

## HEAT SUMMATION 1

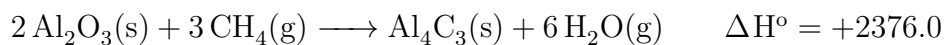


$$-30.9 \text{ kcal} \times \frac{4.184 \text{ kJ}}{1 \text{ kcal}} = -129.3 \text{ kJ}$$

$$\Delta H^\circ = [\Delta H^\circ_{\text{Al}_4\text{C}_3(\text{s})} + 6\Delta H^\circ_{\text{H}_2\text{O}(\text{g})}] - [2\Delta H^\circ_{\text{Al}_2\text{O}_3(\text{s})} + 3\Delta H^\circ_{\text{CH}_4(\text{g})}]$$

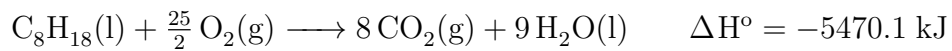
$$\Delta H^\circ = [(-129.3 \text{ kJ}) + 6(-241.8 \text{ kJ})] - [2(-1866.44 \text{ kJ}) + 3(-74.4 \text{ kJ})]$$

$$\Delta H^\circ = +2376.0 \text{ kJ}$$



Please note that the  $\Delta H$  value for water should be  $-241.8 \text{ kJ}$  because water is in the gas state in this question.

## HEAT SUMMATION 2



$$\begin{aligned} \Delta\text{H}^\circ &= [8\Delta\text{H}_{\text{CO}_2(\text{g})}^\circ + 9\Delta\text{H}_{\text{H}_2\text{O}(\text{l})}^\circ] - [\Delta\text{H}_{\text{C}_8\text{H}_{18}(\text{l})}^\circ + \frac{25}{2}\Delta\text{H}_{\text{O}_2(\text{g})}^\circ] \\ -5470.1 \text{ kJ} &= [8(-393.5 \text{ kJ}) + 9(-285.8 \text{ kJ})] - [\Delta\text{H}_{\text{C}_8\text{H}_{18}(\text{l})}^\circ + \frac{25}{2}(0)] \end{aligned}$$

$$\Delta\text{H}_{\text{C}_8\text{H}_{18}(\text{l})}^\circ = -5720.2 \text{ kJ} + 5470.1 \text{ kJ}$$

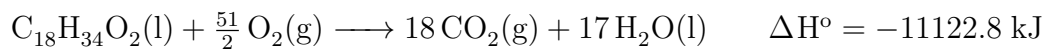
$$\Delta\text{H}_{\text{C}_8\text{H}_{18}(\text{l})}^\circ = -250.1 \text{ kJ}$$

Please note that the textbook value (pg 799) for the heat of formation of  $\text{C}_8\text{H}_{18}$  is -250.1 kJ !!!

### HEAT SUMMATION 3

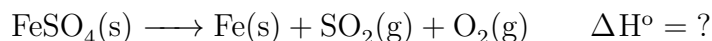


$$\begin{aligned} \Delta \text{H}^\circ &= [18\Delta \text{H}_{\text{CO}_2(\text{g})}^\circ + 17\Delta \text{H}_{\text{H}_2\text{O}(\text{l})}^\circ] - [\Delta \text{H}_{\text{C}_{18}\text{H}_{34}\text{O}_2(\text{l})}^\circ + \frac{51}{2}\Delta \text{H}_{\text{O}_2(\text{g})}^\circ] \\ \Delta \text{H}^\circ &= [18(-393.5 \text{ kJ}) + 17(-285.8 \text{ kJ})] - [(-818.81 \text{ kJ}) + \frac{51}{2}(0)] \\ \Delta \text{H}^\circ &= -11122.8 \text{ kJ} \end{aligned}$$



## HEAT SUMMATION 4

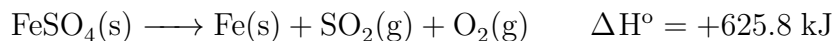
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$$\Delta H^\circ = [\Delta H_{\text{Fe}(\text{s})}^\circ + \Delta H_{\text{SO}_2(\text{g})}^\circ + \Delta H_{\text{O}_2(\text{g})}^\circ] - [\Delta H_{\text{FeSO}_4(\text{s})}^\circ]$$

$$\Delta H^\circ = [(0 \text{ kJ}) + (-296.8 \text{ kJ}) + (0 \text{ kJ})] - [(-922.6 \text{ kJ})]$$

