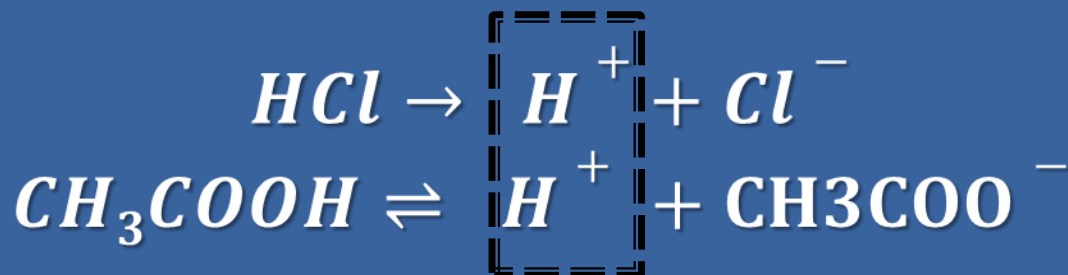


Determination of HCl/Acetic acid sample



1-Principle

HCl is Strong acid \longrightarrow Completely ionized
CH₃COOH is Weak acid \longrightarrow Partially ionized



Common ion effect

HCl hinders ionization of CH₃COOH \longrightarrow HCl reacts first
without interference of CH₃COOH

When all HCl is reacted \longrightarrow CH₃COOH begins to
ionize and reacts with NaOH.

First step

strong acid \neq strong base

Second step

weak acid \neq strong base

At the end point, the following are present:

NaCl
H₂O
CH₃COOH

pH is Acidic



M.O. indicator

NaCl
H₂O
CH₃COONa

pH is Slightly Alkaline



pH.pH. indicator

Two indicators in the same flask



Double indicator method

Conditions required for double indicator method

✓ Both K_1 & $K_2 > 10^{-7}$

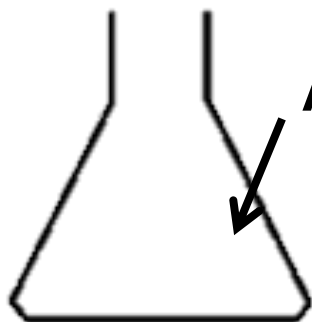
✓ $\frac{K_1}{K_2} > 10^4$

N.B.

K_a of Acetic acid = 1.8×10^{-5}

2-Procedure

First step



Titrate against 0.1 N NaOH
(burette)

Add 10 ml sample (by pipette)
+ 3 drops M.O.

End point:

Red



Orange

With no red tinge

mls A

On the same flask

Second step

Add 10 drops Ph.Ph.
Titrate against 0.1 N NaOH

● End point: first Pink

mls B

$$\text{Conc. of HCL} = \frac{\text{mlsA} \times f \times F \times 1000}{10} = \text{g/L}$$

$$\text{Conc. of acetic acid} = \frac{\text{mlsB} \times f \times F \times 1000}{10} = \text{g/L}$$



pH CALCULATIONS

Strong Acid	Strong Base	Weak Acid	Weak Base
$\text{pH} = -\log [\text{H}^+]$	$\text{pOH} = -\log [\text{OH}^-]$ $\text{pH} = 14 - \text{pOH}$	$\text{pH} = \frac{1}{2} \text{pC}_a + \frac{1}{2} \text{pK}_a$	$\text{pOH} = \frac{1}{2} \text{pC}_b + \frac{1}{2} \text{pK}_b$ $\text{pH} = \text{pK}_w - \frac{1}{2} \text{pC}_b - \frac{1}{2} \text{pK}_b$
Acidic Buffer		Basic Buffer	
$\text{pH} = \text{pK}_a + \log \frac{\text{Salt}}{\text{Acid}}$		$\text{pOH} = \text{pK}_b + \log \frac{\text{Salt}}{\text{Base}}$ $\text{pH} = \text{pK}_w - \text{pK}_b - \log \frac{\text{Salt}}{\text{Base}}$	
$S_{(\text{sA-sB})}$	$S_{(\text{wA-sB})}$	$S_{(\text{sA-wB})}$	$S_{(\text{wA-wB})}$
KCl	Sod. acetate	NH_4Cl	Ammonium acetate
neutral	$\frac{1}{2} \text{pK}_w + \frac{1}{2} \text{pK}_a - \frac{1}{2} \text{pC}_s$	$\frac{1}{2} \text{pK}_w - \frac{1}{2} \text{pK}_b + \frac{1}{2} \text{pC}_s$	$\frac{1}{2} \text{pK}_w + \frac{1}{2} \text{pK}_a - \frac{1}{2} \text{pK}_b$

Problems:

Assuming that pK_a of acetic acid = 4.7, calculate pH of:

1– buffer containing 0.1 N acetic acid and 0.01 N sodium acetate

2– buffer containing 0.01 N acetic acid and 0.1 N sodium acetate

3–buffer containing 0.1 N acetic acid and 0.1 N sodium acetate

□ Given that pK_b of NH_4OH = 4.7, calculate pH of:

a. 0.1 M NH_4OH

b. 0.1 M NH_4Cl

c. Buffer containing 1 M NH_4OH and 0.5 M NH_4Cl

□ What is the pH of acetic acid/sod acetate buffer containing 0.2 M salt and 0.3 M acid? If 1 L of water is added, what will be the pH?

Thank You

