Date: Name: 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?

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

(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?

$\frac{223.9 \text{ g}}{97.46 \text{ g/mol}} = 2.297 \text{ mol} \approx 2.3 \text{ mol}$

Zn 65.39
S 32.07
MM 97.46

$\therefore \frac{2.3 \text{ mol}}{2 \text{ mol}} \times -878.2 \text{ kJ}$

$= -1009 \text{ kJ}$

Date: Name: Class:

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

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

Zn 65.39
O 16.00
81.39

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

$= -5.2\ kJ$

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.

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

or $CaO + H_2O \rightarrow Ca(OH)_2 \quad \Delta H = -65.2\ kJ$

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

$523.3\ kg = 523300\ g$

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

$= 9328\ mol$

MM of Lime
~~($Ca(OH)_2$)~~ (CaO)
Ca 40.08
O 16.00
56.1 g/mol

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

40.0800
15.9994
2 9 4

$\therefore -608185.6\ kJ$

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

40.078

608.316

Date: Name: Class: 6

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

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

(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?

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

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

25000 g C_6H_{14}

$C_6H_{14} + O_2 \rightarrow CO_2 + H_2O$ see above ✓

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

6C = 72.07
14H = 14.11
86.18

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

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

$\frac{1.0 \times 10^5 \text{ kJ}}{4163 \text{ kJ}} = 24$ ✓

∴ 1 : 24 ∴ 24 mol Hexane

24 mol × 86.18 g/mol = 2070 g ✓
= 2.07 kg
= 2.1 kg