

INS Fall 2007 Chemistry Lab 1

Determination of Density

Useful reading: Chemistry text (BLB) pp. 16-17, 20-25

Agenda for laboratory work:

- Turn in safety quiz and complete lab orientation
- Sometime during the day, get your picture taken
- Some demonstrations of good lab practice with the use of balances and liquid transfer
- Working in pairs, determine the density of the indicated solutions and solids. Use this as an opportunity to build some lab skills that you will use repeatedly during chemistry and biology this year.

Background

Some of the most commonly used intensive properties of materials are their densities. The use of density can help identify unknown materials, such as minerals or unknown organic liquids. Differences in density are the basis of many separation techniques in molecular biology. Differences in density help drive the circulation of heat and nutrients in the ocean and other aquatic systems. Density determines which organisms float and which sink, and organisms have evolved ways to change their density. Brewers and vintners use it to follow the sugar and alcohol content of their creations.

The use of density is also a convenience in lab. It is often easier and faster to measure the volume of a liquid material than to directly measure its mass. If you know the density, mass and volume are easily interconvertible. This is a conversion that should become second nature to you.

The density of solutions is usually provided in a few common units in most tables of data. The general symbol for density is the Greek letter rho, ρ .

D_{4}^{20} is the relative density, which refers to the density of the solution in question measured at 20° C, compared to the density of water at 4° C. By definition, the density of water at 4° C is 1 kg/l. The normal units for density are kg/l or g/ml.

Specific gravity is sometimes referred to. This is the ratio of the density of the material in question to the density of water at the same temperature. This is a dimensionless number.

Pipettes are usually labeled TD or TC. TD indicates that the volume is to deliver-the calibration assumes that surface tension will hold a small amount of liquid behind. TC indicates to contain-the volume assumes that all liquid contained is blown out. The pipette should also indicate its calibration temperature, usually 20 °C. Glass does expand and contract with temperature, but this calibration is usually good within 5 °C of the given temperature. All volumetric glassware is based on using the base of them meniscus as the reading line for liquid level.

NEVER mouth pipette!

Procedures

A. Density of Liquid:

This procedure will be repeated for a deionized (DI) water sample, a sample of unknown salinity, and a sample of a water-glycerol solution.

1. Get a volumetric pipette of 10-25 ml. Make sure that it is not chipped and check its cleanliness by doing some trial runs with DI water. If the pipette is clean, the water should cleanly run out and not leave drops behind. If your pipette has problems, try a different one.
2. Tare a clean dry beaker of a reasonable size.
3. Using the demonstrated technique, transfer 10 or 25 ml of the liquid to the tared beaker. You should also note the temperature of the liquid (or the room, if they are the same temperature) Remember, you never pipette out of a stock bottle in lab. Transfer some (Think about how much you need!) to a clean labeled beaker and move this supply to your work area.
4. Determine the mass of the beaker plus liquid and determine the mass of liquid transferred.
5. Repeat this procedure 3-5 times for each liquid. Determine the mean and standard deviation for your transferred masses. With this and the marked volume of your pipette, estimate the density of the liquid in question. Be sure to express your results using the correct number of significant digits.
6. When you have completed a given solution, make sure the pipette is rinsed several times with DI water. Dried goo in pipettes can be nearly impossible to remove.

Looking at this data:

1. For the DI water, compare your density with the density provided by a standard reference. (Probably the best is the CRC handbook (, which gives the density of water at many temperatures.) How does your data compare to the literature value? What are possible sources of difference between your value and the literature value? In your lab notes, you should clearly indicate the citation for any literature source that you use.
2. Determine the density of your saline solution. The CRC handbook has a set of tables (“Concentrative properties of aqueous solutions: conversion tables”). Using the table for sodium chloride and your density value, what is the concentration of salt in your solution? Is it more or less salty than sea water? More or less salty than human plasma? Be clear about the units of concentration you are using to express your salt concentration.
3. What is the concentration of the glycerol solution?

The density of a solid object.

1. Select one of the solid objects provided.
2. Determine its mass.
3. With the measuring tools provided, estimate the volume of the object. With the data you have collected, determine the density of the object.
4. Using this density, what can you say about the identity of the material? For example, are there metals you can rule out? Are there reasonable possible metals that have similar masses?