

**2023/TDC(CBCS)/ODD/SEM/
CHMDSC/GE-101T/260**

TDC (CBCS) Odd Semester Exam., 2023

CHEMISTRY

(1st Semester)

Course No. : CHMDSC/GE-101T

**(Atomic Structure, Bonding, General Organic
Chemistry and Aliphatic Hydrocarbons)**

Full Marks : 50

Pass Marks : 20

Time : 3 hours

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

SECTION—A

Answer *fifteen* questions, taking any *three* from
each Unit : $1 \times 15 = 15$

UNIT—I

1. State the Heisenberg uncertainty principle.
2. What are the orbitals possible in a subshell for which $l = 1$?

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(Turn Over)



(2)

3. How many nodal planes are possible in 3s atomic orbital?
4. Arrange the following in the decreasing order of their energy :

3s, 2p, 3d and 4s

UNIT—II

5. Define dipole moment. What is the dipole moment of CO₂ molecule?
6. Arrange the following in decreasing order of ionic character of the bond :

KF, KBr, KCl and KI

7. What is the hybridization of central atom in BF₃ molecule? Draw the structure of BF₃.
8. Which of the following has the highest bond order?

O₂, O₂⁺ and O₂⁻

UNIT—III

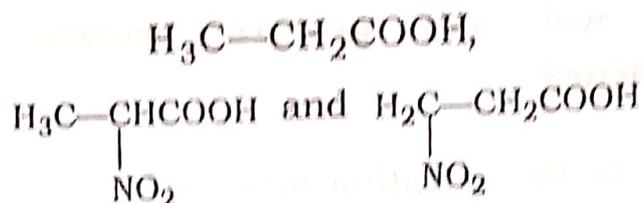
9. Give one example each of a neutral electrophile and a neutral nucleophile.
10. What is the condition for homolytic and heterolytic cleavage of a covalent bond?

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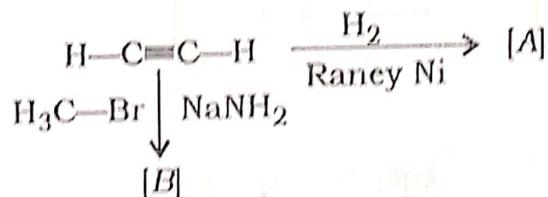
11. Arrange the following in the increasing order of their acid strength :



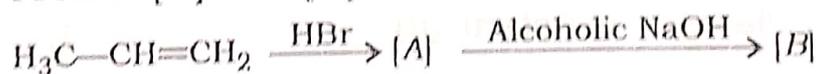
12. What is the hybridization of central carbon atom in $\dot{\text{C}}\text{H}_3$ radical?

UNIT—IV

13. Identify [A] and [B] for the following reactions :



14. What is Lindlar's catalyst?
15. Why is Wurtz reaction always carried out in the presence of dry ether?
16. Predict [A] and [B] :



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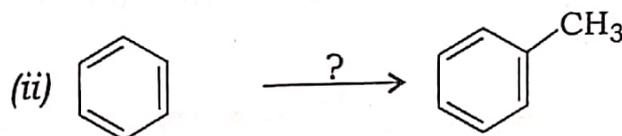
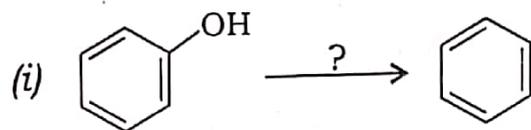
UNIT—V

17. How will you prepare benzene from acetylene?

18. What is the nitrating mixture?

19. What happens when benzene is treated with Br_2 in the presence of FeBr_3 ? Write the appropriate chemical reaction.

20. Predict the suitable reagents for the following conversions : $\frac{1}{2} \times 2 = 1$



SECTION—B

Answer *five* questions, taking *one* from each Unit :

