BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: BE **SEMESTER: VI**
BRANCH: CHEMICAL **SESSION : SP/2020**

SUBJECT : CL6009-ADVANCES IN REACTION ENGINEERING

TIME: 1.5 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1 (a) What is Variable heat capacities? Write the steady state energy balance equation in case of variable heat capacities. [2]

(b) Derive the rate expression for steady state tubular reactor with heat exchange. [3]

Q2 The elementary liquid-phase reactions [5]

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$

take place in a 10-dm^3 CSTR. What are the effluent concentrations [Find up to final expression of R(T) and G(T)] for a volumetric feed rate of 10 dm^3/min at a concentration of A of 0.3 mol/dm^3 ?
The inlet temperature is 283 K.

Additional information:
$C_{PA} = C_{PB} = C_{PC} = 200$ J/mol.K
$k_1 = 3.03\ min^{-1}$ at 300 K, with $E_1 = 9900$ cal/mol
$k_2 = 4.58\ min^{-1}$ at 500 K, with $E_2 = 27000$ callmol
$\Delta H_{RX1A} = -55000$ J/mol A
UA = 40000 J/min-K with $T_a = 57^0C$
$\Delta H_{RX2B} = -71500$ J/mol B

Q3 Discuss the non-isothermal multiple chemical reactions in PFR and CSTR reactors. [5]

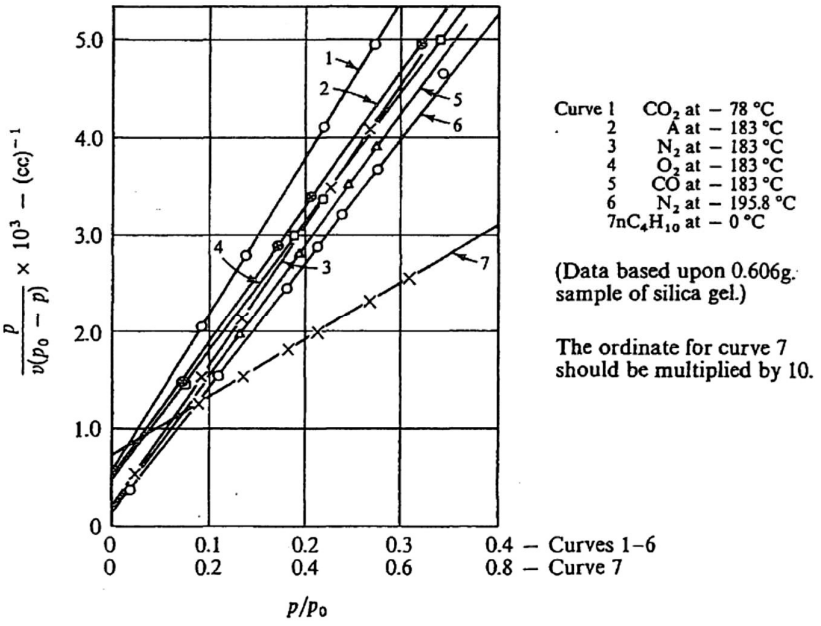
Q4 What is Adsorption? Also discuss the types of adsorption. [5]

Q5 Discuses and derive the expression for Langmuir adsorption isotherm. [5]

Q6 Curve 3 of Figure given bellow is a Brunauer-EmmeU-Teller plot for the adsorption data of N_2 at -183°C on the sample of silica gel. The density of liquid N_2 at this temperature is 0.751 g/cm3. Estimate the area of the silica gel from these data in square meters per gram. [5]

PTO

Figure for Question 6



Curve 1 CO_2 at − 78 °C
2 A at − 183 °C
3 N_2 at − 183 °C
4 O_2 at − 183 °C
5 CO at − 183 °C
6 N_2 at − 195.8 °C
7 nC_4H_{10} at − 0 °C

(Data based upon 0.606g. sample of silica gel.)

The ordinate for curve 7 should be multiplied by 10.

:::::: 26/02/2020 ::::::M