Titration

1. weak acid vs strong base

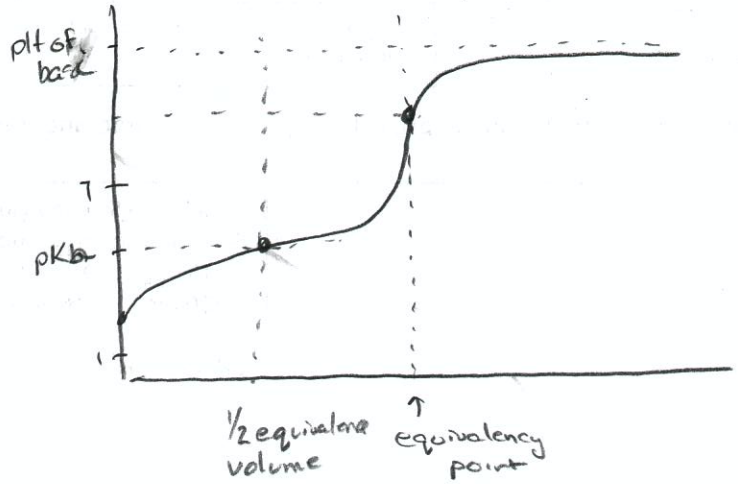
$HA_{(aq)} \rightleftharpoons H^+_{(aq)} + A^-_{(aq)}$ $\quad HA_{(aq)} + NaOH_{(aq)} \rightarrow NaA_{(aq)} + H_2O_{(l)}$

a) initial pH → depending on [HA]

b) ½ equivalence $\quad pH = pK_A$

c) equivalency $\quad A^-_{(aq)} + H_2O_{(l)} \rightleftharpoons HA_{(aq)} + OH^-_{(aq)}$ ∴ basic

d) excess base → approaches pH of base



2. a) Acid-base indicators are conjugate acid base pairs where the acid (HIn) and conjugate base (In^-) have different colours

b) that the acid and conjugate base are diffent colours

c) the $[H^+]$ as it will determine the degree the weak acid (HIn) will ionize

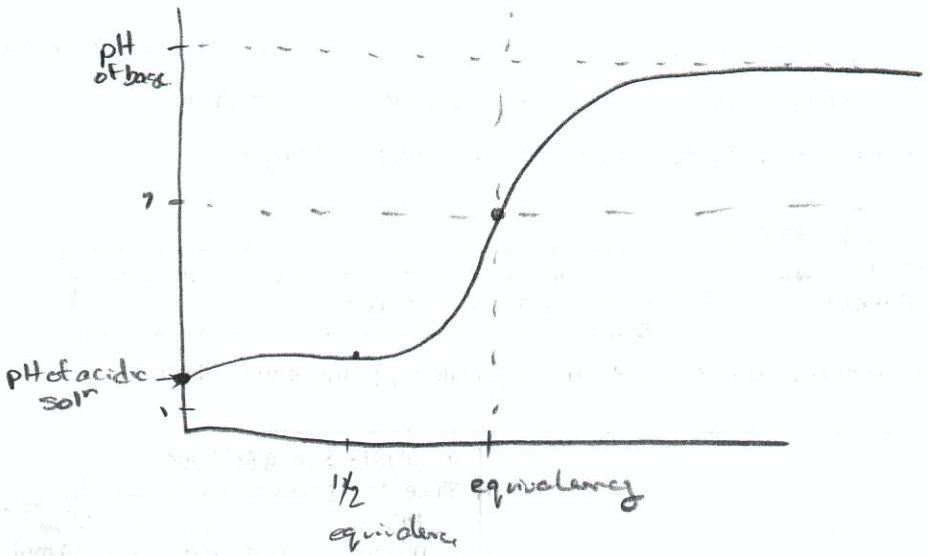
strong acid & strong base

3. a) pH of acid

b)

c) equivalency pH=7
as no hydrolysis rxn occurs

d) pH is approaching pH of base



4.

phenolphthalein	colourless	<8.2
methyl orange	yellow	>4.0
methyl red	yellow	>6.0

Since the soln caused phenolthalein to be colourless, the pH must be below 8.2, and given it was yellow in methyl red this tells us the pH is above 6.0
Therefore the pH of the soln is btw 6.0 and 8.2

