

## Thermochemistry and Thermodynamics Worksheet 2

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

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

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

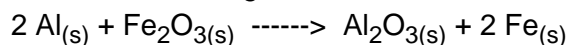
(A) Calculate the heat of formation of  $\text{CO}_2(\text{g})$ .

(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  $\text{C}_2\text{H}_4$  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  $\Delta H$  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  $23.0^\circ\text{C}$  to  $50.0^\circ\text{C}$ ? (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  $2.5 \times 10^3$  J/ $^{\circ}$ C and the initial temperature of the water is  $23.2$   $^{\circ}$ C.

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

(B) How much water can be warmed from  $23.2$   $^{\circ}$ C to  $56.5$   $^{\circ}$ C when  $172.0$  g of the compound is burned in the bomb?

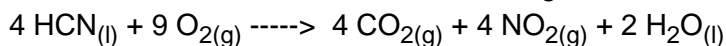
5. A  $50.0$ -g piece of metal at  $60.0$   $^{\circ}$ C is placed in  $200.0$  g of water at  $22.0$   $^{\circ}$ C contained in a coffee-cup calorimeter. The metal and water come to the same temperature at  $32.5$   $^{\circ}$ C.

(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  $80$   $^{\circ}$ 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  $\Delta H$  for the following reaction:



Given:

