

A First Course on Kinetics and Reaction Engineering

Activity 19.1

A gas mixture contains 1500 ppm of A, 1000 ppm of B and 7% C. The remainder of the gas is inert (non-reactive). A 3 L reactor steel reactor is charged with this mixture at 1115 K and 1.7 atm. Reactions (1) and (2) take place adiabatically with rates given by equations (3) and (4). The pre-exponential factors for reactions (1) and (2) are $6.1 \times 10^{16} \text{ L mol}^{-1} \text{ s}^{-1}$ and $5.5 \times 10^{13} \text{ s}^{-1}$, respectively, and the activation energies are 250 and 320 kJ/mol, respectively. Calculate the parts per million of B after 0.5, 1 and 5 seconds. You may assume the heats of reactions (1) and (2) to be constant and equal to -1700 kJ/mol and -800 kJ/mol, respectively. The heat capacities of the gases may be taken to equal that of the inert, $32 \text{ J mol}^{-1} \text{ K}^{-1}$, and to be independent of temperature.



$$r_1 = k_{0,1} \exp\left\{\frac{-E_1}{RT}\right\} C_A C_B \quad (3)$$

$$r_2 = k_{0,2} \exp\left\{\frac{-E_2}{RT}\right\} C_A \quad (4)$$