

## Students' Note

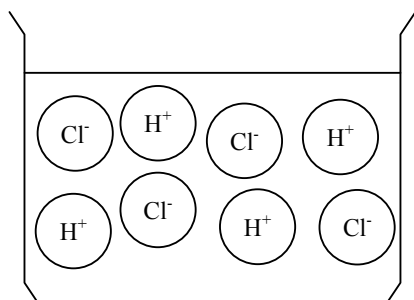
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1. What is "an acid"?
2. What is "a base"?
3. What does neutralization reaction mean?
4. Can we determine the amount of  $\text{CH}_3\text{COOH}$  in a mixture of  $\text{HCH}(\text{aq})$  and  $\text{CH}_3\text{COOH}(\text{aq})$ ?

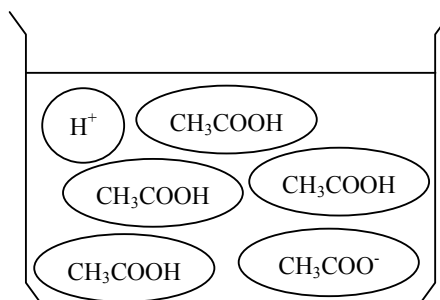
## Conductimetric Titration of Acid-Base Neutralization

### Basic knowledge

**Acid** is a compound which produces  $H^+$  ion in aqueous solution.



HCl disassociates 100% into  $Cl^-$  and  $H^+$  in aqueous solution. It is called strong acid.



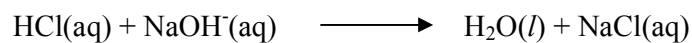
$CH_3COOH$  disassociates only 1% into  $CH_3COO^-$  and  $H^+$  in aqueous solution. Other 99% is presented as  $CH_3COOH(aq)$ . It is called weak acid.

Fig. 1

### Neutralization

Neutralization is the reaction between acid and base, producing salt and water. For example, when HCl solution reacts with NaOH solution it forms water and sodium chloride.

When neutralization is completed, the amount of acid equals to that of base. In the case of  $HCl(aq)$  and  $NaOH(aq)$ :



$$n_{HCl} = n_{NaOH}$$

$$\text{or } C_{HCl} \times V_{HCl} = C_{NaOH} \times V_{NaOH}$$

Where  $n_{HCl}$  is the mole number of  $HCl(aq)$ ,  $n_{NaOH}$  is the mole of  $NaOH(aq)$

$C_{HCl}$  is the concentration of  $HCl(aq)$  in  $mol/L$ ,  $C_{NaOH}$  is the concentration of  $NaOH(aq)$  in  $mol/L$ ,  $V_{HCl}$  is the volume of  $HCl(aq)$  in L, and  $V_{NaOH}$  is the volume of  $NaOH(aq)$  in L.

## Materials

A 50 mL beaker, an improvised conductivity meter, an ammeter, 0.25 mol/L NaOH solution, 0.25 mol/L HCl solution and 0.25 mol/L CH<sub>3</sub>COOH solution.

### I. Neutralization of HCl(aq) by NaOH(aq)

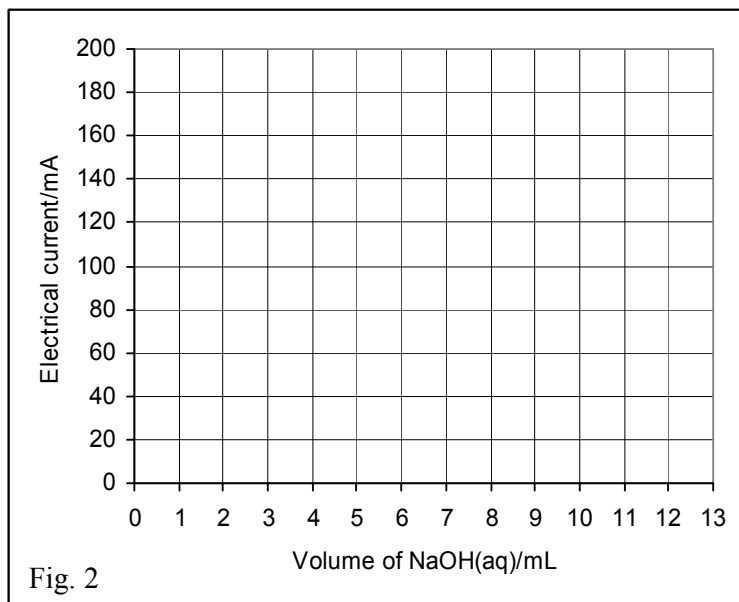
#### Procedures

1. Put 10 mL of HCl solution into a 50 mL beaker.
2. Connect the improvised conductivity meter correctly to an ammeter.
3. Without adding NaOH solution, measure the electrical current flow of HCl solution and record the result into Table 1.
4. Add 1 mL of NaOH solution into HCl solution and shake the solution well. Measure the electrical current and record the result.
5. Continue to measure the electrical currents at every adding 1 mL of NaOH solution into HCl solution until 13 mL of NaOH solution were added. Record the results.

#### Result and Discussion

Table 1

NaOH(aq)/mL	Current/mA
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	



1. Write the chemical equation of this neutralization reaction.



2. Plot the graph in *Fig. 2*, and find the point that the neutralization is completed.

Neutralization is completed at \_\_\_\_\_ mL of NaOH(aq).

