

Molecular Mass of Carbon Dioxide Lab

Theory:

Purpose – When Alka Seltzer reacts with water, CO₂ gas is produced. In this lab, you will collect the gas given off from this reaction. Using the mass difference, you will determine the mass lost by the process, and thus the mass of CO₂ produced. You will use the ideal gas law to calculate the number of moles of gas produced, and from this, the molar mass of CO₂.

Materials: Erlenmeyer flask, Alka Seltzer tablets, mortar and pestle, balloon, scoop, thermometer, scissors

Procedure

1. Fill a flask to overflowing with tap water.
2. Obtain 3 Alka Seltzer tablets and crush.
3. Get a large, round balloon and remove the air from it.
4. Place the tablets in the balloon and attach carefully to the flask (balloon hangs to side).
5. Use electrical tape or duct tape to secure the balloon tightly to the flask.
6. Place the balloon upright to start the reaction.
7. As the reaction continues, hold the balloon and invert the tube several times to ensure completion.
8. After all bubbling stops, measure the circumference of the balloon with a string. If the balloon is misshapen, try to push it into the shape of a sphere while measuring the circumference.
9. Place the system on the electronic balance. Record this mass.
10. Grab the top of the balloon and flatten a small section. Make a small cut in the balloon and slowly release the gas. Record the new mass. Be sure that no water leaves the balance.
11. Record the room temperature and the barometric pressure below.

Data

1. Circumference of balloon:
2. Mass of system before releasing gas:
3. Mass of system after puncturing balloon:

- Mass of gas (subtract 1 from 2 above):
- Room temperature (in Kelvin):
- Atmospheric Pressure (in mm Hg):

Calculations

- The pressure inside the balloon is equal to atmospheric pressure, which includes both CO₂ and water vapor. Ask your teacher for the value for water vapor at this temperature and subtract this from atmospheric pressure. You now have the pressure of your gas. Convert this to atmospheres:
- Using the circumference of the balloon, calculate the volume of the gas produced.

$$\frac{\text{Circumference}}{2\pi} = \text{radius} \quad \text{Volume of a sphere} = \frac{4}{3} \pi r^3 \quad \text{Convert cm}^3 \text{ to liters.}$$
- You now have all the values needed to solve for “n” with the ideal gas law. The value for R is 0.0821 liter-atm/mol K. (PV = nRT) Solve for “n”.
- The gas in the balloon is CO₂. Using your value for n and the mass of the gas you generated, what is your value for the molar mass of CO₂? (n = your mass/molar mass) Remember, molar mass is the unknown in this equation!

Error Analysis:

- What is your percent error for your value of the molar mass of CO₂ ?

$$\frac{\text{your value} - \text{periodic table value}}{\text{periodic table value}} \times 100 =$$

- What could be the sources of error?
 Would this error make your value come out too high or too low? Explain.

Discussion:

- CO₂ is quite soluble in water. Would this fact make your value for molar mass too low or too high?
- If the balloon full of gas that you produced were brought out into a cold day (-20 °C) and put under 3.5 atm of pressure, what would the new volume be?

Resources:

Conclusion: