Determination of Density: Measurements

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Experimental

You will be assigned a copper block; record the number of your block, and make all of your measurements on the same block.

Obtain the mass of the block to three decimal places using one of the top-loading balances located in the laboratory. It is **never** good lab practice of set a chemical directly on a balance pan. Therefore, place a piece of weighing paper or a plastic weigh boat on the pan. Zero the balance by pressing the tare button and then place the copper block on the weighing paper or in the weigh boat. Record the block's mass, making sure that all three decimal places are recorded, even if some, or all, of them are 0. If a balance is not displaying three decimal places, or if the number of decimal places changes when you put your block on the balance, bring it to the attention of your instructor and he or she will assist you. We will assume that the uncertainty associated with the mass measurement, Δm, is ±1 in the last decimal place measured (i.e., Δm = ±0.001 g for balances reading three decimal places).

Determination of Density using a Ruler to Measure the Volume

Measure the length, width and height of your block using a plastic ruler. The rulers are marked off every 0.1 cm, but you can estimate and report the measurements to ±0.01 cm (see Fig. 1). We will assume that the copper pieces are perfect rectangular blocks (the four lengths are the same, as are the four widths and the four heights, and all sides meet at 90º angles).

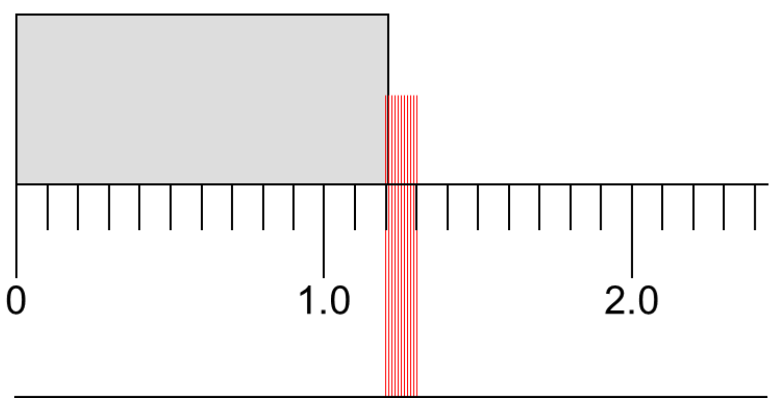

Figure 1. How to estimate the length of an object to the nearest 0.01 cm with a ruler that is graduated in increments of 0.1 cm by dividing the distance between the gradations with ten imaginary lines (shown in red). The length of this object is 1.21 or 1.22 cm.

Determination of Density by Water Displacement
Add enough water to a 50-mL graduated cylinder so that your copper block will be completely submerged. The 50-mL graduated cylinder is marked in 1-mL increments, but you should be able to estimate the volume to the nearest 0.1 mL, as shown in Fig. 2. Record the starting volume of water in your notebook. Carefully place the copper block into the graduated cylinder so that you do not break the graduated cylinder or splash out any water. Gently tap the cylinder to dislodge any air bubbles that are clinging to the copper, and record the new volume. Calculate the difference between the final and initial volumes to determine the volume of water displaced.

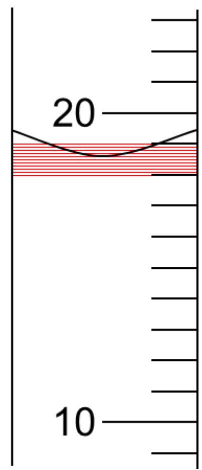

Figure 2. How to estimate the volume to the nearest 0.1 mL in a graduated cylinder that is marked with 1 mL gradations by dividing the distances between gradations into imaginary lines (shown in red). The volume in the case shown would be 18.6 mL although others might estimate it as 18.5 or 18.7 mL.

Clean-up
Wipe the copper blocks, their holders, the rulers, the graduated cylinders, the bench top, and any part of the drawer that you touched with wipes to minimize the chance of transferring any viruses.

Results and Analysis
Share your mass, length, width, height, and volume displaced with your professor. He or she will share the data with you in an Excel file for analysis. All significant figures will be shown. Unless formatted otherwise, spreadsheets drop trailing zeros, even if they are significant. Since all of the length, width, and height measurements were measured to the nearest 0.01 cm, the professor will select the block of these measurements and click on the increase decimal places button ( in the Number group) to display two digits after the decimal in all of these cells. The professor will adjust all mass measurements to three digits after the decimal.