

CE 329, Fall 2015
Assignment 21

Problem Statement

Suppose pure gas phase reactant is fed to an adiabatic 5 L CSTR at a temperature of 1000 K, pressure of 1.87 atm, and flow rate of 6.5 m³ h⁻¹. Reaction (3.1) takes place in the CSTR at constant pressure. The rate expression is given in equation (3.2).



$$r_{3.1} = (5.0 \times 10^{16} \text{ min}^{-1}) \exp\left(\frac{-66500 \text{ cal mol}^{-1}}{RT}\right) C_A \quad (3.2)$$

What will be the conversion and outlet temperature? Thermodynamic data are provided in the following table where heat capacities are given in the form of equation (3.3) in units of cal mol⁻¹ K⁻¹ and the temperature should be expressed in K.

$$\hat{C}_{p-i} = \alpha_i + \beta_i T + \gamma_i T^2 + \delta_i T^3 \quad (3.3)$$

	A	R	S
α_i	1.51	1.53	4.6
β_i	6.2×10^{-2}	3.9×10^{-2}	1.3×10^{-2}
γ_i	-3.0×10^{-5}	-2.6×10^{-5}	-2.9×10^{-6}
δ_i	4.9×10^{-9}	6.4×10^{-9}	-2.7×10^{-9}
$\Delta H_{f(298K)-i}^0$	-52,000 cal/mol	-15,000 cal/mol	-18,000 cal/mol