Chhatrapati Shahu Ji Maharaj University, Kanpur

Answer Script Details
Barcode 1246440

Roll No. 24063001034
Total Mark 57/75.00
Exam MASTER OF SCIENCE _ODD EXAM-DEC-24
Subject B020702T - ORGANIC CHEMISTRY - I

Question wise Mark Summary

Q.No	Mark	Q.No	Mark	Q.No	Mark	Q.No	Mark
1A	4/5						
1B	4/5						
1C	4/5						
1D	4/5						
1E	2/5						
1F	4/5						
1G	4/5						
1H	4/5						
1I	4/5						
2	12/15						
3	0/15						
4	0/15						
5	0/15						
6	0/15						
7	11/15						
8	0/15						
9	0/15						

PART-I

Date of Exam: 28/1/25 Shift: 1st Room No.: 20

Paper Code: B020702T Subject: Organic Chemistry Year/Sem: 1st

Name of Candidate: Priya Kumari Gupta

Roll No.: 2 4 0 6 3 0 0 1 0 3 4

OIC Facsimile

Signature of Invigilator

Priya Kumari Gupta
Signature of Candidate

Chhatrapati Shahu Ji Maharaj University
Kanpur, Uttar Pradesh

PART-II

MARKS OBTAINED

Q.	1	2	3	4	5	6	7	8	9	10
(a)										
(b)										
(c)										
(d)										
(d)										
(f)										
(g)										
(h)										
(i)										
(j)										
Total										

Total Marks in Figures | Max. Marks

Total Marks in Words

B 0 2 0 7 0 2 T
Paper Code

Signature of Evaluator

PART-III

Course: M.Sc.(CH)(Chemistry)

Session: 2024-25 Year/Semester: 1st

Subject: Organic Chemistry

Paper Code
B 0 2 0 7 0 2 T

Exam Date
2 8 - 0 1 - 2 5

Name of Candidate
PRIYA KUMARI GUPTA

महाविद्यालय का कोड College Code: U N 0 1

परीक्षा केन्द्र का कोड Exam Centre Code: U N 0 1

परीक्षा का प्रकार Type of Exam

संस्थागत Regular ● भूतपूर्व परीक्षार्थी Ex. Student ○

व्यक्तिगत Private ○ बैक पेपर परीक्षा Back paper Exam ○

ANSWER BOOKLET NO.

1246440

B 0 2 0 7 0 2 T
Paper Code

PART-IV

नामांकन संख्या Enrollment Number: C S J M A 2 4 0 0 0 0 6 3 1 7 1

परीक्षार्थी अनुक्रमांक संख्या Candidate's Roll Number: 2 4 0 6 3 0 0 1 0 3 4

पेपर कोड Paper Code: B 0 2 0 7 0 2 T

Priya Kumari Gupta
Signature of Candidate

Signature of Invigilator

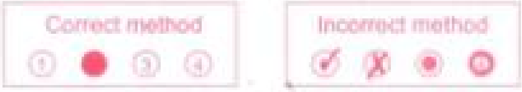
C S Facsimile

INSTRUCTIONS TO THE CANDIDATE FOR FILLING PART-I

1. Read the instructions carefully given on the answer script and admit card.
2. Write Date of Exam, Shift, Paper Code & Name of Subject Correctly.
3. Write Name & Roll No. Correctly.
4. Write Semester & Branch Correctly.

INSTRUCTIONS TO THE CANDIDATE FOR FILLING PART-III

1. Use blue or black ball point pen for writing alphabets & numerals in ☐ Boxes.
2. Carefully study the example before you start marking.
3. As shown in the example below blacken the circles completely.



4. Make no Stray marks on this sheet.
5. **DO NOT WRITE OR MARK ON THE BAR CODE.**

IN ORDER TO AVOID UFM (UNFAIR MEANS) :

1. The Roll No. and Answer Book no. found elsewhere or any other symbol found in the answer book will be treated as unfair means.
2. Any tempering of Bar Code and Booklet no shall be treated as Unfair Means.
3. Do Not bring the materials like slip of paper/mobile/digital diaries/ study material/ revision notes in examination hall. Possession of the mobiles/ digital diaries/ electronic watch and any other electronic gadget except memory less scientific calculator shall be considered as UFM case.
4. Do not keep or paste currency note in answer script it shall be consider as UFM.

