LESSON 103 LAB

Fuelish Choices
Heat of Combustion

Name ______________________

Date ____________ Period ______

Purpose

To perform a calorimetry procedure to compare two liquid fuels.

Materials

- 2 alcohol burners
- box of matches
- thermometer
- wire gauze
- ruler
- ring stand
- ring clamps
- 50 mL graduated cylinder
- 50 mL beaker
- 50 mL water
- 25 mL methanol, CH_4O
- 25 mL isopropanol, C_3H_8O

Procedure

1. Perform steps 2–6 with the alcohol burner containing methanol. Then repeat these steps with isopropanol.
2. Measure the mass of the burner including cap, wick, and alcohol. Record the mass in the data table.
3. Fill a 50 mL beaker with 25 mL of water. Record the temperature of the water in the data table.
4. Use the alcohol burner to heat the water to about 20 °C above its original temperature. Make sure the burner is located about 2 or 3 cm below the bottom of the beaker.
5. Quickly extinguish the flame by placing the cap over the wick. Record the water temperature in the data table. Remove the beaker from the ring stand.
6. Measure the mass of the entire burner again, including the cap. Record the mass in the data table.

Alcohol	Measured Data				
	Initial mass of burner (g)	Final mass of burner (g)	Initial temperature of water (°C)	Final temperature of water (°C)	Volume of water (mL)
methanol					
isopropanol					

Analysis

1. Complete the calculations to determine the mass of water, the change in temperature, and the mass of alcohol burned. Fill in the values in this table.

Alcohol	**Calculations**		
	Mass of water (g)	**Change in temperature (ΔT) (°C)**	**Mass of alcohol burned (g)**
methanol			
isopropanol			

2. Write the balanced chemical equations for the combustion of both fuels.

3. Use your data to calculate the energy, in calories, transferred to the water by burning the methanol.

4. Use your data to calculate the energy, in calories, transferred to the water by burning the isopropanol.

5. Determine the number of calories transferred per gram when you burn 1 g of methanol.

6. Determine the number of calories transferred per gram when you burn 1 g of isopropanol.

7. Determine the number of calories transferred per mole of methanol.

8. The molar mass of isopropyl alcohol is 60.0 g/mol. Determine the number of calories transferred per mole of isopropanol.

9. This table lists energy data for the combustion of a variety of fuels. Complete the table.

Fuel	**Chemical formula**	**Energy (kcal/mol)**	**Molar mass (g/mol)**	**Energy (kcal/g)**
octane	$C_8H_{18}(l)$	1300 kcal/mol	114 g/mol	
propane	$C_3H_8(g)$	526 kcal/mol		11.9 kcal/g
glucose	$C_6H_{12}O_6(s)$	676 kcal/mol	180 g/mol	3.7 kcal/g
hexanol	$C_6H_{14}O(l)$	951 kcal/mol	102 g/mol	
isopropanol	$C_3H_8O(l)$	480 kcal/mol	60.0 g/mol	

Fuel	Chemical formula	Energy (kcal/mol)	Molar mass (g/mol)	Energy (kcal/g)
paraffin	$C_{22}H_{46}(s)$	3493 kcal/mol	310 g/mol	11.3 kcal/g
methane	$CH_4(g)$	213 kcal/mol	16 g/mol	
methanol	$CH_4O(l)$	174 kcal/mol		
nitromethane	$CH_3NO_2(l)$	175 kcal/mol	61 g/mol	2.9 kcal/g
hydrogen	$H_2(g)$	68 kcal/mol		

10. Why do you think your experimental values for methanol and isopropanol are so different from the actual values given in the table?

11. List the top three fuels from the table in terms of the amount of energy released per mole of substance combusted.

12. List the top three fuels in terms of the amount of energy released per gram of substance combusted.

13. What is the main difference between the fuels listed in question 11 and those in question 12?

14. Which releases more energy: burning 100 g of octane, 100 g of methanol, or 100 g of hydrogen? Which provides the least amount of energy?

15. **Making Sense** If you had to choose among methane, methanol, or hexanol as fuel for a rocket, which would you prefer? Explain your answer.

16. **If You Finish Early** Hydrogen is used as a rocket fuel. How many grams of octane would you need to burn to produce the same amount of energy as burning 100,000 g of hydrogen?