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 : 1×15=15

UNIT—I

1. State the Heisenberg uncertainty principle.

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

3. How many nodal planes are possible in 3*s* atomic orbital?

4. Arrange the following in the decreasing order of their energy :

3*s*, 2*p*, 3*d* and 4*s*

UNIT—II

5. Define dipole moment. What is the dipole moment of CO_2 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 BF_3 molecule? Draw the structure of BF_3.

8. Which of the following has the highest bond order?

O_2, O_2^+ and O_2^-

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?

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

$H_3C—CH_2COOH$,

$H_3C—\underset{\displaystyle NO_2}{\underset{|}{C}}HCOOH$ and $H_2\overset{\displaystyle NO_2}{\overset{|}{C}}—CH_2COOH$

12. What is the hybridization of central carbon atom in $\dot{C}H_3$ radical?

UNIT—IV

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

$$H—C\equiv C—H \xrightarrow[\text{Raney Ni}]{H_2} [A]$$

$$H_3C—Br \xrightarrow{NaNH_2} [B]$$

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*] :

$$H_3C—CH=CH_2 \xrightarrow{HBr} [A] \xrightarrow{\text{Alcoholic NaOH}} [B]$$

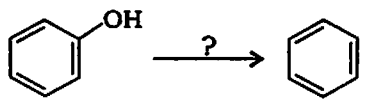
UNIT—V

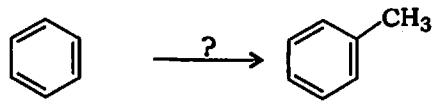
17. How will you prepare benzene from acetylene?

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 : ½×2=1

(i) 

(ii) 

SECTION—B

Answer *five* questions, taking *one* from each Unit : 2×5=10

UNIT—I

21. What will be the de Broglie wavelength of an electron moving with speed of light?
[Planck's constant $(h) = 6 \cdot 626 \times 10^{-34}$ JHz^{-1} and Mass of electron $= 9 \cdot 10 \times 10^{-31}$ kg]

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.

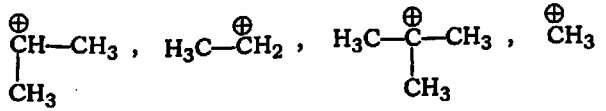
UNIT—II

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 SF_4 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.

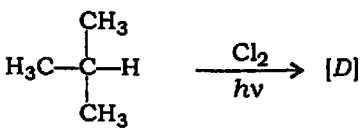
UNIT—IV

27. Identify [*A*], [*B*], [*C*] and [*D*] for the following reactions : ½×4=2

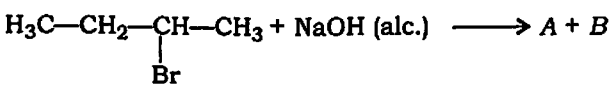
(i) $H_3CCOONa \xrightarrow[\Delta]{NaOH/CaO} [A]$

(ii) $H_2C{=}CH_2 \xrightarrow{alk.KMnO_4} [B]$

(iii) $H_3C{-}CH{=}CH_2 \xrightarrow{HBr/H_2O_2} [C]$

(iv) 

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 $H_3C{-}CH{=}CH_2$. 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 2*d*-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

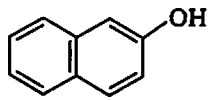
(b) How does polarizing power of a cation determine the percentage of ionic character in a covalent compound? 1

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 He_2 molecule not exist? Explain. 1

UNIT—III

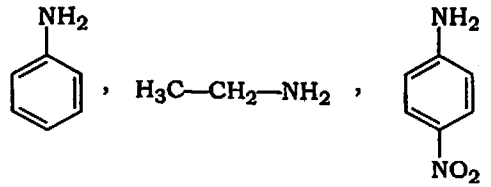
35. *(a)* Explain the aromatic or non-aromatic or anti-aromatic behaviours of



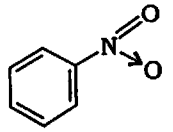
by using Hückel's rule. 2

(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



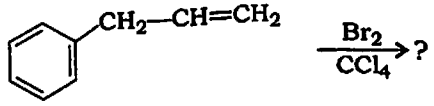
36. *(a)* Write the resonance structure for the following compound indicating the movement of electron using curved arrow notation : 2



(b) What is the difference between resonance and hyperconjugation? Why is hyperconjugation named as no-bond resonance? 2+1=3

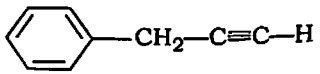
UNIT—IV

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 : ½×3=1½

(i) $CH_3CH_2MgBr + H_2O \xrightarrow[\Delta]{} ?$

(ii) $CaCl_2 + 2H_2O \xrightarrow[\Delta]{} ?$

(iii) $H_3C-\underset{\underset{OH}{|}}{CH}-CH_2-CH_3 \xrightarrow{\text{conc. } H_2SO_4} ?$

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

(Continued)

(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

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