अनुचित साधन से बचने हेतु:

1. उत्तर पुस्तिका के निर्देशित स्थान को छोड़कर अनुक्रमांक एवं उत्तरपुस्तिका का क्रमांक कहीं और न लिखें तथा कोई भी चिन्ह न बनायें क्योंकि यह अनुचित साधन प्रयोग की परिधि में आता है।
2. उत्तर पुस्तिका के बारकोड अथवा उत्तर पुस्तिका संख्या पर छेड़ करने पर अनुचित साधन प्रयोग माना जायेगा।
3. परीक्षा कक्ष में निम्न वस्तुएं साथ न लायें, जैसे लिखे हुए कागज के टुकड़े, मोबाईल, डिजिटल डायरी, कॉपी, पुस्तक यह सभी वस्तुएं जो अनुचित साधन के अन्तर्गत आती है। केवल संबंधित प्रश्नपत्र में ही मेमोरी लैस साइंटफिक कैल्कुलेटर ले जाने की अनुमन्यता होगी।
4. उत्तर पुस्तिकाओं में रुपये न रखें न ही उत्तर पुस्तिका में चिपकायें। ऐसा करना अनुचित साधन प्रयोग की परिधि में आता है।

परीक्षार्थी के लिए निर्देश

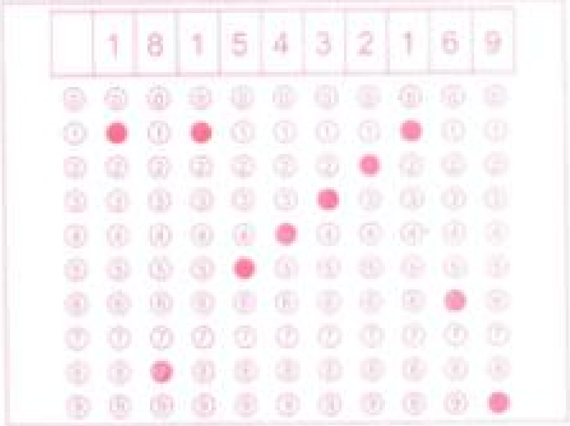
1. प्रवेश पत्र एवं उत्तर पुस्तिका पर दिये गये निर्देशों को ध्यान से पढ़ें।
2. कवर पृष्ठ के दूसरी तरफ कुछ न लिखें।
3. उत्तर पुस्तिका के पृष्ठों पर दोनों तरफ लिखें।
4. प्रश्न पत्र पर अपने अनुक्रमांक के अतिरिक्त कुछ न लिखें।
5. प्रश्न पत्र कोड एवं प्रश्न पत्र कोड सावधानी पूर्वक लिखें।
6. अपनी स्थिति स्पष्ट लिखें।
7. उत्तर पुस्तिका के पृष्ठों की संख्या देखें। अगर उत्तर पुस्तिका में पृ (1–24) से कम है या कटे हुए है, तो परीक्षा शुरू होने के पूर्व दूसरी उ पुस्तिका ले लें।
8. प्रश्नपत्र को देख, यदि प्रश्नपत्र के विषय कोड, विषय का नाम तथा प्र में कोई त्रुटि है तो उसके परीक्षा शुरू होने के 30 मिनट के अन्दर क निरीक्षक को तत्काल सूचित करें, उसके बाद विश्वविद्यालय द्वारा क कार्यवाही नहीं की जायेगी।
9. प्रश्नों के उत्तर लिखने के लिये पेंसिल का प्रयोग न करें।
10. B कॉपी या अतिरिक्त ग्राफ नहीं दिया जायेगा।

INSTRUCTIONS TO THE CANDIDATE

1. Read the instructions carefully given on the Question Pap Admit Card & Answer Script.
2. Do not write anything on back side of the cover page.
3. Write on both sides of pages of answer book.
4. Do not write anything on question paper except Roll Number.
5. Write Paper Code & Question Paper Id carefully.
6. CHECK the number of pages (1-32) or any other kind of damag in your answer script. If found than change the answer scr immediately before the commencement of examination.
7. CHECK the Question Paper for any kind of discrepancy e. Subject Code, Subject Name and Question of the Questi Paper during first THIRTY MINUTES of the commencement the exam, so that it can be corrected in TIME. After that n corrections shall be entertained by the university.
8. Do not use pencil for answering the question.
9. Write status correctly e.g. those appearing in carry over pape should fill in status as Carry Over. Those appearing as E Students should fill in status as ex.
10. No supplementary answer book & graph paper will be provided.

