Purpose:

In this investigation, you will carry out and measure the mass of reactants and products of a simple chemical reaction. The data you measure will allow you to determine both the theoretical yield of the reaction and the actual percent yield of the reaction.

Theoretical yield is the amount of product formed from the complete conversion of a limiting reactant in a chemical reaction.

The theoretical yield is calculated using the balanced chemical equation to determine moles of reactants and moles of product, converting moles to grams.

You will also use the data from an experiment to calculate the percent yield.

Percent yield is the ratio of the actual yield and the theoretical yield of a material. It is a measure of the reaction's efficiency. It is calculated by dividing the actual yield of a reaction by the theoretical yield, multiplied by 100.

Safety:

It is important to wear eye protection goggles. All material should be disposed of following teacher instructions.

Materials:

1 250 mL flask	balance
effervescent tablet (Alka-Seltzer®)	water
graduated cylinder	calculator
periodic table	safety goggles

Procedure:

When an effervescent tablet is added to water, sodium bicarbonate ($NaHCO_3$) reacts with tartaric acid ($H_2C_4H_4O_6$) from the tablet. The products of this reaction are sodium tartrate ($Na_2C_4H_4O_6$), carbon dioxide (CO_2) and water (H_2O).

1. First, put on safety goggles. Use the balance to find the mass of the effervescent tablet. CAUTION: Keep the tablet dry.

2. Fill a flask about 1/3 full of water and find the mass of the water-filled flask.

3. Drop the tablet into the flask and allow the reaction to take place. It is a good idea to stir the mixture to be sure the reaction is complete.

4. Find the mass of the flask and its content after the reaction is complete.

Data Table:

Mass of the effervescent tablet	
Mass of flask with water	
Mass of flask and contents after the reaction	

Data Analysis:

Use the following BALANCED equation together with the data you collected in your investigation to answer the following questions.

$$2NaHCO_3 \quad + \quad H_2C_4H_4O_6 \quad \rightarrow \quad Na_2C_4H_4O_6 \quad + \quad 2\,CO_2 \quad + \quad 2\,H_2O$$

| baking soda | tartaric acid | sodium tartrate | carbon dioxide | water |

1. The total mass of the reaction system before the reaction is _____.
   (mass of tablet + mass of flask with water)

2. The carbon dioxide is the gas that bubbled away in the reaction. The mass of carbon dioxide that bubbled away is _____.
   (total mass of reaction system – mass of the flask and contents after the reaction)

3. Using the mass of carbon dioxide from question 2, what is the mass of sodium bicarbonate ($NaHCO_3$) in the tablet?_____

4. Using the mass of carbon dioxide from question 2, what was the mass of tartaric acid ($H_2C_4H_4O_6$), in the tablet?_____.

5. Using the mass of carbon dioxide from question 2, what mass of water should have been produced by this reaction?_____.

Concluding calculations:

1. An effervescent tablet was measured to contain 0.94 g sodium bicarbonate. The tablet is placed in water and the reaction occurs as in the experiment you conducted. What is the theoretical yield of carbon dioxide from this 0.94 g tablet??_____.

2. When the reaction is complete, the mass of carbon dioxide that bubbled away is found to be 0.46 g. What is the percent yield of carbon dioxide for this reaction?_____.