

**LAB: Mole Ratio in a Chemical Reaction**

In this experiment you will react baking soda ( $\text{NaHCO}_3$ ) with hydrochloric acid ( $\text{HCl}$ ) to produce salt ( $\text{NaCl}$ ). You will determine the moles of reactant used and product produced through careful measurement of masses and by dividing by the appropriate formula weights.

**Procedure: Put your goggles on now!**

- 1) Clean and dry a test tube. You have to heat the water off with Bunsen burner and let cool in subsequent trials.
- 2) Measure and record in the data table the mass of the empty test tube to the nearest 0.01 gram.
- 3) Add just enough baking soda to fill the curved bottom of the test tube.
- 4) Measure and record the mass of the test tube with baking soda in the data table.
- 5) Determine the mass of baking soda in the test tube by calculating the differences between the measurements made in steps #4 and #2. ***If necessary, adjust the mass of baking soda so that it is greater than 0.25 grams, but less than 0.50 grams.***

**CAUTION: Hydrochloric acid is caustic and corrosive. Avoid contact with skin and eyes. If any acid should spill on you, immediately flush the area with water and notify your teacher.**

- 6) To the test tube add 3M HCl one drop at a time, allowing the drop to run down the inside wall of the test tube, listen and watch the reaction. Gently agitate the tube after each drop until the reaction stops. Continue to add drops until there is no evidence of any further reaction.
- 7) Evaporate off the liquid in the test tube by gently heating the tube above the Bunsen burner flame, ***slowly circling in and out of the flame. There must be no eruption of fluid out of your test tube!*** If you lose any fluid from the test tube the trial must be repeated. Proceed until dry. ***Make sure the open end of the test tube is not pointed at anyone!***
- 8) Remove your test tube from the flame, and test it for water vapor by inverting a clean dry test tube over the mouth of the test tube. If you see condensation, you must continue the drying procedure for an additional minute and test again. Repeat until there is no condensation.
- 9) Measure and record the mass of the test tube and salt (the product remaining!).
- 10) Repeat the above procedure so that you have a total of 3-4 trials.
- 11) ***Clean up around your lab bench!***

**Data Table:**

	TRIAL #1	TRIAL #2	TRIAL #3	TRIAL #4
Mass of empty test tube				
Mass of test tube & baking soda				
Mass of test tube & salt (at end!)				

**Analysis: SHOW YOUR WORK for the first trial! (for other trials, you can just calculate & record answers)**

- 1) Determine the mass of baking soda in each test tube.
- 2) Determine the mass of sodium chloride produced in each test tube
- 3) Determine the moles of baking soda for each test tube
- 4) Determine the moles of sodium chloride for each test tube.
- 5) Determine the experimental mole ratio of  $\text{NaHCO}_3$  to  $\text{NaCl}$  to the correct number of significant figures.

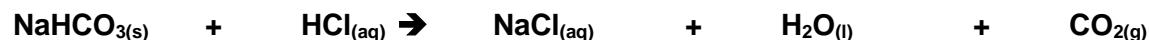
**Table of Analysis Examples and Values**

Mass of Baking Soda	Trial 1 Example	Trial 2
		Trial 3
		Trial 4
Mass of Sodium Chloride	Trial 1 Example	Trial 2
		Trial 3
		Trial 4
Moles of Baking Soda	Trial 1 Example	Trial 2
		Trial 3
		Trial 4
Moles of Sodium Chloride	Trial 1 Example	Trial 2
		Trial 3
		Trial 4
Mole Ratio: $\text{NaHCO}_3/\text{NaCl}$	Trial 1 Example	Trial 2
		Trial 3
		Trial 4

**Complete the attached page with post-lab / analysis questions!**

**Questions:**

1) Balance the equation for this reaction:



2) What is the mole ratio of NaHCO<sub>3</sub> to NaCl from this balanced equation? \_\_\_\_\_

3) Calculate the AVERAGE experimental mole ratio of NaHCO<sub>3</sub> to NaCl using the results of all trials from the analysis table above.

4) Using your experimental mole ratio from each trial and the theoretical mole ratio (from the balanced equation), calculate the percent error for the mole ratio.

5) List 3 possible sources of error unique to this lab & suggest methods to fix / improve them in future similar experiments.

6) If a sample contains 20.0 grams of hydrochloric acid and 20.0 grams of sodium bicarbonate, do they contain the same number of moles? **Explain.**

7) What is the advantage of doing multiple trials instead of one?

8) If 112.3 g of NaHCO<sub>3</sub> react with excess HCl, what is the **theoretical yield** of NaCl (in grams)?