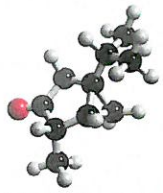
HESS'S LAW 2 – USING ΔH_c

Answer copy



1) Calculate the enthalpy change for this reaction given the following enthalpies of combustion.
-75 kjmol^{-1}

$$C(s) + 2\,H_2(g) \rightarrow CH_4(g)$$

$\Delta H|_c$: C(s) -393; $H_2(g)$ -286; $CH_4(g)$ -890 kJ mol^{-1}

2) Calculate the enthalpy of formation of ethanol (C_2H_5OH) given the following enthalpies of combustion.
-273kjmol^{-1}

$\Delta H|_c$: C(s) -393; $H_2(g)$ -286; $C_2H_5OH(l)$ -1371 kJ mol^{-1}

3) Calculate the enthalpy of combustion of propane (C_3H_8) given the following enthalpy changes.
-2220 kjmol^{-1}

$\Delta H|_c$: C(s) -393; $H_2(g)$ -286 kJ mol^{-1}, $\Delta H|_f$: $C_3H_8(l)$ -103 kJ mol^{-1}

4) Calculate the enthalpy of combustion of $CS_2(l)$ given the following enthalpy changes.
-1075 kjmol^{-1}

$\Delta H|_c$: C(s) -393; S(s) -297 kJ mol^{-1}, $\Delta H|_f$: $CS_2(l)$ +88 kJ mol^{-1}

5) Calculate the enthalpy change for the following reaction using the enthalpies of combustion given.
+2 kjmol^{-1}

$$C(\text{graphite}) \rightarrow C(\text{diamond})$$

$\Delta H|_c$: C(graphite) -393; C(diamond) -395 kJ mol^{-1}

6) Calculate the enthalpy change during the fermentation of glucose using the enthalpies of combustion given.
-84kjmol^{-1}

$$C_6H_{12}O_6(s) \rightarrow 2\,C_2H_5OH(l) + 2\,CO_2(g)$$

$\Delta H|_c$: $C_6H_{12}O_6(s)$ -2820; $C_2H_5OH(l)$ -1368 kJ mol^{-1}

7) Calculate the enthalpy of formation of pentane, $C_5H_{12(l)}$, given the following enthalpies of combustion.
-172 kjmol^{-1}

$\Delta H|_c$: $H_2(g)$ -286; C(s) -393; $C_5H_{12}(l)$ -3509 kJ mol^{-1}

8) Calculate the enthalpy of combustion of propanone, $CH_3COCH_3(l)$, given the information below.
-1820kjmol^{-1}

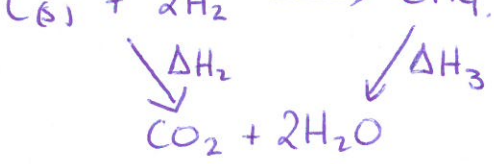
$\Delta H|_c$: $H_2(g)$ -286; C(s) -393 $\Delta H|_f$: $CH_3COCH_3(l)$ -217 kJ mol^{-1}

9) Calculate the standard enthalpy change for the following reaction using the enthalpy changes given.
-235kjmol^{-1}

$$SO_2(g) + 2\,H_2S(g) \rightarrow 3\,S(s) + 2\,H_2O(l)$$

$\Delta H|_c$: S(s) -297 kJmol^{-1} $\Delta H°_f$: $H_2O(l)$ -286; $H_2S(g)$ -20 kJ mol^{-1}

(1)



$\Delta H_2 = -393 + 2(-286)$

$= -965$

$\Delta H_3 = -890.$

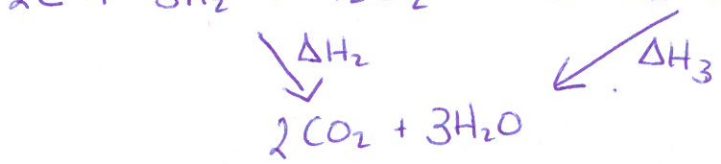
$\Delta H_1 + \Delta H_3 = \Delta H_2.$

$\Delta H_1 = \Delta H_2 - \Delta H_3$

$\Delta H_1 = -965 - (-890)$

$= \underline{-75 \text{ kJ mol}^{-1}}$

(2)



$\Delta H_2 = 2(-393) + 3(-286)$

$= -1644$

$\Delta H_3 = -1371$

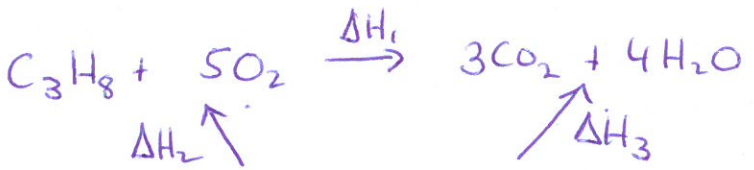
$\Delta H_1 + \Delta H_3 = \Delta H_2$

$\Delta H_1 = \Delta H_2 - \Delta H_3$

$\Delta H_1 = -1644 - (-1371)$

$= \underline{-273 \text{ kJ mol}^{-1}}$

(3)