INSTRUCTIONS TO THE CANDIDATE FOR FILLING PART-IV

1. Use blue or black ball point pen for writing alphabets & numberals in ☐ Boxes.
2. Use blue or black ball point pen for filling the circles.



Note - If your Roll No. is of 10 digits. Please leave first three column

Section-C

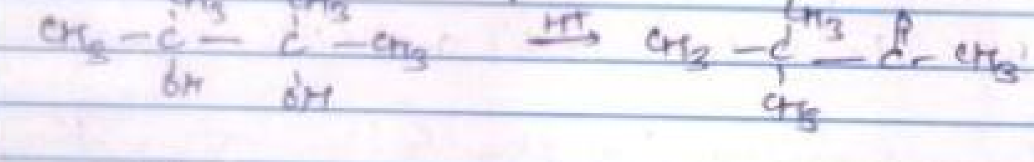
2. Rearrangement reactions the molecules undergo a structural rearrangement, often involving a shift of atoms or groups within a molecule, to form a new product. These reactions often occur via intermediates, such as carbocations, radicals and so on.

Types of rearrangement reactions are as follows:-

- Sigmatropic Rearrangement.
- Electrocyclic Rearrangement.
- Pericyclic Rearrangement.
- Carbocation Rearrangement.

Pinacol-pinacolone rearrangement:-

Pinacols are ditertiary 1,2-diols. The simplest member is $Me_2C(OH)\cdot C(OH)Me_2$. When this is treated with dilute or concentrated H_2SO_4 a rearrangement reaction takes place which leads to the formation of $Me_3C-CO-Me$ (pinacolone)

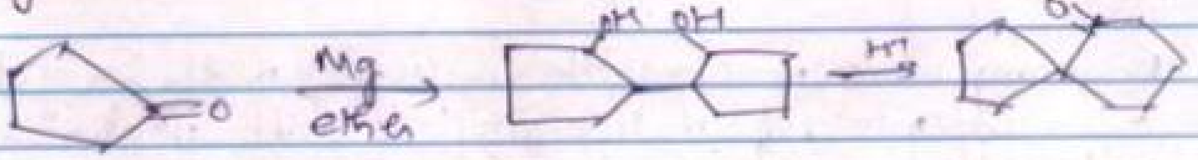


$$CH_3-\underset{OH}{\overset{CH_3}{C}}-\underset{OH}{\overset{CH_3}{C}}-CH_3 \xrightarrow{H^+} CH_3-\underset{CH_3}{\overset{CH_3}{C}}-\overset{O}{C}-CH_3$$

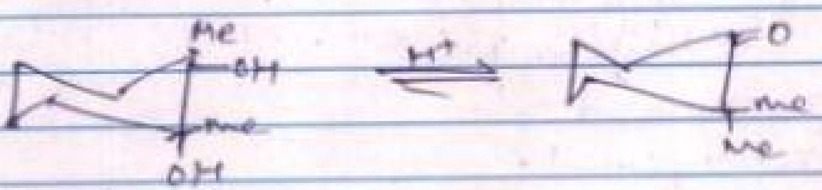
1,2-diols containing substituents with strong $-I$ effect do not undergo the pinacol-pinacolone rearrangement reaction.

$$F_3C-\underset{OH}{\overset{CF_3}{C}}-\underset{OH}{\overset{Me}{C}}-CH_3 \xrightarrow{H^+} \text{no reaction.}$$

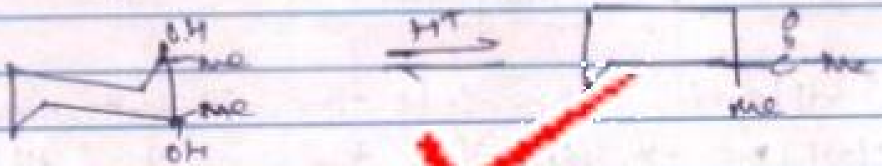
Spiranes and their derivatives can be easily prepared by this reaction.



It has been found that in the alicyclic system that a group trans to the leaving group usually migrates in pinacol-rearrangement reaction.



(cis-form).



(trans-form)

In sigmatropic rearrangement reaction the rearrangement takes place in [1,3], [5,5] and [3,3] rearrangement position.

When the rearrangement takes place in [1,3] position through the substitution of one group with other the result formation of product in [1,3] position.

Section-B.

1. The theory is based on their polarizability, charge density, and the type of interactions they prefer.

Hard and Soft Nucleophiles:-

- Have high ~~charge~~ charge density (small and compact size).
- Low polarizability (difficult to distort electron cloud).
- Tend to react with hard electrophiles (ionic or electrostatic interactions dominate).

