

Heats of Combustion

Name _____

Sample Question:

How much thermal energy would be produced by burning 12.0 g octane, C_8H_{18} ?

- Table 3.9 indicates that burning 1.00 g octane releases 47.8 kJ. Burning 12 times more octane produces 12.0 times more thermal energy, so
 $12 \times 47.8 \text{ kJ} = 574 \text{ kJ}$

How much energy, in kilojoules, is released by completely burning 25.0 mol hexane, C_6H_{14} ?

- Table 3.9 indicates that the molar heat of combustion of hexane is 4141 kJ. This means that 4141 kJ of energy is released as 1.00 mol hexane burns. So, burning 25.0 times more hexane will liberate 25.0 times more energy, so
 $25 \times 4141 = 104,000 \text{ kJ}$

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
nonane	C_9H_{20}	44.3	5685
decane	$C_{10}H_{22}$	44.2	6294

Problems:

1) Write a chemical equation, including thermal energy, for the complete combustion of each of the following alkanes:

a) Propane

b) Butane

c) Octane

d) Decane

Use the table and/or the equations above to answer the following questions:

2) How much energy is released when 62 grams of pentane are burned?

3) How much energy is released by the combustion of 29 grams of nonane?

- 4) How much energy would be produced by burning 5 moles of propane?
- 5) How much energy would be produced by burning 20 moles of decane?
- 6) How much energy would be produced from 0.76 moles of butane?
- 7) How much energy would be produced by burning 1.97 moles of propane?
- 8a) How much thermal energy is produced by burning six moles of octane?
- b) How many moles of octane are in one gallon of octane (2660 grams)?
- c) Using the answer to (b), how much thermal energy is produced by burning one gallon of octane?
- d) Suppose a car operates so inefficiently that only 16% of the thermal energy from burning fuel is converted to useful "wheel turning" (mechanical energy). How many kilojoules of useful energy would be stored in a 20.0-gallon tank of gasoline? (Assume that octane burning and gasoline burning produce the same results.)