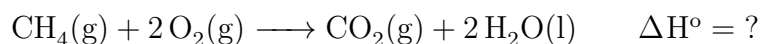
$$\Delta H^\circ = +625.8 \text{ kJ}$$



$$Q = -\Delta H$$

$$Q = -625.8 \text{ kJ/mol FeSO}_4(\text{s})$$

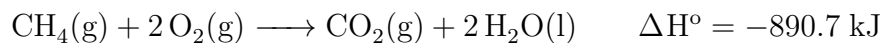
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$$\Delta H^\circ = [\Delta H_{\text{CO}_2(\text{g})}^\circ + 2\Delta H_{\text{H}_2\text{O}(\text{l})}^\circ] - [\Delta H_{\text{CH}_4(\text{g})}^\circ + 2\Delta H_{\text{O}_2(\text{g})}^\circ]$$

$$\Delta H^\circ = [(-393.5 \text{ kJ}) + 2(-285.8 \text{ kJ})] - [-74.4 \text{ kJ} + 2(0)]$$

$$\Delta H^\circ = -890.7 \text{ kJ}$$



$$Q = -\Delta H$$

$$Q = 890.7 \text{ kJ/mol CH}_4(\text{g})$$

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$$\begin{aligned} 750 \text{ kg FeSO}_4 \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol FeSO}_4}{151.92 \text{ g FeSO}_4} \times \frac{625.8 \text{ kJ}^*}{1 \text{ mol FeSO}_4} \times \frac{1 \text{ mol CH}_4}{890.7 \text{ kJ}} \\ \times \frac{16.05 \text{ g CH}_4}{1 \text{ mol CH}_4} \times \frac{1 \text{ kg}}{1000 \text{ g}} = 55.7 \text{ kg CH}_4 \end{aligned}$$

\* Please note that the sign has been dropped on the conversion factor for heat per mole of ferrous sulphate. This is done for convenience. Heat energy is absorbed by this decomposition reaction is provided by heat produced by the combustion of methane.

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## HEAT SUMMATION 5



$$-273.65 \text{ kcal} \times \frac{4.184 \text{ kJ}}{1 \text{ kcal}} = -1145.0 \text{ kJ}$$

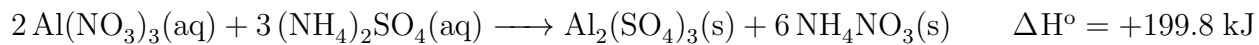
$$-281.86 \text{ kcal} \times \frac{4.184 \text{ kJ}}{1 \text{ kcal}} = -1179.3 \text{ kJ}$$

$$-820.98 \text{ kcal} \times \frac{4.184 \text{ kJ}}{1 \text{ kcal}} = -3435.0 \text{ kJ}$$

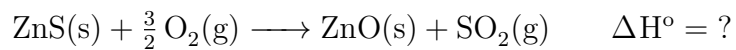
$$\Delta H^\circ = [\Delta H^\circ_{\text{Al}_2(\text{SO}_4)_3(\text{s})} + 6\Delta H^\circ_{\text{NH}_4\text{NO}_3(\text{s})}] - [2\Delta H^\circ_{\text{Al}_2(\text{NO}_3)_3(\text{aq})} + 3\Delta H^\circ_{(\text{NH}_4)_2\text{SO}_4(\text{aq})}]$$

$$\Delta H^\circ = [(-3435.0 \text{ kJ}) + 6(-365.6 \text{ kJ})] - [2(-1145.0 \text{ kJ}) + 3(-1179.3 \text{ kJ})]$$

$$\Delta H^\circ = +199.8 \text{ kJ}$$



## HEAT SUMMATION 6



$$\Delta H^\circ = [\Delta H_{\text{ZnO(s)}}^\circ + \Delta H_{\text{SO}_2(\text{g})}^\circ] - [\Delta H_{\text{ZnS(s)}}^\circ + \frac{3}{2} \Delta H_{\text{O}_2(\text{g})}^\circ]$$

$$\Delta H^\circ = [(-350.5 \text{ kJ}) + (-296.8 \text{ kJ})] - [(-206.0 \text{ kJ}) + \frac{3}{2}(0)]$$

$$\Delta H^\circ = -441.3 \text{ kJ}$$

