OBJECTIVE:

To calibrate glassware such as burette, pipette, volumetric flask, beaker, and measuring cylinder and list possible errors that could occur in an experiment.

LEARNING OUTCOMES

After conducting this experiment, you should be able to:
1. State the reasons why laboratory equipments must be calibrated prior to use;
2. Calibrate glassware's; e.g. burette, pipette and volumetric flasks; and
3. List the possible errors that could occur in an experiment.

INTRODUCTION:

Chemists use a variety of glassware to measure the volume of chemicals. The specific type of glassware used in any situation depends on how accurately or precisely the volume needs to be known. An error is a bound on the precision and accuracy of the result of a measurement.

These can be classified into two types: **random error** and **systematic error**. Random error is caused uncertainty and carelessness in the measurement apparatus, where as systematic errors is occur when the equipments used are imperfect or faulty and were not calibrated before use. These errors could be minimized by checking and calibrating the equipments prior to use.

Glassware is used for a wide variety of functions which include volumetric measuring, storing chemicals or samples, mixing or preparing solutions or other mixtures. For the **burette**, **pipette** and **volumetric flask** are made to determine specific volume of a solution at a specific temperature. Therefore, it is important to determine the type of glassware that will be used and calibrate it. Meanwhile, there are types of glassware are used for the approximate measurement of volume likes **reagent bottles**, **beakers**, **conical flasks**, and **graduated cylinders**. Normally they are used to prepare solutions with an approximate concentration.

There are three general methods commonly employed to calibrate glassware. These are as follows: **Direct calibration:** A volume of water delivered by a burette or pipette, or contained in a volumetric flask, is obtained directly from the weight of the water and its density (refer to Table 1.1). **Indirect calibration:** Volumetric glassware can be calibrated by comparison of the mass of water it contains or delivers at a particular temperature with that of another vessel which had been calibrated directly. The volumes are directly related to the masses of water. This method is convenient if many pieces of glassware are to be calibrated. **Relative calibration:** It is often necessary to know only the volumetric relationship between two items of glassware without knowing the absolute volume of either.

This experiment will acquaint you with the precision, accuracy, and tolerance of measurements made using a beaker with calibration marks, a graduated cylinder, a burette, and a pipette. The objective of this experiment is to determine the accuracy and precision of your volumetric glassware, so that you can chose the proper instrument for our next analytical experiments

Table 1.1: Density of Water at Various Temperatures

Temperature, (°C)	Density, (g/mL)	Temperature, (°C)	Density, (g/mL)
23	0.9966	28	0.9955
24	0.9964	29	0.9952
25	0.9962	30	0.9949
26	0.9959	32	0.9944
27	0.9957	33	0.9941

LAB EQUIPMENT

100 mL volumetric flask
50 mL burette
20 mL pipette
150 mL beaker
100 mL beaker
100 mL measuring cylinder
analytical balance
funnel
dropper
wash bottle

CHEMICALS AND MATERIALS

Distilled water

EXPERIMENTAL PROCEDURE

Part A: Calibrate Burette

1. Wash, clean and dry 100 mL beaker (label A), and record its weight.
2. Clean the burette with distilled water.
3. By using funnel (avoid spilling) to pour the distilled water into the burette to a point the mark for 0.00 volume; (make sure the portion of the burette below the stopcock is filled or without any air bubbles).
4. Transfer 50 mL water from burette into beaker (label A).
5. Repeat step 3 and 4, by adding distilled water into beaker (label A) from burette until the volume reaches 100 mL.
6. Record the weight of water and beaker for 100 mL volume. Calculate the density of water (in g/mL).
7. Compare value of density was measured with standard density of water at ambient temperature.

$$density = \frac{mass}{volume} \qquad \text{(eq. 1.1)}$$

8. Compare this calculated density to its actually density (via temperature) using the percent error formula shown below:

$$\frac{|\ Theoriticd - Experiment\ |}{Theoreticd}\ x \quad 100\% = \%Error \qquad \text{(eq. 1.2)}$$

Part B: Calibrate Pipette

1. Rinse, clean and dry the 100 mL beaker (label A) has been used, and records its weight.
2. Rinse the 20 mL pipette with distilled water.
3. Fill the pipette by using pipette bulb until the distilled water is reach pipettes level line
4. Transfer 20 mL water from pipette into beaker (label A). Withdraw the last drop of water by touching it to the glass surface for about 15 seconds.
5. Repeat step 3 and 4, by adding distilled water into beaker (label A) from pipette until the volume reaches 100 mL.
6. Record the weight of water and beaker for 100 mL volume. Calculate the density of water (in g/mL).
7. Compare value of density was measured with standard density of water at ambient temperature.

Part C: Calibrate Volumetric Flask

1. Rinse, clean and dry the 100 mL beaker (label A) has been used, and records its weight.
2. Rinse and clean the 100 mL volumetric flask with distilled water.
3. Pour the distilled water into the volumetric flask until approximately ½ from the marked level by using a funnel.
4. Use a clean dropper to add the water until it reaches the required level. Position your eyes parallel to the meniscus level.
5. Transfer 100 mL water from volumetric flask into beaker (label A).
6. Record the weight of water and beaker for 100 mL volume. Calculate the density of water (in g/mL).
7. Compare value of density was measured with standard density of water at ambient temperature.

Part D: Calibrate Measuring Cylinder

1. Rinse, clean and dry the 100 mL beaker (label A) has been used, and records its weight.
2. Rinse and clean the 100 mL measuring cylinder with distilled water.
3. Pour the distilled water into the measuring cylinder until it reaches the 100 mL level. Position your eyes parallel to the meniscus level.
4. Transfer 100 mL water from measuring cylinder into beaker (label A).
5. Record the weight of water and beaker for 100 mL volume. Calculate the density of water (in g/mL).
6. Compare value of density was measured with standard density of water at ambient temperature.

Part E: Calibrate Beaker

1. Rinse, clean and dry the 100 mL beaker (label A) has been used, and records its weight.
2. Rinse and clean the 150 mL beaker with distilled water.
3. Pour the distilled water into the beaker until it reaches the 100 mL level. Position your eyes parallel to the meniscus level.
4. Transfer 100 mL water from measuring cylinder into beaker (label A).
5. Record the weight of water and beaker for 100 mL volume. Calculate the density of water (in g/mL).
6. Compare value of density was measured with standard density of water at ambient temperature.