Synthesis Reactions

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In this photo of Los Angeles, California, the air over the city is brown with smog. A major component of smog is nitrogen dioxide, which is a toxic gas with a sharp odor. Nitrogen dioxide can irritate the eyes and throat and trigger asthma attacks. Where does this poisonous gas come from? It forms when nitric oxidesources such as car exhaustwith oxygen in the air. This reaction is a synthesis reaction.

What Is a Synthesis Reaction?

A synthesis reaction occurs when two or more reactants combine to form a single product. A synthesis reaction can be represented by the general equation:

\[ A + B \rightarrow C \]

In this equation, the letters A and B represent the reactants that begin the reaction, and the letter C represents the product that is synthesized in the reaction. The arrow shows the direction in which the reaction occurs.

Q: What is the chemical equation for the synthesis of nitrogen dioxide (NO\(_2\)) from nitric oxide (NO) and oxygen (O\(_2\))?  
A: The equation for this synthesis reaction is:

\[ 2NO + O_2 \rightarrow 2NO_2 \]
Examples of Synthesis Reactions

Another example of a synthesis reaction is the combination of sodium (Na) and chlorine (Cl) to produce sodium chloride (NaCl). This reaction is represented by the chemical equation:

\[ 2Na + Cl_2 \rightarrow 2NaCl \]

Sodium is a highly reactive metal, and chlorine is a poisonous gas. Both elements are pictured in the Figure 1.1. The compound they synthesize has very different properties. Sodium chloride is commonly called table salt, which is neither reactive nor poisonous. In fact, salt is a necessary component of the human diet. You can see more examples of synthesis reactions at this URL: http://www.youtube.com/watch?v=dxlWtsFinTM.

Summary

- A synthesis reaction occurs when two or more reactants combine to form a single product. This type of reaction is represented by the general equation: \( A + B \rightarrow AB \).
- An example of a synthesis reaction is the combination of sodium (Na) and chlorine (Cl) to produce sodium chloride (NaCl). This reaction is represented by the chemical equation: \( 2Na + Cl_2 \rightarrow 2NaCl \).

Vocabulary

- **synthesis reaction**: Chemical reaction in which two or more reactants combine to form a single product.

Practice

Watch the two-video sequence on synthesis reactions at the following URLs, and then answer the questions below.

http://www.youtube.com/watch?v=HIZoGe-CR5Q&feature=related

http://www.youtube.com/watch?v=JG121vFEle4&NR=1&feature=endscreen
1. Why is it easy to identify synthesis reactions?
2. What is the product of the synthesis reaction in which sodium combines with oxygen?
3. Write a balanced chemical equation for the synthesis reaction in which nitrogen reacts with hydrogen.
4. Complete the following two synthesis reactions by filling in the missing products:
   a. 2Al + 3Br₂ → ?
   b. 2K + S → ?

Review

1. What is a synthesis reaction?
2. Describe the synthesis reaction that produces table salt.
3. Which of the following is a synthesis reaction?
   a. 2H₂O → 2H₂ + O₂
   b. 2NO + O₂ → 2NO₂
   c. 2K + 2H₂O → 2KOH + H₂
   d. CH₄ + 2O₂ → CO₂ + 2H₂O

References

1. Sodium: User:Jurii/Wikimedia Commons; Chlorine: User:Greenhorn1/Wikimedia Commons; Salt: Dubravko Sorić. Sodium: CC BY 3.0; Chlorine: Public Domain; Salt: CC BY 2.0