

M.Sc. 2nd Semester Examination, 2013

CHEMISTRY

PAPER—CEM - 204

Full Marks : 40

Time : 2 hours

Answer any **four** questions

The figures in the right-hand margin indicate marks

Provide mm graph papers wherever required

1. (a) Define manufactured fuels with example.
(b) What is the significance of octane number.
(c) What is the significance of volatile matter in coal ?
(d) Define carbonization. Differentiate between HTC and LTC. 2 + 2 + 2 +4
2. (a) Why pretreatment of petroleum crude is necessary ?

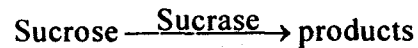
(Turn Over)

(b) What is fractional distillation ?

(c) What is reforming ?

(d) Describe Bergius process. 2 + 2 + 2 + 4

3. At room temperature sucrose is hydrolyzed by the catalytic action of the enzyme sucrase as follows :



Starting with a sucrose concentration, $C_{A0} = 1.0$ millimol/lit and an enzyme concentration, $C_{E0} = 0.01$ millimol/lit, the following kinetic data are obtained in a batch reactor :

C_A (millimol/lit)	0.84	0.68	0.53	0.38	0.27	0.16	0.09	0.04	0.018	0.006	0.0025
t (hr)	1	2	3	4	5	6	7	8	9	10	11

Determine whether these data can be reasonably fitted by a Kinetic equation of the Michaelis-Menten type or :

$$-r_A = \frac{K_3 C_A C_{E0}}{C_A + M}$$

where, M is Michaelis constant. If the fit is reasonable evaluate the constants K_3 and M . 10

4. We are planning to operate a batch reactor to convert A into R . This is a liquid reaction, the stoichiometry is :



and the rate of the reaction is given in the following table :

C_A in (mol/lit)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.3	2.0
$-r_A$ in mol/lit.min	0.1	0.3	0.5	0.6	0.5	0.25	0.10	0.06	0.05	0.045	0.042

How long must we react each batch for the concentration to drop from $C_{A_0} = 1.3$ mol/lit to $C_{A_f} = 0.3$ mol/lit ? 10

5. (a) Explain how integral analysis of a kinetic data set is carried out.
- (b) Derive the design equations for constant volume and variable volume batch reactors.

- (c) In a homogeneous isothermal liquid polymerization, 20 % of the monomer disappears in 34 min for initial monomer concentration of 0.04 and also for 0.08 mol/lit. What is the rate of disappearance of the monomer ? 3 + 4 + 3

6. (a) Derive Fick's first law of diffusion.
- (b) Formulate inter-phase mass transfer for an immiscible liquid-liquid system using the equilibrium relationship :

$$C_{A1i} = mC_{A2i}$$

where C_{A1i} is the interface concentration of the diffusing component A in the liquid phase 1 and C_{A2i} is the same in the liquid phase 2.

- (c) What is overall mass transfer coefficient ? 3 + 5 + 2