FE 101 General Chemistry Lab.
Acid - Base Titration

Titration is a process which is carried out by the carefully controlled addition of one of solution to another. Therefore, two solutions are used during the titration, which are **standard** and **sample** solutions. The **standard solution** is a reagent of known concentration that is used to carry out a volumetric analysis. The standard solution is gradually added to a second solution known as **sample solution** which is often placed in an erlenmeyer flask. The standard solution is placed in a container known as a buret which is used to measure the volume of standard solution added during the titration. A titration is performed by slowly adding a standard solution from a buret to a solution of the analyte until the reaction between the two is complete. The volume needed to complete the titration is determined from the difference between the initial and final buret readings.

The **equivalence point** in a titration is reached when the amount of added titrant is chemically equivalent to the amount of analyte in the sample. For example, the equivalence point in the titration of sulfuric acid, H_2SO_4, with sodium hydroxide, NaOH, is reached after introduction of two moles of base for each mole of acid.

The equivalence point of a titration is a theoretical point that cannot be determined experimentally. It can only be estimated by observing some physical change associated with the condition of equivalence. In acid – base titrations, acid base indicators are used for this purpose. Indicators are often added to the analyte solution to produce an observable physical change (color change) at or near the equivalence point. This change is called the **end point** for the titration.

In an **acid – base titration**, a solution containing a known concentration of base is slowly added to an acid (or an acid is added to a base). Acid – base indicators can be used to observe a color change in the sample solution at the end point.

In this experiment, you will first determine the concentration of an acid (part a). In part b the standardized acid will be used to determine the molarity of a sodium hydroxide, NaOH, solution. In part c, you will determine the amount of sodium hydroxide in an unknown solution.

PROCEDURE

1. Determination of Concentration of HCl Solution:

- Using a pipet place 10 mL of a known concentration of Na_2CO_3 solution in each of two flasks.

- Add two drops of methyl orange indicator to each of the flasks and mix the solution with a gentle shaking.

- Fill your burette with HCl as instructed above.

- Place one of the Erlenmeyer flasks under the tip of the burette.

- Handle the stopcock of the burette with your left hand while shaking the flask gently with your right hand.

- Carefully run HCl from the burette into the Na_2CO_3 solution until the end point is reached.

- The end point is the first appearance of a permanent red color.

- To prevent the effect of dissolved CO_2 on the pH, boil the mixture for a few minutes.

- After cooling the solution add a few drops of HCl until the end point is observed again.

- Record the volume of HCl added.

- Titrate the solution in the second flask following exactly the same procedure. Try to detect the end point as closely as possible.

- Calculate the molarity of the HCl solution.

2. Quantitative Determination of NaOH:

- Using a pipette, add 10 mL of 0.1 M NaOH to each of two erlenmeyer flasks.

- Add two drops of methyl orange to each flask and titrate just as you did with sodium carbonate, Na_2CO_3.

- It is not necessary to boil the solution.

- Calculate the molarity of the NaOH solution and compare your result with the actual concentration.

3. Unknown

You will be given an unknown solution of NaOH. Titrate this solution just as you did above and calculate the number of grams of NaOH in the solution.

QUESTIONS

1. Explain the meaning of the following terms

a. Titration

b. End Point

c. Standard Solution

d. Meniscus

2. Explain the preparation of 500 mL of 0.2 M standard NaOH solution.
   (MW of NaOH = 40 g/mole)

3. How does dissolved CO_2 affect the end point in the titration of Na_2CO_3 with HCl? Explain by using chemical formulas. Does the pH decrease or increase in the presence of dissolved CO_2?

4. Why did you carry out the same procedure with two times for the titration of Na_2CO_3 and NaOH? Were the results same with each other? If not what can be the reason of obtaining different results?

FE 101 GENERAL CHEMISTRY DATA
Acid - Base Titration

Date:

For the standardization of HCl solution

	1	2
Volume of Na_2CO_3 solution		
Initial buret reading		
Final buret reading		
Volume of HCl used for Na_2CO_3		

For NaOH solution

	1	2
Volume of NaOH solution		
Initial buret reading		
Final buret reading		
Volume of HCl used for NaOH		

For unknown solution

	1	2
Initial buret reading		
Final buret reading		
Volume of HCl used for unknown		

Group no:	
Members :	

Submitted to