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DETERMINING THE DENSITY OF PRESTONE ANTIFREEZE*

Purpose

In this experiment you will find the density of Prestone Antifreeze, a liquid, by determining the mass of one cubic centimeter of the substance.

To do this you will weigh a Beral pipet containing some Prestone Antifreeze. Then you will remove exactly one milliliter of the liquid and weigh the pipet again. The difference in mass is the mass of 1 mL (or 1 cc) of the liquid. This value, with the units g/cc, is the density of Prestone Antifreeze determined experimentally by you.

You will then look up the value of the density of ethylene glycol in a handbook and compare it with your value of the density of Prestone Antifreeze.

Materials

- a Beral Microtip pipet
- a 10 mL graduated cylinder (0.1 mL graduations)
- a distribution container of ethylene glycol
- a student-built milligram balance
- a paper towel or facial tissue
- access to a chemistry handbook

* Prestone Antifreeze consists of mostly ethylene glycol with very small amounts of several other components dissolved in it.

PROCEDURE

1. Compress the bulb of a Beral pipet with your fingers, put the tip in a container of Prestone Antifreeze, relax your fingers, and let the liquid enter the pipet until it is about 3/4 full. (It doesn't have to be completely filled).

2. Carefully transfer the liquid from the filled pipet into the 10 mL graduated cylinder. You want to bring the liquid level up to exactly the 1.00 mL mark. Once this has been done, refill the pipet.

3. Zero your milligram balance.

4. Use a paper towel or tissue to remove any liquid clinging to the exterior of the pipet. Then put the pipet bulb-end-down in the weighing pan of the milligram balance and weigh it. Record the mass on the data sheet.

5. Remove the pipet from the balance and carefully add to the liquid already in the graduated cylinder enough additional antifreeze to bring the liquid level up to exactly the 2.00 mL mark. Don't allow droplets to collect on the inside of the graduated cylinder.

6. Return the pipet bulb-end-down to the weighing pan of the balance, and weigh it again. Record the mass on the data sheet.

7. We now have enough information to calculate a value for the density of Prestone Antifreeze. However, to make sure this density value is correct, we want to get another value for comparison. To do this we basically retrace steps 5 and 6 in the procedure described below.

   Remove the pipet from the balance and carefully add enough additional antifreeze to that which is already in the graduated cylinder to bring the liquid level up to exactly the 3.00 mL mark.

8. Return the pipet bulb-end-down to the weighing pan of the balance, and weigh it again. Record the mass on the data sheet.

9. The difference between the new mass recorded and the last mass recorded obviously is the mass of antifreeze associated with the volume needed to raise the liquid level from 2.00 mL to 3.00 mL. This volume is obviously 1.00 mL.

10. We have now twice calculated the mass of a 1.00 mL volume of Prestone Antifreeze. Calculate the average of these values and enter the average value on the data sheet.

11. We can assume that 1.00 mL = 1.00 cc. Therefore, we have just determined experimentally the density of Prestone Antifreeze (density = $\frac{\text{grams}}{\text{cc}}$).

12. Look up the value for the density of ethylene glycol (the major component of Prestone Antifreeze) in the Handbook of Chemistry and Physics (or some other reference) and record this value on the data sheet.

DATA SHEET

DETERMINATION OF THE DENSITY OF A LIQUID

Name of Liquid _____

Record all masses to four significant digits; i.e., out to a thousandth of a gram.

INITIAL DETERMINATION

Mass of Beral pipet after liquid level brought to 1.00 mL level _____ g

Mass of Beral pipet after liquid level brought to 2.00 mL level _____ g

Mass of 1.00 mL of the liquid _____ g

REPEAT DETERMINATION

Record <u>again</u> the mass of the Beral pipet after liquid level brought to 2.00 mL. _____ g

Mass of Beral pipet after liquid brought to 3.00 mL level _____ g

Mass of 1.00 mL of the liquid _____ g

RESULTS

Average of the initial and repeat determinations of the mass of 1.00 mL of the liquid _____ g

Mass of 1.00 cc of the liquid _____ g

Density of the liquid (Determined Experimentally) _____ g/cc

Density of the liquid (Handbook Value) _____ g/cc

TEACHER'S GUIDE TO
DETERMINATION OF THE DENSITY OF PRESTONE ANTIFREEZE

Density is a concept that is difficult for students to grasp. They can learn and use the formula $D = \frac{M}{V}$ but don't see much relevance of this information to what is in their experience. This fact would argue for more experiments involving density so students can gain familiarity with the concept.

Unfortunately the lack of balances in the laboratory often makes it impractical to do many, if any, density experiments. This situation is remedied by the introduction of the inexpensive but very accurate student-built, milligram balance.

Most lab manuals include an experiment involving the density of solids, but very few deal with the density of liquids. In this experiment students will determine in the most straightforward way possible the density of a liquid using the milligram balance and a 10 mL graduated cylinder.

We have chosen anti-freeze (ethylene glycol) as the liquid to be used in this experiment. It is readily available and contains a dye which gives the liquid a brilliant color for easy visualization.

*********************** HAZARD WARNING ***********************

Antifreeze is poisonous to humans if ingested, but can be used safely in the laboratory. Spills on the skin should be washed off immediately with soap and water.

Students should be alerted to the hazard of spills when putting antifreeze in an automobile radiator at home. The liquid is extremely dangerous when swallowed by dogs or cats. They tend to be attracted to antifreeze spills because the liquid has a taste that appeals to them. Spills of antifreeze should be immediately washed off a garage floor or pavement with water.

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