$\Delta H_3 = 3(-393) + 4(-286)$

$= -2323$

$\Delta H_2 = -103$

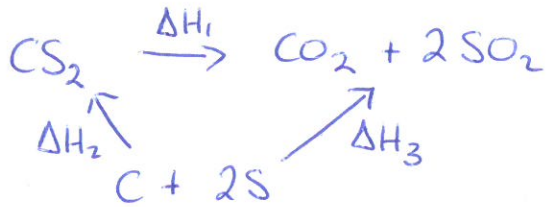
$\Delta H_1 + \Delta H_2 = \Delta H_3$

$\Delta H_1 = \Delta H_3 - \Delta H_2.$

$= -2323 - (-103)$

$= \underline{-2220 \text{ kJ mol}^{-1}}$

(4)



$\Delta H_2 + \Delta H_1 = \Delta H_3$

$\Delta H_1 = \Delta H_3 - \Delta H_2$

$= -987 - (88)$

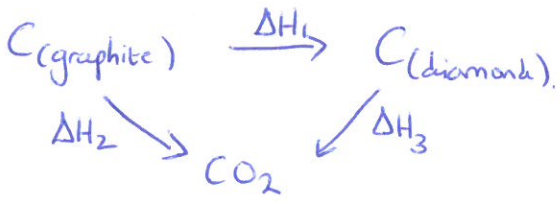
$= \underline{-1075 \text{ kJmol}^{-1}}$

$\Delta H_3 = -393 + 2(-297)$

$= -987$

$\Delta H_2 = +88$

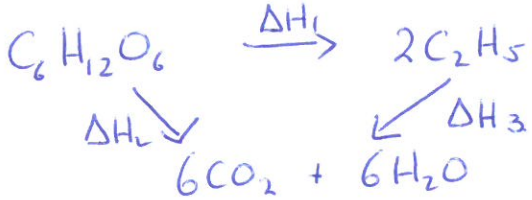
(5)



$\Delta H_1 + \Delta H_3 = \Delta H_2$

$\Delta H_1 = \Delta H_2 - \Delta H_3 = -393 - (-395) = \underline{+2 \text{ kJmol}^{-1}}$

(6)



$\Delta H_1 + \Delta H_3 = \Delta H_2$

$\Delta H_1 = \Delta H_2 - \Delta H_3$

$= -2820 - (-2736)$

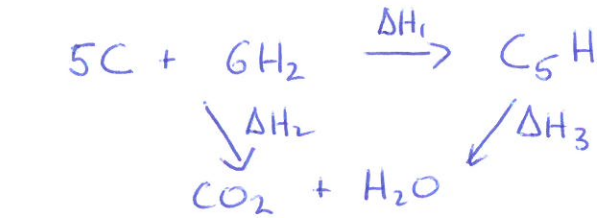
$= \underline{-84 \text{ 12Jmol}^{-1}}$

$\Delta H_2 = -2820$

$\Delta H_3 = 2(-1368)$

$= -2736$

(7)



$\Delta H_1 + \Delta H_3 = \Delta H_2$

$\Delta H_1 = \Delta H_2 - \Delta H_3$

$= -3681 - (-3509)$

$= \underline{-172 \text{ kJmol}^{-1}}$

$\Delta H_2 = 5(-393) + 6(-286)$

$= -3681$

$\Delta H_3 = -3509$

(8) $3C + 3H_2 + \frac{1}{2}O_2 \xrightarrow{\Delta H_1} CH_3COCH_3$

ΔH_3 ↓ ; ↑ ΔH_2

$3CO_2 + 3H_2O$

$\Delta H_1 = -217$

$\Delta H_3 = 3(-393) + 3(-286)$

$= -2037.$

$\Delta H_1 + \Delta H_2 = \Delta H_3$

$\Delta H_2 = \Delta H_3 - \Delta H_1$

$= -2037 - (-217)$

$= -1820 \quad kJ\,mol^{-1}$

(EXT)

(9) $SO_2 + 2H_2S \xrightarrow{\Delta H_1} 3S + 2H_2O$

ΔH_2 ↑ ; ΔH_3 ↗

$3S + 2H_2 + O_2$

$\Delta H_1 + \Delta H_2 = \Delta H_3$

$\Delta H_1 = \Delta H_3 - \Delta H_2.$

$\Delta H_3 = 2 \times \Delta H_f\ H_2O = 2(-286) = -572.$

$\Delta H_2 = [1 \times \Delta H_c\ S] + [2 \times \Delta H_f\ H_2S]$

$= -297 + 2(-20)$

$= -337$

$\Delta H_1 = -572 - (-337)$

$= -235 \quad kJ\,mol^{-1}$