CALIBRATION OF A PIPET

Introduction:

Whenever a measurement is made in the chemistry laboratory, some uncertainty exists. It is desirable to keep this uncertainty as small as possible and obtain measurements that are both precise and accurate. Precision in the laboratory implies that when a series of measurements are taken that they will be close in value to each other. When measurements of an object are accurate, they are close to the true value of that object. Ideally, our laboratory glassware and instruments will always be both accurate and as precise as possible.

In this experiment, you will determine the accuracy of a pipet. Pipets are commonly used in the laboratory to quickly measure or transfer small amounts of liquids. Many pipets are labeled with the uncertainty of the pipet. The true volume of the pipet will be determined indirectly from the mass of a sample of distilled water and the known density of the water. Using the equation, $D = M/V$, the volume of the pipet may be found from the other two variables. An analytical balance and a list of densities of water at given temperatures will allow you to determine the volume to four significant digits. This procedure will be repeated to give some indication of the precision of your measurements. Once the volume of the pipet has been determined, the pipet will be used to measure the density of an unknown liquid.

Purpose:

The purpose of this experiment is to calibrate a pipet and to use this pipet to determine the density of an unknown liquid.

Equipment/Materials:

pipet	pipet bulb
analytical balance	Kimwipes
vial, small beaker, or flask	unknown liquid

Safety:

- An apron and goggles should always be worn in the lab
- Never draw liquid into a pipet by mouth. Use a pipet bulb.
- The balances are delicate instruments and should be treated with care.

Procedure:

1. It is necessary to determine the true volume of the pipet you will use in this experiment. To calibrate your pipet, weigh a small, clean flask or beaker as accurately as possible. Handle the container with a Kimwipe to avoid contaminating it with oil or moisture from your skin. Record the mass of the container on the data sheet.

2. Carefully fill the pipet, adjust the water to the line, and transfer the contents to the container. Make sure you know whether the last bit of water should be removed from the pipet. Weigh the container and the water. Record the value in the data table.

3. Repeat the procedure two more times.

4. Since the density of water varies with temperature, measure the temperature of the water that you used. Refer to the following table to find the density of the water. Record the value in the data table.

Temp. °C	Density g/mL	Temp. °C	Density g/mL
18	0.9986	22	0.9978
19	0.9984	23	0.9976
20	0.9982	24	0.9973
21	0.9980	25	0.9971

5. Using the mass of water in the sample and the density of the sample, calculate the volume of the sample and thus the volume of the pipet.

6. Select an unknown liquid and record its number or letter on your data sheet.

7. Weigh a clean, dry container as you did earlier in the experiment. Record the value in the data table.

8. A common technique to remove traces of a liquid from a container is to rinse the container several times with the new liquid that will be used. Draw several portions of the unknown into the pipet, rinse, and discard.

9. Fill the pipet to the line, and transfer the liquid to the pre-weighed container. Record the mass of the container and liquid in the data table.

10. Repeat the procedure two more times. Discard the unknown liquid as directed by your instructor.

11. Using the calculated volume of the pipet (from Step 5) and the mass of the unknown sample, determine the density of the unknown.

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Data:

Calibration of the Pipet

	Trial 1	Trial 2	Trial 3
Mass of container & water			
Mass of empty container			
Mass of water			
Temp. of water			
Volume of water			
True volume of pipet			

Average value for volume of pipet _____

(Use this value for future calculations)

Density of Unknown Liquid

	Trial 1	Trial 2	Trial 3
Mass of container & unknown			
Mass of empty container			
Mass of unknown			
Volume of pipet			
Density			

Unknown Number _____

Average value for density _____

Questions:

1. Sammy Erhead applied for a job last summer in the quality control lab of the Acme Pill Company. The job was to determine the amount of aspirin in aspirin tablets. He was given twelve samples of known aspirin content (325 mg) to analyze during his training session. He completed four sets of trials with three samples in each trial. Which sets had results that were:
    a. precise and accurate?
    b. precise but not accurate?
    c. not precise but accurate?
    d. neither precise nor accurate?

Set A	Set B	Set C	Set D
325 mg	300 mg	400 mg	250 mg
325 mg	325 mg	400 mg	280 mg
325 mg	350 mg	400 mg	350 mg

PS - Sammy spent the remainder of the summer sweeping floors at the factory. Good technique is important!

2. A student completes this experiment using a dirty pipet. He does not notice that several drops of liquid remain in the pipet each time it is used. How would this affect the determination of the volume of the pipet?

3. How would this experiment be affected if the balance gives masses that are 20 mg higher than the true masses every time it is used?

4. What are some things that could have been done to increase the accuracy and precision of your determination of the volume of the pipet?