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

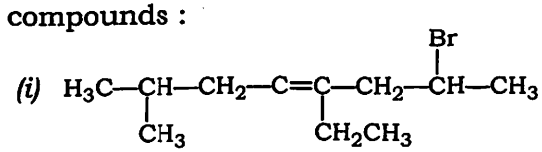
The figures in the margin indicate full marks for the questions

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

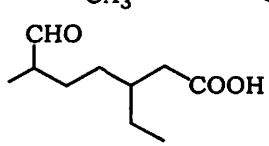
UNIT—1

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

(i)

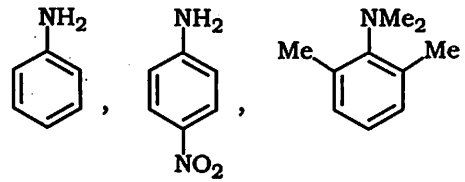


(ii)



(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) $CH_3{-}CH_2{-}\underset{\leftarrow}{\underset{|}{CH_2}}{-}H$ *or* $CH_3{-}\underset{\leftarrow}{\underset{|}{CH}}{-}CH_3$ (H)

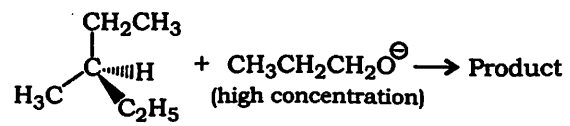
(ii) $H_3C\overset{\uparrow}{-}CH_3$ *or* $CH_3{-}CH_2\overset{\uparrow}{-}CH_3$

(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

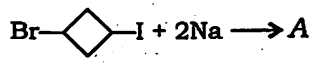


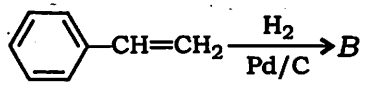
(f) Which of the following is a better base or better nucleophile and why? 2

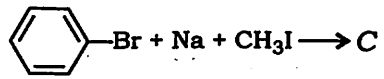
^-OH *or* H_2O

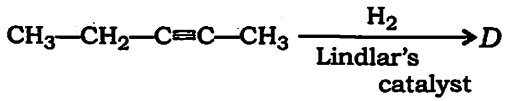
UNIT—2

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

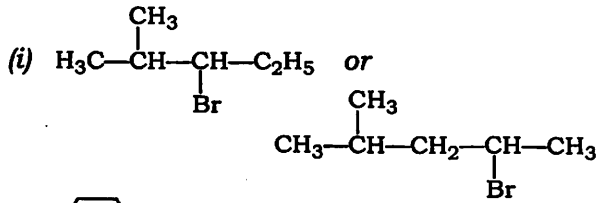
(i) 

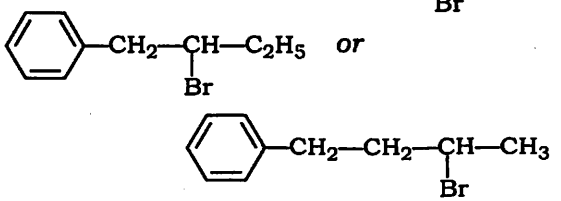
(ii) 

(iii) 

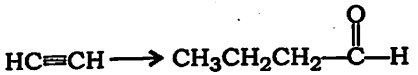
(iv) 

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

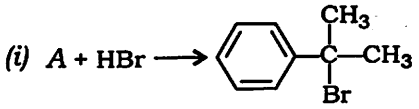
(i) 

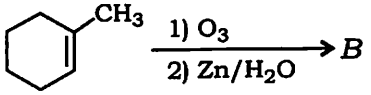
(ii) 

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

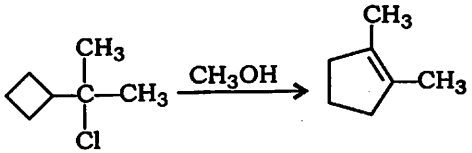


4. *(a)* Complete the following reactions and provide plausible mechanism : 2×2=4

(i) 

