

**2024/FYUG/ODD/SEM/
CHMDSM-201T/191**

FYUG Odd Semester Exam., 2024

**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

1. Answer any two of the following questions :

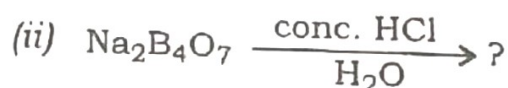
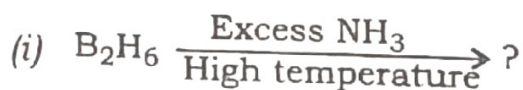
2×2=4

(a) "B(OH)₃ is an acid but Al(OH)₃ is amphoteric." Explain.

2

(b) Complete the following reactions and draw the structures of the products formed :

1+1=2



(c) What are allotropes? Give two examples of allotropes of carbon.

2

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(2)

2. Answer any *one* of the following questions : 10

- (a) (i) Predict the products of the following reactions : 1×3=3
1. $\text{BCl}_3 + \text{H}_2\text{O} \longrightarrow ?$
 2. $2\text{CaO} \cdot 3\text{B}_2\text{O}_3 + 2\text{Na}_2\text{CO}_3 \longrightarrow ?$
 3. $\text{B}_2\text{H}_6 + \text{Cl}_2 \xrightarrow{298\text{ K}} ?$
- (ii) "Orthoboric acid is a very weak acid but in the presence of glycerol or ethylene glycol, it acts as a strong acid." Explain. 2
- (iii) Why is concentrated HNO_3 suitable for transportation in aluminium containers, whereas concentrated HCl is not? Explain. 2
- (iv) Discuss in detail the structure of diborane. 3
- (b) (i) What is catenation? Why is carbon particularly well-suited for this property compared to other elements of group-14? Explain. 1+2=3
- (ii) Write short notes on the following : 2×2=4
1. Silicones
 2. Zeolites
- (iii) Explain why diamond is a good electrical insulator, while graphite is a good conductor of electricity. Explain the role of graphite in the production of fullerenes. 2+1=3

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(3)

UNIT—II

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

- (a) Define extensive and intensive properties with one example of each. 2
- (b) Define the terms 'bond energy' and 'resonance energy'. 2
- (c) What is integral enthalpy of solution? 2

4. Answer any *one* of the following questions : 10

- (a) (i) State the first law of thermodynamics. Give the mathematical formulation of the first law of thermodynamics. 1+2=3
- (ii) The enthalpy of combustion of $\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$ is -2816 kJ mol^{-1} at 25°C . Calculate the standard enthalpy of formation (ΔH_f°) of $\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$. The ΔH_f° values for $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\text{l})$ are $-393.5\text{ kJ mol}^{-1}$ and $-285.9\text{ kJ mol}^{-1}$ respectively. 2
- (iii) For one mole of an ideal gas, deduce the relationship between heat capacity at constant pressure (C_p) and heat capacity at constant volume (C_v). 3
- (iv) "Enthalpies of formation of $\text{H}_2\text{O}(\text{g})$ and $\text{H}_2\text{O}(\text{l})$ are not same." Justify the statement with proper reasonings. 2

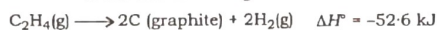
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(4)

- (b) (i) What is standard enthalpy of formation? Discuss in detail the variation of enthalpy of a reaction with temperature. 1+3=4

- (ii) Calculate the C=C bond enthalpy from the following data :



and enthalpy of C—H bond is 413 kJ. 3

- (iii) What is inversion temperature? Why is Joule-Thomson coefficient of an ideal gas always zero? 1+2=3

UNIT—III

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

- (a) What do you mean by ideal and non-ideal solutions? Explain. 2
- (b) What is azeotropic mixture? Give one example of it. 2
- (c) Write the mathematical expression of Gibbs' phase rule and explain the various terms involved in it. 2

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(5)

6. Answer any one of the following questions : 10

- (a) (i) State the Raoult's law for a solution of volatile liquids. Show that the relative lowering of vapour pressure for a solution is equal to the mole fraction of the solute when solvent alone is volatile. 1+2=3

- (ii) Give the labelled phase diagram of water system and discuss the importance of various points, lines and areas. 1+3=4

- (iii) The vapour pressures of pure components A and B are 120 mmHg and 96 mmHg respectively. What will be the partial pressures of the components and the total pressure, when the solution contains 1 mole of component A and 4 moles of component B and the solution is ideal? 3

- (b) (i) Draw the labelled phase diagram of sulphur system and discuss its salient features. 1+3=4

- (ii) Determine the number of components, phases and degrees of freedom in the following equilibrium system : 2



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(6)

- (iii) Explain why KCl-NaCl-H₂O system is regarded as a 3-component system, whereas KCl-NaBr-H₂O system is regarded as a 4-component system. 2
- (iv) Draw and discuss the vapour pressure composition diagram for ideal solutions. 2