$2 \times 5 = 10$

UNIT—I

21. What will be the de Broglie wavelength of an electron moving with speed of light?

[Planck's constant (h) = $6.626 \times 10^{-34} \text{ JHz}^{-1}$

and Mass of electron = $9.10 \times 10^{-31} \text{ kg}$]

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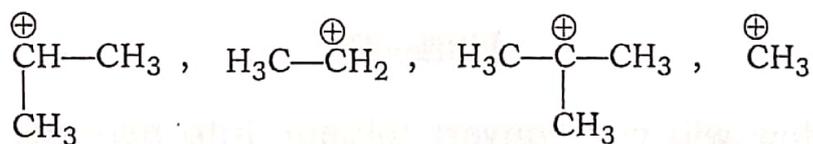
22. Explain why half-filled and completely filled orbitals are more stable than the partially filled orbitals. Give one example of atom, which has completely filled atomic orbitals.

UNIT—II

23. Define bonding and anti-bonding molecular orbitals in terms of LCAO approximation. What is non-bonding combination of atomic orbitals?
24. Discuss the geometry of SF₄ molecule with the help of VSEPR theory.

UNIT—III

25. What is hyperconjugation? Discuss the stability order of the following carbocations on the basis of hyperconjugation :

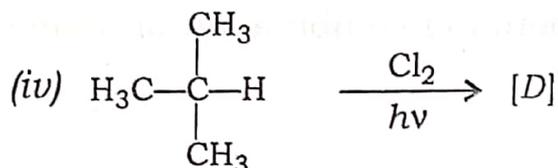
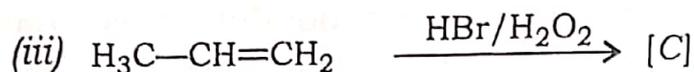
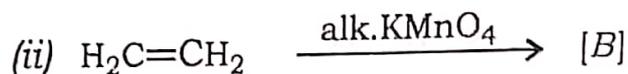
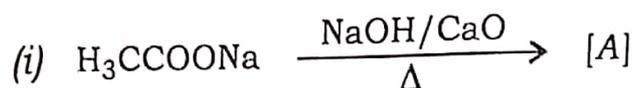


26. Between phenol and alcohol, which one is more acidic? Justify your answer on the basis of resonance effect.

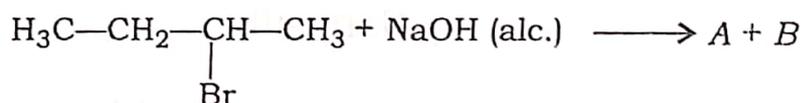
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UNIT—IV

27. Identify [A], [B], [C] and [D] for the following reactions : 1/2 × 4 = 2



28. (a) Predict the Saytzeff's and Hofmann's products for the following elimination reaction : 1



(b) Write only the reaction involve in the ozonolysis of $\text{H}_3\text{C}-\text{CH}=\text{CH}_2$. 1

UNIT—V

29. How will you convert toluene into benzene? Write the appropriate chemical reaction for each involved step. 2

30. Toluene undergoes nitration reaction much easily than benzene. Justify the statement with suitable reasons. 2

SECTION—C

Answer *five* questions, taking *one* from each Unit :

5×5=25

UNIT—I

31. (a) Write the time-independent Schrödinger equation for three-dimensional motion of a particle and explain the meaning of each term involve in it. 2
- (b) Explain the significance of ψ and ψ^2 . 2
- (c) Explain the physical significance of Azimuthal quantum number. 1
32. (a) Discuss the Bohr's theory of atomic model. Mention two limitations of this theory. 3
- (b) What is Pauli's exclusion principle? 1
- (c) Explain why $2d$ -atomic orbital does not exist. 1

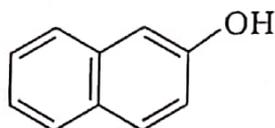
UNIT—II

33. (a) What is lattice energy? Illustrate the Born-Haber cycle by taking the example of formation of NaCl(s). 1+3=4
- (b) How does polarizing power of a cation determine the percentage of ionic character in a covalent compound? 1

