K. K. Wagh Institute of Engineering Education & Research, Nashik

(An Autonomous Institute From A.Y. 2022-23)

WINTER-2025	
Exam Seat No.:	
Academic Year: 2025-2026	Semester: III
Class: SY	Program: B.Tech
Branch Code: CHE	Pattern: 2023
Name of Course: Chemical Reactions and Synthesis I	Course Code: 2307203
Max. Marks: 60	Duration: 2.30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 02 pages.
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

		Marks	CO
Question No. 1			
1	Discuss the paramagnetic character of the oxygen molecule in terms of its molecular orbital diagram.	(6)	CO1
Question No. 2			
2	Derive the integrated rate law for a second-order reaction when the initial concentrations of the two reactants are equal. Explain the significance of each term.	(6)	CO2
Question No. 3			
3.a)	Outline working principle, experimental setup, and major applications of Thin layer chromatography.	(6)	CO3
	OR		
3.b)	What is Gas Chromatography (GC)? Discuss its types, instrumentation, and the mechanism by which separation occurs.	(6)	CO3
3.c)	What is Beer's Law? Derive its mathematical expression and explain the relationship between absorbance and concentration using a graph.	(6)	CO3
	OR		
3.d)	Explain the block diagram of a typical UV-Visible spectrometer setup. How does each component contribute to the overall functioning of the instrument?	(6)	CO3
3.e)	Identify and explain the possible electronic transitions that can occur in acetaldehyde (CH_3CHO) molecule when exposed to UV-visible radiation.	(4)	CO3
	OR		
3.f)	Explain the principle, technique and applications of flame photometry.	(4)	CO3
Question No. 4			
4.a)	What is Raoult's law in the context of a non-volatile solute? Show through derivation how it leads to the concept of relative lowering of vapor pressure as a colligative property.	(6)	CO4

OR

4.b)	State Henrys law give its mathematical expression and discuss significance of Henry's Law constant K_H and its unit.	(6)	CO4
4.c)	Define osmotic pressure. How is it related to the concentration of a solution? Derive the formula for osmotic pressure using van't Hoff's equation.	(6)	CO4

OR

4.d)	Demonstrate different condition under which colligative properties are not applicable	(6)	CO4
4.e)	A solution has a vapour pressure of 7.20×10^4 N/m^2 while the pure solvent has a vapour pressure of 8.00×10^4 N/m^2 Calculate (a) ΔP (b) P/P^0 (c) $\Delta P/ P^0$	(4)	CO4

OR

4.f)	What is the boiling point of a solution with 0.5 moles of urea (NH_2CONH_2) in 300 g of ethanol? Given Kb for ethanol = 1.22 °C·kg/mol and pure ethanol boils at 78.4 °C.	(4)	CO4

Question No. 5

5.a)	List and explain the variables that affect how fast an SN^2 reaction occurs.	(6)	CO5

OR

5.b)	Demonstrate the mechanism of SN^1reactions with P.E. diagram.	(6)	CO5
5.c)	Alkyl benzene undergoes electrophilic substitution at ortho and para, justify it.	(6)	CO5

OR

5.d)	Give the nitrating agents and mechanism involve in nitration of benzene and its application.	(6)	CO5
5.e)	Predict the major product of the Beckmann rearrangement and explain the rearrangement process.	(4)	CO5

OR

5.f)	Discuss the Favorskii rearrangement with a suitable example.	(4)	CO5

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