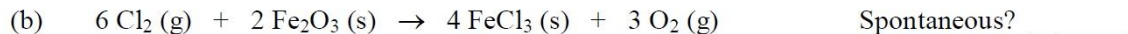


## Gibbs Free Energy Questions

### Thermochemistry: Gibbs Free Energy Calculations

1. Calculate  $\Delta G^\circ$  to predict if the following reactions are spontaneous under standard conditions.



2. Consider the following chemical equation: **A + B  $\rightarrow$  C + D**

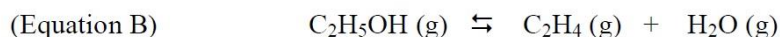
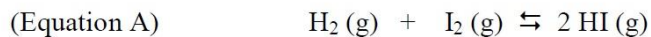
If  $\Delta H^\circ = -844 \text{ kJ}$  and  $\Delta S^\circ = -165 \text{ J/K}$ , is this reaction spontaneous at 298 K ?

3. Consider the following chemical equation: **A + B  $\rightarrow$  C + D**

If  $\Delta H^\circ = 572 \text{ kJ}$  and  $\Delta S^\circ = 179 \text{ J/K}$ , is this reaction spontaneous at 298 K ?

If a reaction is not spontaneous under standard conditions at 298 K, at what temperature (if any) would the reaction become spontaneous?

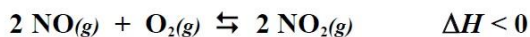
4. Use the Gibbs table to calculate the  $\Delta G^\circ$  for each reaction. Then, calculate the  $K_{eq}$  at 298 K for each of the following reactions.  $\Delta G^\circ = -RT \ln K$



5. Based on your values for  $K_{eq}$  in the previous problem, which side (reactants or products) of the equilibrium reaction is favored? Recall that a BIG  $K_{eq}$  favors the products side.

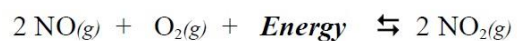
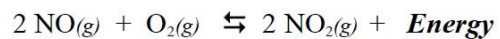
(Equation A) \_\_\_\_\_ (Equation B) \_\_\_\_\_

6. Consider the following equation:



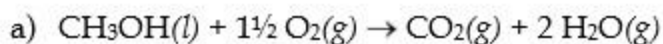
(a) Is this an endothermic or exothermic process? Explain your reasoning.

(b) Which equation shown below would best fit the above equation?

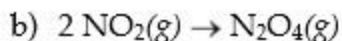


(c) Would you expect to  $\Delta S$  to be positive or negative for this chemical reaction? Explain.

7. Calculate  $\Delta G^\circ$  using  $\Delta G^\circ = \Delta H - T\Delta S$ . Also, for each question, tell whether or not the reaction will be spontaneous.

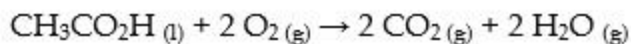


$$\Delta H = -638.4 \text{ kJ} \quad \Delta S = 156.9 \text{ J / K}$$



$$\Delta H = -57.2 \text{ kJ} \quad \Delta S = -175.9 \text{ J / K}$$

8. Again find  $\Delta G$  at  $25^\circ\text{C}$  for the reaction



This time using the Table of Thermochemical Data and the formula:

$$\Delta G = \sum \Delta G^\circ_{\text{products}} - \sum \Delta G^\circ_{\text{reactants}}$$

9. For the reaction below,



Calculate the standard free energy of formation of the ferric oxide,  $\text{Fe}_2\text{O}_3$ .

10. Calculate  $\Delta G$  at  $25^\circ\text{C}$  for the following reaction using  $\Delta G = \Delta H - T\Delta S$ . Will this reaction be spontaneous at this temperature?

