Ministry of Higher Education and Scientific Research

Mustansiriyah University

College of Science / Department of Chemistry

Practical Analytical Chemistry

For First Year Students Biology Department

Nabih M. Abdulnabi

2018

Acid / base titrations

Standardization of hydrochloric acid solution (HCl) using a standard solution of sodium carbonate (Na_2CO_3)

- ***Purpose:*** Determine the exact normality of a hydrochloric acid solution.
- ***Theory:*** A titration is a process used to determine the volume of a solution that is needed to react with a given amount of another substance.

Hydrochloric acid (HCl) is not pure enough to be used as a primary standard, it was standardization with basic primary standard sodium carbonate (Na_2CO_3), then used hydrochloric acid as a secondary standard for standardization another solutions. In this experiment, a primary standard solution of sodium carbonate is used to determine the exact concentration of a hydrochloric acid solution.

Requirements for chemical reaction used in titrimetric methods of analysis

1. The reaction between reagent (titrant) and (analyte) should be rapid.
2. The reaction should be stoichiometric.
3. The reaction should not involve side reactions between constituents of the solutions.
4. There are several methods must be valid for determination when the reaction is complete.

Reaction

Neutralization reaction between Na_2CO_3 and HCl acid takes place in two steps:

$$HCl + Na_2CO_3 \longrightarrow NaCl + NaHCO_3$$

$$HCl + NaHCO_3 \longrightarrow NaCl + H_2O + CO_2$$

