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3 (Sem-2/CBCS) CHE HC 1

2023

CHEMISTRY

(Honours Core)

Paper : CHE-HC-2016

(Organic Chemistry-I)

Full Marks : 60

Time : Three hours

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

1. Answer **all** the questions : $1 \times 7 = 7$

(a) Draw the orbital diagrams of singlet and a triplet carbon.

(b) Write the structure of (R,R)-tartaric acid.

(c) Draw the Newman projection formula of the lowest energy conformer of butane.

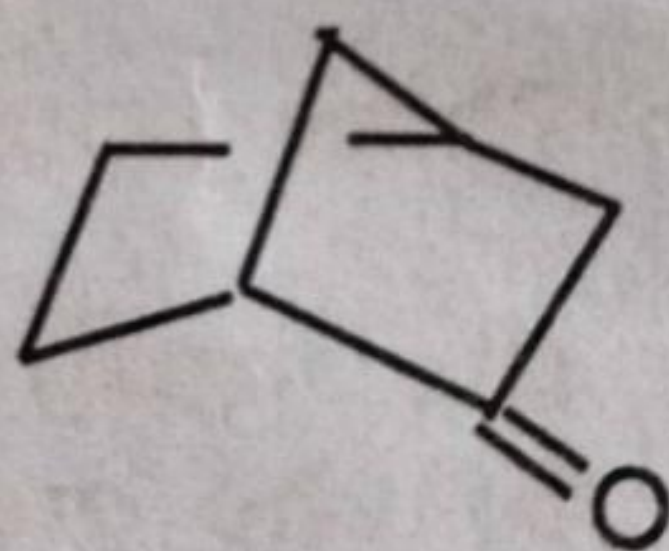
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(d) Between ammonia and trimethylamine which one is more likely to favour elimination over substitution and why?

✓ (e) Define a meso compound.

(f) Is cyclopentadiene acidic? Give reasons.

✓ (g) Write the IUPAC name of the following compound :



2. Answer **all** the questions : 2×4=8

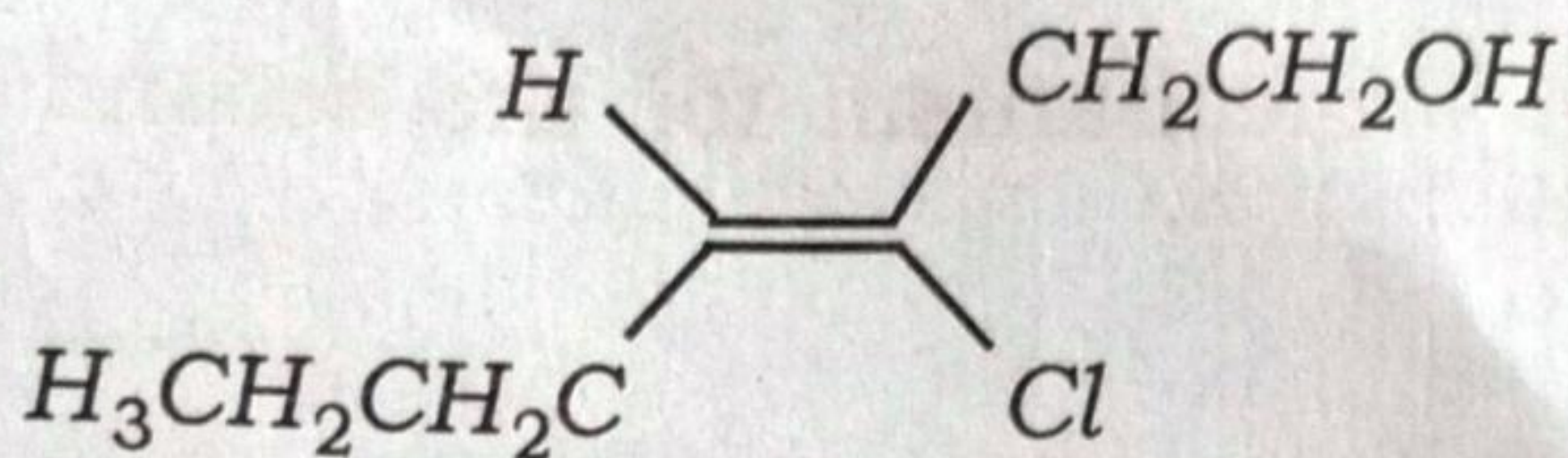
✓ (a) What product is obtained when cyclohexane is subjected to ozonolysis? Write the reaction involved.