UNIT-IV

7. Answer any two of the following questions : 2×2=4
- (a) Predict the products of the following reactions : 1+1=2
- (i) $2\text{CH}_3\text{CH}_2\text{Br} + 2\text{Na} \xrightarrow{\text{Dry ether}} ?$
- (ii)  $\xrightarrow[\Delta]{\text{Zn dust}} ?$
- (b) What happens when—
- (i) propene is treated with H₂ in the presence of Raney Ni as catalyst;
- (ii) cyclohexene is treated with dilute alkaline KMnO₄? 1+1=2
- (c) How will you prepare carbonyl compounds from alkenes? Explain with appropriate chemical reaction. 2

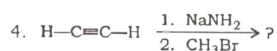
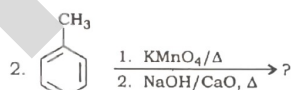
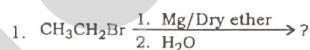
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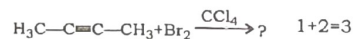
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8. Answer any one of the following questions : 10

(a) (i) Complete the following reactions : 1×4=4

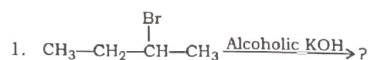


(ii) Predict the product of the following reaction with plausible mechanism :



(iii) Discuss with mechanism the Friedel-Crafts alkylation reaction of benzene. 3

(b) (i) Predict the products of the following reactions : 1×4=4



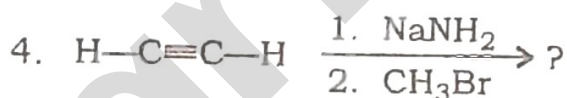
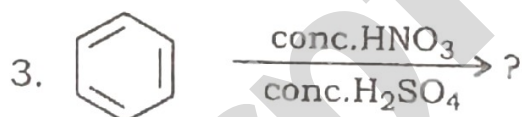
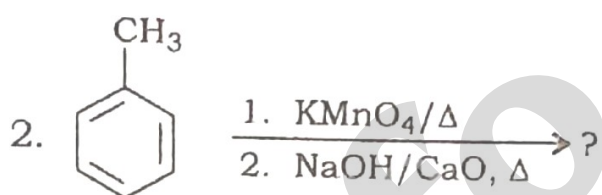
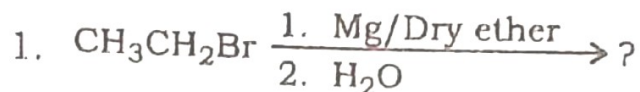
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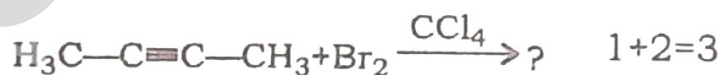
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(a) (i) Complete the following reactions :

1×4=4



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

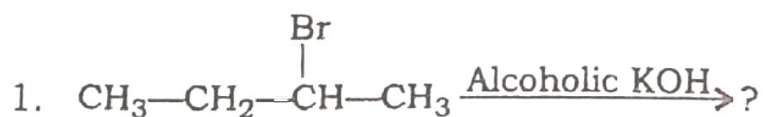


(iii) Discuss with mechanism the Friedel-Crafts alkylation reaction of benzene.

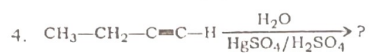
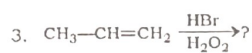
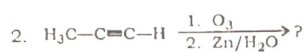
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(b) (i) Predict the products of the following reactions :

1×4=4



(8)



(ii) Discuss with mechanism—

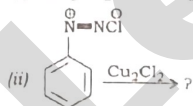
1. sulphonation reaction of benzene;
 2. halogenation reaction of benzene.
- 3+3=6

UNIT—V

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

(a) "Aryl halides, unlike alkyl halides do not undergo nucleophilic substitution reaction easily." Justify the statement with proper reasons. 2

(b) Complete the following reactions : 1+1=2



(c) How will you synthesize ethoxybenzene from phenol? Explain with appropriate chemical reaction. 2

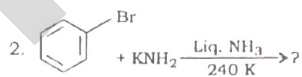
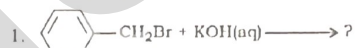
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10. Answer any one of the following questions : 10

(a) (i) Predict the products of the following reactions with plausible mechanisms : 3+3=6



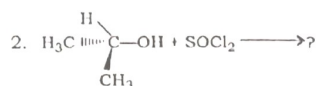
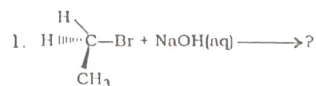
(ii) Carry out the following conversions : 2

Iodobenzene from Aniline

(iii) What happens when ethyl bromide is treated with—

1. KCN;
 2. AgCN?
- (Write only the reactions.) 1+1=2

(b) (i) Complete the following reactions with appropriate mechanisms : 3+3=6



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(10)

(ii) What happens when methyl bromide is treated with—

1. AgNO_2 ;

2. KNO_2 ?

(Write only the reactions.) 1+1=2

(iii) Outline the synthesis of—

1. 2-bromopropane from propene;

2. *p*-nitrophenol from *p*-nitro-chlorobenzene. 1+1=2

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