Ch 8: Introduction to Thermodynamics Worksheet

1. Briefly explain the terms state function and path function as they apply to thermodynamic quantities. Give one example of each.

   State functions are independent of the path taken to the current state. An example would be ΔH
   Path functions are dependent on the history/path taken to current state. Example is work.

2. What is Hess' Law? What property does Hess' Law depend on?

   $\Delta H_{reaction} = \sum \Delta H_{f\,product} - \sum \Delta H_{f\,reactant}$

   Dependent on ΔH being a state function, so it doesn't matter what path the compounds took to create its products

3. The standard molar enthalpy of formation, ΔH_f^o, for diborane, B_2H_6, cannot be found directly because the compound cannot be prepared by the reaction of boron and hydrogen. However, it can be calculated using the following reactions:

   $4\,B_{(s)} + 3\,O_{2\,(g)} \rightarrow 2\,B_2O_{3\,(s)}$ ΔH^o_{rxn} = -2543.8 kJ
   $2\,H_{2\,(g)} + O_{2\,(g)} \rightarrow 2\,H_2O_{\,(g)}$ ΔH^o_{rxn} = -484. kJ
   $B_2H_{6\,(g)} + 3\,O_{2\,(g)} \rightarrow B_2O_{3\,(s)} + 3\,H_2O_{\,(g)}$ ΔH^o_{rxn} = -2032.9 kJ

   +35.0kJ

4. Calculate ΔH^o_{rxn} for $CH_{4\,(g)} + 2\,O_{2\,(g)} \rightarrow CO_{2\,(g)} + 2\,H_2O_{\,(l)}$ given that:

$\Delta H^o_f\ CH_{4\,(g)}$ = -74.8 kJ/mol
$\Delta H^o_f\ CO_{2\,(g)}$ = -393.5 kJ/mol
$\Delta H^o_f\ H_2O_{\,(l)}$ = -285.8 kJ/mol

-890. kJ/mol

5. Given the following bond enthalpies:

$\Delta H_B[H-H]$ = 436 kJ/mol
$\Delta H_B[O-O]$ = 157 kJ/mol
$\Delta H_B[O=O]$ = 496 kJ/mol
$\Delta H_B[O-H]$ = 463 kJ/mol

What is the reaction enthalpy for $H_2O_2 \rightarrow 1/2\ O_2 + H_2O$?

-91kJ/mol

6. Given: $2H_2 + O_2 \rightarrow 2\,H_2O$ $\Delta H = -572\,kJ$

$N_2O_5 + H_2O \rightarrow 2\,HNO_3$ $\Delta H = -77\,kJ$

$1/2\,N_2 + 1\,1/2\,O_2 + 1/2\,H_2 \rightarrow HNO_3$ $\Delta H = -174.2\,kJ$

Calculate the change in enthalpy of the reaction $2\,N_2 + 5\,O_2 \rightarrow 2\,N_2O_5$

+29kJ

7. What mass of propane, $C_3H_{8\,(g)}$ must be burned to supply 2580. kJ of heat? The standard enthalpy of combustion of propane at 298K is -2220. kJ/mol.

51.14g