1. Consider the following equilibrium reaction

\[ \text{Br}_2 (g) + \text{Cl}_2 (g) \rightleftharpoons 2 \text{BrCl} (g) \quad K_p = 2.65 \times 10^{-3} \text{ at 300 K} \]

(3) At equilibrium, would you expect to have more products or reactants? Why?

(2) If the products and reactants are mixed so that all three have equal partial pressures, will the reaction go forward as written, go in reverse as written, or stay the same to establish equilibrium? (Circle one)

forward \hspace{1cm} reverse \hspace{1cm} stay the same

(6) Show a simple calculation to support your answer:

(8) Once equilibrium is established, what will happen if the following changes are made? Circle ONE for each change.

- \text{Br}_2 is removed from the reaction mixture \hspace{1cm} Shift to \hspace{1cm} Shift to \hspace{1cm} No products reactants \hspace{1cm} change

- Pressure is increased \hspace{1cm} Shift to \hspace{1cm} Shift to \hspace{1cm} No products reactants \hspace{1cm} change

- \text{Cl}_2 is added to the reaction mixture \hspace{1cm} Shift to \hspace{1cm} Shift to \hspace{1cm} No products reactants \hspace{1cm} change

- Volume is increased \hspace{1cm} Shift to \hspace{1cm} Shift to \hspace{1cm} No products reactants \hspace{1cm} change
When the reaction vessel is heated to 500 K, more BrCl is produced. What further information does this give you about the reaction?

How does the equilibrium constant at 500 K compare to the equilibrium constant at 300 K? (Circle ONE)

\[
\begin{align*}
K_{300\text{ K}} &< K_{500\text{ K}} \\
K_{300\text{ K}} & = K_{500\text{ K}} \\
K_{300\text{ K}} &> K_{500\text{ K}}
\end{align*}
\]

How does the \( K_p \) at 300 K compare to the \( K_c \) at 300 K for this reaction?

\[
\begin{align*}
K_p &< K_c \\
K_p &= K_c \\
K_p &> K_c
\end{align*}
\]

2. Multiple Choice: Each question may have more than one answer. Circle ALL that are correct. You will receive 1 point for each choice that is correctly circled and 1 point for each choice that is correctly left un-circled. It is not in your best interest to guess blindly!

The equilibrium constant for a reaction

A. is large when a reaction goes to completion
B. can be calculated from the concentration of reactants and products under any reaction conditions
C. can be calculated from the concentration of reactants and products at equilibrium
D. changes with temperature

Which of the following statements about equilibrium is true?

A. Rates of forward and reverse reaction are equal
B. Concentrations of products and reactants are equal
C. Forward and reverse reactions stop when equilibrium is reached
D. Equilibrium can be reached starting from only reactants or starting from only products of a reaction.

For an endothermic reaction with an equilibrium constant close to 1, product formation is favored by

A. increasing temperature
B. removing products
C. decreasing temperature
D. adding more reactants
3. PCl₅ decomposes at high temperatures to produce PCl₃ and Cl₂:

\[
\text{PCl}_5 (g) \rightleftharpoons \text{PCl}_3 (g) + \text{Cl}_2 (g) \quad K_c = 1.8 \text{ at } 250 \, ^\circ C
\]

(4) 31.2 g of PCl₅ is placed in a 0.500 L bulb and heated to 250 °C. What is the initial concentration of PCl₅?

(14) After equilibrium is reached, what are the concentrations of PCl₅, PCl₃, and Cl₂?

\[[\text{PCl}_5] = \]
\[[\text{PCl}_3] = \]
\[[\text{Cl}_2] = \]

(8) What is \( K_p \) at 250 °C?