本試題是否可以使用計算機：☑可使用 ，☐不可使用　（請命題老師勾選）

1. The following first-order reaction takes place in a CSTR with a volume of V:

$$A \rightarrow B$$

The activation energy of the reaction, E_a, is 20 kcal/mol. Pure A is fed to the reactor at T=350 K under the following conditions: F_{A0} (flow rate of A) = 10 mol/min, C_{A0} (concentration of A) = 1 mol/dm^3 to have a conversion X=0.8. What is the conversion in a PFR at 315 K with the same volume, F_{A0} and C_{A0}? (12%)

2. A CSTR and a PFR are connected in series. Consider that the liquid phase reaction, $A \rightarrow B + C$, is carried out in this network. The reaction rate expression for this reaction is $r = kC_AC_B$. The feed to the first reactor (CSTR) contains a C_{A0} (concentration of A) of 2.0 kmoles/m^3, while neither species B or C is present in this stream. Both reactors operate isothermally at the same temperature. The CSTR and PFR each have a volume of 0.1 m^3. The rate at which A is fed to the first reactor, $F_{A0,}$ is 150 kmol/ksec. Note that this is an autocatalytic reaction in which a product acts as a catalyst for subsequent reaction. Steady-state operation may be assumed.

(a) If the conversion X_1 leaving the CSTR is 0.3, what is the reaction rate constant? (4%)

(b) What is the effluent composition from the second reactor? (8%)

(c) It has been suggested that the rate of product of species C by this network can be increased by operation the first reactor at X_1= 0.45. To what value must F_{A0} be changed under this operation conditions? Will the rate of production species C by this combination of reactors be increased under these circumstances? The composition of the feed stream is to remain unchanged. (9%)

(背面仍有題目,請繼續作答)

3. A case for enzyme reaction in a simplified form assumes the following reaction:

$$E_f + S \underset{k_{-1}}{\overset{k_1}{<=>}} E_cS \xrightarrow{k_2} E_f + \text{Product}$$

where E_f is free enzyme, S is substrate, and E_cS is enzyme-substrate complex.

The total enzyme concentration in the system, [E], remains constant and is equal to $[E_f]+[E_cS]$. The rate of enzyme-substrate complex formation is generally much faster than the overall reaction rate, so the enzyme-substrate complex can be considered as being at pseudo-stead-state concentration.

(a) Please show the rate of product formation as a function of [E] and [S]. (12%)

(b) It was found that 1 g of bacteria could decompose the waste at a maximum rate of 20 g/day when the waste concentration is very high. Also, it was found that the bacteria would decompose waste at a rate of 10 g/day when the waste concentration was 15 mg/L. What would be the rate of waste decomposition by 2 g of bacteria if the waste concentration was maintained at 5 mg/L? (10%)

4. Given the following laboratory data concerning the disappearance of a chemical in water, do the data fit a zero-order, first-order, or second-order rate expression? Provide sufficient justification for your answer, and report the correct rate constant in the correct units. (12%)

Time, h	Concentration, mg/L
0	100
0.5	61
1	37
2	14
3	5.0
5	0.67

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5. A jacket CSTR is a CSTR reactor surrounded with a heat exchanger. One of this type reactor is used to carry out irreversible gas phase reaction

$$A + B \rightarrow C.$$

The temperature of the medium in the heat exchanger is constant T_a. The feed temperature is T_O. To obtain the reactor volume (V) from a given inlet concentration (C_{AO}) and conversion (X), many variables or constants are required. (1) List all of the variables or constants you need to collect. (2) Write down the general expression between the variables and constant. (3) Describe how you will use these information with necessary assumptions to solve this problem. You need to give the answer **in detail**. (20%)

6. Reversible reaction $A + B \Leftrightarrow C$ is carried out in an adiabatic CSTR. Explain how the inlet temperature (T_O) affects the conversion (X) in a plot of conversion vs. inlet temperature,

(1) if the reaction is exothermic, and

(2) if the reaction is endothermic. (13%)