

Chemistry 30: Enthalpy of Hydrocarbon Combustion Lab

Name _____ Partner(s) _____ Score _____ / 17

In this experiment, you will determine a lab value for the molar enthalpy for the combustion when candle wax burns ($C_{25}H_{52(s)}$). When a candle burns, more energy is released when the new bonds form in the products than is required to break the existing bonds of the reactants.

Purpose: To find the experimental value for the molar enthalpy of combustion for candle wax.

Prelab:

- Write a balanced equation for the complete combustion of candle wax. (1 mark)
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- Using the theoretical value for combustion of candle wax as $1.01 \times 10^4 \frac{kJ}{mol}$, calculate the heat of formation for candle wax. (2 marks)

Materials needed:

- Candle, tin can and lid, metal calorimeter, ring stand, glass rod, ring clamp, thermometer, water, electronic scale, matches

Procedure:

1. Attach the candle to the tin can lid. Weigh and record the mass.
2. Weigh the smaller empty clean, dry can. Record.
3. Fill the can about 2/3 with cold tap water (should be 10 to 15 °C below room temperature). Be sure to record the initial temperature of the water. Record room temperature at the beginning and end of the lab today.
4. The candle that is attached to a base should be adjusted so the top of the flame is about 5 cm from the bottom of the small can containing the water. Place a larger can round the outside to help protect the flame and try to keep heat from leaving the system.
5. Light the candle and quickly place all the parts of the apparatus in their correct places and continue to heat until the water reaches a temperature as far above the room temperature as it initially was below the room temperature. Stir gently (with the stir rod – not the thermometer) while the water is heating.

6. Blow out the candle when the desired water temperature is reached. Continue to stir the water for about 3 minutes and record the highest temperature that the thermometer shows during that time.
7. Re-weigh and record the mass of the candle and lid
8. Re- weigh and record the mass of the can and water
7. Empty the water from the can and dry it thoroughly. Weigh the can and record the mass.
8. Record whether or not any carbon black has formed on the bottom of the can
9. If carbon black has formed, use steel wool to remove it and weigh the can again. (any difference in mass between 10 and 11 will be the mass of carbon black produced by the burning of the candle)

Observations: On a separate sheet make a clear and legible table to organize all the observations that are made in this lab. If you attach no observations – **expect no marks for this lab. (5 marks)**

Analysis:

- a) Use the data from your observations to calculate the lab value for the molar enthalpy of combustion of candle wax. (Note the specific heat capacity value for carbon black is $0.712 \text{ kJ/kg}^\circ\text{C}$). Note the specific heat capacity for air is given in your data booklet) (3 marks)
- b) If the theoretical value for the combustion of candle wax is $-1.01 \times 10^4 \text{ kJ/mol}$, find the percentage yield for this lab. Give justifiable reasons why you are either over or under. Remember that reasons for one are VERY different from the reasons for the other. Be sure to consider such things as (3 marks)
 - a. Did water disappear from the can? If so, what does this mean?
 - b. Is there carbon black on the bottom of the can? If so, what does this mean?
 - c. Did the temperature of the room change as the experiment proceeded? If so, what does this mean?
- c) Compare your data with at least two other lab groups. (Make a table comparing the Δt , mass of candle burned and the molar enthalpy of combustion that you calculated.) Explain either the similarity or the difference between your observations and that of the other groups. (3 marks)