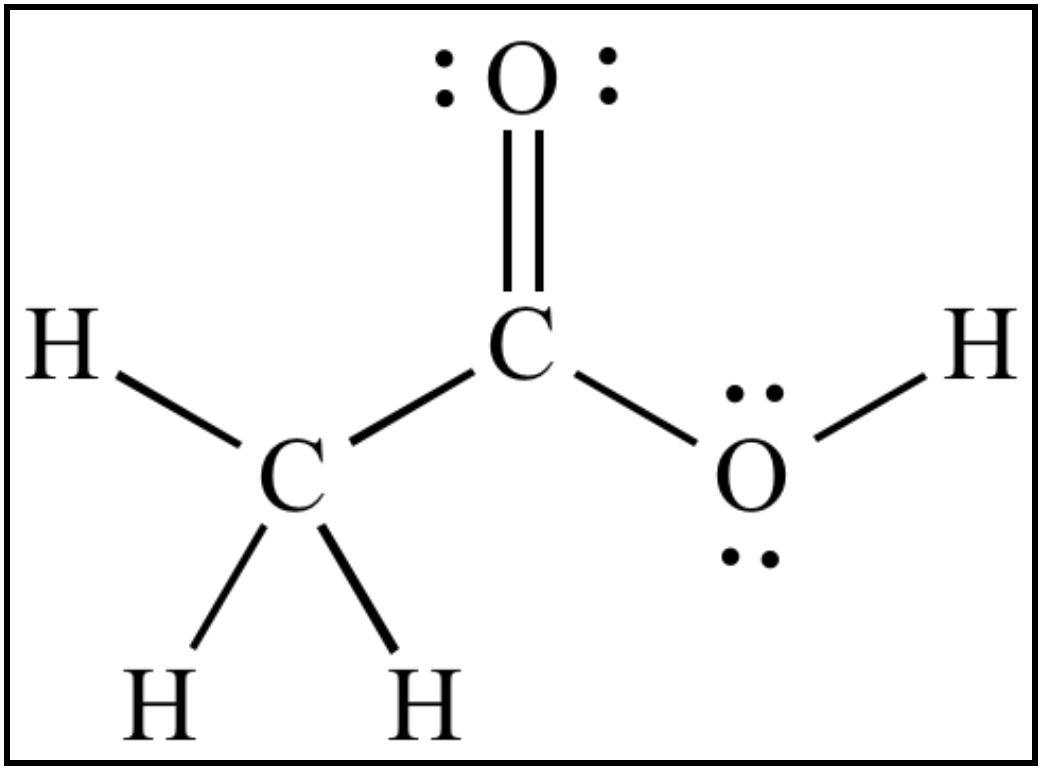
Manipulating Ionic Reactions

Chemistry Lab Report



Second Bimester

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Introduction

Chemistry analyses the relationship between elements and their reactions when exposed to a plethora of physical and chemical conditions. Throughout the exploration of this subject, chemists and students alike discover scientific patterns that favor the development of the *Science, Technology, Engineering, Art, and Math* fields worldwide.

A chemical reaction is a process where one or more substances- reactants, are converted into chemical compounds through the rearrangement of their constituent atoms to form substances with new properties and electronic configurations.

"The reactions between elements and compounds, and the chemical and physical properties of reactants and products are the focus of chemical research."

*- **Gary Horner** (Middle Years Programme Chemistry. Oxford)*

These reactions can be simplified into written formulas that display the interaction between reactants and products; with this information we can identify the dependent and independent variables of an experiment involving controlled chemical reactions.

Inside this lab report, we want to manipulate the reactants (independent variables), in order to create a linear increase in the final product (dependent variable). Analyzing whether this is factible will be our inquiry problem.

Research Background

Among some of the first reactions we study inside any given science course lies the classic vinegar and baking soda experiment, which consists in a solution of these ingredients inside a plastic bottle with a balloon for a cap.

The vinegar (acetic acid) and the baking soda react aggressively, which makes for a thrilling view as the baking soda dissolves onto the vinegar and releases carbon dioxide, inflating the balloon over the aperture of the plastic bottle.

