Problem 4.1

Problem Purpose

This problem will help you determine whether you have mastered the learning objectives for this unit.

Problem Statement

Consider the representative reaction 2A + B → Y + Z. For parts (a) through (f) of this question, assume that the rate is to be expressed in units of moles per volume per time.

a. What are the units of the rate coefficient if the rate expression is $r = k\sqrt{C_A}$, and the concentration is in units of mol cm^{-3}?

b. What are the units of the rate coefficient if the rate expression is $r = kC_A C_B$, and the concentration is in units of mol L^{-1}?

c. What are the units of the rate coefficient if the rate expression is $r = kP_A$, and the partial pressure is in units of Torr?

d. What are the units of the rate coefficient if the rate expression is $r = kP_A^2\left[1 - \frac{P_Y P_Z}{K P_A^2 P_B}\right]$, K is the equilibrium constant for the reaction divided by 1 atm, all species can be treated as ideal gases and the partial pressures are in units of atm?

e. If the rate of reaction with respect to Y is 27 mol cm^{-3} s^{-1}, what is the rate of reaction with respect to A?

f. If the generalized rate of reaction is 35 mol cm^{-3} s^{-1}, what is the rate of reaction with respect to B?

g. Suppose that glass catalyzes the reaction and the generalized rate was measured in cylindrical glass reactor that was 10 cm in diameter and 15 cm in axial length. Suppose further that the rate was found to equal 0.2 mol cm^{-2} s^{-1}. If a poorly-trained engineer measured the rate and assumed that it took place homogeneously in the gas phase, what rate with respect to A would that engineer report?