

Reinforcement

Chapter 5

BLM 5-2

Thermochemical Equations and Stoichiometry

Goal

Reinforce your understanding of the stoichiometry of thermochemical equations.

Procedure

Answer the questions below in the spaces provided.

Questions

1. Consider the following thermochemical equation:



- (a) How much heat is released when 3.0 mol ZnS_(s) reacts in excess oxygen?

$$\frac{3}{2} \times -878.2 = \underline{\underline{-1317.3 \text{ kJ}}}$$

- (b) How much heat is released when 2.3×10^{-2} mol ZnS_(s) reacts in excess oxygen?

$$\frac{2.3 \times 10^{-2} \text{ mol}}{2 \text{ mol}} \times -878.2 \text{ kJ} = \underline{\underline{-10.1 \text{ kJ}}}$$

- (c) What is the enthalpy change when 223.9 g ZnS_(s) reacts in excess oxygen?

$\frac{223.9 \text{ g}}{97.46 \text{ g/mol}} = 2.297$	$= 2.3 \text{ mol}$	Zn 65.39
		S 32.07
		<u>97.46</u>

$$\therefore \frac{2.297}{2 \text{ mol}} \times -878.2 \text{ kJ} = \underline{\underline{-1009 \text{ kJ}}}$$

→ (d) What is the enthalpy change when 0.96 g ZnO(s) is produced?

$$\frac{0.96 \text{ g}}{81.39 \text{ g/mol}} = 0.0118 \text{ mol}$$

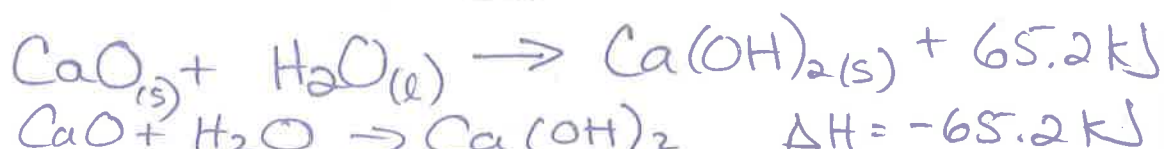
$$\frac{0.0118}{2} \times 878.2 = -5.18 \text{ kJ}$$

$$= -5.2 \text{ kJ}$$

Zn	65.39
O	16.00
	<u>81.39</u>

2. Slaked lime (Ca(OH)₂(s)) is produced when lime (calcium oxide, CaO(s)) reacts with liquid water. 65.2 kJ of heat is released for each mol of Ca(OH)₂ that is produced.

(a) Write a thermochemical equation for the reaction.



(b) What is the enthalpy change when 523.3 kg of lime reacts with excess water?

$$523.3 \text{ kg} = 523300 \text{ g}$$

$$\frac{523300 \text{ g}}{56.1 \text{ g/mol}} = 9327.986 \text{ mol}$$

$$= \underline{\underline{9328 \text{ mol}}}$$

mm of Lime
(~~Ca(OH)₂~~) (CaO)

Ca	40.08
O	16.00
	<u>56.1 g/mol</u>

$$\frac{-65.2 \text{ kJ}}{1 \text{ mol}} = \frac{x \text{ kJ}}{9328 \text{ mol}}$$

$$\therefore \underline{\underline{-608185.6 \text{ kJ}}}$$

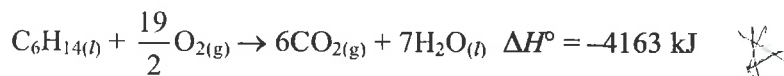
$$\text{or } \underline{\underline{-6.08 \times 10^5 \text{ kJ}}}$$

$$608.316$$

$$\begin{array}{r} 40.0800 \\ 15.9994 \\ \hline 24.0806 \end{array}$$

$$40.078$$

3. The following reaction represents the complete combustion of hexane, $C_6H_{14(l)}$, at SATP.

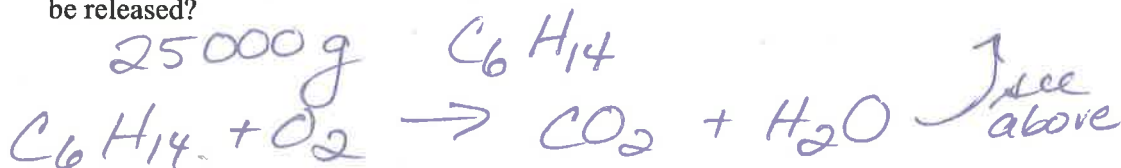


- (a) If 0.537 mol of carbon dioxide is produced in the reaction represented by the equation above, how much heat is released by the reaction?

$$\frac{0.537}{6} \times -4163 = \underline{\underline{-372.6 \text{ kJ}}}$$

✓✓

- (b) If 25.0 kg of hexane is burned in sufficient oxygen, how much heat will be released?



$$\frac{25000 \text{ g}}{86.18 \text{ g/mol}} = 290 \text{ mol} \quad \checkmark$$

$$\begin{array}{r} 6C = 72.07 \\ 14H = 14.11 \\ \hline 86.18 \end{array}$$

$$\frac{290 \text{ mol} \times -4163}{1} = -1,207,270 \text{ kJ} \\ = \underline{\underline{-1.21 \times 10^6 \text{ kJ}}} \quad \checkmark$$

- (c) What mass of hexane is required to produce 1.0×10^5 kJ of heat by complete combustion?

$$\frac{1.0 \times 10^5 \text{ kJ}}{4163 \text{ kJ}} = 24 \text{ mol} \quad \checkmark$$

$\therefore 1.24$ or 24 mol Hexane

$$24 \text{ mol} \times 86.18 \text{ g/mol} = 2070 \text{ g} \quad \checkmark$$

$$= 2.07 \text{ kg}$$

$$= \underline{\underline{2.1 \text{ kg}}}$$