✓ (b) Suggest two ways by which you can convert —OH group into good leaving group. 1+1=2

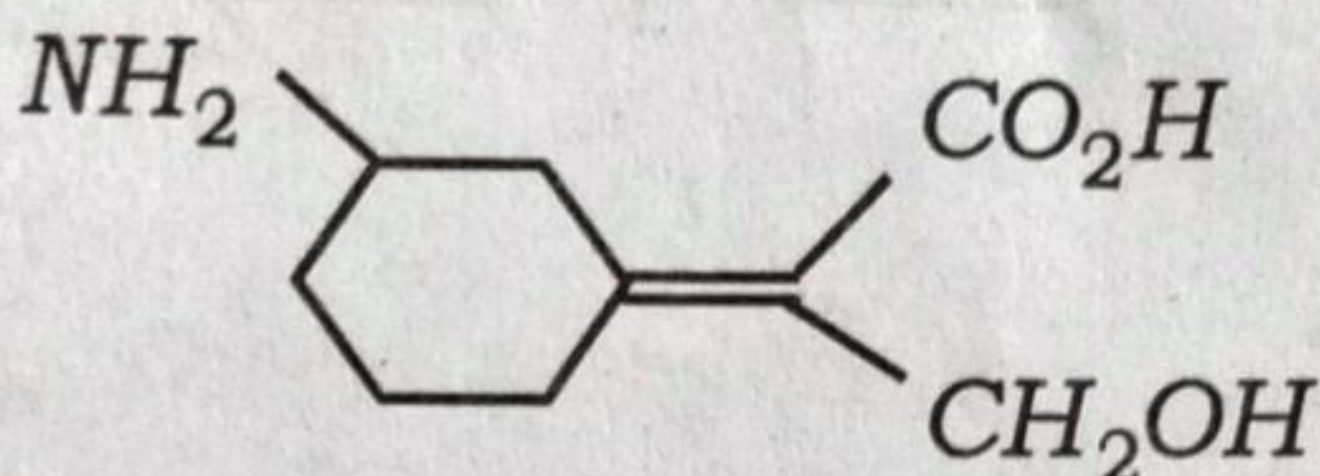
(c) Invoking hybridisation, explain the structure of methyl free radical.

(d) Label the following as *E*- or *Z*-isomer :

(i)



(ii)