Acetic acid and baking soda react because of an acid base reaction. An acid is anything that donates a proton and a base is anything that accepts a [1]proton, so in this reaction the vinegar is donating a proton to the water. The carbonic acid formed as a result immediately decomposes into water and carbon dioxide.

- This reaction can be simplified in the formula:
  $NaHCO3 + HC2H302 = NaC2H302 + H2O + CO2.$

This chemical equations tells us how reactants (Sodium Bicarbonate) and (Acetic Acid/Vinegar) combine into the chemical product of (Acetate Acid) plus (Water) plus (Carbon Dioxide).

While we will not change the overall chemical equation, we intend to manipulate the quantities of sodium bicarbonate to induce changes in the production of carbon dioxide.

[1] hydrogen atom without its electron

Hypothesis

If we can manipulate the ratio of reactants inside a chemical reaction to alter the product, **then** we can change the amount of sodium bicarbonate added to a fixed amount of vinegar to increase the amount of carbon dioxide released by the product, **because** manipulating the sodium bicarbonate as an independent variable will lead to a linear increase of carbon dioxide.

Materials

1. Plastic Bottle
2. Baking Soda
3. Vinegar
4. Balloon
5. Measuring Spoons
6. Safety Goggles
7. String

Safety Precautions

While this experiment does not include any toxic chemicals, it's important to wear safety goggles at the time of the expected chemical reaction when the balloon inflates. In case it bursts out, your goggles will ensure no solution comes in contact with your eyes.

Wearing a lab coat, and arranging your hair into a ponytail if applicable is also important, as it can help prevent unwanted stains.

Procedure

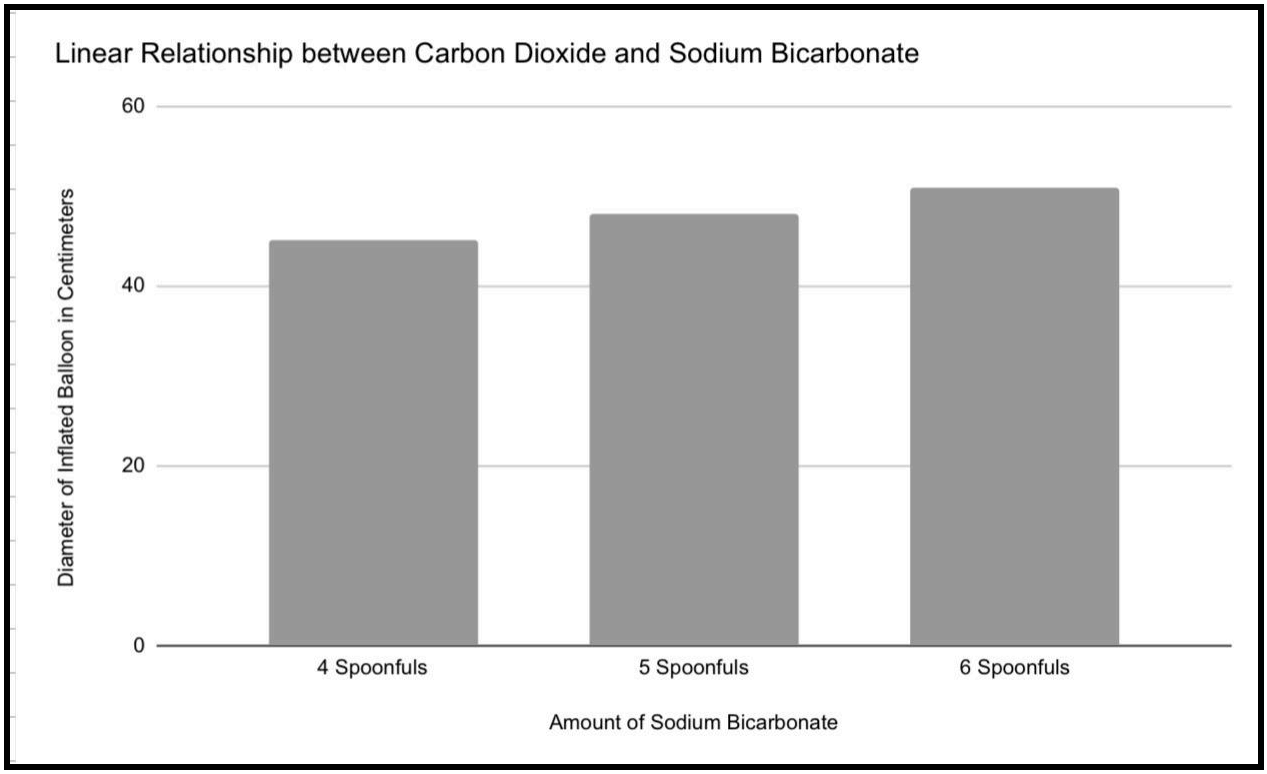
1. Gather the needed materials.
2. Using a measuring cup, measure the amount of vinegar to be poured inside the bottle.
3. Pour the fixed amount of vinegar into the bottle.
4. Open the uninflated balloon and pour the correct amount of spoonfuls of baking soda according to your set, into the hollow interior of the de inflated balloon. Avoid breaking the balloon or spilling the baking soda.