E.g. OH^-, NH_3, F^-, RO^-

Soft Nucleophiles:-

- Have low charge density (large more diffuse).
- High polarizability (easier to distort electron cloud)
- Tend to react with soft electrophiles (covalent interactions dominate)

E.g. I^-, RS^-, CN^-, $C=C$

Hard and Soft Electrophiles

Electrophiles are electron deficient species that accept electrons to form a bond

Hard Electrophiles:-

- Small and have high positive charge density

- Low polarizability.
- Prefer ionic or electrostatic interaction

E.g. – H^+, Na^+, Mg^{2+}.

Soft Electrophiles :-

- Large, with low positive charge.
- High polarizability.
- Prefer covalent bonding in with soft nucleophiles.

Eg Hg^{2+}, Ag^+, I_2

- Hard and hard Interaction – strong and stable due to ionic character.

E.g. OH^- reacting with H^+

$$H^+ + OH^- \rightleftharpoons H_2O$$

- Soft - soft interactions :- strong and stable due to covalent character.

E.g. RS^- reacting with CH_3I.

Applications of HSAB :-

1. Reaction Prediction – Helps in predicting which nucleophile will attack which electrophile.

2. Selectivity in Organic Reactions – ~~soft~~ It tells which electrophile will react with nucleophile like hard

electrophile will react with hard nucleophile.

3. Complex Formation – It predicts which metal ion binds preferentially to specific ligands in coordination chemistry.

e.g. Cu^+ forms a stable complex with CN^-.

4. Solubility and Precipitation – It is used to understand the solubility of compounds. Hard–[illegible] interactions leads to more insoluble compounds.

e.g. Mg^{2+} forms an insoluble salt with CO_3^{2-} i.e. $MgCO_3$.

5. Catalysis – It explains the catalysis of reactions with reactants in both homogeneous and heterogeneous catalysis.

6. Biological Chemistry – It explains metal ion selectivity in enzymes and biological systems.

e.g. Zn^{2+} binds to S-containing amino acids like cysteine in enzymes.

7. Environmental Chemistry – Explains the mobility of metal ions in the environment.

Section-A

1. (a) Carbocations are organic carbon compounds having vacant p-orbital. Its hybridization is sp^3.

- The general stability trend is :-

Tertiary > Secondary > Primary > Methyl.

- Inductive Effect - Alkyl groups are electron donating via the inductive effect, which reduces the positive charge on the carbocation. Therefore, tertiary carbocation have more electron donating capacity compared to secondary and primary.

- Resonance Stabilization - Carbocations stabilized by resonance are highly stable.
e.g. Benzyl carbocation and allylic carbocation are more stable than tertiary one.

- Hyperconjugation - Alkyl groups stabilizes carbocation through hyperconjugation, where electrons from adjacent C-H bonds delocalizes into the empty p-orbital of the carbocation.

- Aromaticity - Aromatic carbocations such as the ~~carbo~~ cyclopropyl methyl carbocation gain extra stability due to aromatic resonance.

Thus the stability of carbocation is determined by how effectively the positive charge is delocalised.

b) Aromaticity of a compound is determined basically by Huckel's Rule.

The features of an aromatic compound are :-

- The structure must be cyclic.
- Each atom in the ring must have an unhybridised p-orbital.
- These p-orbitals must be parallel.
- The overlapping π-system must have $4n+2\pi$ electrons
- Delocalising of π-electrons in the ring must lower the electronic energy.

It states that a molecule is aromatic if it contains a planar geometry, cyclic structure with a number of π electrons that follows the formula of $4n+2\pi$ integer.

Some of the examples of aromatic compounds are:

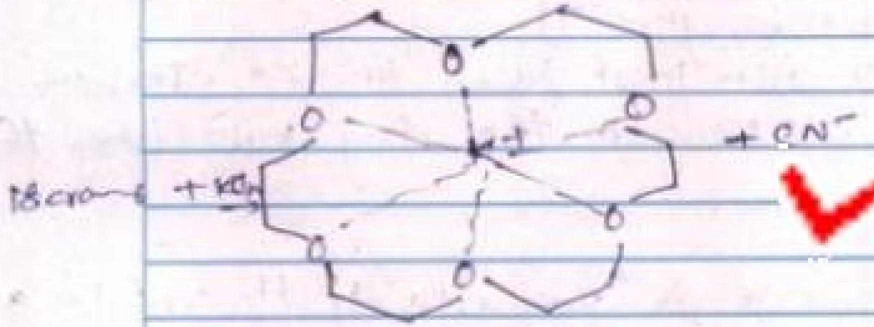
Benzene — It is planar, cyclic and follows the Huckel rule.