34. (a) Draw the energy-level diagram for the MOs of 'NO' molecule. Calculate the bond order of 'NO' molecule and compare its bond length with 'CO' molecule. 2+2=4
- (b) Why does He₂ molecule not exist? Explain. 1

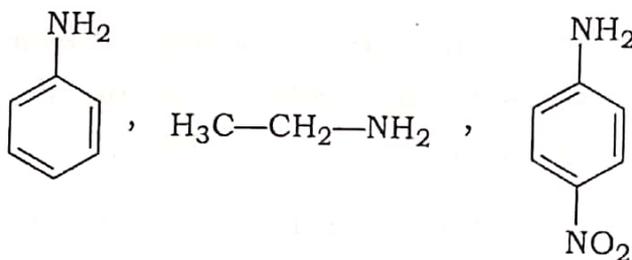
UNIT—III

35. (a) Explain the aromatic or non-aromatic or anti-aromatic behaviours of



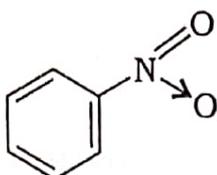
by using Hückel's rule. 2

- (b) Write the difference between electromeric and inductive effect by taking suitable examples. 2
- (c) Determine the order of basicity for the following compounds : 1



36. (a) Write the resonance structure for the following compound indicating the movement of electron using curved arrow notation :

2



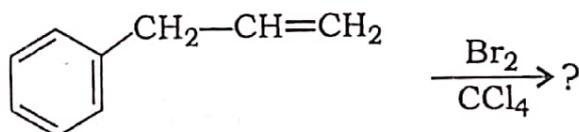
- (b) What is the difference between resonance and hyperconjugation? Why is hyperconjugation named as no-bond resonance?

2+1=3

UNIT—IV

37. (a) Write the product of the following reaction with appropriate mechanism :

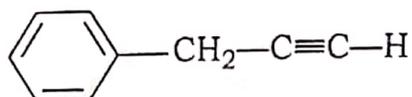
1+2=3



- (b) Why does the pink colour of Baeyer's reagent disappear when added to any alkene?

2

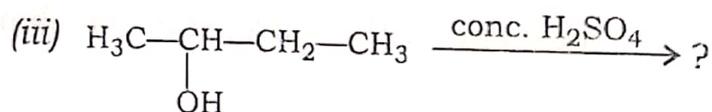
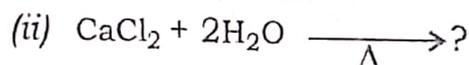
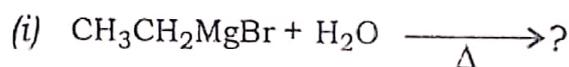
38. (a) A compound A having molecular formula $C_2H_4Br_2$ reacts with alcoholic KOH to form an alkyne B, which in the presence of $NaNH_2$ reacts with C to form :



Predict the compounds A, B and C with appropriate chemical reactions. 2½

- (b) Why does hydrogen iodide (HI) not show any anti-Markownikoff's addition reaction? 1

- (c) Complete the following reactions : $\frac{1}{2} \times 3 = 1\frac{1}{2}$



UNIT—V

39. (a) Discuss the Friedel-Craft acylation reaction of benzene with appropriate mechanism. What is the Lewis acid used in this reaction? Explain the specific role of Lewis acid in this Friedel-Craft acylation reaction. 2½+½+1=4

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(11)

- (b) Write the chemical reactions involved in the generation of electrophile during sulphonation reaction of benzene. 1
40. (a) Write the chemical reaction with suitable mechanism for the nitration of benzene to form corresponding nitrobenzene. 1+2=3
- (b) Although benzene is highly unsaturated, it does not undergo addition reactions but undergoes electrophilic substitution reaction easily. Justify this observation with proper reasons. 2
