– **Table of Contents**

– CONTENTS

Calibration of volumetric glassware

Calibrating volumetric glassware for further experiments

Dishant Tanmay (23110100), Faayza Vora (23110109), Goraksh Bendale (23110118), Haravath Saroja (23110127), Hriday Pandya (23110136)

I. Introduction

In this experiment, our aim is to calibrate the volumetric glassware which is a pipette, graduated pipette, test tube, measuring cylinder and volumetric flask.

This glassware is regularly used for gravimetric and titrimetric analyses. Any kind of error due to these instruments is further propagated. Such errors are called systematic errors. In order to minimize such errors, the instruments are calibrated so that the calculations can be done accordingly and such errors are avoided.

This is done by using water and measuring the weights of both filled and empty containers, subtracting them to get the mass of the water and then this mass, along with the given density of water $(0.997\ g/mL)$, is used to find the volume of the water.

II. Experimental details

A. Apparatus

1) Beaker (50ml)
2) Volumetric Flask (100ml)
3) Measuring Cylinder (10ml)
4) Burette (10ml)
5) Standard Pipette (10ml)
6) Test Tube (Volume Unknown)
7) Wash bottle with water
8) Weighing machine
9) Hand-held Vacuum Pump

B. Materials

1) Distilled Water
2) Gloves and Glasses for safety

C. Procedure

1) Subsection Volumetric Pipette and Graduated Pipette Calibration:

a. Rinse the pipette thoroughly before beginning the experiment.
b. Weigh the empty beaker on a precision balance and record the measurement.
c. Insert the pipette into the water container.
d. Use a rubber suction bulb to draw water above the mark for volumetric pipettes or inside the pipette for graduated pipettes.
e. Remove the bulb and place a finger over the end of the pipette.
f. Withdraw the pipette and wipe off any excess water with tissue paper.
g. Adjust the water level until the lower meniscus aligns with the marked line.
h. Transfer the water from the pipette to the beaker and record the weight of the beaker with the water.
i. Repeat the process for graduated pipettes, ensuring to transfer the water up to the specified mark.
j. Weigh the beaker again and note down the readings. 11. Repeat the procedure thrice, ensuring complete drying between each repetition.

2) Subsection Volumetric Flask and Measuring Cylinder Calibration:

a. Rinse the volumetric flask and measuring cylinder before starting the experiment.
b. Weigh the empty volumetric flask and measuring cylinder using a precision balance and record the measurements.
c. Fill the volumetric flask and measuring cylinder with distilled water up to the marked line.
d. Record the new weight of the water-filled apparatus.
e. Repeat the process twice more, ensuring complete drying between each repetition.
f. Record all measurements accurately.

3) Subsection Volume Calculation:

a. To calculate the original volume, subtract the weight of the empty apparatus from the weight of the water-filled apparatus.
b. Divide this difference by the density of water to obtain the volume.

III. RESULTS

A. Methods for calculation:

The values that we know beforehand:

- Measure the weight of the dry instrument $= W_1$
- Measure the weight of the instrument filled with water $= W_2$
- Indicated volume of water on the instrument $= V_{indicated}$
- Density of water $= 0.997$ g/ml

We calculate the actual Volume of water using the given formula:

$$V_{actual} = \frac{W_2 - W_1}{0.997}$$

After taking the average of 3 lab readings, we obtain an average value of V_{actual} The percentage deviation from $V_{indicated}$ is given by:

$$\text{Percent Deviation} = \frac{|V_{indicated} - V_{actual}|}{V_{indicated}} \times 100$$

Standard deviation for unknown value of Test Tube is given by:

