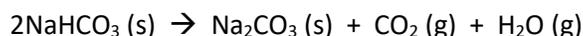


Thermal Decomposition of Sodium Bicarbonate

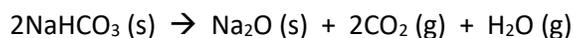
Your Task: There are at least four different balanced chemical equations that could explain how atoms are rearranged during the thermal decomposition of sodium bicarbonate (NaHCO_3). The first potential explanation is that the sodium bicarbonate decomposes into sodium hydroxide (NaOH) and carbon dioxide (CO_2) when it is heated. The balanced chemical equation for this reaction is



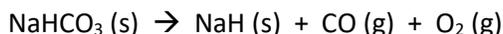
The second potential explanation is that the sodium bicarbonate decomposes into sodium carbonate (Na_2CO_3), carbon dioxide (CO_2), and water when it is heated. The balanced chemical equation for this reaction is



The third potential explanation is that the sodium bicarbonate decomposes into sodium oxide (Na_2O), carbon dioxide, and water when it is heated. The balanced chemical equation for this potential reaction is



The fourth potential explanation is that the sodium bicarbonate decomposes into sodium hydride (NaH), carbon monoxide (CO), and oxygen when it is heated. The balanced chemical equation for this potential reaction is



Your goal is to determine which of these four balanced chemical equations best represents how atoms are rearranged during the thermal decomposition of sodium bicarbonate.

Guiding Question—What is the correct balanced equation for the thermal decomposition of sodium bicarbonate?

Materials

You may use any of the following materials during your investigation:

Consumable	Equipment
Solid NaHCO_3	portable burner
	flint sparker
	glass stirring rod
	test tube
	test tube clamp
	electronic scale
	weighing boat
	scooper/spatula
	wood splints

Safety Precautions

Follow all normal lab safety rules. In addition, take the following safety precautions:

- Wear your safety goggles at all times while in the lab
- Use caution when working with Bunsen burners. They can easily burn skin, and combustibles and flammables must be kept away from the open flame. If you have long hair, tie it back behind your head.
- Inspect your test tube for cracks. If it is cracked, exchange it for a new one.
- Be careful with the test tube after removing it from a flame since it may still be hot.
- Wash your hands with soap and water before leaving the lab.

Getting Started

As part of your investigation, you will need to use a Bunsen burner and a test tube (see Figure 1) to increase the temperature of sodium bicarbonate enough for it to decompose. The thermal decomposition of sodium bicarbonate will occur rapidly at 200 °C, but the solid product of the decomposition reaction will begin to decompose at temperatures over 850 °C.

To answer the guiding question, you will also need to determine what type of data you will need to collect during your investigation, how you will collect the data, and how you will analyze the data.

To determine *what type of data to collect*, think about the following questions:

- How much NaHCO_3 will you need to use?
- What will you need to measure or observe?
- How will you know if CO_2 , O_2 , or H_2O gas is produced?

To determine *how you will collect the data*, think about the following questions:

- How long will you need to heat the NaHCO_3 ?
- How will you empirically determine when the decomposition of the NaHCO_3 is complete?
- How will you reduce error?

To determine *how you will analyze the data*, think about the following questions:

- What type of calculations will you need to make?
- How will you know you chose the correct potential chemical equation?
- How will your group consider the precision of the balance in your analysis?

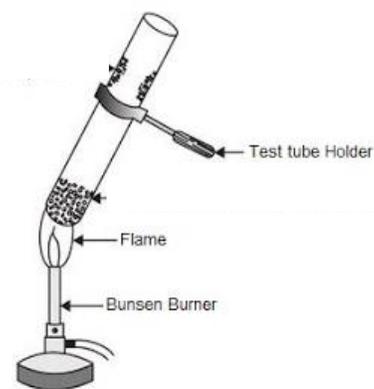


Figure 1

Initial Argument

Once your group has finished collecting and analyzing your data, you will need to develop an initial argument. Your argument must include a claim, which is your answer to the guiding question. Your argument must also include evidence in support of your claim. The evidence is your analysis of the data and your interpretation of what the analysis means. Finally, you must include a justification of the evidence in your argument. You will therefore need to use a scientific concept or principle to explain why the evidence that you decided to use is relevant and important. You will create your initial argument on a whiteboard. Your whiteboard must include all the information shown in Figure 2.

Guiding Question:	
Our Claim:	
Our Evidence:	Our Justification of the Evidence:

Figure 2

Note: This lab is modified by an original provided by Mr. Ben Meacham ([@MeachTeach](#))