



Determining Density with a Pichnometer Lab #1

This lab has several purposes. The first is to be sure that you understand the concept of density. The second is to give you an opportunity to use a pichnometer, a device specifically designed for finding the density of liquids. Thirdly, this lab will give you the opportunity to do some glass-working and blowing. Although most things that you will need for a chemistry class are available commercially, there is still a need for the skill of working glass into new and useful shapes. We will tackle these goals in reverse order.

Materials:

Glass tubing	Bunsen burner	Beaker	Balance
Thermometer	Deionized or distilled water		Unknown solution(s)

Procedure:

A. Making the pichnometer.

Caution: Hot glass can look like cold glass. Be very careful during the following steps!

Obtain a piece of glass tubing approximately 15-20 cm long. In order to break off the appropriate length of tubing, use a triangular file to scratch a single line across the tube. This can be very short and is best when made in a single motion. Apply a small amount of water to the scratch. Hold the tubing with the mark away from you, placing your thumbs just to either side of the mark. Apply gentle pressure away from you. The tube should snap cleanly at the mark.

You will need to fire polish the ends. Hold the rough ends of the tube (one at a time) in the hot part of the burner flame (the edge of the inner cone). Rotate the tube slowly in your hand, by rolling it in your fingers. The fire will melt the tip of the glass taking away the roughness. Be careful, as extended heating will seal the tubing and one end must remain open.

Seal one end of the tube, by heating it until the glass closes over on to itself.

Continue to heat this end of the tubing until you have a small bright orange blob of glass that begins to fall or flop in the flame. Be sure to continue rolling the tubing in your fingers to heat it evenly.

Caution: Do not inhale too close to the heated tube. The air around it will be hot enough to sear your lungs!

Caution: Even hot glass can shatter! Wear your goggles!

Blow the glass into a small ball. Place the cold end of the tubing into your mouth and blow gently but firmly (in other words use a lot of force but control it.) Do not over blow. If the bubble pops you will have to restart. The final bubble should be between 1 and 3 cm wide. As this cools, it will be extremely fragile. BE CAREFUL.

When the bulb has cooled (you can touch it), mark a line with the file on the tube. Exactly where you mark it does not matter but the mark should be within 5 cm of the top.

B. Using the Pichnometer:

The pichnometer is designed to have a known volume. Because of this you can fill it with a liquid and by only taking the mass, find the density of the liquid using the formula

$$\text{Density} = \text{mass/volume.}$$

To find the mass of your pichnometer, weigh it and record the value in your lab notebook.

To find the volume of your pichnometer we will use the fact that the density of water is known very exactly at a wide range of temperatures. Fill your pichnometer **above** the line with deionized water and place it in a large beaker of tap water. Be sure that the tap water is below the top of the pichnometer. Place your thermometer into the beaker and allow the apparatus to sit undisturbed for several minutes. This will allow the water inside the pichnometer to reach the same temperature as the water in the beaker. Measure the temperature of the water in the beaker. Adjust the level of water in the pichnometer so that the bottom of the meniscus is at the scratched line. Dry the outside of the pichnometer completely and weigh it carefully.

Empty the pichnometer. Fill the pichnometer with one of the unknown solutions, adjust the level to the line, dry the outside and weigh it. Empty the pichnometer.

Calculations:

Determine the mass of the water by subtraction. Look up the density of water at the appropriate temperature, and then, using the formula for density, calculate the volume of your pichnometer.

Determine the mass of the unknown solution in the pichnometer and then use the mass and the volume to determine the density.

Use the table below to determine the identity of your unknown.

Possible solutions and their densities

Substance	Density (g/ml)
Acetone	0.7908
Aniline	1.0216
Butane	0.6012
tert-Butyl alcohol	0.7856
ethyl alcohol	0.7893
isopropyl alcohol	0.7851
methyl alcohol	0.7914
naphthoic acid	1.398

References: This laboratory is based on one originally designed by Donald Nelson at Churchill Area High School, Churchill, Pennsylvania.