$$\sigma = \sqrt{\frac{\Sigma(\bar{V} - V_i)^2}{n}}$$

where i = 1, 2, 3 and n = 3

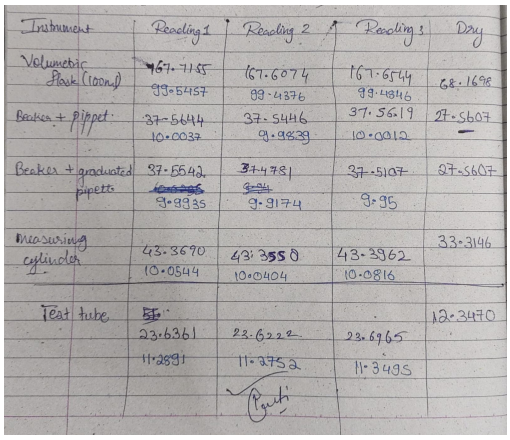
For Volumetric Flask Weight of Dry Volumetric Flask = 68.1698 g	Reading 1	Reading 2	Reading 3	**Average Volume of Water (in mL)**	**% Deviation from expected value**
With Water	167.7155	167.6074	167.6544	99.788	0.211
Only Water	99.5457	99.4376	99.4846		
Volume of Water (in mL)	99.8452	99.7368	99.7839		
For Pipette Weight of Dry Beaker = 27.5607 g	Reading 1	Reading 2	Reading 3	**Average Volume of Water (in mL)**	**% Deviation from expected value**
With Water (g)	37.5644	37.5446	37.5619	10.026	0.03
Only Water (g)	10.0037	9.9839	10.0012		
Volume of Water (in mL)	10.0338	10.0139	10.0312		
For Graduated Pipette Weight of Dry Beaker = 27.5607 g	Reading 1	Reading 2	Reading 3	**Average Volume of Water (in mL)**	**% Deviation from expected value**
With Water (g)	37.5542	37.4781	37.5107	9.984	0.016
Only Water (g)	9.9935	9.9174	9.9500		
Volume of Water (in mL)	10.0236	9.9472	9.9800		
For Measuring Cylinder Weight of Dry Beaker = 33.3146 g	Reading 1	Reading 2	Reading 3	**Average Volume of Water (in mL)**	**% Deviation from expected value**
With Water (g)	43.369	43.355	43.3962	10.089	0.09
Only Water (g)	10.0544	10.0404	10.0816		
Volume of Water (in mL)	10.0846	10.0706	10.1119		
For Test Tube Weight of Dry Test Tube = 12.3470 g	Reading 1	Reading 2	Reading 3	**Average Volume of Water (in mL)**	**Standard Deviation** (σ)
With Water (g)	23.6361	23.6222	23.6965	11.339	0.032
Only Water (g)	11.2891	11.2752	11.3495		
Volume of Water (in mL)	11.3231	11.3091	11.3836		

TABLE I
OBSERVATIONS AND RESULTS

IV. Conclusion

1) This experiment gave the idea of the importance of measuring the right volume. Firstly, we calibrated the given glassware. Next, we calculated the volume of water by using the relation between density, mass, and volume, with the help of a given density at room temperature. After the calculation of the mean volume obtained was 99.788 mL, 10.026 mL, 9.983 mL, 10.089 mL and 11.338 mL for volumetric flask, pipette, graduated pipette, measuring cylinder and test tube respectively. The deviation observed is 0.211%, 0.030%, 0.016%, 0.090% and 0.032 mL respectively
2) The experiment used the following measuring instruments: A volumetric flask (100ml), a Measuring cylinder, a Graduated pipette, a Test tube. The results showed that these instruments have a small error.

V. Reading images



Instrument	Reading 1	Reading 2	Reading 3	Dry
Volumetric Flask (100ml)	167.7155 99.5457	167.6074 99.4376	167.6544 99.4846	68.1698
Beaker + pippet	37.5644 10.0037	37.5446 9.9839	37.5619 10.0012	27.5607
Beaker + graduated pipette	37.5542 9.9935	37.4781 9.9174	37.5107 9.95	27.5607
Measuring cylinder	43.3690 10.0544	43.3550 10.0404	43.3962 10.0816	33.3146
Test tube	23.6361 11.2891	23.6222 11.2752	23.6765 11.3295	12.3470

VI. Author Contributions

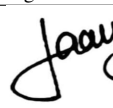
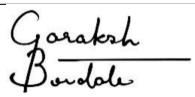
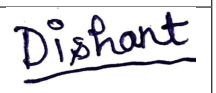
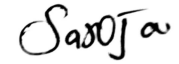
Name	Roll number	Contribution	Signature
Faayza Vora	23110109	Introduction, Compilation, Handling of Volumetric flask and test tube	
Goraksh Bendale	23110118	Calculation, Error calculation, Compilation, Handling of Measuring Cylinder and pipet and Taking weights	
Dishant Tanmay	23110100	Procedure and Taking weights	
Hriday Pandya	23110136	Results tabulation, Handling of graduated pipet and pipet and Taking weights	
Haravath Saroja	23110127	Conclusion	
Praneet Khairnar	23110166	Apparatus used	

TABLE II
Author's Contribution