

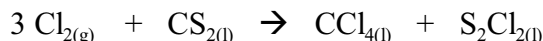
## Hess's Law and Calorimetry Problems

1. Given  $\Delta H_f^\circ = -394 \text{ kJ}$  for  $\text{CO}_2(\text{g})$ ,  $\Delta H_f^\circ = -286 \text{ kJ}$  for  $\text{H}_2\text{O}(\text{l})$  and  $\Delta H_{\text{comb}}^\circ = -891 \text{ kJ}$  for  $\text{CH}_4(\text{g})$ , determine  $\Delta H_f^\circ$  for  $\text{CH}_4(\text{g})$ .
2. Determine  $\Delta H^\circ$  for the following reaction



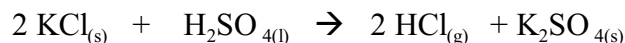
Given the following equations:

- 1)  $\text{C}_{(\text{s})} + \text{O}_{2(\text{g})} \rightarrow \text{CO}_{2(\text{g})}$   $\Delta H_1^\circ = -395 \text{ kJ}$
  - 2)  $\text{CO}_{(\text{g})} + \frac{1}{2} \text{O}_{2(\text{g})} \rightarrow \text{CO}_{2(\text{g})}$   $\Delta H_2^\circ = -281 \text{ kJ}$
  - 3)  $\text{H}_{2(\text{g})} + \frac{1}{2} \text{O}_{2(\text{g})} \rightarrow \text{H}_2\text{O}_{(\text{l})}$   $\Delta H_3^\circ = -242 \text{ kJ}$
3. Given  $\Delta H_{\text{comb}}^\circ = -1301 \text{ kJ}$  for  $\text{C}_2\text{H}_2(\text{g})$ ,  $\Delta H_f^\circ = -394 \text{ kJ}$  for  $\text{CO}_2(\text{g})$  and  $\Delta H_f^\circ = -286 \text{ kJ}$  for  $\text{H}_2\text{O}(\text{l})$ , calculate the  $\Delta H_f^\circ$  for  $\text{C}_2\text{H}_2(\text{g})$ .
  4. Exactly 3.0g of  $\text{C}_{(\text{s})}$  was burned to  $\text{CO}_2(\text{g})$  in a copper calorimeter. The mass of the calorimeter was 1.500 kg and the mass of the water in which the calorimeter was immersed was 1.500 kg. The initial temperature of the system was  $20^\circ\text{C}$  and the final temperature was  $31.0^\circ\text{C}$ . Calculate the heat formation of  $\text{CO}_2(\text{g})$ , under the conditions present in the calorimeter. The specific heat of copper is  $0.39 \text{ J/g}^\circ\text{C}$ .
  5. Given  $\Delta H_f^\circ = -85 \text{ kJ}$  for  $\text{C}_2\text{H}_6(\text{g})$ ,  $\Delta H_f^\circ = -394 \text{ kJ}$  for  $\text{CO}_2(\text{g})$  and  $\Delta H_f^\circ = -286 \text{ kJ}$  for  $\text{H}_2\text{O}(\text{l})$ , calculate  $\Delta H_{\text{comb}}^\circ$  for  $\text{C}_2\text{H}_6(\text{g})$ .
  6. One step in the manufacturing of  $\text{CCl}_4(\text{l})$  includes the reaction



where  $\Delta H_f^\circ = -88 \text{ kJ}$  for  $\text{CS}_{2(\text{l})}$ ,  $\Delta H_f^\circ = -139 \text{ kJ}$  for  $\text{CCl}_{4(\text{l})}$ ,  $\Delta H_f^\circ = -60 \text{ kJ}$  for  $\text{S}_2\text{Cl}_{2(\text{l})}$ . If the reaction takes place inside a reactor which is cooled by water at  $25^\circ\text{C}$  must pass through the cooling coils of the reactor for each kilogram of  $\text{Cl}_{2(\text{g})}$  reacting in order to keep the temperature at  $25^\circ\text{C}$ ?

7. We can generate hydrogen chloride by heating a mixture of sulfuric acid and potassium chloride according to the reaction



Calculate  $\Delta H^\circ$  for this reaction from the following thermochemical equations. Give your answer in kilojoules.