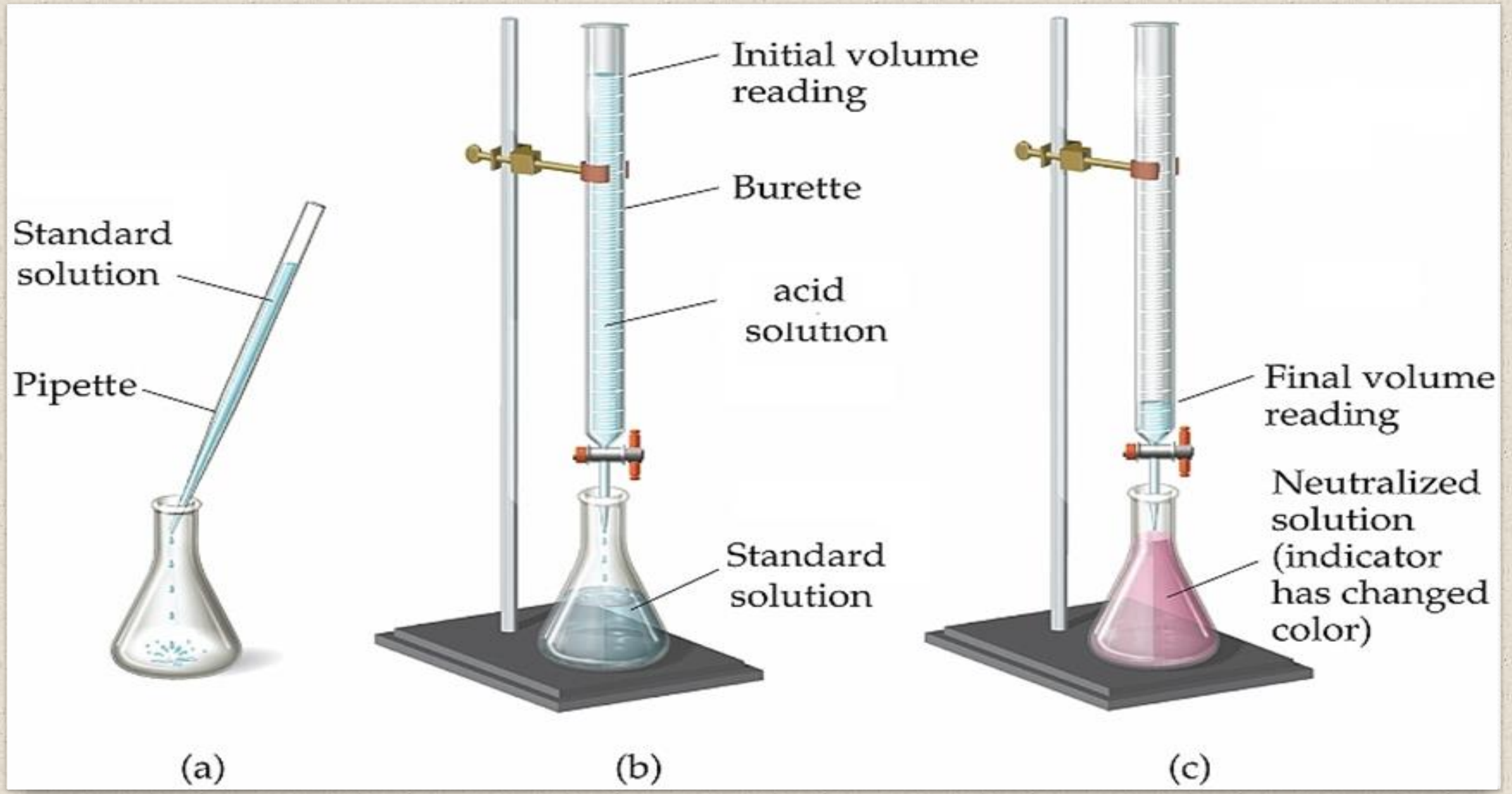
The final reaction

$$2HCl + Na_2CO_3 \longrightarrow 2NaCl + H_2O + CO_2$$

Equipment	***Materials***
• Burette	Hydrochloric acid solution (HCl) unknown
• Beaker	Sodium carbonate (Na_2CO_3) solution 0.1N
• Pipette	Methyl orange indicator
• Pipette filler	Distilled water
• Conical flask	
• Dropper bottle	
• Funnel	
• Stand	
• Clamp	
• Filter paper	

Procedures

1. Wash the burette, pipette and conical flask with distilled water.
2. Rinse the burette with hydrochloric acid solution (HCl).
3. Using a funnel, fill the burette with hydrochloric acid solution (HCl).
4. Transfer a 5.00 mL volume of the sodium carbonate solution (Na2CO3) (0.1N) by the pipette to a conical flask. indicator solution. Note the color of the solution (solution I).
5. Titration (solution I) by adding hydrochloric acid solution (HCl) from the burette in about 1.00 mL portions to the conical flask, swirling the conical flask (Figure 3) after each addition. The end-point of the titration is reached when the color of the solution in the conical flask changes.
6. Note the burette reading (Figure 4) and calculate how much hydrochloric acid solution (HCl) was used.
7. Repeat the titration for a more accurate reading. Repeat the titration until two readings agree within 0.10 mL. Calculate the normality of the hydrochloric acid solution (HCl).


Standard solution
Pipette
(a)
Initial volume reading
Burette
acid solution
Standard solution
(b)
Final volume reading
Neutralized solution (indicator has changed color)
(c)

