

*Second Examination: March 9, 2005; 12:55 PM – 1:45 PM*

**Total – 100 points**

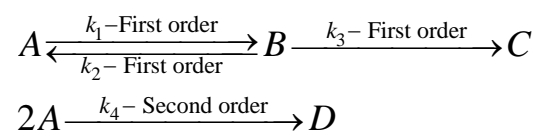
1. A liquid-phase reaction  $A + 2B \rightarrow C$  is taking place in a semi-batch reactor. The reaction is begun with 84 moles of A in the reactor. The initial reactor volume is 50 liters. B is added at a volumetric rate of 2 lit/min and a concentration of 10 mol/lit. The reaction is assumed to be zero order with respect to both A and B. The rate constant  $k$  is  $0.125 \frac{\text{mol}}{\text{lit-min}}$ . How much time does it take to reach a conversion of 50% A? What is the concentration of B at this time?

20 points

2. A series reaction  $A \xrightarrow{\text{1st order}} B \xrightarrow{\text{Zero order}} C$  is taking place in a CSTR. Derive the concentrations of A and B as functions of residence time  $\tau$ , the rate constants ( $k_1$  and  $k_2$ ) and the initial concentration of A ( $C_{A0}$ ). Assume that the concentrations of B and C in the reactor entrance stream are zero.

20 points

3. Determine the composite rates of reaction for all of the species in the following reaction sequence.



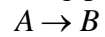
16 points

4. Measured concentrations in a constant-volume batch reactor are tabulated. Determine the order of the reaction and the rate constant.

t (mins)	0	5	13	20	30
Ca (mol/lit)	5	0.93	0.41	0.27	0.18

22 points

5. The following first-order reaction is taking place in a PBR.



The reaction rate and the rate constant are given by:

$$-r'_A = k p_A \frac{\text{mol}}{\text{kg cat-h}}$$

$$k = 0.75 \frac{\text{mol}}{\text{atm-kg cat-h}}$$

A is fed to the reactor with 50% inerts at 327<sup>0</sup>C and 1 atmosphere. Feed rate of A is 37.5 moles/h. The pressure drop parameter  $\alpha = 0.0045 \text{ kg}^{-1}$ . Obtain an expression that relates the conversion in the reactor to the weight of the catalyst used. What conversion can you obtain with 100 kg of the catalyst?

22 points