-Qadisiya University
ollege of Engineering
CHEMICAL ENGINEERING DEPT
Final Examination 2015-2016
Examiner : Dr. Ali A. Jazie

Subject: Reactor Design
Class: 3rd
Time :3 hour
Max. Marks: 100
Date: 2 / 6 / 2016

Answer Five Questions only (Q 5,6 are Compulsory)Questions hold equal marks (20 Mark)

Q1/ R. T. Dillon (1932) studied the reaction between ethylene bromide and potassium iodide in 99% methanol with the following data (Temperature: 59.72°C, Initial KI concentration: 0.1531 kmol/m^3, Initial $C_2H_4Br_2$ concentration: 0.02864 kmol/m^3).

$$C_2H_4Br_2 + 3KI \xrightarrow{k} C_2H_4 + 2KBr + KI_3$$

Time, ksec	dibromide reacted
29.7	0.2863
40.5	0.3630
47.7	0.4099
55.8	0.4572
62.1	0.4890
72.9	0.5396
83.7	0.5795

(A) Derive the integral form for the second order bimolecular kinetic rate equation.
(B) Determine the second order reaction rate constant.

(20 M)

Q2/ The hydrolysis of methyl acetate is an autocatalytic reaction and is first order with respect to both methyl acetate and acetic acid. The reaction is elementary, bimolecular and can be considered irreversible at constant volume for design purposes. The following data are given (Initial concentration of methyl acetate = 0.45 gmol/l, Initial concentration of acetic acid = 0.045 gmol/l). The conversion in 1 hr is 65% in a batch reactor. Calculate (A) the rate constant and specify the rate equation, (B) the time at which the rate passes through the maximum, and (C) What would be the CSTR reactor volume needed for the plant to process 200 m^3/hr in this system?

$$CH_3COOCH_3 + H_2O \xrightarrow{k} CH_3COOH + CH_3OH$$

(20 M)

Q3/ Consider an aqueous feed of A and B (600 l/min, 150 mmol of A/l, 300 mmol of B/l) that is being converted to product in a plug flow reactor. The stoichiometry and rate equation are:

$$A + B \rightarrow C \qquad (-r_A) = 300 C_A C_B \frac{mol}{l.min}$$

(A) Assuming that the reaction is second order, derive the design equation for a plug flow reactor.
(B)Find the volume of the reactor needed for 95% conversion of A to product.

(20 M)

Q4/ (A) Gas A decomposes irreversibly to form gas B according to the reaction $A \rightarrow 2B$, $(-r_A)=kC^2_A$. The reaction is second order and is performed in an isothermal constant pressure batch reactor. assuming that A and B are ideal gases, and starting with pure A at N_{AO}. Derive a general expression for time t in terms of the fractional conversion X_A for 2nd order reaction.