(92) No. of Printed Pages: 02

SARDAR PATEL UNIVERSITY

VALLABH VIDYANAGAR

M.Sc. (3rd Semester) Surface Coating Technology Examination (CBCS), December 2012

PS03ESCT01: Chemical Reaction Engineering

Time: 02:30 pm to 5:30 pm **Thursday, 6th December 2012** **Total Marks: 70**

Q.1 Choose the correct answer from the followings:

Q.1.1 In the given rate expression $-r_A=kC_A^{2/3}C_B^{4/3}$ What is the order of reaction. 1

(a) 0 (b) 1

(c) 2 (d) 3

Q.1.2 What Is the value of 'm' for collision state of theory of temperature dependency? 1

(a) 0 (b) ½

(c) ¾ (d) 1

Q.1.3 Rate expression of Elementary reaction has direct correspondence with 1

(a) reaction stoichiometry (b) Molecularity

(c) Order of reaction (d) rate constant "of reaction"

Q.1.4 Rate of reaction is independent of concentration in the reaction having following order 1

(a) zero (b) Fractional

(c) First (d) Second

Q.1.5 If the space time in plug flow reactor is 13 min, what is the processing time of batch reactor in min? 1

(a) 7 (b) 10

(c) 13 (d) 16

Q.1.6 In which reactor do all the 4 terms of mass balance equation appear? 1

(a) Semi batch (b) Batch

(c) CFSTR (d) PFR

Q.1.7 dy/dx + PY= Q is used to analyzed the following reaction 1

(a) Autocatalytic (b) Zero order (c) Series (d) Parallel

Q.1.8 Mass balance equation is based on 'dv' for the following reactor 1

(a) Batch (b) CFSTR

(c) PFR (d) Semi batch

Q.2 Attempt any Seven Questions: 14

(a) Sketch the Energy of Activation cure. Find the energy of Activation using Arrhenius equation from the data given below:

$k_1 = 3.46 \times 10^{-5}$ at 25°C, sec^{-1}, $k_2 = 4.87 \times 10^{-3}$ at 65°C, sec^{-1}, given R= 8.314 cal / moles.

(b) find the order of reaction from the following half life time data

p_A, mm = 50 100 200

$t_{½}$, min=3.52 1.92 1.00

(c) Liquid A decomposes in the constant volume first order reaction. 50% of A decomposes in 5 min time. How much more time will be required to decomposed 75% of A.

(d) Attempt Q.2 (c) for Second order kinetics.

(e) What are the two complex reactions? what is meant by yield and selectivity in them?

(f) Write about Heat effects in Reactor.

(g) What is meant by Recycle operation? Sketch Batch Recycle Reactor system.

(h) What are the two deviations each from Ideal behavior in CFSTR and PFR?

(i) What is the Fractional change in volume in the gas phase reaction. A→4R. When A is 100% pure and also when A is 80% pure.

Q.3 a What is an autocatalytic reaction? Derive an integrated rate expression for it. 6

Q.3 b Find the first order rate constant in the variable volume system for the disappearance of A in the gas phase reaction 2A→R, if on holding the pressure constant, the volume of reaction mixture starting with 80% A decreases by 20% in 3 minutes? 6

Or

Q.3 b For the simultaneous reaction $A \xrightarrow{k_1} R$, $A \xrightarrow{k_2} S$ constant volume, liquid phase, irreversible, first order, 90% of A is converted in 50 minutes. 9.1 moles of R are formed per mole of S. Initially no R & S are present. Determine the rate constants k_1 and k_2. 6

Q.4 a Enlist the classification of chemical reactors. derive an integrated rate expression for isothermally operated Batch reactor. 6

Q.4 b Give a brief account of Semi batch process. 6

Or

Q.4 b For a gas phase reaction 2A=R+S, space velocity of 1 min^{-1} is required for 90% conversion of A in a plug flow reactor. Find the space time and mean residence time in the reactor? 6

Q.5 a Discuss the application of energy balance to an Adiabatically operated Batch reactor. 6

Q.5 b A liquid phase reaction of constant volume $-r_A = 0.158\ C_A$ gm mole/cc min take place in 2CFSTR of 2.5 ltr capacity each connected in series. The volumetric flow rate to each reactor is 500 cc/min. What is the conversion? 6

Or

Q.5 b A first order liquid phase reaction $-r_A = k_C\ C_A$ is being executed in CFSTR and PFR. For 90% conversion of A, show that in CFSTR $V/Q = 9/ k_C$ and in PFR $V/Q = 2.303/ k_C$. 6

Q.6 a What are the seven steps involved in kinetics of heterogeneous fluid-solid reaction? write about the global rate of reaction. 6

Q.6 b How will you find surface area per gram of a pigment particle by BET adsorption technique. 6

Or

Q.6 b What are catalyst promoters and Inhibitors? Give a brief account of Unimolecular gas-solid catalyzed surface reaction. 6

— X —