

IB2 HL Chemistry

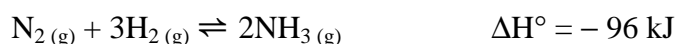
2. Equilibrium

Futher Problems:

1. How does a system at equilibrium differ from one not at equilibrium with respect to each of the following factors?
 - (a) concentrations
 - (b) occurrence of reactions
 - (c) rates of opposing reactions.

2. Name three measurable properties that could be used to determine when a chemical system has reached equilibrium.

3. Consider the equilibrium



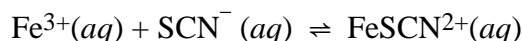
At 25°C and 10 atm pressure, the percentage conversion to ammonia in the equilibrium mixture is 5%.

- (a) If the pressure is increased to 40 atm, while the temperature remains the same, will the percentage conversion to ammonia be greater or less? Explain your answer briefly.
 - (b) If the temperature is increased to 250°C, while the pressure remains at 10 atm, will the equilibrium amount of ammonia be greater or less? Explain.
 - (c) What will happen if a catalyst is added to the equilibrium mixture?
4. For each of the following reactions, indicate whether reactants or products are present in greater concentration at equilibrium at the temperature specified.
 - (a) $\text{COCl}_2(\text{g}) \rightleftharpoons \text{CO}(\text{g}) + \text{Cl}_2(\text{g})$ $K_c = 8.2 \times 10^{-2}$ at 627°C
 - (b) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ $K_c = 626$ at 200°C

5. $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$ $\Delta H = -114.6 \text{ kJ}$

Predict the effect on the numerical value of the equilibrium constant of

- (a) increasing the temperature
 - (b) increasing the NO concentration at equilibrium
6. Suppose that two substances, X and Y, have enthalpies of vaporization equal to 38 and 28 kJ mol⁻¹, respectively. Which compound would you expect to have the higher boiling point? Which compound would be less likely to exhibit hydrogen bonding? Explain your answers.
 7. Benzene has a boiling point of 80.1°C. Tetrachloromethane boils at 76.8°C. If a solution is composed of equal masses of the two compounds, which would have the greater number of moles in the vapor phase? Explain.
 8. Consider the reaction represented by the equation



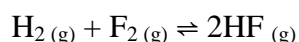
You start with 6.00 M Fe³⁺(aq) and 10.0 M SCN⁻(aq), and at equilibrium the concentration of FeSCN²⁺(aq) is 4.00 M. What is the value of the equilibrium constant for this reaction?

9. A 2.00-mol sample of ammonia is introduced into a 1.00-dm³ container. At a certain temperature, the ammonia partially dissociates according to the equation



At equilibrium 1.00 mol of ammonia remains. Calculate the value for *K*.

10. The equilibrium constant, *K_c*, for the reaction



has the value 2.1×10^3 at a particular temperature. When the system is analysed at equilibrium at this temperature, the concentrations of H₂(g) and F₂(g) are both found to be 0.0021 M. What is the concentration of HF(g) in the equilibrium system under these conditions?