

AFCoKaRE Practice Problem 29.1

Purpose: This problem will allow you to practice the quantitative analysis of a cascade of CSTRs.

Problem Statement: An aqueous solution at 30 °C containing A and B at concentrations of 1.0 and 1.2 M, respectively, is to be fed to two CSTRs in series at a flow rate of 75 L min⁻¹. Reaction (1) will occur in the adiabatic reactors with a rate of reaction that is accurately described by equation (2). The heat of reaction (1) is -10,700 cal mol⁻¹ and may be assumed to be constant. The heat capacity of the solution and the density of the solution may be taken to be constant and equal to those of water (1.0 cal g⁻¹ K⁻¹ and 1.0 g cm⁻³). If 90% of the A needs to be converted, what is the minimum total volume required, and how is it divided between the two reactors?



$$r_1 = (8.72 \times 10^5 \text{ L mol}^{-1} \text{ min}^{-1}) \exp\left\{\frac{-7200 \text{ cal mol}^{-1}}{RT}\right\} C_A C_B \quad (2)$$