Please do not write on this paper.

Heat of Combustion: Applied (show your work, and box answers.)

Heats of Combustion for selected Hydrocarbons			
Hydrocarbon	Formula	Heat of Combustion (kJ/g)	Molar Heat of Combustion (kJ/mol)
Methane	CH_4	55.6	890
Ethane	C_2H_6	52.0	1560
Propane	C_3H_8	50.0	2200
Butane	C_4H_{10}	49.3	2859
Pentane	C_5H_{12}	48.8	3510
Hexane	C_6H_{14}	48.2	4141
Heptane	C_7H_{16}	48.2	4817
Octane	C_8H_{18}	47.8	5450

1. Methane is the largest component of natural gas.
   a. Write a balanced chemical equation, including the quantity of energy produced, for the combustion of methane.
   b. If 10 moles of methane burns completely, how much thermal energy would be produced?
   c. If a home in Rio Rancho uses 23,600 moles (average) of natural gas in one month, how many kilojoules of natural gas would be consumed?

2. Ethane is the second-largest component of natural gas.
   a. Write a balanced chemical equation, including the quantity of thermal energy produced, for the combustion of ethane.
   b. If 11.0 mol ethane burns completely, how much thermal energy (heat) would be produced?
   c. How much thermal energy (heat) would be produced by burning 25.0 g ethane?

3. The balanced chemical equation for the combustion of hexane is provided below.

$$2C_6H_{14} + 19O_2 \rightarrow 12\,CO_2 + 14H_2O + \_\_\_\_\_ \text{ energy}$$

   a. Calculate the amount of thermal energy produced in the complete combustion of hexane as indicated in this equation.

5. The propane tank for most home barbeque grills holds 20 lbs of propane.
   a. How many kg is this? (1kg = 2.2lbs)
   b. How many moles?
   c. Write a balanced chemical equation, including thermal energy produced, for the combustion of propane.
   d. If 200 moles of propane burns completely, how much thermal energy (heat) would be produced (in kJ)?

6. The combustion of ethyne, C_2H_2 (acetylene -used in a welder's torch), can be represented as:

$$\_\_C_2H_2 + \_\_O_2 \rightarrow \_\_CO_2 + \_\_H_2O + 2512\text{ kJ}$$

   a. Balance the equation.
   b. What is the molar heat of combustion of acetylene in kJ per mole?
   c. If 12 mol acetylene burns fully, how much thermal energy will be produced?

7. A gallon of gasoline can be thought of as 2660 g of octane. Using the table provided:
   a. Find the number of kJ obtained by burning 25 gallons of gasoline.
   b. A well-tuned car may only use 25 percent of the energy burned for motion. How many kJ are "lost"?

8. The average person burns 12,000 kJ of food energy per day.
   a. How many kilocalories is this (1kcal = 1C = 4.184kJ)? How many calories (cal) is this?
   b. If the heat of combustion of sugar is 4000 cal/g, how many grams of sugar must you eat to get a day's supply of energy?
   c. If the heat of combustion of fat is 9000 cal/g, how many grams of fat must you eat to get a day's supply of energy?
   d. If your body ran on gasoline, how many grams of gasoline would you have to eat to get a day's supply of energy? How many gallons would this be?

9. Cars can run on grain alcohol (ethanol) instead of gasoline. A car that drives 15,000 miles per year and gets 20 miles/gal would require the alcohol made from 16,500 lbs of grain. An average person can survive if given 400 lbs of grain per year (355 medium-sized boxes of Wheaties cereal).
   a. If an average acre of land produces 1900 lbs of grain per year, how many acres of grain must be grown to supply the average car with ethanol?
   b. How many people could the acres feed?
   c. How far (miles) can a car go on 1 lb of grain (one box of Wheaties) that has been changed to ethanol?
   d. If there are 135 million cars in the United States today, how many acres of grain would be needed for ethanol?