When two reactants are mixed, how much gas is made, and which reactant sets the limit?

Name _____ Date _____

MATERIALS

You supply everything. Tick each item as you gather it.

- ☐ Baking soda (sodium bicarbonate) and white vinegar (5 percent acetic acid)
- ☐ A kitchen scale that reads to the nearest gram
- ☐ 5 identical bottles of about 500 mL (water or soda bottles)
- ☐ 5 balloons of the same kind, a funnel and a measuring cup
- ☐ A string or flexible tape measure to measure around a balloon, and a calculator

SAFETY

Baking soda and vinegar are safe, but the reaction foams and the gas builds pressure. Do not seal it in a rigid closed container. Use a balloon on the bottle, not a stopper, so that the gas can expand. Work over a tray, and wear safety glasses in case a balloon pops or comes off.

PROCEDURE

1. Weigh out 5 g of baking soda for each trial. Use a funnel to put it into a balloon. Record the mass you actually weighed.
2. Pour 20 mL of vinegar into a bottle. Stretch the balloon over the mouth of the bottle without letting the baking soda fall in yet.
3. Lift the balloon so that the baking soda falls into the vinegar. Shake the bottle gently and wait until the fizzing stops, about 2 minutes.
4. Measure around the widest part of the inflated balloon with the string, in centimeters. Convert to volume with $V = C^3 \div (6\pi^2)$, where C is the circumference. Use cm^3 for the volume ($1\ cm^3 = 1$ mL).
5. Repeat with 40, 60, 80 and 100 mL of vinegar, using a new balloon each time and the same 5 g of baking soda.
6. Calculate the moles of $NaHCO_3$ and of acetic acid, find the limiting reactant, and the theoretical volume of CO_2 (24.5 L per mole at room temperature).

RECORD YOUR DATA

Vinegar (mL)	Balloon circumference (cm)	Gas volume (mL)	Theoretical volume (mL)	Percent yield
20				
40				
60				
80				
100				

LAB REPORT

Write a report that gives your table, shows the mole calculations for one trial below the limit and one above it, graphs gas volume against the volume of vinegar, and identifies the point where the limiting reactant changes. Calculate the percent yield and explain why it is below 100 percent.

Report the numbers you actually got, even when they disagree with the lesson. Write on the lines, or type your report on the website and send it to a teacher there.

Question and hypothesis *State the question in your own words, what you expect to happen, and why you expect it.*

Method *What you changed, what you measured, what you kept the same, and how many trials you ran.*

Observations *Describe what you saw, including anything unexpected. Your data tables are added to the report automatically.*

Calculations *Show each calculation step by step, with units.*

Claim and reasoning *Answer the question using your numbers, then explain why, using the science from the unit.*

Limits and next step *What could have affected your results, and one change you would make next time.*