

## CHEMISTRY DAILY PLAN

**Class:**

**Date:**

**Subject: Standard Enthalpies of Formation**

**Time:**

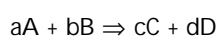
The standard heat of formation of a compound ( $\Delta H_f^\circ$ ) is the heat change when one mole of the compound is formed from the elements in their standard states - that is, all substances are in their most stable states at 1 atm and 25 °C. The superscript "°" shows that the measurement was made at standard conditions.

Consider the following reaction:  $C_{(s)} + O_{2(g)} \Rightarrow CO_{2(g)}$   $\Delta H = -94.0$  kcal (at 25°C and 1 atm)

Since this reaction is carried out under standard conditions, and  $CO_2$  is formed from the elements, we may say that the heat of this reaction is equal to the heat of formation of  $CO_2$ . Or  $\Delta H_f^\circ$  of ( $CO_2$ ) = -94.0 kcal.

A list of the standard enthalpies of formation of a number of compounds is given in Table 8.1.

The enthalpy of a reaction (the heat of reaction) can be expressed as the sum of the heats of formation of the products minus the sum of the heats of formation of the reactants. For a hypothetical reaction;



The heat of reaction may be written :

$$\Delta H^\circ = \sum \Delta H_f^\circ (\text{products}) - \sum \Delta H_f^\circ (\text{reactants})$$

$$\text{Or, } \Delta H^\circ = [c \Delta H_f^\circ (C) + d \Delta H_f^\circ (D)] - [a \Delta H_f^\circ (A) + b \Delta H_f^\circ (B)]$$

**Some remarks about heat of formation are as follows.**

1. The standard heat of formation of an element in its most stable form is arbitrarily assumed to be zero. ( $\Delta H_f^\circ O_2 = 0$  but  $\Delta H_f^\circ O_3 = +34$  kcal/mol)
2. We must always specify the physical states of the reactants and products because the enthalpy changes depend on them.  
 $H_{2(g)} + \frac{1}{2} O_{2(g)} \Rightarrow H_{2O(g)}$   $\Delta H_f^\circ = -57.8$  kcal  
 $H_{2(g)} + \frac{1}{2} O_{2(g)} \Rightarrow H_{2O(l)}$   $\Delta H_f^\circ = -68.3$  kcal
3. Substances having positive enthalpies of formation are usually less stable and have a greater tendency to react than those having negative enthalpies of formation.

**Problem 1:** The  $\Delta H_f^\circ$  of  $SbCl_{3(g)}$  = -75.0 kcal/mol and the  $\Delta H_f^\circ$  of  $SbCl_{5(l)}$  = -105.2 kcal/mol. Calculate the  $\Delta H_f^\circ$  of the reaction,  $SbCl_{3(g)} + Cl_{2(g)} \Rightarrow SbCl_{5(l)}$

**Problem 2:** The heat absorbed on formation of  $NO_{(g)}$  is 720 cal/g. The heat absorbed on formation of  $NO_{2(g)}$  is 176 cal/g. Calculate  $\Delta H$  for the reaction,  $2NO_{(g)} + O_{2(g)} \Rightarrow 2NO_{2(g)}$ .

**Problem 3:** Given the heat of the following reaction, determine the heat of formation of  $CCl_{4(g)}$ . Use Table 8.1



**Problem 4:** The amount of heat produced by the combustion of 10 g of  $C_2H_6_{(g)}$  increases the temperature of 2000 g of  $H_2O$  by 57 °C. Calculate the heat of formation of  $C_2H_6_{(g)}$ .  $\Delta H_f^\circ CO_{2(g)} = -94$  kcal/mol,  $\Delta H_f^\circ H_2O_{(g)} = -58$  kcal/mol.

