TDC (CBCS) Even Semester Exam., 2019

CHEMISTRY

(2nd Semester)

Course No. : CHMHCC–201T

(Organic Chemistry—I)

Full Marks : 50
Pass Marks : 20

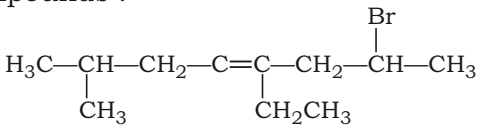
Time : 3 hours

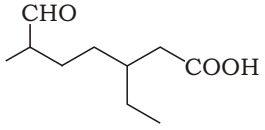
The figures in the margin indicate full marks for the questions

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

UNIT—1

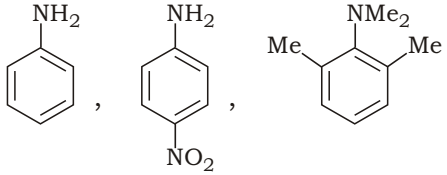
1. *(a)* Write the IUPAC name of the following compounds : 1×2=2

(i) 

(ii) 

(b) Explain why CH_4 is tetrahedral but C_2H_4 and H—C≡C—H are planer. 2

(c) Arrange the following amines in terms of increasing base strength. Justify your answer : 1+1½=2½



(d) The following compound has two isomers, one isomer has dipole moment 0*D* and other has a dipole moment 2·95*D*. Propose structures for the two isomers that are consistent with these data and explain why : 1½

ClCH=CHCl

(e) Give the products of the following reactions—

(i) under condition that favour an S_N2 reaction;

(ii) under condition that favour an S_N1 reaction : 1+1=2

$$H_3CCH{=}CHCH_2Br + CH_3O^- \xrightarrow{CH_3OH} ?$$

2. *(a)* Give the hybridization of the central atom of the following species and draw the shape of these species : 3

$:CH_2(s)$, $^+CH_3$, $^-CH_3$

(b) Arrange the following carbanion in terms of increasing stability : 1

Neopentyl, Benzyl, Phenyl

(c) Which of the following indicated bonds have greater bond strength and why? 1×2=2

(i) $CH_3—CH_2—\underset{\underset{H}{|}}{CH_2}$ ← *or* $CH_3—\underset{\underset{H}{|}}{CH}—CH_3$ ←

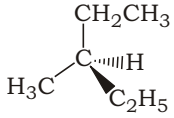
(ii) $H_3C—CH_3$ ↑ *or* $CH_3—CH_2—CH_3$ ↑

(d) Draw curved arrows to show the flow of electrons responsible for the conversion of the following reactants into the product : ½×2=1

(i) $^{\ominus}OH + H_2C(Br)—CH_3 \longrightarrow H_2O + H_2C{=}CH_2 + Br^-$

(ii) $Br^{\bullet} + H_2^{\bullet}C{=}CH_2 \longrightarrow H_2C(Br)—\dot{C}H_2$

(e) Give the configuration of the following reaction : 1



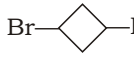
$+ \; CH_3CH_2CH_2O^{\ominus} \longrightarrow$ Product
(high concentration)

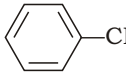
(f) Which of the following is a better base or better nucleophile and why? 2

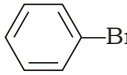
OH *or* H_2O

UNIT—2

3. *(a)* Provide the major products of the following reactions : 1×4=4

(i)  $+ 2Na \longrightarrow A$

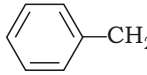
(ii)  $—CH{=}CH_2 \xrightarrow[Pd/C]{H_2} B$

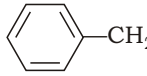
(iii)  $—Br + Na + CH_3I \longrightarrow C$

(iv) $CH_3—CH_2—C{\equiv}C—CH_3 \xrightarrow[\text{Lindlar's catalyst}]{H_2} D$

(b) Which alkyl halide would you expect to be more reactive in an *E*2 reaction and why? 1½×2=3

(i) $H_3C—CH(CH_3)—CH(Br)—C_2H_5$ *or* $CH_3—CH(CH_3)—CH_2—CH(Br)—CH_3$

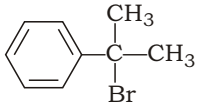
(ii)  $—CH_2—CH(Br)—C_2H_5$ *or*

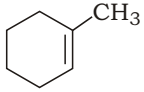
 $—CH_2—CH_2—CH(Br)—CH_3$

(c) Carry out the following transformation with appropriate reagent/reaction condition(s) and provide mechanism of the reactions : 3

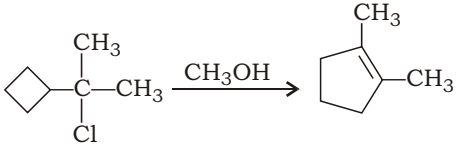
$$HC{\equiv}CH \longrightarrow CH_3CH_2CH_2{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}H$$

4. *(a)* Complete the following reactions and provide plausible mechanism : 2×2=4

(i) $A + HBr \longrightarrow$ 

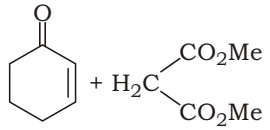
(ii)  $\xrightarrow[2)\ Zn/H_2O]{1)\ O_3} B$

(b) Propose a mechanism for the following reaction : 1½



(c) If 2-fluoropentane were to undergo *E*1 reaction, would you expect the major product to be one predicted by Zaitsev's rule? Explain. 1½