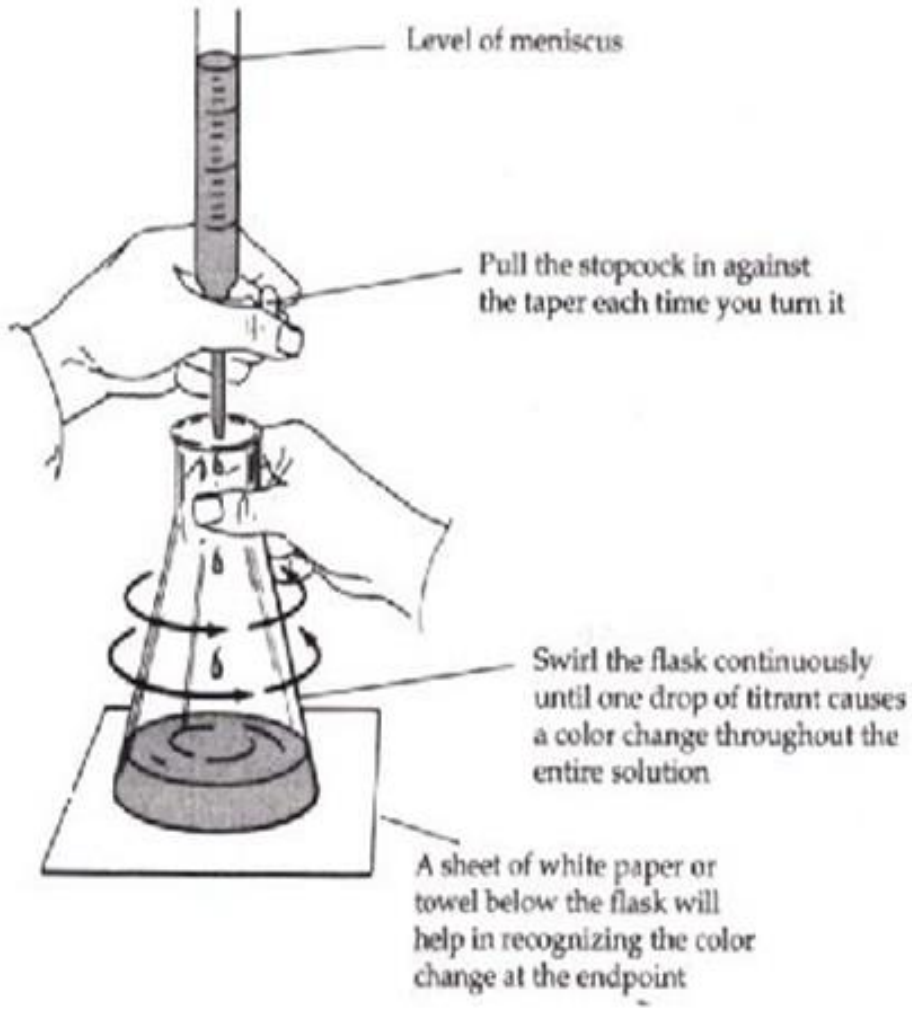


Figure (3)

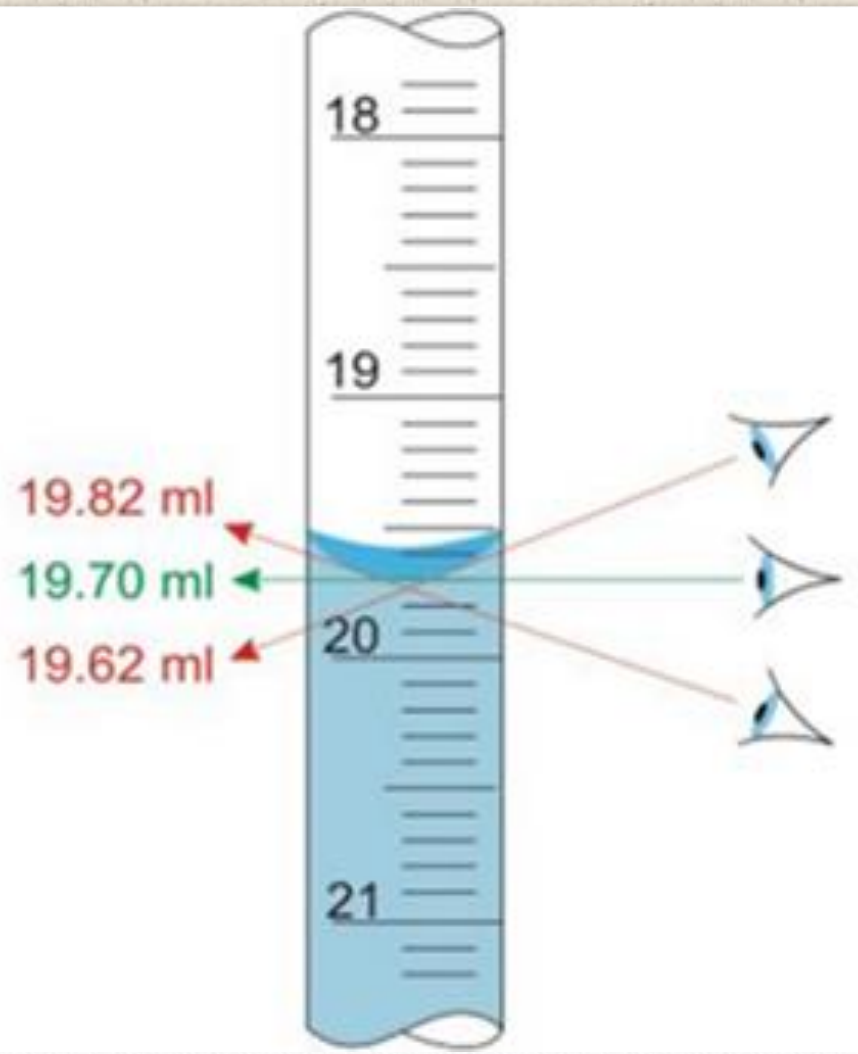


Figure (4)

Calculations

$$N_{1\ acid} \times V_{1\ acid} = N_{2\ base} \times V_{2\ base}$$

(HCl) (Na_2CO_3)

Questions:

Explain briefly:

1. A conical flask, rather than a beaker, used in the experiment?
2. Explain hydrochloric acid is not used as a primary standard?
3. What is the purpose of carrying out the titration more than once?
4. Why it is not important to add a large amount of indicator?