Chemistry II Hess's Law Problems:

ex> Two forms of carbon are graphite, the soft, black, slippery material used in "lead" pencils and as a lubricant for locks, and diamond, the brilliant, hard gemstone. Using the enthalpy of combustion of graphite (-394 kJ/mol) and diamond (-396 kJ/mol), calculate the enthalpy change for the conversion of graphite to diamond. [+2 kJ]

ex2> Diborane (B_2H_6) is a highly reactive boron hydride that was once considered as a possible rocket fuel for the U.S. space program. Calculate the ΔH for the synthesis of diborane from its elements, according to the equation

$$2\ B\ (s) + 3\ H_2\ (g) \text{ -----> } B_2H_6\ (g)$$

using the following data:

(a) $2\ B(s) + 3/2\ O_2\ (g) \text{ -----> } B_2O_3\ (s)$ $\Delta H = -1273$ kJ

(b) $B_2H_6\ (g) + 3\ O_2\ (g) \text{ -----> } B_2O_3\ (s) + 3\ H_2O\ (g)$ $\Delta H = -2035$ kJ

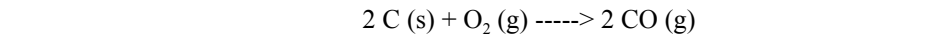
(c) $H_2\ (g) + 1/2\ O_2\ (g) \text{ -----> } H_2O\ (\ell)$ $\Delta H = -286$ kJ

(d) $H_2O\ (\ell) \text{ -----> } H_2O\ (g)$ $\Delta H = 44$ kJ

[+36 kJ]

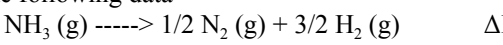
Hess's Law Practice Problems:

1) The enthalpy of combustion of solid carbon to form carbon dioxide is -393.7 kJ per mole of carbon, and the enthalpy of combustion of carbon monoxide to form carbon dioxide is -283.3 kJ per mole of carbon monoxide. Use these data to calculate the ΔH for the reaction

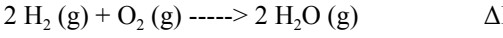


$$2\ C\ (s) + O_2\ (g) \text{-----> } 2\ CO\ (g)$$ [-220.8 kJ]

2) Given the following data

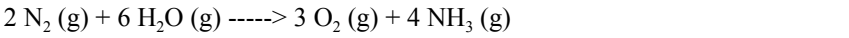


$NH_3\ (g) \text{-----> } 1/2\ N_2\ (g) + 3/2\ H_2\ (g)$ $\Delta H = +46$ kJ



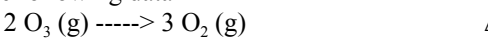
$2\ H_2\ (g) + O_2\ (g) \text{-----> } 2\ H_2O\ (g)$ $\Delta H = -484$ kJ,

Calculate the ΔH for the reaction



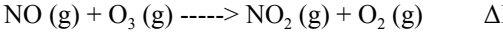
$2\ N_2\ (g) + 6\ H_2O\ (g) \text{-----> } 3\ O_2\ (g) + 4\ NH_3\ (g)$ [+1268 kJ]

3) Given the following data



$2\ O_3\ (g) \text{-----> } 3\ O_2\ (g)$ $\Delta H = -427$ kJ

$O_2\ (g) \text{-----> } 2\ O\ (g)$ $\Delta H = +495$ kJ

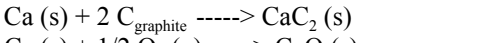


$NO\ (g) + O_3\ (g) \text{-----> } NO_2\ (g) + O_2\ (g)$ $\Delta H = -199$ kJ

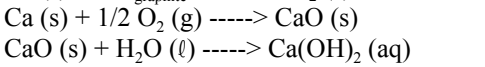
Calculate the ΔH for the reaction

$NO\ (g) + O\ (g) \text{-----> } NO_2\ (g)$ [-233 kJ]

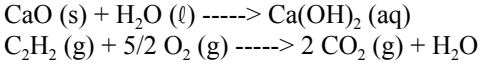
4) Given the following data



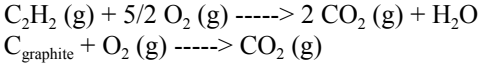
$Ca\ (s) + 2\ C_{graphite} \text{-----> } CaC_2\ (s)$ $\Delta H = -62.8$ kJ



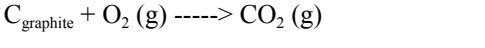
$Ca\ (s) + 1/2\ O_2\ (g) \text{-----> } CaO\ (s)$ $\Delta H = -635.5$ kJ



$CaO\ (s) + H_2O\ (\ell) \text{-----> } Ca(OH)_2\ (aq)$ $\Delta H = -653.1$ kJ

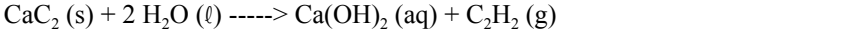


$C_2H_2\ (g) + 5/2\ O_2\ (g) \text{-----> } 2\ CO_2\ (g) + H_2O\ (\ell)$ $\Delta H = -1300.$ kJ



$C_{graphite} + O_2\ (g) \text{-----> } CO_2\ (g)$ $\Delta H = -393.5$ kJ

Calculate the ΔH ofr the reaction



$CaC_2\ (s) + 2\ H_2O\ (\ell) \text{-----> } Ca(OH)_2\ (aq) + C_2H_2\ (g)$ [-713 kJ]

Additional book practice on Hess's Law:

p. 694 #7 (answer in back of book)

p. 707 # 35, 43 [-1428 kJ/mol]