Structure Of All Organic Compounds

Compound	Geometry	No of Bonds	Bond Angle	Bond Length	Hybridization
1. Alkanes (ethane) carbon atom bonded to four other ~~other~~ atoms, so it uses sp^3-hybrid orbitals to form these bonds.	tetrahederal	① 6 – C–H (all σ bonds) linear overlap of sp^3 – s ② 1 – C–C linear overlap of sp^3 – sp^3	109.5° (true angle of sp^3 hybridization	① C–H (154pm) ② C–C (109.5pm)	sp^3
2. Cyclo-alkanes (cyclopropane) like alkanes, 'C' is bonded to four other atoms, so it uses sp^3-hybrid orbitals for bond formation.	carbon atoms form an equilateral triangle.	→ all sigma bonds.	→ 60° (C–C–C) → form bent bonds → 115° approx. (H–C–H)	→ C–C (151 pm) (sp^3 – s overlap) → C–H (108 pm)	sp^3 49.5° angle compression

1) In case of cyclopropane, the sp^3-sp^3 overlap of C–C bond is not max. as in case of alkanes. It is bcz in cyclopropane the C–C–C bond angle is 60° and not 109.5° (teterahederal angle) due to which the orbitals do not overlap exactly along their axes but overlap outside of the inter-nuclear axes and form bent bonds.

Checked By: ____________

2) The C-C bond of cyclopropane is therefore weaker than C-C bond of alkane, due to less effective overlap of sp^3 hybrid orbitals of cyclopropane.

3) In cyclopropane, the three carbon atoms occupy the corners of an equilateral triangles which results in the bond angles to 60°.

4) Since, the hybridization of carbon is sp^3, these C-C-C bond angles should be 109.5°. This deviation from the normal tetrahederal angle of 109.5° to 60° causes a strain in the molecule which is called angle strain.

6) angle strain inc↑ so bond strength dec↓.

↳ angle strain [original / normal angle − bond angle = angle strain]

e.g cyclobutane :- $109.5° - 90° = 19.5°$.

3. Alkenes	Planar	3 sp^2 hybrid orbitals with each C-atom (coplanar)	120° approx. H-C-H and H-C-C	↳ C=C (134 pm) ↳ C-H (108 pm)	sp^2

① {3 orbitals (sp^2)}

sp^2-sp^2 (C-C) | sp^2-s (H) | sp^2-s (H)

sigma bonds.

↓ all sp^2 orbitals are coplanar

② {unhybridized p-orbital}

→ remain perpendicular to the plane of hybridized orbitals

→ overlap in sidewise manner (parallel) to form pi-bond b/w two carbon atoms.

→ carbon atoms are coplanar and the rotation of one C-at wrt other is restricted which results in cis/trans isomerism in lkene.

of ethane (1.54 A°). It is due to inc↑ density b/w carbon atoms.

4. Alkynes (acetylene)	Linear	↳ 3 sigma bond. linear overlap i, C–C (sp-sp) ii, C–H (sp-s) iii, C–H (sp-s) ↳ 2 pi-bonds unhybridized p – p overlap (both)	180° (H – C – C)	→ C≡C (119 pm) → C–H (106 pm) → 113 (old-KF	sp

→ the cloud of the pi-$\bar{e}$s is present cylindrically symmetrical abt the C–C σ-bond.

→ Its a linear molecule hence geometrical isomer is not possible observed in it.

C - atom ↓ 2 sp-orbitals (lie on the same plane).

→ each carbon atom has two unhybridized p-orbitals, which are perpendicular to each other and to the plane of sp-h hybrid orbitals. They approach each other in a sidewise manner to form two pi-bonds. ↓ $(P_y - P_y)$ & $(P_z - P_z)$

5. Benzene	planar	$(sp^2 - sp^2)$ → C – C (6) and C–H (σ) $(sp^2 - s)$	→ 120°	→ C=C (139 pm) → C – H (108 pm)	sp^2

(planar sp^2- hybrid orbitals)

↳ structure of benzene :- best described in terms of molecular orbital hybridization model. (MOT)

↳ each carbon atom has 3 sp^2 and one half-filled unhybridized p-orbital which is perpendicular to the plane of sigma bonds.

↳ the side-wise/lateral overlap of p- orbitals produces delocalized pi- molecular orbitals containing six electrons, which are associated with all six carbon atoms.

↳ Stability of Benzene Ring :- due to the extensive pi-electron delocalization.

