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SARDAR PATEL UNIVERSITY
EXTERNAL EXAMINATION
M.SC. INDUSTRIAL CHEMISTRY
(FOURTH SEMESTER)

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[110]

PS04CICH10: INTRODUCTION TO REACTION ENGINEERING AND STEAM GENERATION
TUESDAY, 10TH APRIL, 2018

Time: 2:00 Pm to 5:00 pm **Total Marks: 70**

Q-1. Answer the following multiple choice question. **[08]**

1. In $k=k_0T^me^{-E/RT}$, based on collision theory the value of m=_____
   a. 1 b. 0.5 c. 0 d. 1/3
2. What is the unit of rate constant for zero order reaction?
   a. Mole/Volume b. Concentration/Time
   c. Volume/Mole d. Concentration.Time
3. The reactor with no mixing or diffusion along the flow path is called
   a. CSTR b. Slurry reactor c. Batch reactor d. PFR
4. Number of reactor volumes of feed can be treated in unit time is known as __
   a. Space velocity b. Space time
   c. Residence time d. Processing time
5. For A → 2R with pure A, the value of ε_A = _____
   a. 2 b. 1 c. 0.5 d. -2
6. A mounting which controls the supply of water to boiler is _____
   a. Blow off cock b. Feed check valve
   c. Heater d. Safety valve
7. Vapour form of water is known as ____
   a. Steam b. Ice c. Aqua d. Gas
8. Which of the following have least calorific value?
   a. Methane b. Propane c. Butane d. Crude oil

Q-2 Answer any seven of following. **[14]**

1. Enlist the variable which affects the rate of heterogeneous reaction.
2. Write a unit for:
   a. Rate of reaction
   b. Rate constant (1st order reaction)
3. What is space time?
4. Distinguish between physical & chemical adsorption.
5. What is residence time distribution?
6. Enlist the steps involved for the catalyst in the reaction.
7. Define calorific value.
8. Define the term boiler efficiency with it's equation.
9. Distinguish between dry saturated steam and superheated steam.

Q-3 a. The rate of reaction at 900K is 2 times the rate at 700K. Calculate the activation energy (All three laws) of reaction using R = 1.98 cal/gm.K. **(06)**

b. Derive the equation for the reaction A + B → R using Integral method. **(06)**

OR

(P.T.O.)

b. Calculate the first order rate constant of the reaction using following data. **(06)**
C_{A0} = 0.22 mole/liter

C_A	0.12	0.07	0.05	0.032	0.032
Time (min.)	100	200	300	400	500

Q-4 **a.** A first order reaction 4A → B + 6C taken place with k=10hr^{-1}. Calculate the time taken for 80% conversion. **(06)**

b. Reactant A with initial concentration 100 mole/liter is fed into CSTR of volume V = 0.1 liter, where it undergoes the reaction 2A → R. Find the rate constant and order of reaction. ε_A = -0.5. **(06)**

V_0	30.0	9.0	3.6	1.5
C_A	85.7	66.7	50.0	33.3

OR

b. Reaction 2A → 4R has $-r_A = 0.01C_A^{0.5}$ in CSTR. Calculate the space time required for 80% conversion of A when C_{A0}= 0.0625mole/liter. **(06)**

Q-5 **a.** Determine the porosity and average pore radius of 102gm catalyst sample with the surface area 2 x 10^{6}cm^2/gm. **(06)**
He displaced = 45.12 cm^3
Hg displaced = 82.70 cm^3

b. Write a short note on trickle bed reactor in detail. **(06)**

OR

b. Glucose is studied with N_2 adsorb at 195^{0}C, if the vapour pressure of N_2 at 195^{0}C is 760 mm Hg. Calculate the surface area (Sg) of glucose using BET method. P_0 = 760 mmHg, N_0 = 6.022 x 10^{23} mole, V = 22400 cm^3/gm.mole, density of N_2 = 0.808 gm/cm^3. **(06)**

P (mmHg)	100	200	400	600	700
V (cm^3)	60	70	79	88	84

Q-6 **a.** Discuss the comparison between fire tube and water tube boiler. **(06)**

b. A fuel mixture contains 85% methane and 15% ethane. Calculate it's gross calorific value. Latent heat = 2442.5 KJ/Kg. **(06)**
$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ (ΔH_C= -802.6 KJ/mole, NCV= 802.6KJ/mole)
$C_2H_6 + 3.5O_2 \rightarrow 2CO_2 + 3H_2O$ (ΔH_C=-1428.64KJ/mole, NCV=1428.64 KJ/mole)

OR

b. Determine the enthalpy of 5 Kg steam at: **(06)**
1. Pressure = 3 bar, 10% wet steam
2. Pressure = 20 bar superheated steam at 300^{0}C.
Cps = 2.1KJ/Kg ^{0}C

P (bar)	Ts (^{0}C)	Sp. Enthalpy (KJ/Kg)		
		hf	Hfg	hg
04	143.6	604.7	2133.0	2737.6
20	212.4	908.6	1888.6	2797.2