Demonstration: Firefighter or Fireball

Background
Chemical reactions happen all around us. It is important for a chemistry student to be able to predict the products of a chemical reaction from the reactants used. In this way, students can decide whether or not one reaction will feed another, or if the products of a reaction will inhibit other reactions. We have learned to classify reactions into types, based on the reactants used and the products that will be formed. The types of reactions that have been discussed include synthesis, decomposition, single replacement, double replacement, and combustion reactions. In this demonstration, you will need to recall these classifications of reactions in order to predict and then confirm, the reactions that occur in the demonstration.

Pre-lab Questions
1. Define the following vocabulary words:
   a. Reactant:
   b. Product:
   c. Synthesis reaction:
   d. Decomposition reaction:
   e. Single replacement reaction:
   f. Double replacement reaction:
   g. Combustion reaction:
   h. Reversible reaction:
   i. Nonreversible reaction:
2. For the following reactions, identify the type of reaction and write it in the blank. Then predict the products of the reaction, then balance the equation:

   a. _______ Na + Cl₂ →
   b. _______ H₂CO₃ →
   c. _______ Li + HCl →
   d. _______ NaCl + Pb(NO₃)₂ →
   e. _______ C₃H₈ + O₂ →

Problem
Can the classification of a chemical reaction be used to predict the reactivity of the products of a chemical reaction?

Safety
- Wear proper safety gear during chemistry demonstrations. Safety goggles and lab apron are required.

Procedure
1. You will observe the demonstration performed by your teacher.
2. In the one balloon, baking soda and vinegar are combined. In the other balloon calcium carbide and water are combined.
3. Make careful observations about the reactions in each balloon in the data table below.

Observations

<table>
<thead>
<tr>
<th>Balloon 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations: What you see, hear, smell, and feel (or when the reaction is described to you)</td>
</tr>
</tbody>
</table>
Balloon 2

<table>
<thead>
<tr>
<th>Observations: What you see, hear, smell, and feel (or when the reaction is described to you)</th>
<th>Evaluation: What you think it means for each observation. Describe what is happening from the chemical point of view.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**Analysis**

Balloon #1:

Finish the chemical reaction for Balloon #1:

\[ \text{NaHCO}_3 + \text{HC}_2\text{H}_3\text{O}_2 \rightarrow \]

1. Usually, in a double replacement reaction, there are 2 products. What are the products of the reaction above, if it was a typical double replacement reaction?

2. Since there was a gas produced from the reaction, what is the identity of the gas? Describe how the reaction of the match with the balloon helps to confirm your guess about the identity of the gas.

3. What are the products for a combustion reaction? How is the reaction for Balloon #1 similar to a combustion reaction?
Analysis

Balloon #2:

Finish the chemical reaction for Balloon #2

\[ \text{CaC}_2 + \text{H}_2\text{O} \rightarrow \]

4. What was different for the reaction of the match with Balloon #2? Which product of the reaction was the match reacting with?

5. Describe the properties of the gasses produced from both reactions. How were they similar? How were they different? List and describe at least 2 similarities and differences between the two gases.

6. When the match was brought close to the balloon, why did the reaction of the gas produced in Balloon #2 stop? What reactant was consumed completely?

Conclusion

Chemical reactions can be reversible or nonreversible. Describe what you have learned about predicting whether a reaction is reversible or nonreversible, based off the type of reaction and the identity of the reactants and products of a reaction. Your description should be at least a paragraph in length and you should answer in terms of the Problem question posed at the beginning of this demonstration. Be sure to address the following aspects in your conclusion:

- Can you predict the reversibility of a chemical reaction from the reactants and products?
- How can you apply what you have learned in this demonstration to a real-life scenario? For example, can you write an equation for a reaction you have observed in real life?