

Determination of Carbon Dioxide in Antacid Tablets

Introduction

We live immersed in a gaseous solution. The earth's atmosphere is a mixture of gases that consists mainly of elemental nitrogen, N₂, and oxygen, O₂. The atmosphere both supports life and acts as a waste receptacle for the exhaust gases that accompany many industrial processes.

During this investigation, you will see how measurements of gas properties lead to various types of laws—statements that show how the properties are related to each other. Then, you will construct a model to explain why gases behave the way that they do.

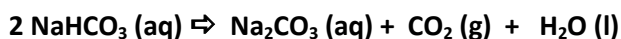
Purpose

In this experiment, you will measure the amount of carbon dioxide gas given off when the antacid tablets dissolve in water in a balloon

Algebraic Equations

$$\text{Circumference} = 2\pi r \quad PV = nRT \quad \text{Volume} = \frac{4\pi r^3}{3}$$

Chemical Reactions



Pre-Laboratory

1. Calculate the molar mass of sodium bicarbonate, NaHCO₃.
2. Calculate the molar mass of sodium carbonate, Na₂CO₃.
3. Calculate the molar mass of water, H₂O.
4. Calculate the molar mass of carbon dioxide, CO₂.

Procedure

1. Break one antacid tablet into small pieces and place into the first balloon.
2. Break two antacid tablets into small pieces and place into the second balloon.
3. Break three antacid tablets into small pieces and place into the third balloon.
4. Use the medicine dropper; squirt approximately 5 mL of cold water into each balloon. When completed, immediately tie off balloon.
5. Shake balloons to mix contents. Allow the contents to warm to room temperature.
6. Carefully measure and record the circumference of each balloon FIVE TIMES during the next 20 minutes into a data table like the one developed for you below.
7. Record the pressure and temperature in the room from your teacher. Place into a data table.

Trial Number	Circumference (in centimeters)		
	Balloon 1	Balloon 2	Balloon 3
1			
2			
3			
4			
5			

Calculations

- Using the temperature from the room that was given by Ms. DePaul, convert the temperature from Fahrenheit to Kelvins.
- Using the pressure from the room that was given by Ms. DePaul, convert the pressure from inches of mercury to atmospheres.
- For Balloon #1, Balloon #2, and Balloon #3:
 - Using the highest measured circumference over the five trials, calculate the radius.
 - Using the radius calculated from the circumference, calculate the volume in milliliters.
 - Convert volume from milliliters to liters.
 - Using the Ideal Gas Law, calculate the number of moles of carbon dioxide gas that was expelled during the chemical reaction.
 - From the moles of carbon dioxide, calculate the grams of carbon dioxide produced in the reaction. Label this result as the Actual Yield.
 - Calculate the molarity of carbon dioxide in the balloon since 5 milliliters of water were used in the chemical reaction to produce a solution.
 - How many grams of sodium carbonate were produced in each balloon? Label this result as the Actual Yield.
- Using the chemical reaction for the laboratory experiment, if a typical antacid tablet contains 2.0 grams of sodium hydrogen carbonate, NaHCO_3 (Approximately 2.0 grams of sodium hydrogen carbonate equals 1 antacid table.):
 - What is theoretical yield, in grams, of carbon dioxide if you used one tablet?
 - What is the theoretical yield, in grams, of carbon dioxide if you used two tablets?
 - What is the theoretical yield, in grams, of carbon dioxide if you used three tablets?
 - What is the theoretical yield, in grams, of sodium carbonate if you used one tablet?
 - What is the theoretical yield, in grams, of sodium carbonate if you used two tablets?
 - What is the theoretical yield, in grams, of sodium carbonate if you used three tablets?
- Calculate the percent yield of carbon dioxide for Balloon #1, Balloon #2, and Balloon #3.
- Calculate the percent yield of sodium carbonate for Balloon #1, Balloon #2, and Balloon #3.

Final Analysis

- If the actual yield of carbon dioxide produced for the reaction and in the balloon was 8.0 grams:
 - How many moles of carbon dioxide were produced for the reaction?
 - What would be the volume of carbon dioxide in the balloon using the same room temperature and pressure in the laboratory setting?
 - What would be the radius of the balloon?
 - What would be the circumference of the balloon?
 - How many antacid tablets were used in the balloon?