

**2025/FYUG/ODD/SEM/
CHMDSM-201T/461**

FYUG Odd Semester Exam., 2025

CHEMISTRY

(3rd Semester)

Course No. : CHMDSM-201T

(Fundamentals of Chemistry—II)

Full Marks : 70

Pass Marks : 28

Time : 3 hours

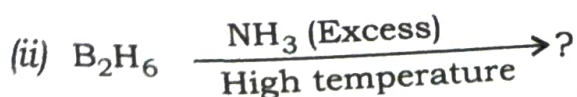
The figures in the margin indicate full marks
for the questions

UNIT—I

Answer any two of the following questions :

2×2=4

- (a) Graphite is a conductor of electricity but diamond is not. Explain with proper reasoning.
- (b) Predict the products of the following chemical reactions and draw the structure of the products : 1+1=2



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(2)

(c) What is meant by the property of carbon? Why does carbon exhibit a stronger tendency for catenation compared to other elements of group-14?

2. Answer any one of the following questions:

(a) (i) Write one method of preparation of B_2H_6 . Discuss the structure and bonding in B_2H_6 . Why are the B—H—B bond angles smaller than the normal tetrahedral angle?

(ii) Discuss the chemistry of borax bead test taking copper salt as an example.

(iii) Predict the products of the following reactions :



(b) (i) What are silicones? How will you synthesize silicone from methyl chloride? Give two uses of silicones.

(3)

(c) What are zeolites? Discuss the use of zeolites as catalysts. $1+2=3$

(ii) What is inorganic benzene? Boron fluoride does not exist as BH_3 .

(iii) Fluoride does not exist as BF_3 with hydride the statement $1+2=3$ justify the appropriate reasons.

UNIT—II

Answer any two of the following questions : $2 \times 2 = 4$

(a) Give the mathematical formulation of first law of thermodynamics and explain the terms involved in it.

(b) Explain the terms enthalpy of formation and standard enthalpy of formation. $1+1=2$

(c) Prove that in a reversible process, net entropy change for the system and surroundings is zero.

Answer any one of the following questions : 10

(a) (i) Define heat capacity at constant pressure (C_p) and heat capacity at constant volume (C_v). Deduce the relation between C_p and C_v for n moles of an ideal gas. $2+3=5$

(Turn Over)

(4)

- (ii) What are integral and differential enthalpies of solution? Explain.
- (iii) Is enthalpy of formation intensive or extensive property? The heat evolved on dissolving CuSO_4 in water is 86.6 kJ mol^{-1} . Calculate the standard enthalpy of formation (ΔH_f°) of $\text{CuSO}_4(\text{s})$.
- [$\Delta H_f^\circ(\text{Cu}^{2+}) = 64.4 \text{ kJ mol}^{-1}$, $\Delta H_f^\circ(\text{SO}_4^{2-}) = -747.8 \text{ kJ mol}^{-1}$]
- (b) (i) What is meant by bond energy? How does bond energy help to determine the enthalpy of a reaction? How does the enthalpy of a reaction vary with temperature? Discuss in detail.
- (ii) Calculate the enthalpy change for the following reaction :



The bond energies of H—H, Br—Br and H—Br are 435 kJ mol^{-1} , 192 kJ mol^{-1} and 364 kJ mol^{-1} respectively.

(5)

- What is resonance energy? The enthalpy of hydrogenation of typical benzene is -209 kJ mol^{-1} . Calculate enthalpy of hydrogenation energy of alkene is -120 kJ mol^{-1} . the resonance in kJ mol^{-1} .

UNIT—III

2×2=4

- Answer any two of the following questions :
- (i) What do you mean by phase diagram? Explain the term 'triple point' with an example.
- (ii) Write the difference between ideal and non-ideal solutions with appropriate examples.
- (iii) Write the mathematical expression of Gibbs' phase rule and explain the various terms involved in it.
6. Answer any one of the following questions : 10
- (a) (i) State Raoult's law for a solution of volatile liquids. Prove that the relative lowering of vapour pressure of a solution containing non-volatile solute is equal to the mole fraction of the solute in the solution.

(Turn Over)

(6)

- (ii) Liquid A (molecular mass 46 g mol⁻¹) and liquid B (molecular mass 18 g mol⁻¹) form an ideal solution. At 293 K, the vapour pressure of pure A and pure B are 44.5 mm and 17.5 mm of Hg, respectively. Calculate—
- (1) the vapour pressure of solution of A in B (mole fraction of A is 0.2);
 - (2) the composition of the vapour phase.

- (iii) Draw the labelled phase diagram of sulphur system and discuss the significance of various areas, curves and points.

- (b) (i) Draw and explain the vapour pressure composition curves for non-ideal solutions showing positive and negative deviations from Raoult's law.

- (ii) What are azeotropes? Define maximum boiling azeotropes and minimum boiling azeotropes with one example of each.