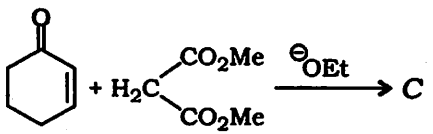
(ii) 

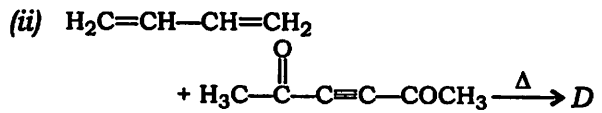
(b) Propose a mechanism for the following reaction : 1½

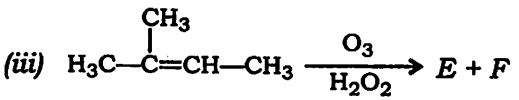


(c) If 2-fluoropentane were to undergo *E*1 reaction, would you expect the major product to be one predicted by Zaitsev's rule? Explain. 1½

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

(i) 

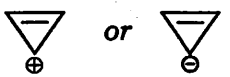
(ii) 

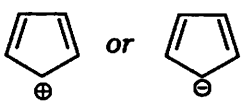
(iii) 

UNIT—3

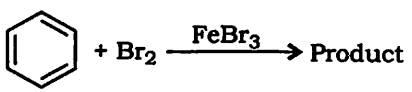
5. (a) State Hückel's rule of aromaticity. 1½

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

(i) 

(ii) 

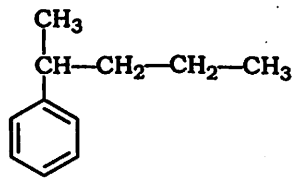
(c) Predict the product of the following reaction and provide mechanism :



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

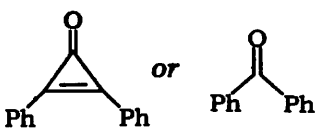


(b) When phenol is treated with Br_2, a mixture of monobromo, dibromo and tribromo phenol is obtained. Design a synthesis that would convert phenol primarily to *ortho*-bromo phenol. 2

(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



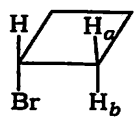
UNIT—4

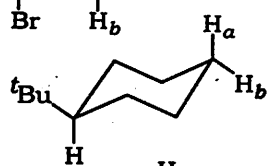
7. *(a)* Draw Fischer projection of the following compound(s) : 1×2=2

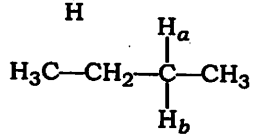
(i) (2*S*, 3*R*)-3-chloro-2-pentanol

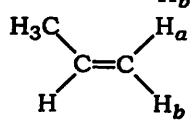
(ii) (*S*)-3-chloro-1-pentanol

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

(i) 

(ii) 

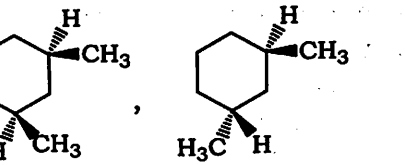
(iii) 

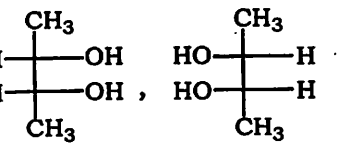
(iv) 

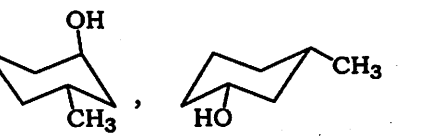
(c) Discuss with an example, the resolution method through the formation of diastereomers. 3

(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

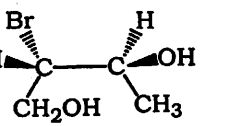
(i) 

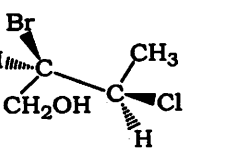
(ii) 

(iii) 

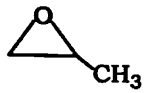
(b) Define optical rotation and specific rotation. 1+1=2

(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

★★★

TDC (CBCS) Even Semester Exam., 2019

CHEMISTRY

(2nd Semester)

Course No. : CHMHCC-202 T

(Physical Chemistry—II)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 20)

