

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2018

Subject Code: 2172602/2172607
Date: 19/11/2018
Subject Name: Polymer Kinetics
Time: 10:30 AM TO 01:00 PM
Total Marks: 70
Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a) The rate constants for a certain reaction are 1.6×10^{-3} and 1.625×10^{-2} (second) $^{-1}$ at 10°C and 30°C respectively. Calculate the activation energy. 03
- Q.1 (b) Compare collision theory to transition state theory. 04
- Q.1 (c) The primary reaction occurring in the homogeneous decomposition of nitrous oxide is found to be $\text{N}_2\text{O} \rightarrow \text{N}_2 + 1/2\text{O}_2$ with a rate $-r_{\text{N}_2\text{O}} = k_1 [\text{N}_2\text{O}] / (1 + k_2 [\text{N}_2\text{O}])$. Devise a mechanism to explain this observed rate. 07

- Q.2 (a) Give classification of reactors based on its thermal behavior. 03
- Q.2 (b) Differentiate integral method of analysis and differential method of analysis. 04
- Q.2 (c) Derive integral rate expression for second order irreversible bimolecular reaction $\text{A} + \text{B} \rightarrow \text{P}$ for variable volume system. 07

OR

- Q.2 (c) The decomposition of NH_3 on tungsten wire at 856°C yield the following result: 07
- | | | | | |
|------------------------|-----|-----|-----|------|
| Total Pressure, (Torr) | 228 | 250 | 273 | 318 |
| Time(s) | 200 | 400 | 600 | 1000 |
- Determine the order of reaction and calculate value of the rate constant.

- Q.3 (a) Write a brief note on term 'molecularity' 03
- Q.3 (b) With the suitable examples, explain the term space time and space velocity respectively. 04
- Q.3 (c) Assuming a stoichiometry $\text{A} \rightarrow \text{R}$ for first order gas reaction, we calculate the size of plug flow reactor needed for given duty (99% conversion of pure feed) to be $V = 32$ liters. Infact, however, the reactions stoichiometry is $\text{A} \rightarrow 3\text{R}$ with this corrected stoichiometry, what is the required reactor volume? 07

OR

- Q.3 (a) Write a brief note on order of reaction. 03
- Q.3 (b) Consider a gaseous feed $C_{\text{A}0} = 100$, $C_{\text{B}0} = 200$ to a steady flow reactor operated at constant temperature and pressure. The isothermal gas phase reaction taking place is $\text{A} + \text{B} \rightarrow \text{R} + \text{S}$. For $X_{\text{A}} = 0.8$, find C_{A} , C_{B} , and X_{B} . 04
- Q.3 (c) The homogeneous gas phase decomposition of phosphine proceeds at 649°C , $4\text{PH}_3 \rightarrow \text{P}_{4(\text{g})} + 6\text{H}_{2(\text{g})}$ with the first order rate $r_{\text{PH}_3} = (10/\text{hr}) * C_{\text{PH}_3}$. What size of plug flow reactor for operating at 649°C and 4.6 atmosphere can produce 80% conversion of feed consisting of 2 kgmoles of pure phosphine per hour? 07

- Q.4 (a) Write down the practical significance of chain modifier with suitable rubber reaction chemistry. 03
- Q.4 (b) Explain the kinetics of non-catalyzed polycondensation reaction. 04
- Q.4 (c) Discuss the kinetics of cationic polymerization. 07

OR

- Q.4 (a) With reaction chemistry explain the term 'telomerization'. 03
- Q.4 (b) Explain the kinetics of catalyzed polycondensation reaction. 04
- Q.4 (c) Discuss the kinetics of anionic polymerization. 07

PTO.

- Q.5 (a) Explain the principle of membrane osmometry method to determine the polymer molecular weight. 03
- Q.5 (b) Write about the methods used to determine the reactivity ratio. 04
- Q.5 (c) The following data were obtained on the osmotic pressure of solution of β -globulin in 0.15MNaCl at 37°C 07

C, grammole/100ml	19.27	12.53	5.81
Π , mmH ₂ O	453	253	112

Calculate the polymer weight of polymer.

OR

- Q.5 (a) Write down the full form of USLV. Also give it's major advantages. 03
- Q.5 (b) Write in brief about the effect of reactivity ratio on copolymerization behavior. 04
- Q.5 (c) Calculate the intrinsic viscosity of polystyrene sample in toluene from the following relative viscosity data obtained at 25°C. 07

$C \times 10^3$ Kg mole/m ³	0.002	0.004	0.006	0.008	0.010
η_r	1.102	1.208	1.317	1.430	1.548

Calculate M_v , if the Mark Houwink constants are $\alpha=0.69$ and $K=1.7 \times 10^{-3} \text{ m}^3/\text{Kg mole}$

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