(7)

the following questions
1+1=2

- (iii) Answer the following questions using Gibbs' phase rule :
- (1) Water can exist in three phases: solid, liquid and vapour. Calculate the number of degrees of freedom at the triple point in the water system.
 - (2) Can a one-component system exist in four phases in equilibrium? Justify.

UNIT—IV

- (iii) Answer any two of the following questions :
2×2=4
1+1=2

- (a) How can you prepare the following?

(i) Ethane from sodium propionate

(ii) Benzene from ethyne

- (b) What happens when (write equation only)
- (i) two molecules of ethylbromide is treated with metallic sodium in dry ether;

- (ii) 2-methylpropene is treated with H—Br in the presence of H₂O₂?

(Turn Over)

(8)

(c) Show the mechanism of addition of bromine to but-2-yne. Comment on the stereochemistry of the product.

8. Answer any one of the following questions:

(a) (i) Predict the products of the following reactions :



(ii) Discuss with appropriate mechanism—

(1) nitration reaction of benzene;

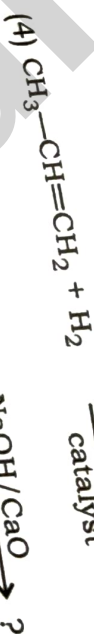
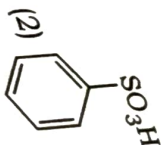
(2) Friedel-Crafts acylation reaction of benzene. 3-3

(b) (i) Why does the pink colour of Baeyer's reagent disappear when added to any alkene? Discuss with appropriate chemical reaction.

(9)
of the
1×5=5

(ii) predict the chemical reactions :

1. NaNH_2
2. $\text{CH}_3\text{CH}_2\text{Br} \rightarrow ?$
3. NaNH_2
4. PhCH_2Br



(iii) State and justify Markwonikoff's rule taking a suitable reaction as example. 3

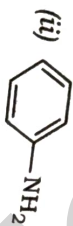
UNIT—V

9. Answer any two of the following questions: 2×2=4

(a) What happens when ethylbromide is treated with (i) AgCN and (ii) KCN ? Give 1+1=2 the chemical reactions. (Turn Over)

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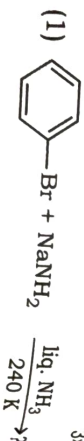
(b) Predict the products of the following chemical reactions :



(c) How can anisole be synthesized from methyl iodide using the Williamson ether synthesis reaction? Give the chemical reactions.

10. Answer any one of the following questions:

(a) (i) Complete the following chemical reactions with appropriate mechanisms :



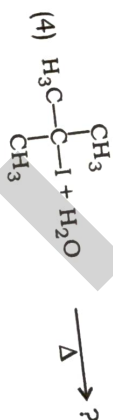
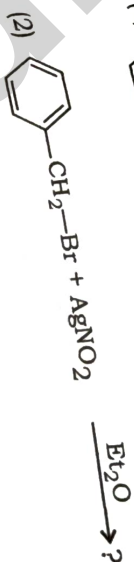
(ii) Chlorine in chlorobenzene, unlike chloroalkanes, shows very less reactivity towards nucleophilic substitution reaction of halogen by reagents such as NaOH , NH_3 , KCN , etc. Justify.

(11)

(b) How will you synthesize aryl halides using the Gattermann reaction? Give the chemical equations.

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(c) Predict the products of the following chemical reactions : $1 \times 4 = 4$



(ii) Predict the product of the following reaction with appropriate mechanism :

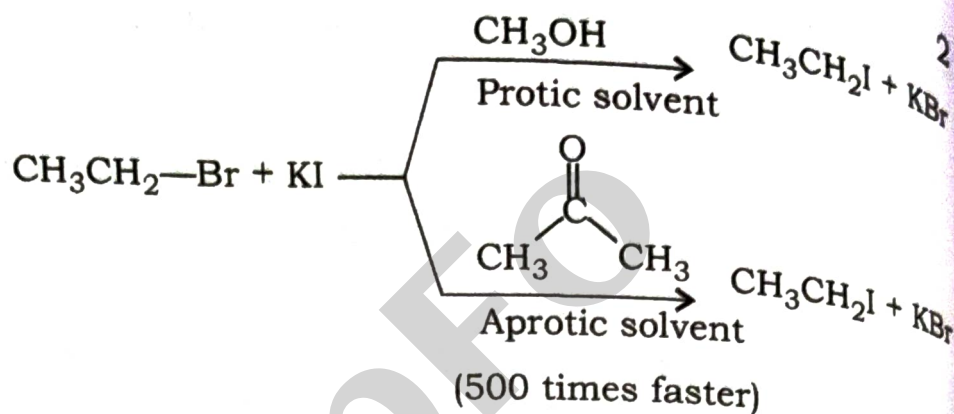


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(iii) Explain the following observation with suitable reasons :



(iv) How would you prepare vicinal ethylene dibromide from ethene? Give the chemical equation.

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