→ $4n+2\pi$ Rule.
Here $n=3$.

a) A group of long-ring polyethers, because of 3-D shapes are called crown ethers. The compounds are cyclic polymers of ethylene glycol.

Crown ether are able to complex various metal ions through ion-dipole involving the unshared pair of electrons on oxygen atom. A crown ether complexes effectively that particular cation which fits neat into the cavity of the crown.

e.g. 18-crown-6 ~~form~~ forms strong compound with K^+ ion (diameter 2.66 Å).



~~18 crown~~
The new cation is lipophilic on outside and has positive charge burried within the molecule. The lipophilicity makes it soluble in organic solvents of low polarity.
When it enters in organic solvent, it gets the anion into it. The anion is shielded from the positive charge on the K^+ by the bulky side of the crown. thus forming only loose ion pairs and is highly reactive.

d) Steric Inhibition of Resonance refers to a phenomenon in which bulky groups attached to a molecule prevent effective resonance due to steric hindrance. This occurs when the bulky substituents distort the planarity required to conjugate between a π-system and a lone pair or another π-system. With proper overlap of orbitals, resonance is either reduced or completely inhibited.

Key factors of steric Inhibition Resonance:-

- Planarity Disruption- Bulky groups can twist or distort the molecular geometry, forcing the orbitals out of alignment.

- Steric Hindrance- Large substituents can repel each other, creating strain and preventing the molecule from adopting the planar structure which leads to resonance destabilization.

The steric inhibition can leads to resonance destabilisation of a compound.

f) Optical activity of allenes:-

The optical activity of a compound undergoes specific structural condition. Optical activity refers when a molecule is chiral, meaning it lacks a plane of symmetry or a centre of symmetry and cannot be superimposed on its mirror image.

Chirality in Allenes:-

Allenes are compounds with the general structure $C=C=C$.

where the central carbon is sp-hybridized, and the two terminal carbons are sp^2-hybridised.
The chirality in allenes depends on the following conditions:-

1. Perpendicular Plane of substituents - Due to linear structure of the central carbon and the perpendicular arrangement of the p-orbitals, the substituents on one terminal C lie in a plane perpendicular to the substituents on the terminal C.

Condition for optical Activity in Allenes:-

- The two substituents on each terminal carbon must be different from each other.

e.g $CH=C=C(CH_3)R$ where $R \neq CH_3$.

- The substituents on one terminal carbon must also differ from those on the other terminal carbon.
e.g. $CH=C=C(CH_3)(Cl)$.

Q) Singlet Methylene $(^1CH_2)$

- Electronic Configuration -
Both valence electrons on C are paired in the same sp^2-hybridized orbital.
The electronic configuration is $(sp^2)^2(p_z)^0$.

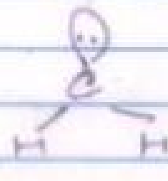
- Spin state -
spin multiplicity is 1. It is diamagnetic species.

Geometry – Singlet methylene has a bent structure with an approximate bond angle of 102° due to sp^2 hybridisation.

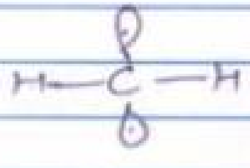
Reactivity – Highly reactive and often acts as an electrophile due to empty p_z orbital

Triplet ~~Co~~ Methylene ($^3CH_2$)

- Electronic Configuration – Two unpaired electrons occupy separate orbitals. The electronic configuration is $(sp^2)^1(p_z)^1$.
- Spin state – Spin multiplicity is 3. It is a paramagnetic species.
- Geometry – Triplet methylene has a linear structure with a bond angle of 180° as the unpaired electrons in orthogonal orbital minimizes repulsion.
- Reactivity – Less reactive than singlet methylene and typically acts as a diradical in reactions.



