

3 (Sem-1) CHM M 2 (O)

2019

CHEMISTRY

( Major )

Paper : 1.2

( Organic Chemistry )

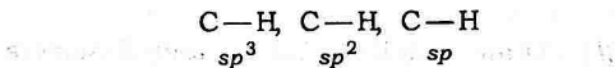
Full Marks : 60

Time : 3 hours

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

1. Answer the following questions : 1×7=7

(a) Arrange the C—H bond lengths in increasing order :

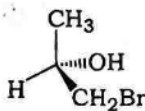


(b) Why is the boiling point of *n*-pentane more than neopentane?

(c) Why is acetic acid a stronger acid than propanoic acid?

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- (d) Why does pentane-2,4-dione mostly exist in the enol-form?
- (e) Assign *R*- or *S*-configuration for the molecule :



- (f) What is the state of hybridization of carbon in  $\overset{\ominus}{\text{C}}\text{H}_2\text{—NO}_2$ ?
- (g) Why is the dipole moment of *ortho*-dichlorobenzene not zero?

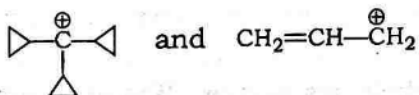
2. Answer any *four* of the following questions :

2×4=8

- (a) Draw the Newman projections for all the conformers that result from rotation about the C-2 and C-3 bonds of butane and identify the most stable amongst them.
- (b) Draw and label the *E*- and *Z*-isomers of 1,2-dichloro-3-ethyl-4-methyl-2-pentene.
- (c) Between *ortho*-nitrophenol and *para*-nitrophenol, which has higher boiling point and why?

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- (d) Explain why  $\text{Ph-S-CH}_2\text{-CH}_2\text{-Cl}$  reacts with water 100 times faster than  $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-Cl}$ .
- (e) Which of the following carbocations is more stable and why?



3. Answer any *three* of the following questions :

5×3=15

- (a) What do you mean by kinetically controlled and thermodynamically controlled reactions? Draw the energy profile diagram for these two reactions.

2+3=5

- (b) (i) What is  $\text{S}_{\text{N}}2$  mechanism? Give an example to explain it.

1+1=2

- (ii) Explain why *trans*-2-chlorocyclohexanol gives epoxy-cyclohexane in high yield on treatment with a base whereas the *cis*-isomer does not react with the base.

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- (c) What are non-classical carbocations? Give example of it. Discuss the stability of non-classical carbocations.

1+1+3=5

(d) Why is it difficult to separate racemic mixture? Describe a method of resolving a racemic mixture.  $1\frac{1}{2}+3\frac{1}{2}=5$

(e) What is atropisomerism? What types of isomerism are shown by 3-bromopent-2-ene? Give their structures along with their designation. Why are enantiomers not easily separated?

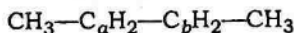
$1+1+2+1=5$

4. Answer either (a) or (b), (c) or (d) and (e) or (f) from the following questions :  $10 \times 3 = 30$

(a) (i) Explain why C—N bond length in methylamine is more than that in urea. 2

(ii) What is hyperconjugation and what are its types? What are the conditions for any organic species to exhibit hyperconjugation?  $1+2+2=5$

(iii) Arrange the following  $C_a-C_b$  bond lengths in increasing order and explain the observation : 3



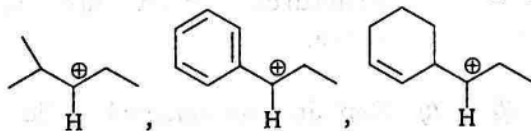
(b) (i) What is  $pK_a$ ? How is it related to acid strength? Explain why  $pK_a$ -value of picric acid is much lower than phenol.  $1+1+2=4$

(ii) What is diagonal hybridization?  
What are its characteristics? 1+2=3

(iii) What is inductive effect? What are  
its applications in determining the  
stability of carbocations? 1+2=3

(c) (i) Which of the two alkenes,  
1-pentene or 2-pentene on reaction  
with HBr will produce 2-bromo-  
pentane exclusively? Explain the  
reason. 3

(ii) How can you generate carbo-  
cations? Arrange the following  
carbocations in increasing order of  
stability and explain the reasons :  
2+3=5



(iii) Write a reaction to show evidence  
that  $S_N1$  mechanism involves  
carbocation intermediate. 2

(d) (i) What are pyrolytic eliminations?  
Give an example. Propose a  
mechanism for the pyrolytic  
elimination reaction. 1+1+3=5

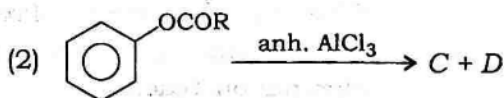
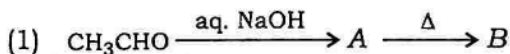
(ii) Write a general mechanism for elimination reactions proceeding via the  $E1$  pathway. Provide two evidences in support of the mechanism.  $3+2=5$

(e) (i) Explain why the chair-conformation of cyclohexane is more stable than the boat-conformation. Which conformer of cis-1,3-cyclohexane-diol is more stable and why?  $3+2=5$

(ii) How many stereoisomers are there for 2,3-diphenylbutane? Use Fischer projection formulas to draw all the stereoisomers and assign  $R$ - or  $S$ -designation to the asymmetric carbon atoms. Indicate the structures which are optically active.  $1+3+1=5$

(f) (i) Explain why benzylchloride is more reactive than alkyl chloride in nucleophilic substitution. 2

(ii) Give the products A, B, C and D in the following reactions :  $1 \times 2 = 2$



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(iii) Olefinic double bonds are prone to electrophilic addition whereas carbonyl  $C=O$  bonds are prone to nucleophilic addition. Explain. 3

(iv) Explain why elimination reactions always complete with substitution reaction. 3

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