AFCoKaRE Practice Problem 8.4 Solution

Purpose: This problem allows you to practice generating a rate expression for a non-elementary reaction when there is a rate-determining step in the mechanism.

Problem Statement: Phosgene formation, reaction (1), is non-elementary; it has been proposed to occur via the mechanism consisting of reactions (2) through (4). Generate a rate expression for the non-elementary reaction (1) assuming mechanistic step (4) to be rate-determining.

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\text{CO} + \text{Cl}_2 \rightleftharpoons \text{COCl}_2 \quad (1)
\]
\[
\text{Cl}_2 \rightleftharpoons 2 \text{Cl} \quad (2)
\]
\[
\text{Cl} + \text{Cl}_2 \rightleftharpoons \text{Cl}_3 \quad (3)
\]
\[
\text{Cl}_3 + \text{CO} \rightarrow \text{COCl}_2 + \text{Cl} \quad (4)
\]