Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Period: \_\_\_\_\_\_

**Airbag Lab (gas stoichiometry)**

**Lab objective**:

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**Materials**:

* Vinegar (5% acetic acid)
* Baking soda (sodium bicarbonate)
* Electronic scale
* Graduated cylinders
* Ziploc bag
* Calculator

**Procedure:**

1. Balance the chemical reaction of baking soda and vinegar:

\_\_ NaHCO3 + \_\_ HC2H3O2 🡪 \_\_ NaC2H3O2 + \_\_ CO2 + \_\_ H2O

1. Find a partner (groups of 2) and get a Ziploc bag from Mr. Schultz
2. Record the current temperature:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Pressure: \_\_\_\_\_\_\_\_\_\_\_\_\_ in the room.
3. Determine the volume of your Ziploc bag in liters: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Calculate the mass of baking soda (sodium bicarbonate) required to completely fill your airbag.
5. Calculate the volume vinegar (5% acetic acid) required to completely fill your airbag. This can’t simply be done using stoichiometry because your calculated answer in grams of vinegar would only be correct if you were using pure acetic acid (very reactive). So not what? We MUST consider the concentration of vinegar is only 5% acetic acid meaning it is 95% water and only 5% acid. The way we do this is using molarity (mol/ 1 liter solution). Vinegar has a molarity (M) of 0.833 mol/1 liter solution. The volume of vinegar required to inflate your airbag is inversely proportional to the concentration (molarity) of vinegar. The lower the concentration of vinegar the greater the vol of vinegar required to inflate the airbag. As a result you MUST use the following ratio ($\frac{0.833 mol acetic acid}{1 L solution }$ ) somewhere in your stoichiometric calculations for #6. GOOD LUCK!!!!!!
6. Measure out the calculated amounts of vinegar and baking soda from questions steps 5 and 6.
7. Figure out at technique to keep both reactants separated inside the sealed before you mix them.
8. Carefully shack your airbag until the reaction has stopped?
9. Open your airbag and rise it out. All the contents of your airbag can go down the drain.
10. Did your airbag fully inflate? Yes or No. If no, discuss reasons why
11. Repeat steps 1-10 for a second trial.

**Follow-up Questions:**

1. Did you consider how much of the total volume of your airbag the reactants take up before the baking soda and vinegar were mixed together? Explain in detail.
2. Was the reaction endothermic or exothermic? How could you tell?
3. A typical airbag contains 50.0 g of sodium azide, NaN3. Upon impact, the airbag deploys and inflates within 40 milliseconds to a volume of about 60 L, at a velocity between 150 and 250 mph. The airbag inflates due to the decomposition reaction of NaN3 and fills with nitrogen gas in the following reaction:

2NaN3(s) 🡪 2Na(s) + 3N2(g)

* 1. If 50.0 g of NaN3 decompose, how many moles of N2(g) will be produced? How many grams of N2(g) will be produced?
	2. How many moles of Na(s) will be formed from this reaction? How many grams of Na(s) will be formed?
	3. A second reaction has to occur to remove the Na, which is highly reactive and potentially explosive. Balance the following reactions, and determine how many grams of KNO3 that should be placed in the airbag to fully react with the Na.

\_\_\_ Na + \_\_\_ KNO3 🡪 \_\_\_ K2O + \_\_\_ Na2O + \_\_\_N2 (g)

* 1. How much additional N2(g) in grams will be produced by the second reaction?