



1. (15%)

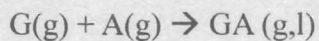
Please write the mole balance equation for dimethyl ether in terms of the reaction volume and concentration within a batch reactor, a continuous-stirred tank reactor, and a tubular reactor, respectively, as the gas phase decomposition of dimethyl ether to form methane, hydrogen, and carbon monoxide is a first-order reaction.

2. (15%)

Please show the design equation, i.e. reactor volume, in terms of the conversion for a batch reactor, a continuous-stirred tank reactor, and a tubular reactor, respectively, under a first-order reaction.

3. (20%)

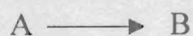
For a chemical vapor deposition process in which condensation occurs, e.g.,



The reaction is first order in both species of G and A. The feed contains only G and A in stoichiometric amounts and the reaction is performed isothermally. The total pressure is 1 atm and GA has a vapor pressure 20.26 kPa at 300 K. Please calculate the conversion at which condensation begins and express the concentration of reaction species and the rate of reaction as a function of conversion.

4. (25%)

The elementary isomerization



is carried out at 350K in a CSTR with  $F_{A0} = 5 \text{ mol/min}$  and  $C_{A0} = 0.5 \text{ mol/dm}^3$ . Pure A is fed into the reactor and the final isomerization ratio is 75%. If the activation energy is equal to 20 kcal/mole, what will the isomerization ratio be in a same volume PFR at 325 K with same feeding condition?

5. (25%)

The complex liquid phase reactions 1 and 2 follow elementary rate law. (a) Write the net formation rates of species A, B, C, and D in terms of concentration and reaction constant  $k_{1A}$  and  $k_{2D}$ . (b) If C is the desired product and D is the byproduct, write the instantaneous selectivity.

