

Thermochemistry and Thermodynamics Worksheet 2

1. Given the following: $\text{C}_2\text{H}_4(\text{g}) + 3 \text{O}_2(\text{g}) \rightarrow 2 \text{CO}_2(\text{g}) + 2 \text{H}_2\text{O}(\text{g}) \quad \Delta H = -1322.9 \text{ kJ}$

$$\Delta H_f \text{C}_2\text{H}_4(\text{g}) = +52.3 \text{ kJ/mol}$$

$$\Delta H_f \text{H}_2\text{O}(\text{g}) = -241.8 \text{ kJ/mol}$$

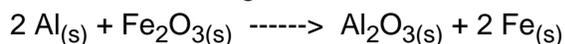
(A) Calculate the heat of formation of $\text{CO}_2(\text{g})$.

(B) How much heat will be evolved when 140.0 g $\text{C}_2\text{H}_4(\text{g})$ is consumed?

(C) How many moles of $\text{C}_2\text{H}_4(\text{g})$ will be required to produce 2,300 kJ of heat?

(D) If the molar volume of $\text{C}_2\text{H}_4(\text{g})$ is 22.4 L/mol, how many liters of C_2H_4 are required in part (C)?

2. Given the following chemical reaction:



$$\Delta H_f \text{Fe}_2\text{O}_3(\text{s}) = -822.2 \text{ kJ/mol} \quad \Delta H_f \text{Al}_2\text{O}_3(\text{s}) = -1669.8 \text{ kJ/mol}$$

(A) Calculate ΔH for this reaction.

(B) If all the heat given off by reacting 1 mole of $\text{Fe}_2\text{O}_3(\text{s})$ is absorbed by the products, what would be the change in temperature if the reaction goes to completion. (The specific heat of $\text{Al}_2\text{O}_3(\text{s}) = 0.19 \text{ J/g}\cdot\text{C}$ and the specific heat of $\text{Fe}(\text{s})$ is $0.48 \text{ J/g}\cdot\text{C}$)

3. The combustion of 1.00 mol of sucrose, $\text{C}_{12}\text{H}_{22}\text{O}_{11}$, evolves $5.65 \times 10^3 \text{ kJ}$ of heat. A bomb calorimeter with a calorimeter constant of $1.23 \text{ kJ}/^\circ\text{C}$ contains 0.600 kg of water. How many grams of sucrose should be burned to raise the temperature of the calorimeter and its contents from 23.0°C to 50.0°C ? (The calorimeter constant represents the heat capacity of the empty calorimeter.) The specific heat of water is $4.184 \text{ J/g}\cdot^\circ\text{C}$.

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4. The heat of reaction for burning 1 mole of a certain compound X is known to be -477.7 kJ. The calorimeter constant of the bomb being used is $2.5 \times 10^3 \text{ J/}^\circ\text{C}$ and the initial temperature of the water is 23.2°C .

(A) If 96.54 g of compound X (MM = 46) is burned in the bomb calorimeter containing 2000 ml of water (S.H. = $4.184 \text{ J/g}\cdot^\circ\text{C}$), what will be the final temperature?

(B) How much water can be warmed from 23.2°C to 56.5°C when 172.0 g of the compound is burned in the bomb?

5. A 50.0-g piece of metal at 60.0°C is placed in 200.0 g of water at 22.0°C contained in a coffee-cup calorimeter. The metal and water come to the same temperature at 32.5°C .

(A) How much heat did the metal give up to the water?

(B) What is the specific heat of the metal?

(C) How many grams of the metal at 80°C would have to be used to heat half as much water (100.0 g) by to the same temperature?

6. Use Hess' Law to calculate ΔH for the following reaction:



Given:

