1. A second order, A→2R type reaction is conducted in two ideal tubular reactors connected in series. The reaction rate is independent from the stoichiometry and can be described as r=k‧cA2. The reactors are operated in steady state. The first reactor operates adiabatically with an inlet temperature of 36 °C. The second reactor operates at constant 60 °C temperature. The bulk density of the mixture is considered constant, 940 kg/m3. The specific heat capacity is constant as well: 3.64 kJ/(kg‧K). The reaction enthalpy is -82.8 kJ/mol. The volume of each reactor is 11 dm3. The inlet concentration of component A is 2 M, while the feed does not contain any product. The reaction rate coefficient is 4,6‧1010\*e-7100/T(K) m3/(kmol‧h).
   1. Determine the maximum of the volumetric flowrate of the feed if the outlet temperature of the first reactor is 60 °C. What is the concentration of the component A at the outlet of the first reactor? (40 p)
   2. How many kilograms of product can be produced hourly in a steady state in the two reactors, if the inlet volumetric flowrate is 4.5 dm3/min and a solution containing 1 M of A enters the second reactor? (20 p)
2. A 36 kmol/h 52 mol% benzene + toluene mixture is separated on a continuously operated distillation column into a 95 mol% distillate and a 10 mol% residue. Compositions are given for the benzene. The operational reflux ratio is 2.5. The feed contains 40% liquid and its position is optimal. The diameter of the column operating with a partial reboiler is 0.7 m, the average plate efficiency is 0.70. The distance between the plates is 0.4 m.
   1. Determine the distillate and residue streams in kmol/h. (10 p)
   2. In order to perform the separation, what is the minimal number of theoretical plates and what is the minimal reflux ratio? (10 p)
   3. Calculate the height of the column! (20 p)

In case of performing numerical integration, 5 points are sufficient.