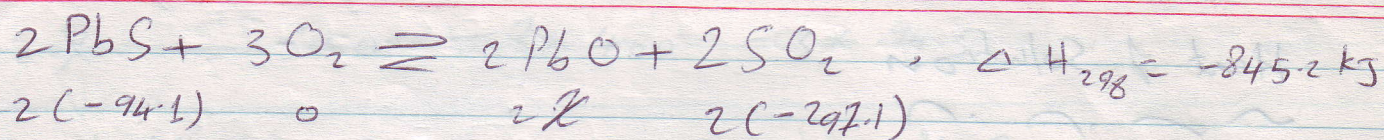


(19)



Heat of reaction of 298K is (-845.2 kJ)

X : kJ be the unknown heat content

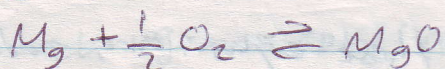
$$\begin{aligned}
 \Delta H_{298} = -845.2 &= 2X - 594.1 - (-188.2 + 0) \\
 &= 2X - 594.1 + 188.2
 \end{aligned}$$

$$\therefore X = -219.7 \text{ kJ/mol of PbO}$$

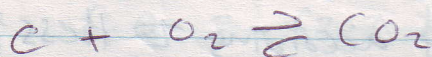
Heat of Combustion of a Substance

The enthalpy change when 1 mole of the substance (element or compound) is completely burnt in oxygen

Example



$$\Delta H_{298} = -602.5 \text{ kJ}$$



$$\Delta H_{298} = -393.7 \text{ kJ}$$

Heat of Transformation (L_t)

The change in enthalpy when 1 mole of a substance undergoes a specific physical change. This general term can be given the symbol (L_t), but is commonly described according to the transformation

Latent heat of fusion $L_f \rightarrow$ solid to liquid
 $=$ $=$ evaporation $L_e \rightarrow$ liquid to gas

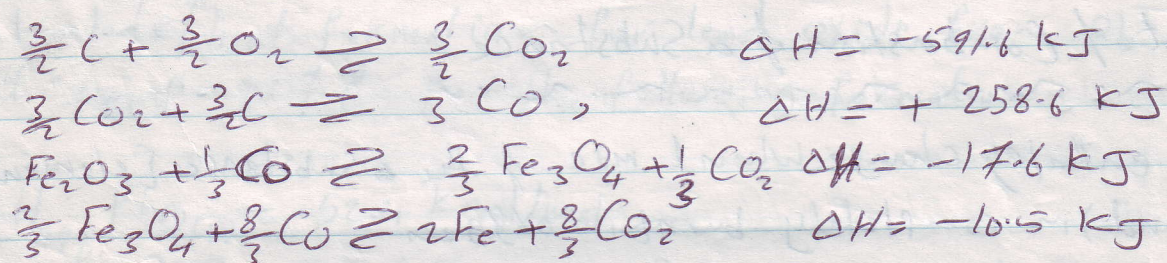
(20)

Heat of Solution

When one substance dissolves in another there will be a change in enthalpy. This is called the heat of solution.

Example

The reduction of haematite to magnetite, by carbon monoxide and finally the reduction of magnetite to iron

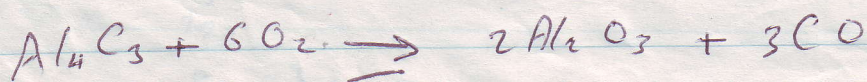
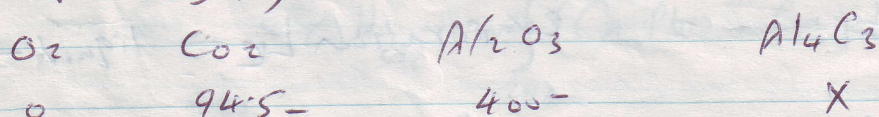


It will be seen that if all these eqns. are added together we have the overall reaction [according to Hess's law], the overall reaction will be the sum of the heats of reaction of the stages

$$\begin{aligned} \Delta H \text{ for the overall reaction} &= 258.6 - (591.6 + 17.6 + 10.5) \\ &= -361.1 \text{ kJ} \end{aligned}$$

