CHEM. I LAB: MASS AND MOLE RELATIONSHIPS IN A CHEMICAL REACTION

What to turn in:	Hypothesis, Data Table 1, Data Table 2, Data Table 3, Calculations, Error analysis (if needed), Questions # 1-5

Objectives

- To relate masses and moles of reactants and products in a chemical reaction
- To predict mole ratios and compare experimental vs. theoretical results.

Background Information

Chemical equations provide both qualitative (verbal) and quantitative (numerical) information.

In this lab you will be reacting solid *sodium bicarbonate (sodium hydrogen carbonate)* with *hydrochloric acid* to form *carbon dioxide, water, and sodium chloride*. The solid product will be dried and massed. The experimental determination of the masses involved will allow you to calculate numbers of moles. The results can be tested against the balanced equation.

Materials

sodium bicarbonate (baking soda)	small graduated cylinder	stirring rod
hydrochloric acid, 3 M concentration	evaporating dish	spatula or scoopula
hot plate or burner with tubing	watch glass	crucible tongs or forceps

Procedure

1) Measure the mass of a clean, dry evaporating dish and watch glass cover. Use as many decimal places as shown. Record in Data Table 2.
2) Zero (tare) the balance.
3) Add 1.00 to 1.25 grams of sodium bicarbonate to the evaporating dish. Any amount in between in acceptable. Record the exact mass in Data Table 2.
4) Using your graduated cylinder, obtain 5 mL of hydrochloric acid.
5) Slowly add the 5 mL of hydrochloric acid to the sodium bicarbonate in the evaporating dish. Stir. If necessary, add a few more drops of acid *until the bubbling stops.*

Caution: Hydrochloric acid is caustic and corrosive. Do not breathe vapors. Flush spills with water.

6) Place the evaporating dish on the hotplate on medium high heat (or on a ring clamp with wire gauze clamped to a ring stand, with burner and tubing).
7) Heat uncovered until the liquid is mostly evaporated. Cover the dish with the watch glass, concave side up, to prevent spattering and loss of product.

Caution: Handle hot glassware with forceps and tongs.

8) If necessary, remove the watch glass to blot the condensation on a paper towel. Be careful not to lose any solid residue.
9) Heat the contents until only a dry solid remains. Be sure it is completely dry, that no more vapor is coming off.
10) Remove the evaporating dish from the heat, and cool it for at least 10 minutes.
11) Mass the cool evaporating dish, cover, and solid product. Record in Data Table 2.
12) Clean the glassware.

Calculations

1) mass → moles of sodium bicarbonate
2) mass → moles of sodium chloride
3) whole number experimental mole ratio of sodium bicarbonate to sodium chloride
   *** ERROR ANALYSIS IS NEEDED IF NOT 1:1 ***
4) theoretical yield of sodium chloride (mass-mass)
5) percent yield (actual / theoretical) x 100
   *** ERROR ANALYSIS IS NEEDED IF BELOW 60% ***

DATA TABLE 1

Balanced equation (double displacement): _____

Balanced equation (with three products): _____

	NAME	FORMULA
solid reactant	_____	_____
liquid reactant	_____	_____
solid product	_____	_____
liquid product	_____	_____
gaseous product	_____	_____

Theoretical mole ratio (coefficients) of sodium bicarbonate : sodium chloride _____ : _____

DATA TABLE 2

PRE-REACTION:

Mass of evaporating dish and watch glass cover	_____ g
Mass of evaporating dish, watch glass cover, and sodium bicarbonate	_____ g
Mass of sodium bicarbonate used	_____ g
Moles of sodium bicarbonate used	_____ moles

POST-REACTION:

Mass of evaporating dish, watch glass cover, and sodium chloride	_____ g
Mass of sodium chloride produced	_____ g
Moles of sodium chloride produced	_____ moles

CALCULATED experimental mole ratio of sodium bicarbonate : sodium chloride

_____ : _____

WHOLE NUMBER experimental mole ratio of sodium bicarbonate : sodium chloride

_____ : _____

DATA TABLE 3

Actual yield of sodium chloride (g) _____

Theoretical yield of sodium chloride (g) _____

Percent yield (%) _____

Questions

1) Why should acid be added to the solid reactant "until all bubbling stops"?
2) Why must all chemical equations be balanced? What Law is being proved?
3) How are you sure this reaction involved a chemical change?
4) Give the chemical formula of the gaseous product that was lost to the air.
5) Explain the relationship between moles and coefficients of a balanced equation.