PRELIMINARY ACTIVITY FOR

Fossil Fuel Energy

Hydrocarbons are compounds containing only hydrogen and carbon atoms. Many common fuels such as gasoline, diesel fuel, heating oil, aviation fuel, and natural gas are essentially mixtures of hydrocarbons. Paraffin wax, used to make many candles, is a mixture of hydrocarbons with the representative formula $C_{25}H_{52}$.

Ethyl alcohol, a substituted hydrocarbon with the formula C_2H_5OH, is used as a gasoline additive (gasohol) and as a gasoline substitute.

In the Preliminary Activity, you will determine the heat of combustion of paraffin wax (in kJ/g). You will first use the energy from burning paraffin wax to heat a known quantity of water. By monitoring the temperature of the water, you can find the amount of heat transferred to it (in kJ), using the formula

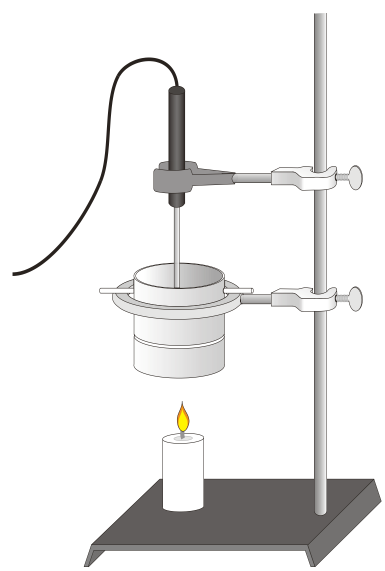
$$q = C_p \bullet m \bullet \Delta t$$

where q is heat, C_p is the specific heat capacity of water, m is the mass of water, and Δt is the change in temperature of the water. Finally, the *amount* of fuel burned will be taken into account by calculating the heat *per gram* of paraffin wax consumed in the combustion.

After completing the Preliminary Activity, you will first use reference sources to find out more about fossil fuel energy before you choose and investigate a researchable question. Some topics to consider in your reference search are:

- combustion
- fuels
- fossil fuels
- hydrocarbons
- gasohol
- energy efficiency

PROCEDURE



1. Obtain and wear goggles.
2. Connect the Temperature Probe and the data-collection interface.
3. Set the data-collection program up to collect data for twenty minutes following your teacher's instructions.
4. Use some melted wax to affix a candle to a small index card.
5. Find and record the combined mass of the candle and index card.
6. Determine and record the mass of an empty can. Add 100 mL of chilled water to the can. Determine and record the mass of the can and water.
7. Set up the apparatus as shown in the figure at the right. Use a ring and stirring rod to suspend the can about 5 cm above the wick. Use a utility clamp to suspend the Temperature Probe in the water. The probe should not touch the bottom of the can. **Important:** Stir the water until the Temperature Probe has cooled to the temperature of the water before you do Step 8.

8. Begin data collection. After about 15 seconds, light the candle. Record the initial temperature. Heat the water until its temperature reaches 40°C and then extinguish the flame. **CAUTION:** *Keep hair and clothing away from an open flame.*
9. Continue stirring the water until the temperature stops rising. Record this final temperature, and then stop data collection.
10. Determine and record the final mass of the cooled candle and index card, including all drippings.

QUESTIONS

1. Find the mass of water heated.
2. Find the change in temperature of the water, Δt.
3. Calculate the heat absorbed by the water, q, using the formula in the introduction of this experiment. For water, C_p is 4.18 J/g°C. Change your final answer to kJ.
4. Find the mass of paraffin wax burned.
5. Calculate the heat of combustion for paraffin wax in kJ/g. Use your Step 3 and Step 4 answers.
6. Calculate the *% efficiency* of the experiment. Divide your experimental value (in kJ/g) by the accepted value, and multiply the answer by 100. The accepted heat of combustion of paraffin wax is 41.5 kJ/g.
7. Discuss heat loss factors that contribute to the inefficiency of the experiment.
8. List at least one researchable question for this experiment.