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GRCI Science
SCH3UI

Comparing Complete and Incomplete Combustion

The combustion of hydrocarbons can be either complete or incomplete, depending on the amount of oxygen that is available and on the conditions during the reaction. In this investigation, you will design a procedure to combust butane gas, $C_4H_{10(g)}$, and candle wax, $C_{25}H_{52(s)}$, under different conditions to compare the products of complete and incomplete combustion. Note that candle wax is a mixture of hydrocarbons, and the chemical formula $C_{25}H_{52(s)}$ is used as a representation of the mixture.

Pre-Lab Questions:

1. Compare and contrast complete and incomplete combustion.
2. Write a list of safety issues concerning combustion reactions and the compound you will be working with in this investigation.

Question:

How can complete and incomplete combustion of a hydrocarbon be recognized?

Materials

- | | |
|------------------------------|--|
| ▪ Candle | ▪ Stand and clamp |
| ▪ Butane lighter | ▪ Wooden splint |
| ▪ Matches | ▪ Graduated cylinder |
| ▪ Cobalt (II) chloride paper | ▪ 2-250ml Erlenmeyer flasks and stoppers |

The products of combustion can be collected by inverting an Erlenmeyer flask over the flame of a Bunsen burner.



Plan and Conduct

Part 1: Complete Combustion of Butane

1. With your group, design a procedure to collect the products of the complete combustion of butane gas. Decide what observations and tests you will use to identify the combustion products you collect.
2. Show your experimental plan to your teacher before beginning your investigation.
3. Conduct your investigation, and record your results in an appropriate observations table.

Part 2: Incomplete Combustion of Candle Wax

4. With your group, design a procedure to collect the products of the incomplete combustion of candle wax. Decide what observations and tests you will use to identify the combustion products you collect.
5. Show your experimental plan to your teacher before beginning your investigation.
6. Conduct your investigation, and record your results in an appropriate observations table.

Analyze and Interpret

1. What products of combustion did you collect in Part 1? How did you identify these products?
2. How did your results indicate that the butane in Part 1 was undergoing complete combustion?
3. What products of combustion did you collect in Part 2? How did you identify these products?
4. What evidence did you use to conclude that the candle wax in Part 2 was undergoing incomplete combustion?

Conclude and Communicate

5. Write the balanced chemical equation for the complete combustion of butane gas.
6. Write the balanced chemical equation of the incomplete combustion of candle wax when 24 molecules of oxygen gas are combined with the candle wax. (Assume all four products are formed)