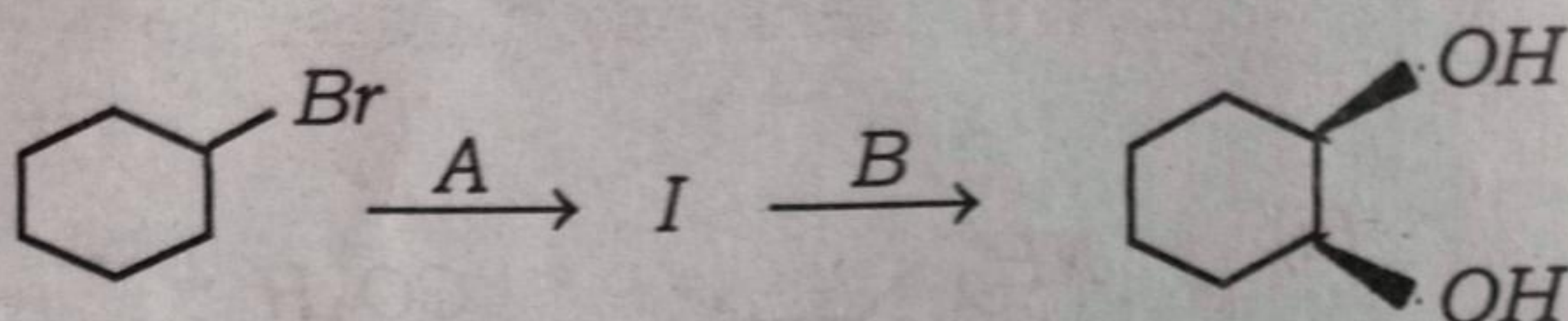


3. Answer **any three** questions : $5 \times 3 = 15$

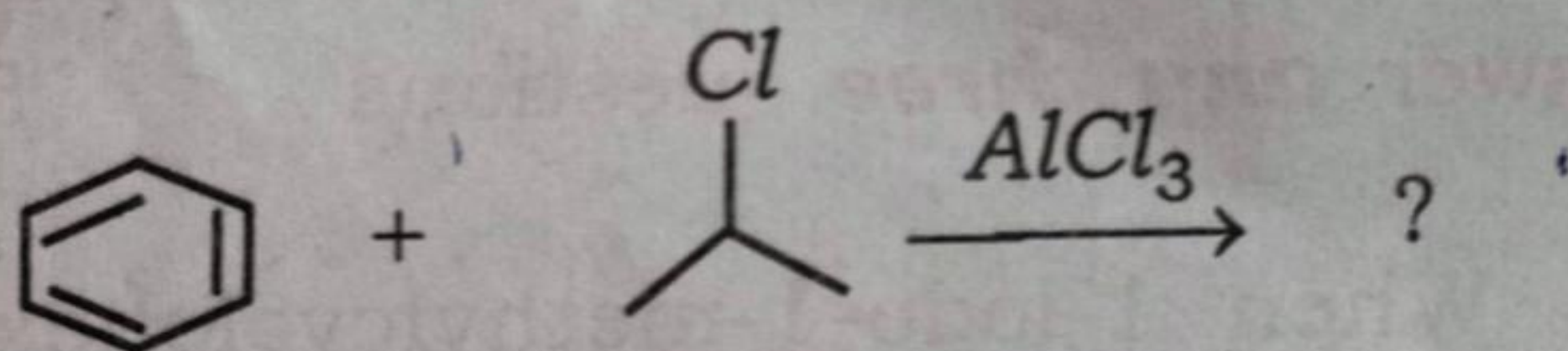
(a) When 1-iodo-1-methylcyclohexane is treated with $\text{NaOCH}_2\text{CH}_3$ as the base, the more highly substituted alkene product predominates. When $\text{KOC}(\text{CH}_3)_3$ is used as the base, the less highly substituted alkene predominates. Write the reactions, giving the structure of the two products and offer an explanation. $3+2=5$

- (b) Identify the reagents and intermediate in the following reaction. Propose a mechanism for the second step.

$$1+1+1+2=5$$



- (c) What product is expected to be formed in the following reaction?



Write the name of the above reaction and propose a mechanism, clearly explaining the steps involved.

$$1+1+3=5$$

- (d) Write the steps involved in an $E2$ mechanism. Provide one evidence in favour of $E2$ mechanism. Under what condition $E2$ is favoured over $E1$ mechanism?

$$2+1+2=5$$

(e) (i) State one method by which carbocations can be generated.

(ii) Account for the stability of a benzyl cation.

(iii) Why is it difficult to form carbocations at bridgehead positions ? $1+2+2=5$

4. Answer **any three** questions : $10 \times 3 = 30$

(a) (i) Toluene undergoes benzylic bromination when heated with NBS. Write the product obtained in the reaction. Propose a mechanism for the reaction.

$1+4=5$

(ii) Why are terminal alkynes acidic ? Write the reaction involved in the conversion of propane to pent-2-yne. $1+2=3$

(iii) How can you convert propyne to propan-2-one ? 2

(b) Give the 1,2- and 1,4- products of the addition of one equivalent of HBr to 2,4-hexadiene. Draw the transition states involved and predict which of them would be the major product and which will be the minor product. What are the 1,2- and 1,4- addition products of HBr to 2-methyl-1,3-cyclohexadiene? What is about the products of 1,2- and 1,4-addition of HX to an unsubstituted cyclic-1,3 diene?

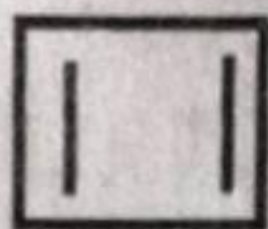
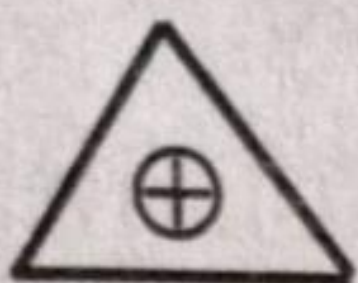
$$2+4+2+2=10$$

(c) (i) What do you mean by a racemic mixture? Why is resolution of a racemic mixture a difficult process? How can you resolve a racemic mixture? Suggest one method.

$$1+1+3=5$$

(ii) The addition of HBr to propene is regioselective. Write the reaction involved. Propose a mechanism to justify the regioselectivity. 1+4=5

- (d) (i) State whether the following compounds are aromatic, non-aromatic or antiaromatic. Give reasons. $2+2=4$



- (ii) Define hyperconjugation. How many hyperconjugation structures are possible for an isopropyl radical? $1+1=2$

- (iii) What do you mean by partial bond fixation? Which position of anthracene is attacked by electrophiles and why? $1+(1+2)=4$

- (e) (i) Explain Baeyer strain theory. 2

- (ii) Draw the energy profile diagram of cyclohexane. 3

- (iii) Why is the chair form of cyclohexane the most stable? 1

- (iv) Convert meso-tartaric acid from Fischer to Newman projection and Sawhorse projection. 2

Contd.

(v) Let (S)-2-bromobutane have a specific rotation of $+23.1^\circ$ and (R)-2-bromobutane have a specific rotation of -23.1° . What is the percentage purity and % composition of a mixture whose specific rotation was found to be $+18.4^\circ$?

2

(f) (i) What are the factors which determine whether an aliphatic nucleophilic substitution reaction proceeds by $SN1$ or $SN2$ reaction? Discuss *any two* factors in brief.

1+4=5

(ii) Using appropriate example write briefly about Saytzeff and Hofmann elimination.

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CH₃
|
C=CH₂