Assignment 5

1. Considering the diagram below, the system consists of two weakly soluble gases in equilibrium at an unspecified temperature.

   ![Diagram of gas system](image)

   - Flow through points A, B, and C is indicated.
   - The system is at equilibrium.

   a) Assume that the system is at equilibrium. Derive the expression for the standard Gibbs energy change for the reaction.

   b) If the temperature is increased, will the reaction proceed in the same direction? Explain your answer.

2. The standard Gibbs energy change for a reaction is given by a temperature-dependent quantity, 

   \[ \Delta G = -RT \ln K \]

   where \( K \) is the equilibrium constant and \( R \) is the gas constant.

   a) If the temperature is increased, will the reaction proceed in the same direction? Explain your answer.

   b) If the temperature is decreased, will the reaction proceed in the same direction? Explain your answer.

3. The reaction rate law for a system is given by 

   \[ r = k [A][B]^{1/2} \]

   where \( r \) is the reaction rate, \( k \) is the rate constant, \( [A] \) is the concentration of \( A \), and \( [B] \) is the concentration of \( B \).

   a) If the concentration of \( B \) is increased, will the reaction rate increase? Explain your answer.

   b) If the concentration of \( A \) is decreased, will the reaction rate decrease? Explain your answer.

4. The chemical equilibrium constant, \( K \), is related to the reaction quotient, \( Q \), by the equation

   \[ K = \frac{[C][D]}{[E][F]} \]

   where \( [C] \), \( [D] \), \( [E] \), and \( [F] \) are the concentrations of the reactants and products.

   a) If the reaction quotient, \( Q \), is greater than the equilibrium constant, \( K \), will the reaction proceed in the forward direction? Explain your answer.

   b) If the reaction quotient, \( Q \), is less than the equilibrium constant, \( K \), will the reaction proceed in the reverse direction? Explain your answer.

5. The reaction rate for a system is given by 

   \[ r = k [A][B]^2 \]

   where \( r \) is the reaction rate, \( k \) is the rate constant, \( [A] \) is the concentration of \( A \), and \( [B] \) is the concentration of \( B \).

   a) If the concentration of \( B \) is increased, will the reaction rate increase? Explain your answer.

   b) If the concentration of \( A \) is decreased, will the reaction rate decrease? Explain your answer.