NATIONAL OPEN UNIVERSITY OF NIGERIA PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI – ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF CHEMISTRY
2025_2 EXAMINATIONS

COURSE CODE: CHM 407
COURSE TITLE: REACTION KINETICS
COURSE UNIT: 2
INSTRUCTION: Answer question one (1) and any other two questions
Time : Two (2) Hours

QUESTION 1

(a) In a tabular form, give three (3) differences between homogneous and heterogeneous catalysis (6 marks)
1. (b) State the two shortcomings of Linderman's mechanism of unimolecular reaction and give the two modifications made by Hinshelwood (8 marks)
(c) Show the effect of positive catalyst on reaction profile using a detailed diagram (6 marks)
(d) In a first order reaction, if the concentration of a reactant changes from 0.2 M to 0.05 M in 45 minutes. Determine (i) the rate of reaction, when the concentration of A is 0.1 M (8 marks) (ii) The half-life of the reaction (2 marks)

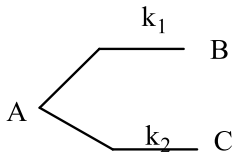
QUESTION 2
2. (a) Write equations to show Ostwald process (4 marks)
2.(b) Enzymes are protein and they catalysed various biochemical reactions. State the specific function of the following classes of enzymes (i) redox enzymes (2 marks) (ii) Transferases (2 marks) (iii)Ligases (2 marks)
2. (c) Define induced catalysis and give two examples. (6 marks)
2. (d) Catalytic converter can be used to convert poisonous hydrocarbon (PHC), NO and NO_2 gases in automobile exhaust to non-poisonous gases. Write two (2) equations to show these processes (4 marks)
QUESTION 3
3. (a) Differentiate between elementary and complex reactions (4 marks)
3. (b) Show that the reaction $2NO + X_2 \rightarrow 2NOX$ occurs through termolecular collision if the mechanism of the reaction is

$$NO + X_2 \underset{k}{\rightleftharpoons} NOX_2 \quad \text{(step 1)}$$

$$NOX_2 + NO \xrightarrow{k_2} 2NOX \quad \text{(step 2)}$$

(7 marks)
3. (c) List three (3) industrial processes that are feasible through the use of catalyst. (3 marks)
3. (d) Give two (2) examples of consecutive reactions, support your answer with appropriate equations. (6 marks)
QUESTION 4

4.(a) Given the following parallel reaction,



(i) Show that $a_t = a_0 e^{-(k_1 + k_2)t}$ (6 marks)
(ii) Derive an expression for the half-life of the parallel reaction. (2 marks)
(iii) If the values of the two rate constants are 1.0 and 0.5 /s, calculate the half life (2 marks)
4. (b) A solution displays a transmittance of 40 % when taken in a cell of 5 cm thickness. Calculate its concentration if the molar absorption coefficient is 7500 dm^3/mol.cm. (4 marks)
4. (c) State the following laws of photochemistry and highlight the exception(s) to the laws (i) Grotthus–Draper law (3 marks) (ii) Stark-Einstein law (3 marks)

QUESTION 5
5. (a) Sketch a reaction profile diagram for elementary step reactions (5 marks)
5. (b) A solution displays a transmittance of 30 % when taken in a cell of 4.0 cm thickness. Calculate its concentration if the molar absorption coefficient is 9, 000 dm^3/mol.cm. (6 marks)
5. (c) (i) The path of excitation can be from singlet ground state to singlet excited state (fluorescence) or from singlet excited state to triplet state (phosphorescence). Draw a labelled energy diagram to illustrates these three states. (5 marks)
(ii) Write an expression for the Beer-Lambert law of absorption (4 marks)