(d) Provide the product(s) of the following reactions : 1×3=3

(i)  $\xrightarrow{\ominus OEt} C$

(ii) $H_2C{=}CH{-}CH{=}CH_2$

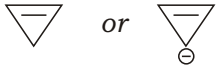
$+\ H_3C{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}C{\equiv}C{-}COCH_3 \longrightarrow D$

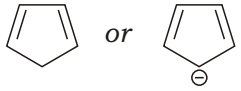
(iii) $H_3C{-}\overset{\overset{\displaystyle CH_3}{|}}{C}{=}CH{-}CH_3 \xrightarrow[H_2O_2]{O_3} E + F$

UNIT—3

5. *(a)* State Hückel's rule of aromaticity. 1½

(b) Which ion in each of the following pairs is more stable and why? (½+1)×2=3

(i)  *or*

(ii)  *or*

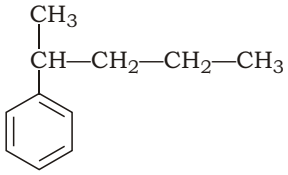
(c) Predict the product of the following reaction and provide mechanism :

$+\ Br_2 \xrightarrow{FeBr_3}$ Product

Why is hydrated $FeBr_3$ inactive as a Lewis acid catalyst? 2+1=3

(d) Describe synthesis of anthracene from benzene. 2½

6. *(a)* How the following compound could be prepared from benzene? Provide the mechanism of the following reaction : 2½

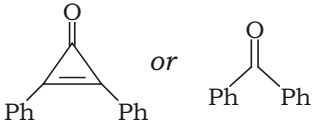


(b) When phenol is treated with Br_2, a mixture of monobromo, dibromo and tribromo phenol is obtained. Design a synthesis that would convert phenol primarily to *ortho*-bromo phenol. 2

(c) Starting from benzene, explain how you can synthesize 2-ethyl-naphthalene. 2

(d) Prove chemically that naphthalene contains two benzene ring fused in *ortho*-position. 2

(e) Which of the following compounds has greater dipole moment and why? ½+1=1½



UNIT—4

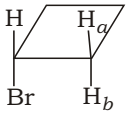
7. *(a)* Draw Fischer projection of the following compound(s) : 1×2=2

(i) (2*S*, 3*R*)-3-chloro-2-pentanol

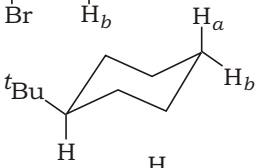
(ii) (*S*)-3-chloro-1-pentanol

(b) Write whether H_a, H_b hydrogens in each of the following compounds are homotropic, enantiotropic or diastereotropic : ½×4=2

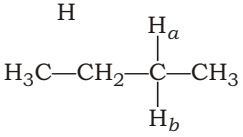
(i)



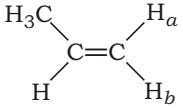
(ii)



(iii)



(iv)

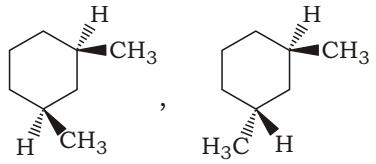


(c) Discuss with an example, the resolution method through the formation of diastereomers. 3

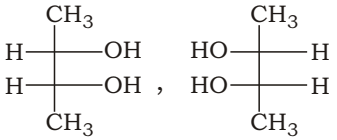
(d) Write the structure of *meso*-tartaric acid in Newman projection and Fischer projection. Show that it contains an S_2 axis. 1+1+1=3

8. *(a)* Give the stereochemical relationship between the pair of compounds : 1×3=3

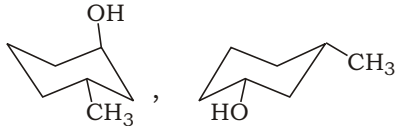
(i)



(ii)



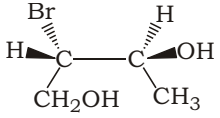
(iii)



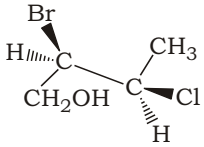
(b) Define optical rotation and specific rotation. 1+1=2

(c) Convert the following perspective formula to Fischer projection : 1×2=2

(i)

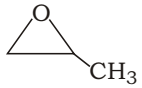


(ii)



(d) Draw projections of the following compounds to show the presence of geometric *cis-trans* isomers and optical isomers : 1½×2=3

(i)



(ii)

UNIT—5

9. *(a)* Explain with example, Baeyer strain theory. 2½

(b) Explain why, in case of cyclohexane, chair conformer is more stable than boat conformer. 2½

(c) Draw most stable conformation of the following compounds : 1×3=3

(i) *cis*-1-tert-butyl-4-methyl cyclohexane

(ii) Butane-2,3-di-ol (in Newman projection)

(iii) *cis*-cyclohexane-1,3-diol

(d) Explain why in 1-methyl-1-phenyl cyclohexane the conformer with axial phenyl and equatorial methyl is more stable than other conformer. 2

10. *(a)* Draw the most stable conformer of cyclopentane. Explain why planar conformation is not stable. 1+1½=2½

(b) Why does cyclobutane have less ring strain than cyclopropane? 1½

(c) Draw Newman projections of various conformations of *n*-butane and arrange them according to their decreasing stability. Also draw the potential energy diagram (energy vs. torsion angle) of *n*-butane. 1+2½=3½

(d) Draw two conformers of 1,2-*cis*-dimethyl cyclohexane. State which one is more stable and why. 1+1½=2½

★★★