Basic Skills for Chemistry
CHEM-1020
Experiment No. 2
Use of Laboratory Equipment

Introduction

In the chemistry laboratory, various kinds of equipment are used to measure length, mass and volume. In this experiment, you will use two mechanical balances and one electronic balance to measure the mass of a metal slug and to weigh out a specific amount of a solid chemical. You will use graduated cylinders for measuring liquid volumes. In a previous experiment, you examined many analog instruments and learned how to read them properly. Experiment No. 2 is designed to reinforce and test that knowledge.

Measurement of Length:

The volume of a regular solid will be calculated by measuring its dimensions and inserting them into the appropriate volume formula.

Measurement of Mass:

Single, clean objects may be weighed on a laboratory balance by placing them directly on the balance pan. Prior to weighing an object without a container, the balance must be zeroed with the zeroing screw adjustment to make the balance read zero grams when there is no mass in the pan.

Chemicals, liquids and granular substances are *never* weighed directly on a balance. To prevent contamination and damage to balances, chemicals are always weighed in suitable container such as a lightweight plastic weigh boat, test tube, small beaker or weighing bottle. On a mechanical balance, the mass of an empty container is determined in a preliminary "tare" step and subtracted from the total mass of container and chemical to get the mass of the chemical alone. When weighing an object or chemical in a container, the balance should not be zeroed in because any weighing error due to an incorrect zero point adjustment will be the same for both mass determinations and will cancel out in the subtraction.

Electronic balances allow you to bypass the subtraction step. Simply place a container on the pan of an electronic balance pan and press the *tare* button. This causes the balance to register the mass of the container as zero. The desired mass of the chemical added is then read directly from the display. A container that is too heavy may cause the displayed mass to lose a decimal place. If taring a heavy container changes the digital display from 0.001g to 0.01g, try the following: Remove the container, clear the balance, replace the container with one of lower mass and push the tare button again.

Measurement of Liquid Volume:

For the highest measuring precision, choose the smallest graduated cylinder that will contain all the liquid to be measured. After you determine how the appropriate graduated cylinder is to be read, pour in the liquid you wish to measure, place the cylinder on a level surface at eye level and read the volume from the bottom of the liquid meniscus.

Report:

You will be graded on the proper use of each instrument and on the accuracy of your measurements. Examine each instrument before you use it to determine the precision to which is properly read. Record all your measurements on the data sheet in black ink. Always express the units of each measurement, each reported result and each calculated result.

Experimental

1. Obtain a rectangular solid and record its number. With a centimeter ruler, measure and record its length, width and height.

2. Obtain a metal unknown mass slug. Record the slug number. You will use this same slug for all subsequent weighings in parts a), b) and c) of this experiment. Remove the slug from its container before you weigh it.

   a) Place a plastic weigh boat on a platform balance pan and record its mass. Place the metal slug in the weigh boat and determine the mass of the two objects together.

   b) Place a plastic weigh boat on a hanging pan balance pan and record its mass. Place the metal slug in the weigh boat and determine the mass of the two objects together.

   c) Place a 250 mL beaker on an electronic balance pan and press the "Tare" key to cause the balance to register zero mass for the beaker. Place the metal slug in the beaker and read the mass of the slug.

   d) Put several grams of table salt (NaCl) into a 100 mL beaker. Weigh a clean, *dry* medium size (15 cm) test tube on a hanging pan balance and record its mass. Move the 1 gram movable mass and the rider to a position exactly 1.500 g more than the empty test tube mass. Transfer salt from the beaker to the test tube until the balance beam is balanced again. Record the combined mass of the test tube and salt. Stopper the test tube with a cork that fits securely without slipping completely inside the test tube. Affix a label to the test tube with the words "Table Salt", your name, the course number and the mass of the mass. Turn the test tube in to your instructor for grading.

3. Measurement of Liquid Volume:

   a) Locate three pre-filled graduated cylinders in the laboratory, labeled A, B, and C. Each cylinder contains an amount of water known to your instructor. Examine the cylinder markings, determine how to read the cylinder and record the volume of water contained in each of the cylinders. If there is more than one cylinder with the same letter designation, read just one A, one B and one C cylinder. Be sure to include any other identifying information such as A1, C4, etc., on your data sheet and in your report.

   b) Obtain a bottle representing an unknown volume and record the bottle number. Fill the bottle to the very top with water and measure the volume of the water using a graduated cylinder of the appropriate size. Report your volume measurement and the size of graduate you used.

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Data Page

1. Measurement of Length

Rectangular Solid Number_____

Length_____ Width_____ Height_____

2. Measurement of Mass:

Unknown mass slug number: _____

a) Mass of plastic weight boat on the platform balance: _____

Mass of plastic weight boat and metal slug on the platform balance: _____

b) Mass of plastic weight boat on the hanging pan balance: _____

Mass of plastic weight boat and metal slug on the hanging pan balance: _____

c) Mass of the metal slug on electronic balance _____

d) Mass of empty test tube _____

Mass of test tube plus salt: _____

3. Measurement of Liquid Volumes:

a) Water Volumes in Pre-Filled Graduated Cylinders:

Graduated Cylinder A___: Cylinder Size: _____ Water Volume:_____

Graduated Cylinder B___: Cylinder Size: _____ Water Volume:_____

Graduated Cylinder C___: Cylinder Size: _____ Water Volume:_____

b) Volume of Unknown Bottle: _____

Bottle number: _____ Size of graduated cylinder used: _____

Volume of water contained by unknown bottle: _____

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Report Page

1. Measurement of Length

From your measurements of the rectangular block's length, width and height, calculate the block volume using the formula V = l x w h. Show your setup. Block Number: _____ (2 points)

2. Measurement of Mass: Unknown mass slug number: _____

a) Mass of plastic metal slug on the platform balance: _____ (2 points)

b) Mass of metal slug on the hanging pan balance: _____ (2 points)

c) Mass of the metal slug on electronic balance _____ (2 points)

d) Mass of salt sample handed in: _____ (2 points)

3 Measurement of Liquid Volume:

a) Water Volumes Read from Pre-filled Graduated Cylinders: (6 points)

Graduated Cylinder A___: Cylinder Size: _____ Water Volume:_____

Graduated Cylinder B___: Cylinder Size: _____ Water Volume:_____

Graduated Cylinder C___: Cylinder Size: _____ Water Volume:_____

b) Volume of Unknown Bottle: (2 points)

Bottle number: _____ Size of graduated cylinder used: _____

Volume of water contained by unknown bottle: _____

4. **Question:** Describe the complete process used to examine any analog instrument in order to determine to what precision it is to be read. (2 points)