T8

Chemistry

Enthalpy Calculation and Stoichiometry

Gaseous Propane or (sold as LP or liquid propane) is the common gas used in gas grills. Over the course of grilling you produce 400g of Carbon Dioxide (product) and 12,700kJ of energy. Some of the energy is used for cooking your food and some just warms the air. The oxygen consumed from the atmosphere is considered to be in excess.

1. Write out the reaction that is occurring and balance it.

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

2. How many moles of CO_2 were used?

44g/mol $\quad 400g \cdot \frac{1\ mol}{44\ g} = \boxed{9.09\ mol} \cdot \frac{1}{3}$ → 3.03 mol C_3H_8

3. Determine the ΔH for the reaction.

→ Need KJ for 1 mol C_3H_8

$\frac{12{,}700KJ}{3.03\ mol} = \boxed{-4191\ KJ/1\ mol}$ ← exothermic

4. What is the original mass of propane used?

$3.03\ mol \cdot \frac{44}{1\ mol} = \boxed{133g}$

In a separate experiment 500g of methanol (CH_3OH) is used to heat up 1 gallon of water (8.3lbs = 3760g) raising the temperature of the water about 70 degrees.

5. Write out the reaction that is occurring and balance it.

$2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$

6. How much energy did the water gain?

$q = m \cdot \Delta T \cdot C$

$3760 \cdot 70 \cdot 4.18 = 110{,}000J$ (1100KJ)

7. Determine the ΔH° for the reaction.

$\frac{1100KJ}{15.6\ mol} = 70.5\ KJ/mol$ $\quad 500g \cdot \frac{1\ mol}{32\ g} = 15.6\ mol$

→ x2 $\boxed{-140KJ\ \Delta H}$ Rxn uses 2moles

8. What is the kJ/g of methanol?

1100/500 = 2.2KJ/g

Hydrogen burning releases 141kJ/g.

9. What is the enthalpy of combustion of hydrogen in the following reaction?

$2H_2 + O_2 \Rightarrow 2H_2O$

$\frac{141\ KJ}{1g} \cdot \frac{2g}{1\ mol} = -\frac{241\ KJ}{mol} \times 2 = -482\ KJ$ ΔH