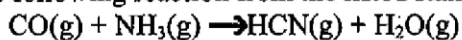


Practice – Heats of Formation

1. Calculate ΔH°_f (kJ) for the following reaction from the listed standard enthalpies of formation:



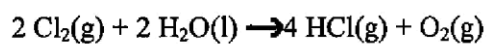
$\Delta H^\circ_f \text{CO(g)} = -110.5 \text{ kJ}$
 $\Delta H^\circ_f \text{NH}_3\text{(g)} = -46.1 \text{ kJ}$
 $\Delta H^\circ_f \text{HCN(g)} = +135.1 \text{ kJ}$
 $\Delta H^\circ_f \text{H}_2\text{O(g)} = -241.8 \text{ kJ}$

$$\Delta H = [\Delta H^\circ_f(\text{HCN}) + \Delta H^\circ_f(\text{H}_2\text{O})] - [\Delta H^\circ_f(\text{CO}) + \Delta H^\circ_f(\text{NH}_3)]$$

$$= +135.1 + (-241.8) - [-110.5 + (-46.1)]$$

$$\Delta H = +49.9 \text{ kJ}$$

2. Use the given standard enthalpies of formation to determine the heat of reaction of the following reaction:



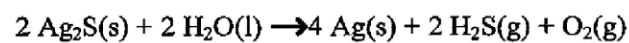
$\Delta H^\circ_f \text{H}_2\text{O(l)} = -285.8 \text{ kJ/mole}$
 $\Delta H^\circ_f \text{HCl(g)} = -92.3 \text{ kJ/mole}$

$$\Delta H = 4 \Delta H^\circ_f(\text{HCl}) + \Delta H^\circ_f(\text{O}_2) - [2 \Delta H^\circ_f(\text{Cl}_2) + 2 \Delta H^\circ_f(\text{H}_2\text{O})]$$

$$= 4(-92.3) + 0 - [2(0) + 2(-285.8)]$$

$$\Delta H = +202.4 \text{ kJ}$$

3. Use the given standard enthalpies of formation to determine the heat of reaction of the following reaction:



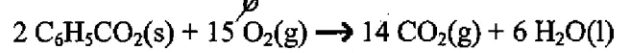
$\Delta H^\circ_f \text{Ag}_2\text{S(s)} = -32.6 \text{ kJ/mole}$
 $\Delta H^\circ_f \text{H}_2\text{S(g)} = -20.6 \text{ kJ/mole}$
 $\Delta H^\circ_f \text{H}_2\text{O(l)} = -285.8 \text{ kJ/mole}$

$$\Delta H = 4 \Delta H^\circ_f(\text{Ag}) + 2 \Delta H^\circ_f(\text{H}_2\text{S}) + \Delta H^\circ_f(\text{O}_2) - [2 \Delta H^\circ_f(\text{Ag}_2\text{S}) + 2 \Delta H^\circ_f(\text{H}_2\text{O})]$$

$$= 4(0) + 2(-20.6) + 0 - [2(-32.6) + 2(-285.8)]$$

$$\Delta H = +595.6 \text{ kJ}$$

4. The heats of formation of $\text{CO}_2\text{(g)}$ and $\text{H}_2\text{O(l)}$ are -394 kJ/mole and -285.8 kJ/mole respectively. Using the data for the following combustion reaction, calculate the heat of formation of $\text{C}_6\text{H}_5\text{CO}_2\text{H(s)}$.



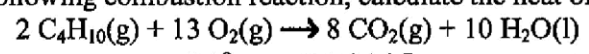
$$\Delta H^\circ_{\text{rxn}} = -6454 \text{ kJ}$$

$$\Delta H = [14 \Delta H^\circ_f(\text{CO}_2) + 6 \Delta H^\circ_f(\text{H}_2\text{O})] - [2 \Delta H^\circ_f(\text{C}_6\text{H}_5\text{CO}_2)]$$

$$-6454 = [14(-394) + 6(-285.8)] - 2X$$

$$X = -388.4 \text{ kJ/mol}$$

5. The heats of formation of $\text{CO}_2\text{(g)}$ and $\text{H}_2\text{O(l)}$ are -394 kJ/mole and -285.8 kJ/mole respectively. Using the data for the following combustion reaction, calculate the heat of formation of $\text{C}_4\text{H}_{10}\text{(g)}$.



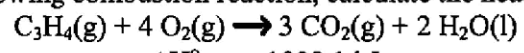
$$\Delta H^\circ_{\text{rxn}} = -5756.1 \text{ kJ}$$

$$\Delta H = [8 \Delta H^\circ_f(\text{CO}_2) + 10 \Delta H^\circ_f(\text{H}_2\text{O})] - [2 \Delta H^\circ_f(\text{C}_4\text{H}_{10})]$$

$$-5756.1 \text{ kJ} = [8(-394) + 10(-285.8)] - 2X$$

$$X = -126.95 \text{ kJ/mol}$$

6. The heats of formation of $\text{CO}_2\text{(g)}$ and $\text{H}_2\text{O(l)}$ are -394 kJ/mole and -285.8 kJ/mole respectively. Using the data for the following combustion reaction, calculate the heat of formation of $\text{C}_3\text{H}_4\text{(g)}$.



$$\Delta H^\circ_{\text{rxn}} = -1939.1 \text{ kJ}$$

$$\Delta H = 3 \Delta H^\circ_f(\text{CO}_2) + 2 \Delta H^\circ_f(\text{H}_2\text{O}) - \Delta H^\circ_f(\text{C}_3\text{H}_4)$$

$$-1939.1 = 3(-394) + 2(-285.8) - X$$

$$X = +185.5 \text{ kJ/mol}$$