LA IMMACULADA CONCEPCION SCHOOL
SENIOR HIGH SCHOOL
GRADE 12 – STEM: GENERAL CHEMISTRY 2

APRIL 20-24, 2020
ACTIVITY ON STANDARD ENTHALPY CALCULATIONS

Activity I. Using the standard molar enthalpies of formation given, calculate the molar enthalpy of reaction of the following chemical equations.

Sample problem:

$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(l)}$

- Standard enthalpies:

  $H_{2(g)} = 0$ kJ/mol
  $O_{2(g)} = 0$ kJ/mol
  $H_2O_{(l)} = -285.8$ kj/mol

- Solution:

  $\sum \Delta H°_{rxn} = (\sum \Delta H° \text{ products}) – (\sum \Delta H° \text{ reactants})$
  $\sum \Delta H°_{rxn} = (-285.8)-(2(0)+0)$
  $\sum \Delta H°_{rxn =} -285.8$ kJ

(standard enthalpies are constant depending on their physical state, you can search for the standard enthalpies of the compound/element)

1. $C_3H_{8(g)} + 5O_{2(g)} \rightarrow CO_{2(g)} + 4H_2O_{(l)}$
2. $2C_{(s)} + O_{2(g)} \rightarrow CO2_{(g)}$
3. $CO_{2(g)} + H_2O_{(l)} \rightarrow C_6H_{12}O_{6(s)} + O_{2(g)}$
4. $4HF_{(aq)} + SiF_{4(g)} \rightarrow 2H_2O_{(l)}$
5. $Yb_2O_{3(s)} + SiO_{2(s)} \rightarrow Yb_2SiO_{5(s)}$

*Note: Copy and answer in a 1 whole sheet of paper.

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TOPIC: HESS LAW

The thermochemical equations for the incomplete combustion of carbon into carbon monoxide is represented as

$$2C(s) + O_2(g) \rightarrow 2CO(g)$$

Compute for the ΔH of the reaction if the overall process above can occur in two steps whose thermochemical equations are given below.

(1) $C(s) + O2(g) \rightarrow 2CO_2(g)$ ΔH = -393.5 kJ
(2) $2CO(g) + O2(g) \rightarrow 2CO_2(g)$ ΔH= -566.0 kJ

Solution:

The ΔH for the overall reaction can be obtained by applying Hess' law.
First, equation (1) needs to be multiplied by 2 since the C(s) in the overall equation has a coefficient of 2. Rule 1 must be observed in doing so.

$[C(s) + O_2(g) \rightarrow 2CO_2(g)$ ΔH = -393.5 kJ] x2
$2C(s) + 2O_2(g) \rightarrow 2CO_2(g)$ ΔH = -787.0 kJ

Second, equation (2) must be reversed since carbon monoxide is in the products side of the desired chemical equation. As such, Rule 2 must be applied.

$2CO(g) + O2(g) \rightarrow 2CO_2(g)$ ΔH= -566.0 kJ

By Hess' law, the ΔH of the overall reaction can be calculated from the ΔH of the two (manipulated) reactions leading to et. In summary,

$2C(s) + \cancel{2}O_2(g) \rightarrow \cancel{2CO_2(g)}$ ΔH = -787.0 kJ

$\cancel{2CO(g)} + \cancel{O2}(g) \rightarrow 2CO_2(g)$ ΔH= -566.0 kJ

$2C(s) + O_2(g) \rightarrow 2CO(g)$ ΔH = -1353.0 kJ

For more info watch the video of Hess' law and heats of formation by Professor Dave explains and Hess' law problems and enthalpy change of The Organic Chemistry Tutor in youtube.

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APRIL 20-24, 2020
ACTIVITY ON SOLVING HESS' LAW PROBLEMS

I. Calculate ΔH for the reaction from the following data
$C_2H_4(g) + H_2(g) \rightarrow C_2H_6$

a. $C_2H_4\,(g) + 3\,O_2\,(g) \rightarrow 2\,CO_2\,(g) + 2\,H_2O\,(l)$ $\Delta H = -1411.\ kJ$
b. $C_2H_6\,(g) + 3½\,O_2\,(g) \rightarrow 2\,CO_2\,(g) + 3\,H_2O\,(l)$ $\Delta H = -1560.\ kJ$
a. c. $H_2\,(g) + ½\,O_2\,(g) \rightarrow H_2O\,(l)$ $\Delta H = -285.8\ kJ$

Solution:

II. Calculate ΔH for the reaction from the following data.
$4\,NH_3\,(g) + 5\,O_2\,(g) \rightarrow 4\,NO\,(g) + 6\,H_2O\,(g)$,

a. $N_2\,(g) + O_2\,(g) \rightarrow 2\,NO\,(g)$ $\Delta H = -180.5\ kJ$
b. $N_2\,(g) + 3\,H_2\,(g) \rightarrow 2\,NH_3\,(g)$ $\Delta H = -91.8\ kJ$
c. $2\,H_2\,(g) + O_2\,(g) \rightarrow 2\,H_2O\,(g)$ $\Delta H = -483.6\ kJ$

Solution:

*Note: Copy and answer in a 1 whole sheet of paper.