5. Align the airway of the balloon onto the aperture of the water bottle with your hand. The balloon should have enough space to expand and your grip should not restrict its airway.
6. Lift the de inflated balloon with the baking soda, to pour the contents of the balloon into the vinegar at the bottom of the bottle.
7. After a minute passes, remove the balloon from the bottle and tie it.
8. Record the diameter of the inflated balloon with a piece of string or measuring tape.
9. Return to step two and repeat until all sets are recorded.

Data and Results

[2]Amount of Sodium Bicarbonate (Baking Soda) **Independent Variable** Sets/trials	Amount of Vinegar **Controlled Variable**	Diameter of the Inflated Balloon **Dependent Variable**
4 Spoons	1 Cup	45cm
5 Spoons	1 Cup	48cm
6 Spoons	1 Cup	51cm

[2] Prior to performing this experiment we classified the variables that were going to take place inside of our lab procedure. Our **control variable** was the amount of vinegar poured inside the plastic bottle for every set of spoonfuls; if this quantity varied from set to set, our results would not be accurate because they would have been torpedo by a similar linear increase in the amount of sodium bicarbonate, our **independent variable**. The independent variable is the factor of change inside an experiment, the one term that we consciously alter to manipulate our results, or **dependent variable**, which happened to be the diameter of the carbon-dioxide balloons of every set. This information can help us contrast the linear relation between each set and help us demonstrate the veracity of our hypothesis.


Linear Relationship between Carbon Dioxide and Sodium Bicarbonate
60
40
20
0
Diameter of Inflated Balloon in Centimeters
4 Spoonfuls
5 Spoonfuls
6 Spoonfuls
Amount of Sodium Bicarbonate

Conclusion

By comparing these diameters, or dependent variables, we can observe a linear increase in the production of the gas of every set, which proves right our initial hypothesis that as more sodium bicarbonate is added to the solution, the more carbon dioxide will be released in the final product.

Our Initial hypothesis is correct.

This henceforth, answers our inquiry problem. It is possible to manipulate reactants, in order to create a linear increase in the final product of a chemical reaction.

We manipulated the independent variable and the outcome was different every time, due to the fact that the sodium bicarbonate reacted to the acetic acid in a linear tendency.

This chemical reaction happen because when vinegar and baking soda are mixed together, hydrogen ions in the vinegar react with the sodium and bicarbonate ions in the baking soda, as a result two new chemicals were made: carbonic acid and sodium acetate.

After that a *decomposition reaction* happens where the carbonic acid formed in the first reaction begins to decompose immediately to become water and carbon dioxide gas. This gas rises to the top of the container rapidly and thus inflates the balloon.

Although the hypothesis was successful, our procedure had areas of opportunity:

- Some of the gas inside the balloon could have escaped when we were tying them, this could potentially affect our results and data interpretation of a linear relationship between the sets.
- Since the chemical reaction generates water and carbon dioxide, we could have measured the volume of the remaining post-reaction solution in the bottle in order to double proof our linear relationship data.
- Sometimes the balloon inflated so rapidly that a couple of grams of baking soda got stuck on the bottom surface of the balloon as the carbon dioxide restricted downward flow. While the amount was minimal, we need to aim for accurate precision in our experiments in order to get efficient results.

References

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