

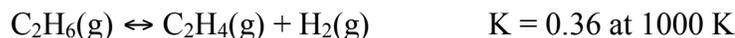
Chem 402—Physical Chemistry
Homework Problem Set—Chapter 7

1. When gaseous iodine is heated, dissociation occurs:



It was found that when 0.0061 mol of iodine was placed in a volume of 0.5 dm³ at 900 K, the degree of dissociation was 0.0274. Calculate K_C and K_P at that temperature.

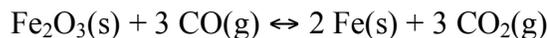
2. When alkanes are heated, they lose hydrogen and alkenes are produced. For example,



If this is the only reaction that occurs when ethane is heated to 1000 K, at what total pressure will ethane be (a) 10% dissociated and (b) 90% dissociated to ethylene and hydrogen.

3. The measured density of an equilibrium mixture of N_2O_4 and NO_2 at 15 °C and 1.103 bar is 3.62 g L⁻¹, and at 75 °C and 1.013 bar is 1.84 g L⁻¹. What is the enthalpy change of the reaction $\text{N}_2\text{O}_4(\text{g}) \leftrightarrow \text{NO}_2(\text{g})$?

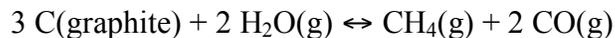
4. The values of K for the following reaction are known:



T (°C)	250	1000
K	100	0.0721

At 1120 °C for the reaction $2 \text{CO}_2(\text{g}) \leftrightarrow 2 \text{CO}(\text{g}) + \text{O}_2(\text{g})$, $K = 1.4 \times 10^{-12}$ bar. What equilibrium partial pressure of O_2 would have to be supplied to a vessel at 1120 °C containing solid Fe_2O_3 just to prevent formation of Fe?

5. At 250 °C, 1 L of partially dissociated phosphorous pentachloride gas at 1.013 bar weighs 2.690 g. Calculate the extent of reaction ξ and the equilibrium constant.
6. Assume that the following reaction is in equilibrium at 1000 K:



$\Delta_r H^\circ(1000 \text{ K}) = 182 \text{ kJ mol}^{-1}$. (a) What will be the effect on the equilibrium composition of raising the temperature at a total pressure of 1 bar? (b) What will be the effect of raising the pressure to 5 bar? (c) What will be the effect of adding nitrogen at constant pressure of 1 bar?

7. The following data apply to the reaction $\text{Br}_2(\text{g}) \leftrightarrow 2 \text{Br}(\text{g})$:

T (K)	1123	1172	1223	1273
K	0.408×10^{-3}	1.42×10^{-3}	3.32×10^{-3}	7.2×10^{-3}

Determine the reaction enthalpy at 1200 K.

8. The vapor pressure of water above a mixture of $\text{CuCl}_2 \cdot \text{H}_2\text{O}(\text{s})$ and $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}(\text{s})$ is given as a function of temperature:

T ($^{\circ}\text{C}$)	17.9	39.8	60.0	80.0
P (bar)	0.0049	0.0250	0.122	0.327

- (a) Calculate $\Delta_r H^{\circ}$ for the reaction



- (b) Calculate $\Delta_r G^{\circ}$ and $\Delta_r S^{\circ}$ for the reaction at 60°C .