

**2025/FYUG/ODD/SEM/
CHMDSM 301T/302T/466**

FYUG Odd Semester Exam., 2025

CHEMISTRY

(5th Semester)

Course No. : CHMDSM 301T/302T

(Fundamentals of Chemistry—III)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

UNIT—I

1. Answer any two questions from the following : 2×2=4

(a) Transition metals are less reactive than alkali and alkaline earth metals. Justify.

(b) Give reason why $\text{Cu}^{2+} (3d^9)$ is more stable than $\text{Cu}^+ (3d^{10})$ in aqueous solution.

(c) Sc^{3+} is more stable than Sc^{2+} . Explain.

(3)

(ii) Explain the following :
 (a) Zn forms Zn^{2+} and

$$2 \times 3 = 6$$

Explain the following :

(1) Zn forms Zn^{2+} and not Zn^{3+} .

- (1) Zn forms Zn^{2+} ion.
- (2) Salts of Zn, Cd and Hg are colourless.
- (3) Transition elements show the catalytic character.

(1) Fe^{3+}

(2) Ni^{2+}

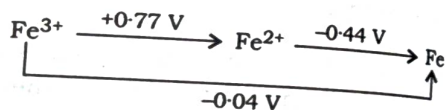
(3) Cu^+

(ii) Why are Zn, Cd and Hg not considered as typical transition elements?

(iii) Explain why lanthanides have poor tendency to form complexes.

(iv) What is lanthanide contraction? Discuss at least two consequences of lanthanide contraction.

(b) (i) Consider the Latimer diagram for iron :



Construct a Frost diagram.

(1) Predict the stability or unstability of Fe^{2+} .

(2) Which of these species is strong oxidant?

UNIT—II

UNIT—II

Answer any two questions from the following :

State of a reaction. Write the rate of

$2 \times 2 = 4$

(a) Define rate of a reaction. Write the expression for instantaneous rate of reaction.

(b) Give two characteristics of rate constant.

(c) Define threshold energy and activation energy.

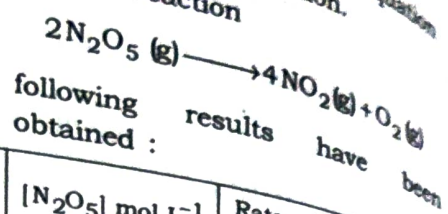
4. Answer any one question from the following : 10

(a) (i) What is half-life period? Show that the half-life period for a zero-order reaction is directly proportional to initial concentration.

(Turn Over)

(4)

- (ii) Derive the integrated rate equation for a first-order reaction.
- (iii) For the reaction



Sl. No.	$[\text{N}_2\text{O}_5]$ mol L ⁻¹	Rate of disappearance of $[\text{N}_2\text{O}_5]$ mol L ⁻¹ min ⁻¹
1	1.13×10^{-2}	
2	0.84×10^{-2}	34×10^{-5}
3	0.64×10^{-2}	25×10^{-5}
		18×10^{-5}

- (1) Calculate the order of the reaction.
- (2) Write the rate law.
- (3) Calculate the rate constant of the reaction.
- (b) (i) Write the expression for Arrhenius equation. Explain the terms involved.
- (ii) Draw the energy profile diagram for reactions—
- when energy of products is lower than that of reactant;
 - when energy of products is higher than that of reactants.

2+2=4

26J/904

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(5)

- The rate of a particular reaction, when temperature changes from 27 °C to 37 °C, is doubled. Calculate the activation energy for the reaction.

4

UNIT—III

- Answer any two questions from the following : 2×2=4

- (a) Write the expression for equilibrium constant for the following reaction :
- $$aA + bB + cC + \dots \rightleftharpoons lL + mM + nN + \dots$$

Write the unit of equilibrium constant, if all the components are gases.

- (b) Derive the relationship between K_p and K_c for a general reaction in equilibrium.

