Answer on Question#59766 – Chemistry | General Chemistry

Calculating the standard enthalpy of combustion/formation

Solution:

1) Hess' Law:

$\Delta H°_{rxn} = \Sigma \Delta H°_{f,\ products} - \Sigma \Delta H°_{f,\ reactants}$

2) Sustitute values into equation. Since oxygen is an element in its standard state, its enthalpy of formation is zero.

1) For CH_4 –

The balanced equation for the combustion of methane is:

$CH_4 + 2O_2 = CO_2 + 2H_2O$

$\Delta H°_{comb} = [1mole(CO_2)* (-394) + 2moles(H_2O)*(-286)] – [1mole(CH_4)*(\Delta H°_f) + 2moles(O_2)* O] =$

$= -890$

$\Delta H°_f (CH_4) = -76$ kJ/mol

2) For $C_2H_4(g)$ -

$C_2H_6 + 7/2O_2 = 2CO_2 + 3H_2O$

$\Delta H°_{comb} = [2*(-394) + 3*(-286)] - [(\Delta H°_f) + (7/2)*0] = -1409$ kJ/mol

$\Delta H°_f (C_2H_4) = -237$ kJ/mol

3) For $C_4H_{10}(g)$ -

$C_4H_{10(g)} + {}^{13}/_2O_{2(g)} \rightarrow 4CO_{2(g)} + 5H_2O_{(l)}$

$\Delta H°_{comb} = [4 * (-394) + 5* (-286)] – [(-125)+13/2*0] = -2881$ kJ/mol

4) For $CH_3OH(l)$ -

$CH_3OH_{(l)} + {}^3/_2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$

$\Delta H°_{comb} = [(-394) + 2* (-286)] – [(\Delta H°_f)+3/2*0] = -715$ kJ/mol

$\Delta H°_f = -251$ kJ/mol

5) For $C_2H_5OH(l)$

$C_2H_5OH\ (l) + (7/2)\ O_2\ (g) \text{---> } 2\ CO_2\ (g) + 3\ H_2O\ (l)$

$\Delta H°_{comb} = [\ 2\ *(-394) + 3\ *(-286)\ ] - [\ (-278) + (7/2)\ *\ (0)\ ] = -1368$ kJ/mol

6) For CH_3COOH

$CH_3COOH + 2O_2 = 2CO_2 + 2H_20$

$\Delta H°_{comb} = [2*(-394) + 2*(-286)] – [(\Delta H°_f)+ 2*0] = -876$ kJ/mol

$\Delta H°_f = -484$ kJ/mol

7) For $CH_3COOC_2H_5(l)$

$CH_3COOC_2H_5 + 5O_2 = 4CO_2 + 4H_20$

$\Delta H°_{comb} = [\ 4\ *(-394) + 4\ *(-286)\ ] - [\ (-481) + (5)\ *\ (0)] = -2239$ kJ/mol