Lab: Titration

SNC2DE_09-10

Introduction

Reactions in solution are used for analysis as well as synthesis.
Titration is an important method, (a volumetric technique), used for determining the amount of a substance present in solution.
One solution is used to analyze another.

A **burette** is a device that can deliver precise volumes of solution. The initial volume reading on the **burette** is taken. Burettes can be read to ± 0.02 mL.

A solution of known concentration is called a **standard solution**.

The purpose of a titration is usually to standardize a solution, i.e. to determine the concentration of an acid or a base.

The standard solution is usually added from a burette to the solution being analyzed in the **Erlenmeyer flask**, until the two reactants have been combined in the stoichiometric ratio, which is the ratio given by the chemical equation.

This point is called the **equivalence point**. The equivalence point is when stoichiometrically equivalent amounts of an acid and base required by the equation for the neutralization reaction have been combined. In order to determine these, the equivalence point of the titration must be determined.

Titrant is the solution being slowly added from a burette to a solution in the Erlenmeyer flask.

A few drops of an appropriate **indicator** are added to the Erlenmeyer flask. The point at which the indicator changes colour is called the **end point**.
A substance whose change in colour shows that the end point has been reached is called an **indicator.**
The indicator is chosen so that the end point takes place as near the equivalence point as possible.

The final volume reading on the **burette** is taken. The two volume readings, the initial and final are used to calculate the total volume of the unknown solution that had been added.

Purpose:

To perform a titration of a strong acid and a strong base, also to determine the types of products made when solutions of acids and bases are combined.

Apparatus

2 burettes with stand (Titration apparatus), Erlenmeyer flask, small beaker, hot plate, safety goggles,

Materials

0.10 M hydrochloric acid, 0.10 M sodium hydroxide solution, phenolphthalein solution as indicator

Procedure

1. Using the burette apparatus add exactly 10.00 mL of hydrochloric acid into an Erlenmeyer flask from the burette. Record the volume of the acid in the Data Collection Table.

2. Add 2 drops of phenolphthalein solution. Swirl the flask. Record the colour of the solution in the Data Table.

3. Record the initial volume of the sodium hydroxide in the second burette in the Data Table.
4. Slowly add the sodium hydroxide solution, drop-wise from the second burette whilst swirling until the colour of the solution **just** turns faint pink for 15 seconds, (persistent faint pink).

5. Record the final volume of sodium hydroxide that was added to make this colour change, also in the Data Table. Keep the Erlenmeyer flask and its contents for later use.

6. Repeat steps 1 — 5, two more times.

7. Set up the heating apparatus as instructed. Place the contents of **1** of the titration into a small beaker and place this on a hot plate.

8. Evaporate the solution close to dryness and then remove from heat. **Do not let the contents of the beaker completely dry out.**

9. Record your observations about the material left in the beaker in the Data Table.

10. When the flask and its contents have cooled sufficiently, dissolve the solid in ~ 5 — 10 mL of water and add a few drops of bromothymol blue indicator. Record your results in the Data Table.

Data Processing and Presentation

1. Prepare suitable Data Collection Tables.
2. Name the products formed when solutions of hydrochloric acid and sodium hydroxide are combined.
3. Write a balanced chemical equation for the reaction of hydrochloric acid and sodium hydroxide.
4. Name the ions present in the hydrochloric acid and sodium hydroxide.
5. Why would this reaction be called a neutralization reaction? (Think of the answer to #2 above.)
6. Explain the role of phenolphthalein in this experiment.
7. What was the role of swirling in this experiment? Use the KMT in your explanation.
8. Why do we stop adding base when the colour of the solution **just** changes?
9. The neutralised solution was evaporated, name the product formed.
10. What is the pH of the solution when the colour of the indicator changes. (Justify your answer, considering the solution that was formed from the product of the evaporation and the addition of bromothymol indicator to this evaporated solution.)
11. Predict how many mL of sodium hydroxide would be needed to obtain the same results with the 5mL of sulfuric acid? Defend your ideas using balanced chemical equations.
12. Hydrochloric acid and sodium hydroxide are electrolytes.

a. State what is meant by the word electrolyte.
b. Explain the difference between weak and strong electrolyte.
c. How would you demonstrate, explain the experiment you would perform and the expected result, to determine whether hydrochloric acid and sodium hydroxide were strong electrolytes or weak electrolytes.