

TITLE: DETERMINING THE MEASUREMENT OF VOLUME AND UNCERTAINTY

SCHOOL OF MEDICINE AND HEALTH SCIENCES

DEPARTMENT OF BASIC SCIENCES

COURSE NAME: CHEMISTRY

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**AIM**

The aim of this experiment was to explore the principle of measurement of Volume and Uncertainty. The experiment involved taking measurement of volume using a burette and pipette. The use of these apparatus was to decide which piece of apparatus is more precise and also determine the precision of the measurements. The experiment plays a big role in highlighting the significance of Precision and Accuracy.

Furthermore the experiment was carefully analyzed and sources of uncertainty were identified and strategies were developed to enhance precision in volume measurement. The findings contributed to valuable insights into minimizing errors, ultimately improving the reliability of the experimental data. This experiment was also done in order to assess accuracy by determining how close the measured values matched the true or expected values. Determining the uncertainty associated with measurements, taking into account both random and systematic errors. Understanding uncertainty is important for conveying the reliability of the results. Lastly by conducting precision and accuracy experiments, Chemists ensure that measurements are reliable and close to the true value as possible.

**INTRODUCTION**

Uncertainty is based on how well measurements can be read considering the avoidable measurement errors that are usually random. The experiment was aimed to explore the fundamental concepts of measurements that are crucial in scientific experiments, impacting the reliability of results. Understanding the sources of uncertainty particularly in volume measurements.

Further, precision and accuracy were both determined. Precision is defined as the closeness of two or more measurements to each other. Precise measurements are not near the correct value. Accuracy is the accepted value of the quantity being measured. The accuracy in measurements depends on the limit or the resolution of the measuring instrument.

As mentioned earlier, the volume of a pipette and burette were recorded in a table. The table shows and indicates the results, the findings were crucial in understanding the concept uncertainty. This report also indicates the different sources of errors that were encountered during the experiment as well as ways in which they could possibly be involved. The calculations of the burette and pipette were compared, the measured volumes were calibrated ensuring that the instruments were functioning within specified limits.

**MATERIALS AND METHODS**

The Materials that were used in the experiment are as follows;

50cm3 Burette

5cm3 Pipette

10cm3 Measuring Cylinder

Polythene Wash Bottle

Retort Stand and Clamp

White Paper

Plastic Droppers

**METHODS**

The experiment was aimed to investigate the measurement of volume and uncertainty. To start with the experiment the burette was clamped and it was filled with water between 24.00 and 25.00cm3 mark using a polyethene wash bottle. The initial volume and recorded as 24.4cm3 then 5.0cm3 of water was added to the initial volume using a measuring cylinder. The new volume was recorded as 19.40cm3. The burette tap was opened and drained of water so that the level was between 24.00 and 25.00cm3. 5cm3 of water from the measuring cylinder was then added to the burette to record the new reading. The follow up experiment went about to determine the uncertainty of the pipette in terms of measuring volume. The burette still in the region of 24.00cm3 and 25.00cm3.

By varying the initial volume between 24.00cm3 and 25cm3, the pipette was used to add 5cm3 of water into the burette. This was repeated a couple of times with different initial volumes in the burette whilst extracting 5cm3 of water into the pipette was kept constant.

**RESULTS**

Determining the Uncertainty of a Measuring Cylinder

|  |  |  |  |
| --- | --- | --- | --- |
| USING A BURETTE | FIRST BURETTE READING (cm3) | SECOND BURETTE READING (cm3) | DIFFERENCE (Volume of water |
| 1 | 24.4 | 19.40 | 5.0 |
| 2 | 24.7 | 19.10 | 5.60 |
| 3 | 24.9 | 19.50 | 5.40 |
| 4 | 24.5 | 19.10 | 5.40 |
| AVERAGE MEAN |  |  | =5.35 |

Average Mean was calculated by using values in the ‘Difference’ table as follows;

Average mean= 5.0+5.60+5.40+5.40/4

=214/4

Giving us an average mean of 5.35

|  |  |  |  |
| --- | --- | --- | --- |
| USING A PIPETTE | FIRST PIPETTE READING(cm3) | SECOND PIPETTE READING(cm3) | DIFFERENCE (Volume of water added) |
| 1 | 24.7 | 19.90 | 4.80 |
| 2 | 24.4 | 19.50 | 4.90 |
| 3 | 24.3 | 19.30 | 5.0 |
| 4 | 24.5 | 19.60 | 4.90 |
| AVERAGE MEAN |  |  | =4.90 |

Average mean was calculated in much the same way as the previous table.

Average mean= Values in the Difference Table/Number of trials

=4.80+4.9+5.0+4.90/4

=19/4

Average mean = 4.90

**DISCUSSION/CONCLUSION**

In this section the results were analyzed and determined from our study on volume and uncertainty. The investigation revealed various sources of uncertainty, including instrument limitations, human errors and environmental factors. It was evident that precise volume measurements were essential for accurate experimental outcomes. By identifying and addressing these uncertainties, we aimed to improve of our data that was recorded. Consistent results were obtained with both the burette and pipette because the instruments provided similar results. Accuracy was assessed in the measured values closely matched to the true values. Some errors were identified; the readings were not correctly taken and so a correction was applied. A white sheet of paper was placed behind the measuring instrument and the values were recorded.

However at the beginning at the beginning of the experiment the instrument was able to produce similar measurements even after the measurements required multiple trials. The precision and accuracy were maintained even though different conditions. Some errors were identified that affected the final measurements, such as the parallax error which occurs when the observers eye is not directly aligned with the measurement scale. This caused errors in the final measurements.

To improve accuracy use proper techniques, ensure instrument calibration and minimize potential sources of errors. Overall the Discussion emphasized on the importance of acknowledging and managing uncertainties in volume measurements. And also enhancing the credibility and applicability of the findings.

**Discussion Questions**

* Sources of Uncertainty or limitations of the procedure of this experiment
* Firstly, the parallax error which could arise if the reader does not correctly place their eyes on the measurement scale.
* Secondly, the right angle may not have been at a right angle due to human error.
* Thirdly, systematic errors could arise from the use of faulty instruments during the experiment.
* Lastly, uncertainties in the experiment could arise from measurement error which lead to wrong readings.

**IMPROVEMENTS TO THE EXPERIMENT**

The experiment could be repeated multiple times to ensure that the readings are consistent.

Ensuring that the stand is always clamped can also help improve results.

The angle should always be 90degrees to the observers eye to improve accuracy in the results.

**References**

Author, Brian Ratcliff, A Level Practical Chemistry Students’Guide & Teachers’Guide (0-521-37899-0 & 0-521-38696-9), Cambridge 1990