Answer **ten** questions, taking **two** from each Unit

UNIT—I

1. What are exact and inexact differentials? Give one example each from thermodynamics. 2

2. Write the mathematical statement for the first law of thermodynamics. 2

3. Define adiabatic flame temperature and explosion temperature. 2

UNIT—II

4. Give the statement of the second law of thermodynamics in terms of entropy. 2

5. Define inversion temperature. What is its significance? 1+1=2

6. Show that

$$\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$$ 2

UNIT—III

7. Explain the term 'partial molar property'. 2

8. Show that

$$\left(\frac{\partial \mu_i}{\partial T}\right)_{P,\,N} = -\bar{S}_i$$

where the terms have their usual meanings. 2

9. Show the variation of chemical potential with temperature, graphically. 2

UNIT—IV

10. Fugacity is a sort of 'fictitious pressure'. Explain. 2

11. Define the degree of advancement of a chemical reaction. 2

12. What is reaction potential? Complete the following sentence : 1+1=2

The decrease of reaction potential is defined as the _____.

UNIT—V

13. State Raoult's law. Define ideal solutions. 1+1=2

14. Mention two differences between osmosis and diffusion. 2

15. Define ebullioscopic constant and cryoscopic constant. 1+1=2

SECTION—B

(*Marks* : 30)

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

UNIT—I

16. *(a)* Prove thermodynamically

$$C_P - C_V = R$$

for one mole of an ideal gas. 4

(b) Compare isothermal and adiabatic expansions of an ideal gas and show that

$$P_{adia} < P_{iso}$$

where P indicates pressure of the ideal gas after expansion. 2

17. *(a)* Deduce Kirchhoff's equations. 3

(b) Calculate the bond enthalpy of C—H bond in methane from the following thermodynamic data : 3

(i) Heat of formation of methane is –75 kJ

(ii) Heat of sublimation of carbon is 720 kJ

(iii) Bond enthalpy of hydrogen gas is 435 kJ

UNIT—II

18. *(a)* State Lewis and Randall's statement for the third law of thermodynamics. 1

(b) Explain the concept of residual entropy. 2

(c) Show that Joule-Thomson effect is isoenthalpic. 3

19. *(a)* Derive the first thermodynamic equation of state using Maxwell relations. 2

(b) Show that

$$-\Delta A_T = w_{max}$$

where the terms have their usual meanings. 2

(c) In the solid state at 0 K, nitric oxide, NO, is capable of existing in two orientations, viz., NONO and NOON, which have practically equal probabilities. Calculate the molar entropy of NO at 0 K. 2

UNIT—III

20. Define chemical potential. What is its significance? Derive an expression to show the variation of chemical potential with pressure. 2+1+3=6

21. Deduce Gibbs-Duhem equations. Mention one important conclusion that can be drawn from Gibbs-Duhem equations. 4+2=6

UNIT—IV

22. *(a)* Derive thermodynamically the relation between Gibbs free energy of reaction and reaction quotient. 4

(b) The extent of dissociation of PCl_5 at a certain temperature is 20% at 1 atm pressure. Calculate the pressure at which this substance is half dissociated at the same temperature. 2

23. *(a)* Derive the integrated van't Hoff equation. 2

(b) The equilibrium constant of a reaction doubles on raising the temperature from 25 °C to 35 °C. Calculate $\Delta H°$ for the reaction. 2

(c) Explain coupling of exoergic and endoergic reactions. 2

UNIT—V

24. *(a)* State and explain the law which explains the effect of pressure on the solubility of a gas. 3

(b) Define van't Hoff factor. Find a relation between van't Hoff factor and degree of dissociation, taking one mole of a uni-univalent electrolyte as an example. 1+2=3

25. *(a)* Apply thermodynamics to derive a relationship between osmotic pressure and vapour pressure lowering of an ideal solution. 4

(b) At 37 °C, osmotic pressure of blood is 7·65 atm. How much glucose should be used per litre for an intraveinous injection that is to have the same osmotic pressure as blood? 2

★★★