Experiment 2
The Floating Egg Problem

Purpose

You are to determine the density (in grams per milliliter) of the salt solution to "just float" an egg.

The goal of the experiment(s) we will be doing is to become directly involved in scientific inquiry. Gaining first-hand knowledge of the processes of scientific inquiry, problem solving, and critical thinking is of equal or greater importance than knowing the "correct" answers to problems. Often, problems do not have a single correct answer; there may be several possible solutions. So, understanding the process of science allows us the ability to address a variety of problems now and in the future. The following problem is designed to further exercise your procedure writing skills and to introduce you to scientific inquiry.

Background

Chemists use special volumetric glassware in the chemistry laboratory (rather than the ordinary beakers and flasks) when they need high-precision measurements of the volumes of liquids. Understanding the proper use and limitations of such glassware is important in achieving reliable results. Experimental technique and the inherent accuracy of the glassware both affect experimental results. One of your personal goals for this course is to develop sound experimental techniques.

In this experiment you will practice using glassware to improve your technique and to solve an important historical problem in practical chemistry.

Historical Background

"For many years soap was made at home from a variety of recipes. Animal fat, usually from cattle (also called tallow) was cooked with a lye solution. Lye, though it was mostly simple sodium hydroxide, could not be made from purified chemicals, as we do now. Instead, the solution was obtained from ashes and water. The ashes were treated with hot water, and then the mixture was filtered to obtain a solution.

But before this could be used in soap making, one had to check the concentration of the lye solution. One simple test was to try to float a raw egg in the solution. If the egg sank, the concentration of the lye in the solution was too low. If the egg floated too high, the concentration of the solution was too great, and water was added before adding the fat. **To "just float" in this case means to make the top of the egg just touch the top of the solution, without any significant amount of the egg protruding above the surface of the solution.**"[1] Because lye is caustic and corrosive, sodium chloride will be substituted in this lab. The solutions are concentrated enough to be an eye hazard so safety goggles must be worn.

Materials Available

Deionized water
Lab Station Supplies
Balances
Eggs
Sodium chloride (salt)
Volumetric flasks

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[1] *Adapted from "Working with Chemistry A Laboratory Inquiry Program" by Donald J. Wink, Sharon Fetzer Gislason and Julie Ellefson Kuehn; W.H. Freeman and Company New York, 2000.*

Experiment 2 Turn-in sheets

The Floating Egg Problem

Before you begin, complete the following with your lab partner:

1. Rephrase your task in this experiment. What are you trying to accomplish? What data do you need to report at the end of the experiment (and in what units)?

2. Formulate a procedure for this experiment. Write down your procedure clearly enough that other people will be able to reproduce your experiment. Use the space below.

*BE very specific in which equipment you intend to use for your measurements (e.g. 50-mL beaker or 10-mL graduated cylinder, etc...) as this will affect your precision.

Data

This page is to keep track of your observations, data, and to record any changes you may have made to your original procedure. Try to make this page as neat as possible, without re-writing your data after the experiment. It is expected that it will not be perfect—but please make it legible. Remember, your work must be understood by others who read it.

If you absolutely must start over, use the next page or a blank sheet provided at the back of this manual.

Always use PEN to record data. Record units for all measurements!
If you make mistakes, do not use white-out. Do not rewrite this page.

Results and Calculations

Summarize your data from the previous page in a concise fashion (you may wish to put the data in a data table). What do you conclude from the data to answer the question posed in this experiment? Show your calculations, using an appropriate number of significant figures. Remember, your work must be understood by others who read it.

Follow-up Questions

1. According to your calculations, what is the density of the solution in which the egg just floated?

2. a) How does this compare to the value determined by other groups? Find at least three other groups and record their values below.

b) What factors do you think contributed to the variation in density values in the class?

3. It is possible to accomplish this lab with a density value reported to 4 significant figures. If your density value did not have at least 4 significant figures, how might you change your procedure in order to achieve this precision?

4. The concentration of the salt solution is different from the density of the salt solution and can be obtained by taking the mass of salt used (in grams) and dividing it by the total volume of solution (in mL) and multiplying by 100 to get a percent by mass-volume. If you have these data, calculate the concentration as % (m/v) of your salt solution.

5. How is the % (m/v) different from density?

 Name_____ Section_____

Pre-Lab Assignment—To be completed BEFORE lab!

Understanding Activity 3 in this manual and significant figures and uncertainty in measurements in general will help you answer the last two questions.

1. In your own words, what is the purpose of this experiment?

2. Briefly outline a procedure for the experiment you will carry out in lab.

3. The density of a liquid is determined using a 50.00 mL volumetric flask (which has an uncertainty of ±0.01 mL). Would the reported density value be better, worse, or the same if a 600-mL beaker (which has an uncertainty of ±10 mL) was used for the volume measurement? Explain how the reported values would be different and which would be preferred.

4. What kinds of limitations will you encounter in the precision of your density measurement(s)? What will you do (or use) in your lab procedure to ensure the highest level of precision possible?