

Baking Soda and Vinegar Lab: Limiting reactants and percent yield

Learning Targets 7.1 and 7.2

Purpose:

Experimentally determine which ratio of reactants causes the limiting and excess reactants to switch based on the amount of carbon dioxide produced.

Materials: Baking Soda (NaHCO_3), Vinegar (CH_3COOH), 2 beakers and electronic balance and 10 small paper towel squares.

Chemical Reaction:

Sodium bicarbonate reacts with acetic acid producing sodium acetate, water and carbon dioxide

**Procedure:**

1. Get small piece of paper towel to weigh your baking soda.
2. Place one paper towel square on your scale and zero it.
3. Add 2 g of baking soda (sodium bicarbonate). Get as close to 2 g as possible and record the exact mass on your data table under trial 1 baking soda added.
4. Measure 10 mL of vinegar in a graduated cylinder.
5. Place beaker A on the scale and zero it. Carefully pour 10 mL of vinegar into the beaker and record the exact mass on your data table for trial 1 column 2. Get as close to 10 mL as possible.
6. Take beaker A off the scale and re zero it.
7. Place beaker A back on the scale and record the mass of ALL the contents **INCLUDING THE MASS OF THE BAKING SODA YOU WILL BE ADDING** in trial 1 column 3.
8. With the vinegar beaker still on your scale carefully add the first 2 g of baking soda from your paper towel square to the vinegar, stir until the reaction has stopped (no more bubbles)
9. Record the new mass in column 4 of your data table.
10. Record the starting mass of your next trial (column 4) as the final mass of the previous trial plus the mass of the next 2 grams of baking soda.
11. Measure 2 g of baking soda on another paper towel square and record the exact mass in trial 2 column 1.
12. Repeat steps 8 through 11 until all 10 of your trials are completed.

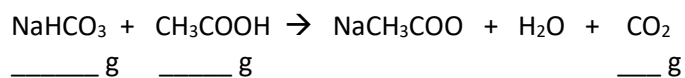
Data Table:

	1	2	3	4	5	6	7		8	
Trial	Baking Soda (2 g added per trial)	Grams of vinegar added.	Mass of beaker, vinegar, baking soda and products	Mass after adding baking soda	Change in mass $\Delta m=3-4$	Bubbles produced? Yes or No	Baking Soda		Vinegar	
1							Limiting	Excess	Limiting	Excess
2		0 g					Limiting	Excess	Limiting	Excess
3		0 g					Limiting	Excess	Limiting	Excess
4		0 g					Limiting	Excess	Limiting	Excess
5		0 g					Limiting	Excess	Limiting	Excess
6		0 g					Limiting	Excess	Limiting	Excess
7		0 g					Limiting	Excess	Limiting	Excess
8		0 g					Limiting	Excess	Limiting	Excess
9		0 g					Limiting	Excess	Limiting	Excess
10		0 g					Limiting	Excess	Limiting	Excess

Analysis Questions:

1. Balance the chemical reaction provided above.
2. Make sure to complete column 5 on your data table
3. Using the data and your observations indicate which reactant the baking soda and vinegar are for each trial. Circle your answer in columns 7 and 8 of the data table.
4. Based on your data which trial did the limiting and excess reactants switch? Justify your answer using data.

5. Underneath the reactants and product determine the total mass of each required/produced in order for the limiting and excess reactants to switch.



6. Calculate how many grams of the excess reactant was used in the first trial.

7. Calculate how many grams of the excess reactant was used in the 4th trial.

8. Based on your answers to questions 4 and 5 what trend happens with each trial? Explain your answer.

9. Calculate the percent yield of CO₂ for trial 1.

10. Calculate the percent yield of CO_2 for trial 4.

11. Should your percent yields for questions 7 and 8 be similar or different? Explain

12. Prove using stoichiometry (Calculations) the limiting and excess reactants switched.