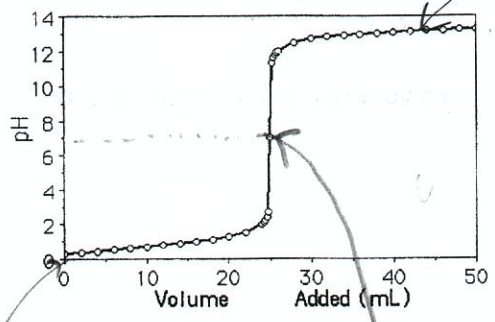
5.

phenolphthalein	colourless	<8.2
bromothymol blue	blue	>7.1
methyl orange	yellow	>4.0

Since the soln caused phenolphthalein to stay colourless, its pH must be below 8.2. By causing bromothymol blue's colour to be blue, its pH must be greater than 7.1

∴ pH is btw 7.1 - 8.2

6a) NaOH ω HCl



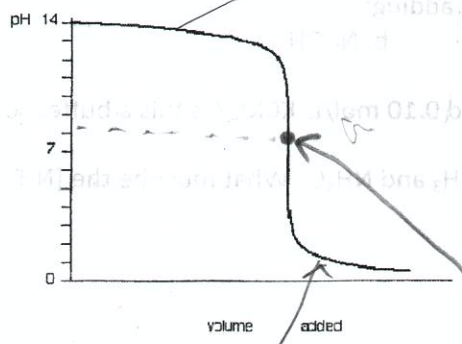
high final pH suggests strong base

added base to acid bcz pH ↑

low initial pH suggest started ω strong acid which has ionized completely

equivalency point has a pH of 7 therefore neither the anion (from the acid) or cation (from the base) cause a hydrolysis rxn

b) NaOH ω $HC_3H_2O_3$



high initial pH suggest started ω a strong base which has dissociated completely

add acid to base bcz pH ↓

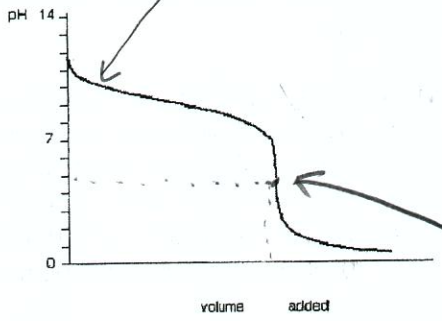
equivalency point has a pH > 7 the anion of a weak acid will act as a conjugate base, causing a hydrolysis rxn

$A^-_{(aq)} + H_2O_{(l)} \rightleftharpoons HA_{(aq)} + OH^-_{(aq)}$

causing basic conditions

pH final approaches a pH of 1 but does not get there

c) NH_3 titrated w/ HCl



start of w/ a weak base as pH is not as high as it would be for if the strong base of same [ ]

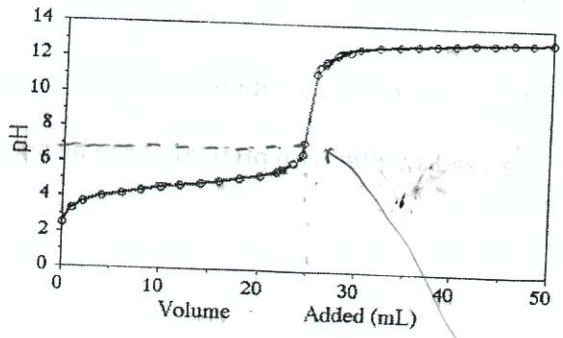
acid add to base bcz pH ↓

equivalency point is below 7 cation of a weak base will cause a hydrolysis rxn

$NH_4^+_{(aq)} + H_2O_{(l)} \rightleftharpoons NH_{3(aq)} + H_3O^+_{(aq)}$

producing H_3O^+ and causing pH to be < 7

d) NH_3 titrated w/ CH_3COOH



base added to acid pH ↑

equivalency point has a pH of 7 Suggesting a strong acid w/ a strong base however, the anion of the weak acid causes a hydrolysis rxn and the cation of a weak base causes a hydrolysis rxn

$C_2H_3O_2^-_{(aq)} + H_2O_{(l)} \rightleftharpoons HC_2H_3O_{2(aq)} + OH^-_{(aq)}$

$K_B = 5.5 \times 10^{-10}$

$NH_4^+_{(aq)} + H_2O_{(l)} \rightleftharpoons NH_{3(aq)} + H_3O^+_{(aq)}$

$K_A = 5.5 \times 10^{-10}$

Since $K_A = K_B$ it will result in a neutral sol^n