CHEMISTRY LAB

Ideal Gas Law

Finding the Molar Mass of the Fluid in a Lighter

MATERIALS

Electronic balance

Bottle

100-mL graduated cylinder

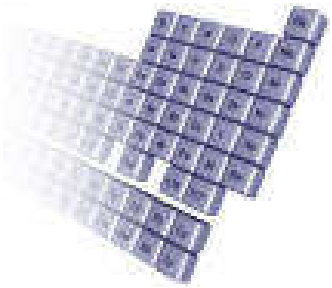
Glass plate

Butane Lighter

Pneumatic trough

thermometer

SAFETY GOGGLES



PROCEDURE

You will use the Ideal Gas Law to determine the molar mass of the liquid in a lighter.

1. Weigh the lighter to the nearest .01 g and record the result in Table 1.

2. Fill the bottle until it is completely full. The water should be to the very top. Be sure there are no air bubbles present.

3. Pour the water into a graduated cylinder and measure its volume. Record the result in Table 1. Be careful not to spill any of the water.

4. Fill the bottle with water again. Place the glass plate over the neck of the bottle. Make sure there are no air bubbles visible.

5. Fill the pneumatic trough with water. Place the thermometer in the water.

6. Carefully invert the bottle into the pneumatic trough. Once the bottle is submerged in the water, remove the glass plate.

7. Position the lighter under the neck opening of the bottle, and open the gas lever of the lighter. Let the gas from the lighter accumulate in the bottle. *Be careful not to let any air into the bottle. It must remain under the water at all times.*

8. Fill the bottle approximately 1/3 full of gas. This may take several minutes.

9. To check to see how much gas you have trapped, place the

READ ALL INSTRUCTIONS BEFORE PROCEEDING

SAFETY NOTE

Make sure to clean and dry all materials well before, between, and after use.

9. To check to see how much gas you have trapped, place the glass plate back over the neck opening of the bottle and turn it upright. If there is not enough gas, do NOT take off the glass plate. Simply invert the bottle back into the water to continue collecting gas.

10. Once you have captured enough gas, it is now safe to turn the bottle upright and remove the glass plate. Measure the new volume of water with the graduated cylinder. Record the new volume in Table 1.

11. Measure and record the temperature of the water in Table 1.

12. Shake the lighter to dry it. Once the lighter is dry, weigh it to the nearest 0.01 g on ***the same balance used in Step 1***. Record the mass on Table 1. Wait 5 minutes and weight it again. If the weight is more than .03 g different from the first weighing, wait another 5 minutes and weigh it again.

13. Find the pressure (P) for your experiment using the atmospheric pressure (P_{ATM}) given by your teacher and the water vapor pressure (P_{H20}) from the table. Place the answer in Table 1.

$$P = P_{ATM} - P_{H20}$$

QUESTIONS

14. Find the number of moles, n, from the equation:

$$PV = nRT$$

15. Determine the molar mass of the gas in your lighter:

$$\text{Molar mass} = (\text{mass}_{initial} - \text{mass}_{final}) / n$$

16. The gas in the lighter is mostly butane (C_4H_{10}). Find the % difference between your molar mass and the molar mass of butane (% differences are calculated by the same method as % errors, but they can be negative. Show your work.

17. The gas in the lighter is an alkane (C_xH_{2x+2}). Use your calculated molar mass to suggest a possible formula for this gas.

18. In this lab we have referred to the gas inside the lighter. However, observations of a transparent lighter clearly show that the substance inside the lighter is a liquid. Explain how this is the case.