- (c) Define the following with suitable examples :

- Strong electrolyte
- Weak electrolyte

6. Answer any one question from the following : 10

- (a) (i) Discuss the criterion of spontaneity in terms of change in free energy. 2

(Turn Over)

(6)

- (ii) Derive the thermodynamic law of chemical equilibrium using the concept of chemical potential (μ).
- (iii) Define buffer solution with suitable examples.
- (iv) Determine the pH of a solution obtained by mixing equal volume of 0.10 N ammonium nitrate and 0.02 N NH_4OH , K_b for NH_4OH is 1.8×10^{-5} .

(b) (i) Apply Le-Chatelier principle to predict suitable conditions for getting maximum yield of ammonia by Haber's process.

(ii) Discuss pH scale.

(iii) Discuss salt hydrolysis for salts of weak acids and weak bases.

UNIT—IV

7. Answer any two questions from the following : $2 \times 2 = 4$

- (a) How will you account for the following?
- (i) Alcohols are weakly acidic in nature.
- (ii) Ethyl alcohol has a higher boiling point than diethyl ether.

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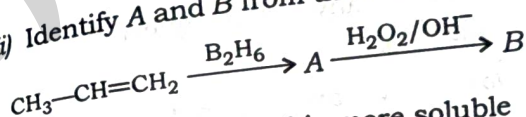
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- How can you convert *n*-butyl alcohol into 1-butene?
- Explain why *p*-nitrophenol is more acidic than phenol.

Answer any one question from the following : 10

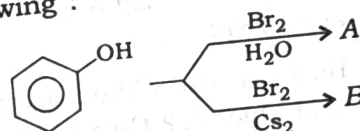
(i) How can you obtain primary alcohol using Grignard's reagent? Write the mechanism. 2

(ii) Identify A and B from the following : 2



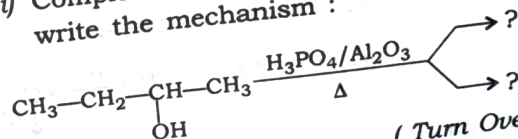
(iii) Explain why phenol is more soluble than toluene in water. 2

(iv) Identify the product(s) from the following : $\frac{1}{2} \times 2 = 1$



(v) Sketch the mechanism of nitration of phenol. 3

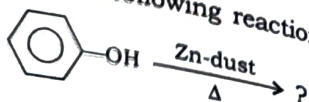
(b) (i) Complete the following reaction and write the mechanism : 4



(Turn Over)

(8)

- (ii) Discuss the mechanism of Reimer-Tiemann reaction. 3
(iii) Give two tests to distinguish phenol from ethyl alcohol. 2
(iv) Complete the following reaction : 1

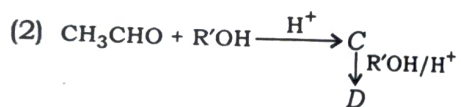


UNIT-V

9. Answer any two questions from the following : 2×2=4
- (a) Why are aromatic aldehydes and ketones less reactive than the corresponding aliphatic aldehydes and ketones? 2
(b) Chloroacetic acid is stronger than acetic acid. Explain. 2
(c) How can you obtain acetaldehyde from acid chloride? Give reaction only. 2

10. Answer any one question from the following : 10

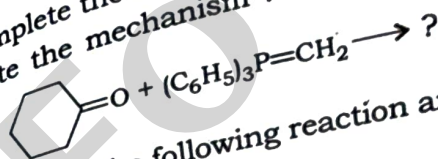
- (a) (i) Complete the following reactions and identify A, B, C and D : ½×4=2



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(9)

- (ii) How can you obtain 1°-alcohol using Grignard reagent? 2
(iii) Complete the following reaction and write the mechanism : 3



- (iv) Complete the following reaction and write the mechanism : 3
 $\text{C}_6\text{H}_5\text{OH} + \text{CHCl}_3 \xrightarrow{\text{NaOH}} ?$

- (i) Write short notes on the following : 2×4=8

- (1) Aldol condensation
(2) Wolff-Kishner reaction
(3) MPV reduction
(4) HVZ reaction
(ii) Discuss the mechanism of alkaline hydrolysis of ester. 2

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