Date: Oct. 15th 2021 Name: Ahmad Alvi Class:

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:

$$2ZnS_{(s)} + 3O_{2(g)} \rightarrow 2ZnO_{(s)} + 2SO_{2(g)} \qquad \Delta H = -878.2 \text{ kJ}$$

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

$\left(\frac{3}{2}\right)(-878.2) = -1317.3\text{ kJ}$

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

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

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

① $\frac{223.9\text{ g}}{97.46\text{ g/mol}} = 2.29 \simeq 2.3$ ② $\left(\frac{2.3\text{ mol}}{2\text{ mol}}\right)(-878.2\text{ kJ})$

$= -1009.93\text{ kJ}$

(d) What is the enthalpy change when 0.96 g $ZnO_{(s)}$ is produced?

① $\frac{0.96\text{ g}}{81.39\text{ g/mol}} = 0.0118\text{ mol}$

② $\left(\frac{0.0118}{2}\right)(-878.2\text{ kJ}) = 5.18\text{ kJ}$

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.

$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(s)} + 65.2\text{ kJ}$

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

$* 523.3\text{kJ} = 523\,300\text{g}$ ① $\frac{523\,300\text{g}}{56.1\text{ g/mol}} = 9327.99\text{ mol}$ ② $\frac{-65.2\text{kJ}}{1\text{ mol}} = \frac{x}{9328\text{ mol}}$

$x = -6.08 \times 10^5\text{ kJ}$

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

$$C_6H_{14(l)} + \frac{19}{2}O_{2(g)} \rightarrow 6CO_{2(g)} + 7H_2O_{(l)} \quad \Delta H = -4163\text{ kJ}$$

(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?

$\left(\frac{0.537}{6}\right)(-4163\text{kJ}) = -372.6\text{kJ}$

(b) If 25.0 kg of hexane is burned in sufficient oxygen, how much heat will be released? $C_6H_{14} + O_2 \rightarrow CO_2 + H_2O$

① $\frac{25000\text{g}}{86.18\text{g/mol}} = 290\text{mol}$ ② $290\text{mol} \cdot -4163 = -1.21 \times 10^6\text{kJ}$

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

① $\frac{1.0 \times 10^5\text{kJ}}{4163\text{kJ}} = 24.02$ ② $24.02\text{mol} \times 86.18\text{g/mol} = 2070\text{ g} = 2.07\text{kg}$

Answers

1. **(a)** -1.3×10^3 kJ

(b) -10 kJ

(c) $\Delta H = -1009$ kJ

(d) $\Delta H = -5.2$ kJ

2. **(a)** $CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_2$ $\Delta H = -65.2$ kJ

(b) $\Delta H = -6.08 \times 10^5$ kJ

3. **(a)** -373 kJ