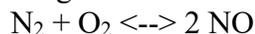


Textbook Questions: 25, 39, 49

Additional Questions:

1. Nitrogen Oxides are very important species in atmospheric chemistry. They are critical for a number of reactions that contribute to photochemical smog. The major anthropogenic (man made) source of NO is from the following reaction:



In this problem you will study the temperature dependence of this reaction to learn how the emission of NO may be reduced. Answer the following questions (assume that ΔH is constant at each temperature):

- a. What is ΔH_{rxn} , ΔS_{rxn} , ΔG_{rxn} , and K (Assume that ΔH_{rxn} and ΔS_{rxn} do not change with temperature. This is not strictly true, but solving this requires advanced calculus):
- 25 °C
 - 1000 °C
 - 2000 °C
 - 3000 °C
- b. The atmospheric pressure of N_2 is 0.80 atm and O_2 is 0.20 atm. Determine the equilibrium pressure of NO at each of the above temperatures.
- c. At high temperatures this reaction fast and reaches equilibrium quickly, but when exhaust gases cool the reaction is very slow and the system stays at the high temperature equilibrium. Would lowering the combustion temperature from 3000 °C to 2000 °C have any effect on the NO emission?
- d. The concentration of NO is normally determined with an instrument that first converts it to NO_2 . Based upon the Gibbs free energy, could the following reaction be used to convert NO into NO_2 at ambient temperatures?
- $\text{NO} + \text{O}_3 \rightleftharpoons \text{NO}_2 + \text{O}_2$
2. Calculate ΔG at 20°C for the reaction $\text{H}_2 + \text{I}_2 \rightleftharpoons 2 \text{HI}$. Starting with 1.0 atm H_2 and 1.0 atm I_2 . What is $[\Delta] G$ when:
- 1% has reacted
 - 10% has reacted
 - 90% has reacted
 - 99% has reacted
3. Using values from your textbook calculate ΔS° and ΔG° for the following reactions:
- $\text{CO}_2 (\text{g}) + \text{H}_2 (\text{g}) \rightarrow \text{CO} + \text{H}_2\text{O} (\text{g})$
 - $4 \text{CO}_2 (\text{g}) + 2 \text{H}_2\text{O} (\text{g}) \rightarrow 2 \text{C}_2\text{H}_2 (\text{g}) + 5 \text{O}_2 (\text{g})$