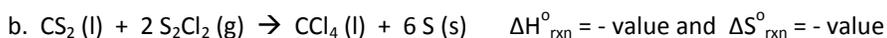
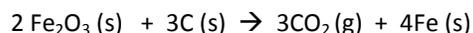


## Thermochemistry #6

1. For the following reactions tell whether the sign of  $\Delta G^\circ_{\text{rxn}}$  is + or - or needs a temperature to know for sure by analyzing the  $\Delta S^\circ_{\text{rxn}}$  and  $\Delta H^\circ_{\text{rxn}}$  signs. If a temperature is needed predict whether it will be a high or low temperature.



2. The following reaction is nonspontaneous under standard state conditions at room temperature.



To make it a spontaneous reaction would you raise or lower the temperature? Explain?

3. Most decomposition reactions have what kind of sign for,  $\Delta H^\circ_{\text{rxn}}$ ,  $\Delta S^\circ_{\text{rxn}}$ , &  $\Delta G^\circ_{\text{rxn}}$ ?
4. Based on your answers for #3, how would the values be different for reverse reactions? What are those reverse reactions called?
5. Given the following data for mercury calculate the normal boiling point of Hg?
- Hg (l) :  $S^\circ = 76.0 \text{ J/mol}\cdot\text{K}$ ;  $\Delta H^\circ_f = 0 \text{ kJ/mol}$
- Hg (g) :  $S^\circ = 175.0 \text{ J/mol}\cdot\text{K}$ ;  $\Delta H^\circ_f = 61.32 \text{ kJ/mol}$
6. Calculate  $\Delta G^\circ$  for the ionization of ammonia with water at  $35^\circ\text{C}$  ( $K_b = 1.8 \times 10^{-5}$ ).
7.  $\text{NH}_4\text{Cl} (\text{s}) \rightarrow \text{NH}_3 (\text{g}) + \text{HCl} (\text{g})$  Calculate  $\Delta H^\circ$  &  $\Delta S^\circ$  for this process. Is the reaction spontaneous at 300K? At 500K? At what Temperature would this reaction become spontaneous?
8. When ammonia reacts with dinitrogen monoxide gas, liquid water and nitrogen gas are formed. What is the heat of the reaction? How much heat is liberated or absorbed by the reaction that produces 275mL of nitrogen gas at  $25^\circ\text{C}$  and 1.022 atm?
9. Consider the dissociation of water into its ions:  $\text{H}_2\text{O} (\text{l}) \rightarrow \text{H}^+ (\text{aq}) + \text{OH}^- (\text{aq})$   $\Delta H^\circ = 55.8 \text{ kJ}$
- What is the  $\Delta S^\circ$  for this reaction? Is this reaction spontaneous? What is the  $K_{\text{eq}}$  for this reaction at  $25^\circ\text{C}$ ?
10. A sample of sucrose,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ , weighing 4.50 g is burned in a bomb calorimeter whose heat capacity is  $24.11 \text{ kJ}/^\circ\text{C}$  and the temperature rises from  $22.15^\circ\text{C}$  to  $25.22^\circ\text{C}$ . Calculate the heat for one mol of sucrose combusting.
11. When 2.80 g of calcium chloride dissolves in 100.0g of water the temperature of the water rises from  $20.50^\circ\text{C}$  to  $25.40^\circ\text{C}$ . What is the heat required to dissolve one mole of calcium chloride?