methyl orange changes colour between 3.2 - 4.3
   - ↓ below this red
   - ↓ above this yellow

2) Phenolphthalein changes colour between 8.3 - 10.0
   - ↓ below this colourless
   - ↓ above this pink/purple

3) Universal indicator



We don't use this as its difficult to notice exactly what pH as colour change is gradual and indistinguishable

Always choose an indicator which changes colour in steep point

- Use methyl orange for strong acid
- Use phenolphthalein for strong base.

(d) 25 cm^3 of 0.10 mol dm^{-3} HCl(aq) is added to a beaker and its pH is recorded.

50 cm^3 of 0.10 mol dm^{-3} NH_3(aq) is added to the HCl(aq) in 5 cm^3 portions.

The pH of the mixture is monitored until all the NH_3(aq) is added.

HCl is a strong Brønsted-Lowry acid.

(i) Describe what is meant by a strong Brønsted-Lowry acid.

A strong Brønsted Lowry acid donates H^+ and completely ionises in aqueous solution. [2]

(ii) NH_3 is a weak base.

Construct an equation that shows the behaviour of NH_3 as a weak Brønsted-Lowry base when dissolved in water.

$NH_3 + H_2O \longrightarrow NH_4^+ + OH^-$ [1]

(iii) On Fig. 2.1 sketch a graph to show the change in pH which occurs when HCl(aq) is titrated with NH_3(aq) as described in **(d)**.

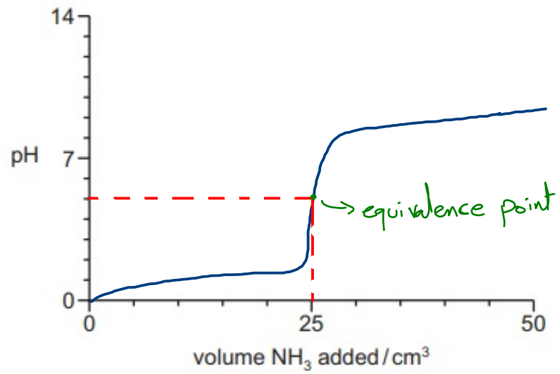


Fig. 2.1

[2]

(d) The hydrogen halides dissolve in water to form strong Brønsted–Lowry acids.

The concentration of a strong acid can be determined by titration.

(i) State what is meant by strong Brønsted–Lowry acid.

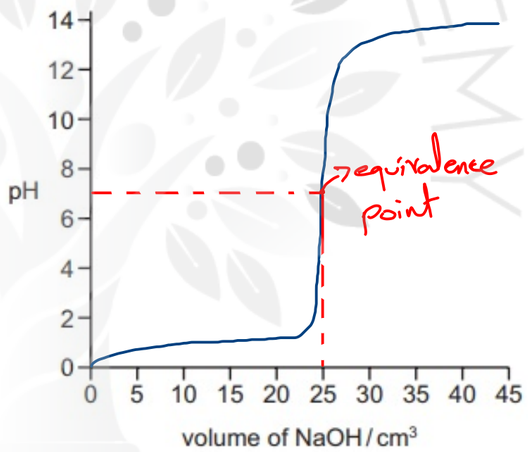
Done

..... [2]

(ii) On Fig. 3.2, sketch the pH titration curves produced when:

- 0.1 mol dm^{-3} NaOH(aq) is added to 25 cm^3 of 0.1 mol dm^{-3} HBr(aq), to excess
- 0.1 mol dm^{-3} NH_3(aq) is added to 25 cm^3 of 0.1 mol dm^{-3} HBr(aq), to excess.

reaction of NaOH(aq) and HBr(aq)



reaction of NH_3(aq) and HBr(aq)

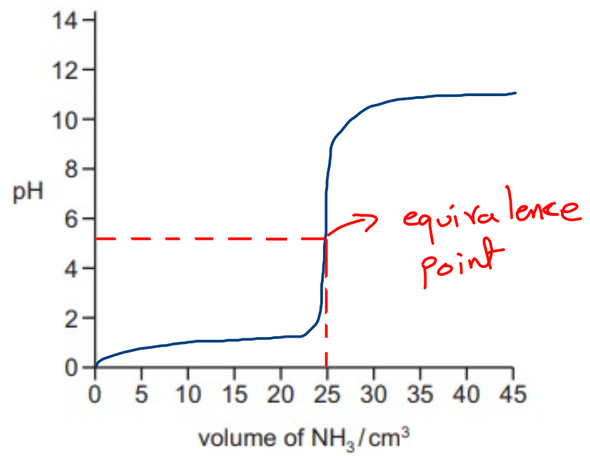


Fig. 3.2

[3]