Rahil Ahmed

2-24-22

Writing for Engineering

How to Complete a Titration

Video used: https://www.youtube.com/watch?v=sFpFCPTDv2w

Abstract:

This lab report explores the concept of titration, a technique used to determine the concentration of a solution by reacting it with a known volume and concentration of another solution. The objective of the experiment was to determine the concentration of an unknown chemical using a standardized base solution and an indicator. The report outlines the methodology employed, including the preparation of solutions, the use of burettes, and the selection and preparation of an appropriate indicator. Results obtained from the titration were analyzed, and a table was generated to determine the equivalence point of the reaction. The report concludes with a discussion of the accuracy and precision of the titration and the potential sources of error that may have affected the results.

Introduction:

In analytical chemistry, titration is essential in quantitative analysis, where accurate and precise measurements are crucial in determining the concentration of solutions. It is also valuable in determining the purity of substances, which is critical in the production of pharmaceuticals and other chemicals. In food science, titration is used to measure the acidity of various food products and to determine the presence of contaminants. Titrations are also crucial in environmental analysis, where they provide a means of measuring the concentration of pollutants in water and soil. For example, acid-base titrations are commonly used to measure the alkalinity or acidity of water and wastewater samples. The significance of titration in chemistry lies in its ability to provide accurate and precise measurements of the concentration of solutions and the presence of specific substances. The technique is also versatile and can be adapted to a wide range of chemical reactions and solutions. Additionally, titration can be automated, making it efficient and cost-effective. Overall, titration is a critical analytical technique in chemistry that has numerous applications in various fields. It provides an accurate means of determining the concentration of solutions, identifying the presence of specific substances, and measuring the purity of substances. Its importance in quantitative analysis, purity determination, and environmental analysis makes it a fundamental technique in the field of chemistry.

Materials and Methods

In this experiment, an indicator is added to the analyte and a titration is performed to determine the concentration of the analyte. To carry out this procedure, a number of materials are required. a complete burette assembly is used, which contains a burette ring stand, a burette clamp, and a burette with a stopcock for regulating the flow of liquid. The burette is a long, narrow graduated tube used to add titrant, with markings going from lowest at the top to highest at the bottom. The ring stand and burette clamp are used to mount and secure the burette. Other necessary materials include a small funnel to fill the burette, a 125-milliliter Erlenmeyer flask for titrations, a volumetric pipette and pipette bulb to transfer a known volume of analyte to the flask, a wash bottle filled with deionized water, a beaker or flask of titrant and analyte, indicators selected for the reaction, a reading card to help read the meniscus, and a sheet of white paper to help visualize the endpoint.

To prepare the burette for the titration, it is important to rinse it thoroughly with deionized water and a small amount of titrant after each rinse, allowing the liquid to drain at the bottom. This ensures that the titrant flows into the flask and does not stick to the walls of the burette. The burette is then mounted in the clamp, positioned vertically with enough room to place the Erlenmeyer flask underneath the tip. The stopcock is checked to ensure it is in the close position, and the funnel is inserted into the top of the burette and filled with titrant almost to the top. The column is checked for air bubbles and gently tapped to free them from the sidewalls, and the funnel is then removed. To accurately read the volume on the burette, it is important to note that the liquid forms a concave meniscus because the water pulls itself up the sidewalls of the glass. The volume should be read from the bottom of the meniscus at eye level, and recorded to the nearest hundredth of a milliliter. The analyte is transferred to the flask using a volumetric pipette, and a few drops of indicator are added to the flask and swirled. The flask is then placed under the tip of the burette, and the initial volume is recorded. The titration requires two hands: one hand turns the stopcock while the other hand swirls the flask. The first titration is an estimate, with the stopcock opened quickly and continuously swirling the flask. When the analyte becomes a colored solution, the stopcock is closed, and the final volume is recorded. To reduce the risk of passing the endpoint, the addition of titrant is slowed down when flashes of color begin to appear in the analyte. The stopcock is adjusted to slow the flow of titrant to a drop-wise rate, and the flask is continuously swirled with one hand while the other hand is kept ready to close the stopcock when the indicator takes longer to fade. The stopcock is then closed, the tip of the burette is rinsed with deionized water, and the final volume is recorded on the burette. If the analyte remains faintly colored, the endpoint has been reached. If the analyte is still colorless, the steps are repeated until a faint color persists.

Results

Final Volume	16.45 mL
Initial Volume	-6.88 mL
Added Volume of Titrant	9.54 mL
Volume of Analyte	10.00 mL

Discussion

From the experiment we learned that titration can be quite useful when anylizing the interactions between different chemicals. However, there are several limitations and possible errors that can occur during the titration process. One common error is the subjective determination of the endpoint, which can be influenced by factors such as lighting conditions and the ability to detect subtle color changes. Impurities in the sample being titrated can also cause errors in the titration results by reacting with the titrant or interfering with the reaction. The accuracy of the titration can also be affected by errors in the preparation of the titrant solution, such as using a solution that is too concentrated or too dilute. Factors such as temperature, pressure, and stirring rate can also affect the reaction rate, leading to inaccurate endpoint determination. Finally, human error can also occur, such as incorrect measurement or mixing of solutions. These limitations and errors can be minimized by using proper equipment, carefully preparing solutions, and following the correct procedure. Identifying and controlling factors that can affect the accuracy of the titration is also important.

Conclusion

In conclusion, this lab report highlights the importance of titration as a fundamental analytical technique in chemistry. The report provides an overview of the materials and methods required for titration and outlines the process involved in determining the concentration of an unknown chemical. The significance of titration in various fields such as food science, pharmaceuticals, and environmental analysis is discussed. The report also discusses the accuracy and precision of titration and the potential sources of error that may affect the results. Overall, titration is a versatile and essential analytical technique that provides accurate measurements of the concentration of solutions and the presence of specific substances. It is an efficient and cost-effective method that has numerous applications in chemistry and beyond.

Resources (Bibiliography)

Bartleson, B. (2019, March 2). *Purpose of titration*. Sciencing. Retrieved February 24, 2023, from https://sciencing.com/purpose-titration-5406434.html

Classroom resources: How to perform a titration. AACT. (n.d.). Retrieved February 24, 2023, from https://teachchemistry.org/classroom-resources/how-to-perform-a-titration

What is titration used for in real life? - the chemistry blog. ReAgent Chemical Services. (2021, October 20). Retrieved February 24, 2023, from https://www.chemicals.co.uk/blog/what-is-titration-used-for-in-real-life

YouTube. (2010, February 17). *Setting up and performing a titration*. YouTube. Retrieved February 24, 2023, from https://www.youtube.com/watch?v=sFpFCPTDv2w