Example

Calculate the heat formation of $[Al_4C_3]$, when the heat reaction equal $(-1035.4) \text{ kcal}$



(21)

$$X \quad 6 \times 0 - 2 \times 400 - 3 \times 94.5$$

$$\Delta H_{298} = 3\Delta H_{CO_2} + 2\Delta H_{Al_2O_3} - \Delta H_{Al_4C_3}$$

$$-1035.4 = -282.2 - 800 - 0 - \Delta H_{Al_4C_3}$$

$$\therefore \Delta H_{Al_4C_3} = -1082.2 + 1035.4 = -46.8 \text{ kcal}$$

Example

Calculate the standard heat of the reaction at (298K & 1 atm) for the reaction



for each molecular for the following: Al_2O_3 , Fe , FeO , Al and for each gram of [iron], if given

$$\Delta H_{298}^{\circ}, FeO = -63.3 \text{ kcal/mole}$$

$$\Delta H_{298}^{\circ}, Al_2O_3 = -400 \text{ kcal/mole}$$

The atomic weight for Fe = 56

Sol-

$$\begin{aligned} \Delta H_{298}^{\circ} &= \sum \Delta H_{298}^{\circ} P - \sum \Delta H_{298}^{\circ} R \\ &= \Delta H_{298}^{\circ} Al_2O_3 + 3\Delta H_{298}^{\circ} Fe - 3\Delta H_{298}^{\circ} FeO - 2\Delta H_{298}^{\circ} Al \end{aligned}$$

$$\begin{aligned} \Delta H_{298}^{\circ} &= \Delta H_{298}^{\circ} Al_2O_3 + 3\Delta H_{298}^{\circ} FeO \\ &= -400 - 3[-63.3] \end{aligned}$$

$$= -210.1 \text{ kcal} \quad \text{The standard heat of reaction} \quad \text{kcal/mole.}$$

$$\begin{aligned} \text{for one molecular from } Al_2O_3 \text{ heat of reaction} &= -210.1 \text{ kcal/mole.} \\ \text{for 3 molecular from Fe} &= = = = \frac{-210.1}{3} = -70.3 \text{ kcal/mole.} \end{aligned}$$

(22)

For 3 molecular from FeO the heat reaction = $-\frac{210.1}{3} = 70.3$ kcal/molecular

$$= 2 = = Al = = = = -\frac{210.1}{2} = 105.05 \text{ kcal/molecular}$$

for Iron for each gram = $-\frac{70.3}{56} = -1.255 \text{ kcal/gram for Fe.}$

Example

~ ~ ~ The standard

calculate heat formation ~ for lead oxide from Pb & O₂ at temp. 227°C for the following formation ~

$$\Delta H_{298} \text{ PbO}_{(s)} = -52.4 \text{ kcal/mol}$$

$$C_p, \text{PbO}_{(s)} = 10.6 + 4 \times 10^{-3} T \text{ cal/deg/mole}$$

$$C_p, \text{Pb}_{(s)} = 5.63 + 2.33 \times 10^{-3} T \text{ cal/deg/mole}$$

$$C_p, \text{O}_{(g)} = 7.16 + 1.0 \times 10^{-3} T - 0.4 \times 10^{-5} T^2 \text{ cal/deg mol}$$

Soln.



$$\Delta H_{298} = -52400 \text{ cal}$$

$$\Delta H_{500}(\text{cal}) = \Delta H_{298}(\text{cal}) + \int_{298}^{500} [C_p(\text{PbO}) - C_p(\text{Pb}) - \frac{1}{2} C_p(\text{O}_2)] dT$$

$$= \Delta H_{298} + \int_{298}^{500} [C_p, \text{PbO} - C_p, \text{Pb}_{(s)} - \frac{1}{2} C_p, \text{O}_2] dT$$

$$= -52400 + \int_{298}^{500} [(10.6 + 4 \times 10^{-3} T) - (5.63 + 2.33 \times 10^{-3} T) - \frac{1}{2} (7.16 + 1 \times 10^{-3} T - 0.4 \times 10^{-5} T^2)] dT$$