Singlet methylene



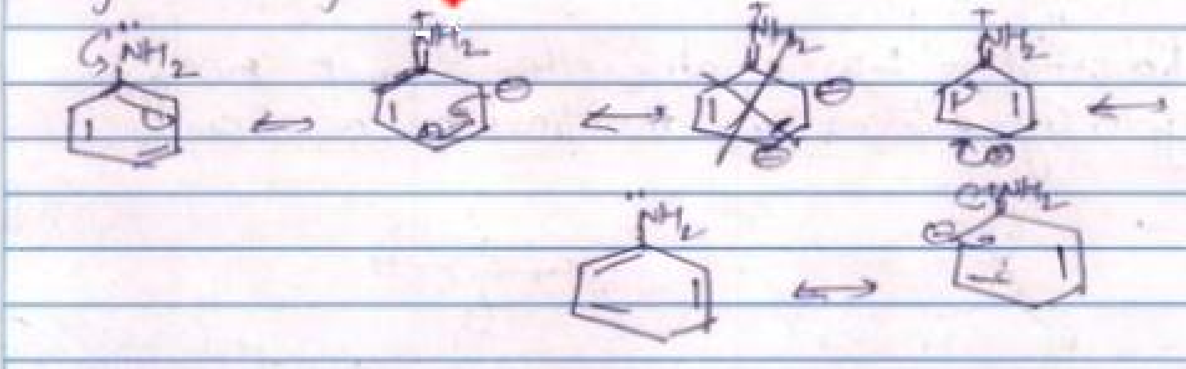
Triplet methylene.

h) Aniline is more reactive than acetanilide in electrophilic substitution reactions due to the difference in electron-donating ability of $-NH_2$ group in ~~aline~~ aniline compared to $-NHCOCH_3$ group in acetanilide.

1. Electron Donating Ability-

In aniline $-NH_2$ group directly donates its lone pair of electrons to the benzene ring through resonance increasing the electron density in the ring. On the other hand, in acetanilide, the lone pair of electrons on N atom is partially delocalized into the carbonyl system of the ring which results in the formation of the ring substituents.

2. Resonance stabilization- The resonance stabilization of the aniline leads to the formation of a complex compound



1) Tautomerism is the rearrangement of atom in the compounds which leads to formation of rearranged products. It The compound is generally reactive in nature. It leads to formation of compounds which are chirally active. The activity of compounds can result in formation compounds which ~~are~~ active +

Some of the features of this compound are as follows:-

- The compound has similar structural formula but different geometries. The molecule or the compound rearranges to form a tautomer.

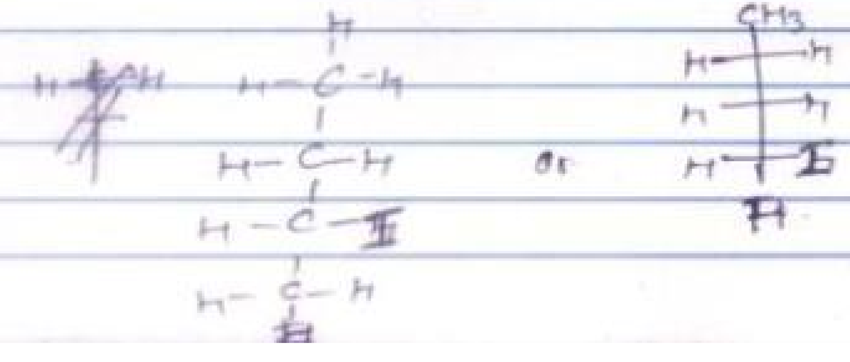
- The chiral activity of a compound leads to ~~format~~ same in both the tautomers.

e.g. The cis- and trans- form of the compound leads to same result in all chemical reaction.

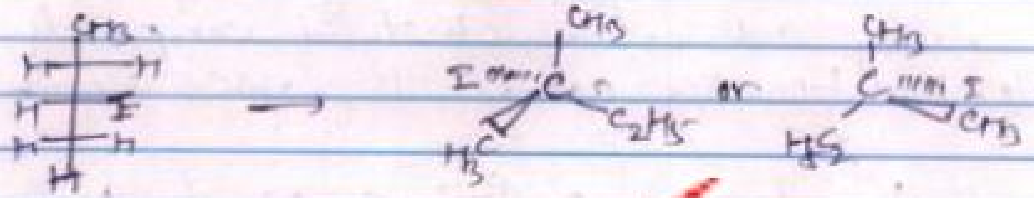
Examples of tautomers are as follows

rearranges in the same ~~manor~~ manner as it does.

e)



The conversion of from Fisher 2-Iodobutane to flying wedge formula is as follows:



Fisher Projection
(2-Iodobutane)

Fly[illegible] Wedge formula
(2-Iodobutane)

Paper Code

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