Density of liquids

INTRODUCTION

In this experiment you will become familiar with how mass and volume measurements are carried out. These mass and volume measurements will then be used to determine the density of a salt solution and liquid water.

The density (mass per unit volume) of liquids can be determined by measuring both the mass and the volume of a given sample. The density is a characteristic property of a substance. As an intensive property it is independent of the quantity of material measured since it is ratio of the mass of an object to its volume. It remains constant unless the temperature or pressure is changed. For liquids a relatively small change in temperature can affect the density appreciably, but a pressure change must be quite great to have a measurable effect. In this experiment you will determine the density of liquid water. Once this density and its change with temperature are known, you can use the information to find out what volume should be occupied by a known mass of water at a given temperature.

Calibration is the process by which a stated measure a mass or a volume is checked for accuracy. Once a data such as concentration vs. density of the solution is obtained, it is possible to plot a curve what we called a calibration curve. When such a plot is obtained we can determine the density of a substance with a known concentration, or the concentration of a substance with a known density.

PROCEDURE

A)

- Weigh an empty cylinder

- Add about 20 mL of distilled water in the clean graduated cylinder.

- Record the volume to the nearest 0.1 mL.

- Weigh the cylinder plus water on an analytical balance and record.

- Measure the temperature of the water

- Calculate the density.

- Compare the calculated density of the water with the values given in the table and calculate the percent error.

- Obtain an unknown solution and determine the density of this unknown in a similar way.

B)

- In clean dry containers, obtain approximately 25 mL of each of four different NaCl solutions: 4, 8, 12, 16 % NaCl by weight.

- Determine the density of each solution as in Part A.

- Obtain a salt solution of unknown concentration of NaCl from your instructor and determine its density.

- Plot a graph showing the density (on the vertical axis) vs. Concentration of NaCl (horizontal axis).

- Using the graph, obtain a value for the concentration of NaCl for your unknown and report it to your instructor.

Table-I

Temp°C	Density(g/mL)	Temp°C	Density (g/mL)
15	0.9979	26	0.9959
17	0.9977	28	0.9955
18	0.9975	29	0.9952
20	0.9972	31	0.9946
22	0.9968	33	0.9941
24	0.9964	35	0.9935

PRELAB QUESTIONS

1. Write the definition of the density and

a) Explain the effect of the temperature and pressure on the density of the liquids. How does the density of liquids changes with the temperature?

b) Why do we need a great pressure change to observe a change in the density of the liquids?

c) If we have a gas sample instead of liquids, do we need great pressure change to have a measurable change in the density? Explain briefly.

d) If we have a solid sample instead of liquid or gas, does the density of this solid change if we increase or decrease pressure too much?

2.

a) Suppose that, you measure the temperature of 20 mL of the water as 30°C when it is actually 20°C. Find the minimum percent error in the calculation of the density by using the table given above.

b) Suppose that you determine the mass of 41.2 mL of water as 41.052 g. at 28°C. Calculate the density from the experimental values and match it with the value given in the table. Calculate the percent error.

3. Plot the temperature vs. density values given in the table. Determine the density of the liquid water at 16°C, 21°C, 23°C and 25°C.

4. What is the calibration? Explain briefly.

DATA

a) Mass of graduated cylinder plus water.....

Mass of graduated cylinder alone.....

Volume of water in the cylinder.....

Temperature of water.....

Mass of graduated cylinder plus unknown.....

Volume of unknown.....

b) Mass of grd. cyl+ known NaCl soln……

Volume of NaCl in cylinder ……

Mass of grd. cyl.+ unknown soln.....

Volume of unknown NaCl soln.....

RESULTS

Calculate:

a) Density of water, percent error, density of unknown

b) Density of known solutions, density of unknown solution