## II. Neutralization of CH<sub>3</sub>COOH(aq) by NaOH(aq)

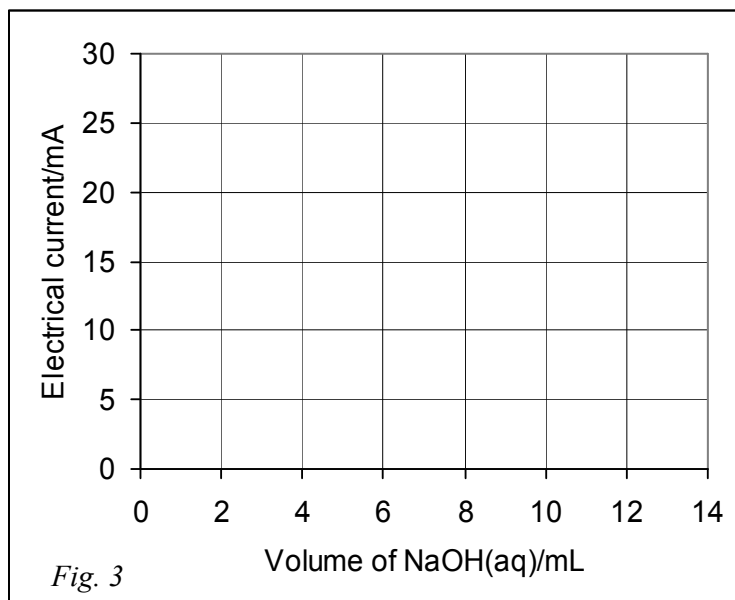
### Procedures

1. Put 10 mL of 0.25 mol/L CH<sub>3</sub>COOH solution into a 50 mL beaker.
2. Connect the improvised conductivity meter correctly to an ammeter.
3. Without adding NaOH solution, measure the electrical current flow of CH<sub>3</sub>COOH solution and record the result into Table 2.
4. Add 1 mL of NaOH solution into CH<sub>3</sub>COOH solution and shake the solution well. Measure the electrical current and record the result.
5. Continue to measure the electrical currents at every adding 1 mL of NaOH solution into CH<sub>3</sub>COOH solution until 13 mL of NaOH solution were added. Record the results.

### Result and Discussion

Table 2

NaOH(aq)/mL	Current/mA
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	



1. Plot the graph in *Fig. 3*, and find the point that the neutralization is completed.  
Neutralization is completed at \_\_\_\_\_ mL of NaOH(aq).
2. Write the chemical equation of this neutralization reaction.  
$$\text{NaOH(aq)} + \text{CH}_3\text{COOH(aq)} \longrightarrow \text{_____} + \text{_____}$$
3. Compare this graph to one of neutralization between HCl(aq) and NaOH(aq) measured in the previous lesson, discuss on it.

### III. Neutralization of HCl(aq)-CH<sub>3</sub>COOH(aq) mixture by NaOH(aq)

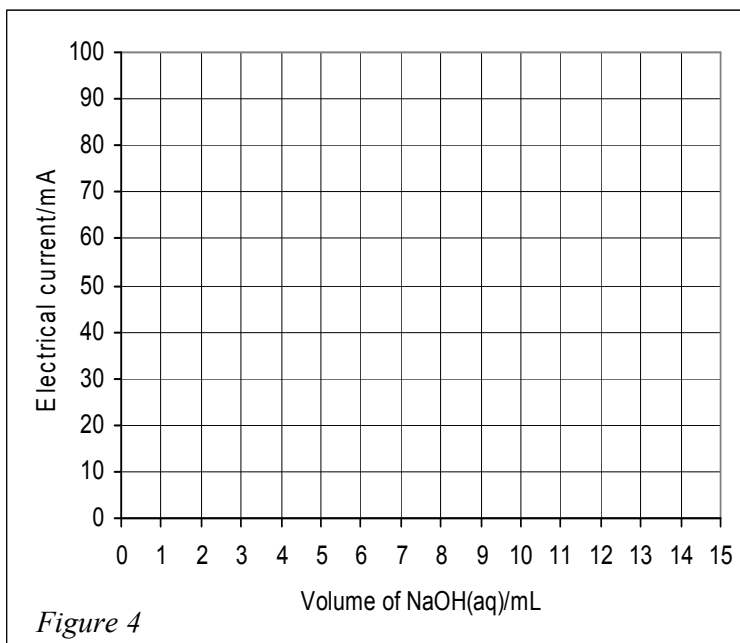
#### Procedures

1. Put 5 mL of 0.25 mol/L HCl solution and 7 mL of 0.25 mol/L CH<sub>3</sub>COOH solution into a 50 mL beaker.
2. Connect the improvised conductivity meter correctly to an ammeter.
3. Without adding NaOH solution, measure the electrical current flow of the mixed solution and record the result into Table 3.
4. Add 1 mL of NaOH solution into the mixed solution and shake the solution well. Measure the electrical current and record the result.
5. Continue to measure the electrical currents at every adding 1 mL of NaOH solution into the mixed solution until 15 mL of NaOH solution were added. Record the results.

#### Result and Discussion

Table 3

NaOH(aq)/mL	Current/mA
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	



1. Plot the graph in *Figure 4*, and assign the amount of each acid by the graph.  
The amount of \_\_\_\_\_ is correspondent to the first 5 mL of NaOH solution.  
The amount of \_\_\_\_\_ is correspondent to the next 7 mL of NaOH solution.
2. Explain why we can determine each amount of HCl and CH<sub>3</sub>COOH.