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Question Paper Code: 95903

B.E./B.Tech. DEGREE EXAMINATION, NOV 2022

Fifth Semester

Chemical Engineering

19UCH503 - CHEMICAL REACTION ENGINEERING I

(Regulations 2019)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The rate constant for a first order reaction CO1- R
 - (a) depends on unit of time
 - (b) has units of reciprocal time
 - (c) does not change on changing the concentration units
 - (d) all of the above.
2. A certain first order reaction is half completed in 23 minutes. The rate constant for the reaction must be CO2- App
 - (a) 0.03 s^{-1}
 - (b) 0.030 min^{-1}
 - (c) 0.030 hr^{-1}
 - (d) 0.110 min^{-1}
3. For identical feed composition, flow rate, conversion and for zero order reactions the ratio of the volume of mixed reactor to the volume of PFR is CO1- R
 - (a) 0
 - (b) 1
 - (c) < 1
 - (d) > 1
4. For identical feed composition and flow rate, N plug flow reactors in series with a total volume V gives the same conversion as a single CO1- R
 - (a) plug flow reactor of volume V
 - (b) CSTR of volume V
 - (c) plug flow reactor of volume V/N
 - (d) plug flow reactor of volume NV

5. For any reaction the maximum attainable concentration of desired product in a plug flow reactor is CO1- R
- (a) always lower than that in a MFR (b) always higher than that in a MFR
 (c) always same that in a MFR (d) None of the above
6. For the desired product formation $r_R/r_S = k_1/k_2.C_A^a.C_B^b$, to maximize the r_R/r_S when a and b are positive we have to maintain the concentration of A and B as CO3- Ana
- (a) low respectively (b) high and low respectively
 (c) high respectively (d) low and high respectively
7. Estimate equilibrium constant (k_2) for a reaction with $k_1=30.8$, $\Delta H_R^0 = -10938$ cal/mol, for T_1 and T_2 as 298 and 600 respectively CO2- App
- (a) 3.15×10^{-3} (b) 2.83×10^{-3} (c) 4.0×10^{-2} (d) 1.5×10^{-3}
8. For an ideal gas, fugacity is equal to CO1- R
- (a) temperature (b) pressure (c) concentration (d) none of the above
9. In which reactor distribution of residence times of fluid within the reactor happens CO1- R
- (a) Batch reactor (b) MFR
 (c) Plug flow reactor (d) all of the above
10. The total area under E curve $\int E dt =$ CO3- Ana
- (a) 0 (b) 2 (c) 1 (d) α

PART – B (5 x 2= 10 Marks)

11. Give the performance equation for a constant volume batch reactor. CO1- U
12. What are continuous reactors? Give examples. CO1- U
13. Give the expression for overall fractional yield for N mixed flow reactors in series. CO1- U
14. Define optimum temperature progression. CO1- U
15. What is residence time distribution in a reactor? CO1- R

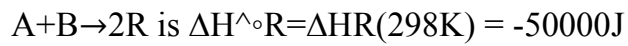
PART – C (5 x 16= 80 Marks)

16. (a) Discuss in detail about integral and differential method used to analyze rate data. CO1- U (16)

Or

- (b) Write short notes on: CO1- U (16)
- (i) Reaction mechanism
(ii) Rate law and rate equation
(iii) Order of reaction
17. (a) Discuss in detail about transition state theory. CO1- U (16)
- Or
- (b) Following results are obtained for the decomposition of nitrous oxide in contact with gold surface at 900°C. Show that the order of reaction is unity. CO2- App (16)
- | | | | | | |
|-------------------------------|----|----|------|----|----|
| Time (min) | 15 | 30 | 45 | 65 | 80 |
| % N ₂ O decomposed | 17 | 32 | 44.5 | 57 | 65 |
18. (a) Describe in detail about constant volume batch reactor. CO3- Ana (16)
- Or
- (b) The half life for the conversion of ammonium cyanate into urea at 303 K at initial concentration of ammonium cyanate of 0.1 mol/l and 0.2 mol/l are 1152 min and 568 min respectively. What is the order of the reaction? CO2- App (16)
19. (a) Derive the performance equation of PFR with graphical representation. CO1- U (16)
- Or
- (b) For the elementary liquid phase reaction A reversibly reacts with R construct a plot of equilibrium conversion as a function of temperature and conversion when pure A at a temperature of 27 °C (300 K) is fed to the reactor. CO2- App (16)
- Datas: $\Delta H_{fA} = -40000$ cal/mol
 $\Delta H_{fR} = -60000$ cal/mol
 $C_{PA} = 50$ cal/(mol.k), $C_{PR} = 50$ cal/mol .k
 $K = 100000$ at 298 K

20. (a) The standard heat of gas phase reaction at 25°C (298K) CO2- App (16)



Indicating that the reaction is strongly exothermic. it is planned to run this reaction at 1000°C. what is the value of heat of temperature? is the reaction still exothermic at 1000°C?

Data:

The mean/average C_p values between 25°C and 1000°C for the various reaction

Components are:

$$C_{pA} = 35J/(mol.k), \quad C_{pB} = 45J/(mol.k), \quad C_{pR} = 70J/(mol.k)$$

Or

(b) Discuss in detail about the adiabatic reactor. CO1- U (16)