

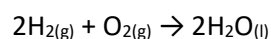


APRIL 20-24, 2020

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:



- Standard enthalpies:

$$\text{H}_{2(g)} = 0 \text{ kJ/mol}$$

$$\text{O}_{2(g)} = 0 \text{ kJ/mol}$$

$$\text{H}_2\text{O}_{(l)} = -285.8 \text{ kJ/mol}$$

- Solution:

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

$$\sum \Delta H^\circ_{\text{rxn}} = (-285.8) - (2(0) + 0)$$

$$\sum \Delta H^\circ_{\text{rxn}} = -285.8 \text{ kJ}$$

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

- $\text{C}_3\text{H}_8(g) + 5\text{O}_2(g) \rightarrow \text{CO}_2(g) + 4\text{H}_2\text{O}(l)$
- $2\text{C}(s) + \text{O}_2(g) \rightarrow \text{CO}_2(g)$
- $\text{CO}_2(g) + \text{H}_2\text{O}(l) \rightarrow \text{C}_6\text{H}_{12}\text{O}_6(s) + \text{O}_2(g)$
- $4\text{HF}(aq) + \text{SiF}_4(g) \rightarrow 2\text{H}_2\text{O}(l)$
- $\text{Yb}_2\text{O}_3(s) + \text{SiO}_2(s) \rightarrow \text{Yb}_2\text{SiO}_5(s)$

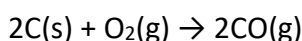
\*Note: Copy and answer in a 1 whole sheet of paper.



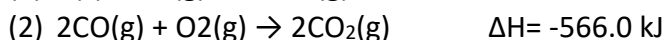
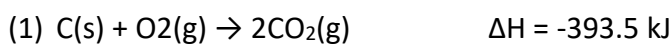
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TOPIC: HESS LAW

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



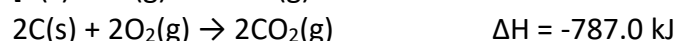
Compute for the  $\Delta\text{H}$  of the reaction if the overall process above can occur in two steps whose thermochemical equations are given below.



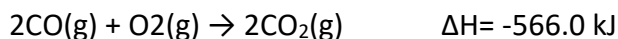
Solution:

The  $\Delta\text{H}$  for the overall reaction can be obtained by applying Hess' law.

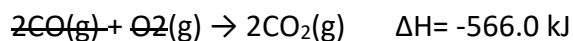
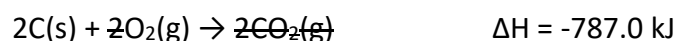
First, equation (1) needs to be multiplied by 2 since the C(s) in the overall equation has a coefficient of 2. Rule 1 must be observed in doing so.



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.



By Hess' law, the  $\Delta\text{H}$  of the overall reaction can be calculated from the  $\Delta\text{H}$  of the two (manipulated) reactions leading to it. In summary,



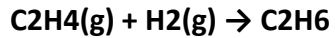
For more info watch the video of Hess' law and heats of formation by Professor Dave explains and Hess' law problems and enthalpy change of The Organic Chemistry Tutor in youtube.



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ACTIVITY ON SOLVING HESS' LAW PROBLEMS

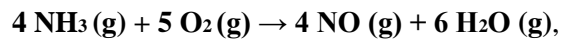
I. Calculate  $\Delta H$  for the reaction from the following data



- a.  $C_2H_4(g) + 3 O_2(g) \rightarrow 2 CO_2(g) + 2 H_2O(l)$   $\Delta H = -1411. \text{ kJ}$   
b.  $C_2H_6(g) + 3\frac{1}{2} O_2(g) \rightarrow 2 CO_2(g) + 3 H_2O(l)$   $\Delta H = -1560. \text{ kJ}$   
a. c.  $H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(l)$   $\Delta H = -285.8 \text{ kJ}$

Solution:

II. Calculate  $\Delta H$  for the reaction from the following data.



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

Solution:

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