2024/FYUG/EVEN/SEM/
CHMDSC–151T/084

FYUG Even Semester Exam., 2024

CHEMISTRY

(2nd Semester)

Course No. : CHMDSC–151T

(Organic Chemistry—I)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer any *ten* questions : 2×10=20

1. What is hyperconjugation? How does it differ from mesomeric effect? 1+1=2

2. Cyclohexylamine is a stronger base than aniline. Explain.

3. Indicate the type of hybridization on each carbon atom in the following species : ½×4=2

   (a) $HC\equiv C-CH_3$

   (b) $\dot{C}H_3$

   (c) $\bar{C}H_3$

   (d) $CH_3-\overset{+}{C}H_2$

4. Corey-House reaction is better method for preparing alkanes than Wurtz reaction. Explain, why.

5. Identify *A*, *B*, *C* and *D* : ½×4=2

   (a) $CH_3CH=CH_2 \xrightarrow{B_2H_6} A \xrightarrow{H_2O_2/OH^-} B \xrightarrow[\Delta]{Al_2O_3} C$

   (b) $HC\equiv CH + H_2O \xrightarrow[HgSO_4]{H_2SO_4} D$

6. Write a short note on Diels-Alder reaction.

7. What are aromatic, antiaromatic and nonaromatic compounds? Give one example of each.

8. In organic synthesis, Friedel-Crafts acylation is preferred to alkylation. Explain with an example.

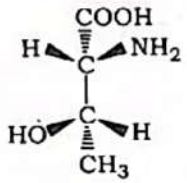
9. How will you convert benzene into—

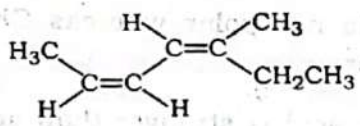
   (a) 2,4,6-trinitrotoluene;

   (b) *p*-nitrobromobenzene? 1+1=2

10. Represent the anti- and fully-eclipsed conformations of 2,3-butanediol by Newman and Sawhorse projection formulae.

11. Assign *R*, *S* or *E*, *Z* notations to the following : 1+1=2

   (a) 

   (b) 

12. Define the following terms with example : 1+1=2

(a) Diastereoisomers

(b) Enantiomers

13. What do you mean by invert sugar? Why is it named so? 1+1=2

14. Write a short note on 'mutarotation'.

15. Why is sucrose a non-reducing sugar? Give the Haworth representation of the structure of sucrose. 1+1=2

SECTION—B

Answer any *five* questions : 10×5=50

16. (a) Explain why : 1½×2=3

(i) CCl_4 is non-polar whereas CH_3Cl is polar.

(ii) Formic acid is stronger than acetic acid.

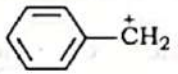
(b) What do you understand by the term 'resonance'? How does it differ from inductive effect? How will you explain the acidic character of phenol by resonance? 1+1+2=4

(c) What do you mean by electrophile and nucleophile? Explain with suitable examples. 1½+1½=3

17. (a) Arrange the following in increasing order of stability and justify your answer : 2

$CH_3\dot{C}H_2$, $\dot{C}H_3$, $(CH_3)_2\dot{C}H$, $(CH_3)_3\dot{C}$

(b) Draw the canonical structure and resonance hybrid of the following species : 1½+1½=3

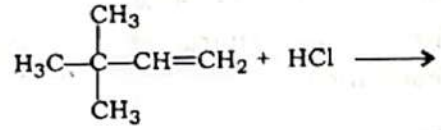
(i) 

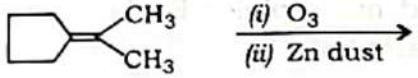
(ii) $CH_2{=}CH{-}CH{=}CH_2$

(c) What are carbenes? How are they formed? Discuss their types, structures and stability. 1+1+3=5

18. (a) What happens, when *cis*-2-butene and *trans*-2-butene are brominated? Write the product and the mechanism. 4

(b) Complete the following reactions and write the mechanism : 2×3=6

(i) 

(ii) 

(iii) $CH_2=CH-CH=CH_2 + Br_2 \xrightarrow{CCl_4}$

19. (a) State Markovnikov's rule and explain the mechanism of addition of HBr to propene in the presence of peroxide. 1+2½=3½

(b) Discuss the mechanism of allylic bromination taking a suitable example. 2½

(c) Give one example of Hofmann elimination reaction. 1

(d) A primary alcohol *A* ($C_6H_{14}O$) on treatment with hot sulphuric acid yields an unsaturated compound *B* (C_6H_{12}), which on ozonolysis, gives a mixture of compound *C* (C_2H_4O) and butanone. Deduce the structure of *A*, *B* and *C*, and write the chemical reaction of each step. 3

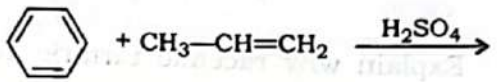
20. (a) Explain the following : 1½+1½=3

(i) Nitration of toluene can take place more readily than that of benzene.

(ii) Nitrobenzene is used as a solvent in Friedel-Crafts reaction.

(b) Discuss the mechanism of sulphonation of benzene. 2½

(c) Complete the following reaction and write the mechanism : 2½



(d) Explain why anthracene is more likely to undergo electrophilic substitution at the 9 position. 2

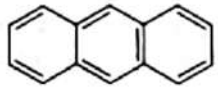
21. (a) Write the Haworth synthesis of naphthalene from benzene. 3

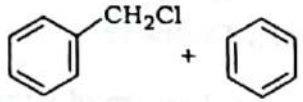
(b) Give evidence in favour of the fact that—

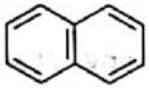
(i) naphthalene is a bicyclic compound;

(ii) anthracene has diene character. 2½+1½=4

(c) Complete the following reactions : 3

(i)  dil. HNO_3 →

(ii)  anhyd. $AlCl_3$ →

(iii)  conc. H_2SO_4, 160 °C →

22. (a) Explain why racemic tartaric acid can be resolved but not mesotartaric acid. Give the chemical method of resolution of racemic lactic acid. 1½+2½=4

(b) What are conformers? Describe the different conformations of *n*-butane with energy diagrams. 1+3=4

(c) Explain why chair conformation of cyclohexane is more stable than boat conformation. 2

23. (a) The presence of a chiral carbon in a molecule is not a necessary condition for showing optical activity. Explain. 2

(b) A racemic mixture of 2-butane showed a specific rotation of +6·76°. The pure S-(+)2-butanol gives specific rotation +13·52°. What will be enantiomeric excess of S-(+)2-butanol and actual composition of its enantiomeric mixture? 2½

(c) Discuss the conformations of 1,3-disubstituted cyclohexane and explain their stability. 3

(d) Discuss Sachse-Mohr theory of stainless rings. 2½

24. (a) What are the limitations of open-chain structure of glucose? How is the ring size of glucose molecule established? 1½+2½=4

(b) Give Kiliani-Fischer synthesis of D-glucose from D-arabinose. 3

(c) Explain the following with necessary chemical reactions : 1½+1½=3

(i) Glucose and fructose give the same osazone.

(ii) Fructose reduces Tollens reagent although it is a ketohexose.

25. *(a)* Write a short note on Ruff's degradation of an aldohexose to aldopentose. 2½

(b) Convert glucose into fructose. 2

(c) Establish the fact that—

(i) carbonyl group in fructose is a keto group;

(ii) sucrose contains a α-glycosidic linkage. 1+1½=2½

(d) Draw the chair conformation of starch and cellulose and indicate the glycosidic linkage in each structure. 3

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