↳ the electronic cloud of these delocalized pi- electrons lies half - below and half above the ring.

(Full Concept → FTB)

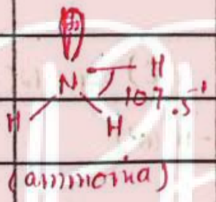
Checked By: ______

to the EN & polarizability of the halogen.

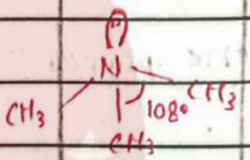
6. Alkyl Halides (methyl chloride)	teterahedral	→ all 'C' bonds are sigma bonds.	→ 109.5° approx. H-C-H & H-C-Cl	→ C-Cl (178 pm) → C-H (108 pm)	sp
	→ 4	sp³ hybrid	orbitals		
7. Amines	trigonal pyramidal	→ all are sigma bonds.	→ close to 107.5°		sp

sp³-s (C-H) sp³-s (C-H) sp³-s (C-H) sp³- half-filled p-orbital of Cl (C-Cl)

all are sigma bonds



(ammonia)



(trimethyl amine)

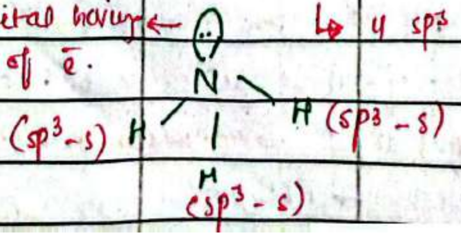
→ 'N' in amines is sp³-hybridized with a lone-pair in one of its sp³-hybrid orbitals.

→ Amines are the derivatives of NH_3 molecule where one/more hydrogen atoms have been replaced by alkyl/aryl groups.

→ Since, NH_3 has trigonal pyramidal geometry, the resulting amines also have the same geometry.

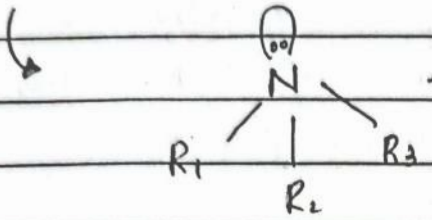
→ FTB (amines have nearly tetrahedral structure).

4th sp³-orbital having lone pair of ē. ← ↳ 4 sp³ hybrid orbitals



→ the non-bonding ē-pair is extremely imp in explaining the chemical behaviour of amines bcz it is responsible for the basic & nucleophilic properties of these compounds.

→ An amine with 3 diff. groups is optically active.



→ tertiary amine is optically active.

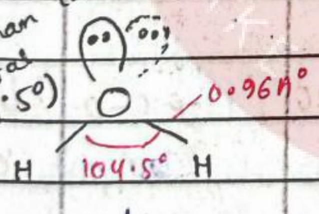
3. Alcohols	teterahedercal	→ all are σ bonds.	108.9° ↳ C-O-H	(sp3 - sp3) → C-O (142pm) → O-H (96pm)	sp3

↓ alkyl derivatives of H_2O-molecule.

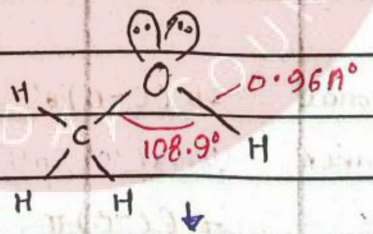
↓ has the sp^3 hybridized teterahederal oxygen atom.

↓ with non-bonding ē-pairs occupying two of the four sp^3- hybrid orbitals.

104.5° slightly smaller than the teterahederal angle (109.5°)



↓ angular geometry



↓ teterahederal geometry

→ Both the C-O and the O-H bonds are polar due to high EN of the O-atom.

3. Phenols	teterahedercal	→ C-H (σ bond)	→ C-O-H (109°)	→ C-O (136pm)	sp^2
		→ C-C (σ + delocalized π(π bond)	→ internal angles (120°)	→ O-H (96pm)	

- the molecule of phenol is planar.
- In phenol, six carbon atoms are sp²-hybridized forming a hexagonal ring with internal angles to be 120°.

- Since, the bonds formed by sp²-hybridized carbon are shorter than those formed by sp³-hybridized carbon; therefore C–O bond length (136 pm) is slightly less than the C–O bond length in methanol (142 pm).

- In resonance terms, shorter C–O bond in phenol is due to the partial double bond character that results from conjugation of the unshared ē-pair of the 'O' with the aromatic ring.

- Phenol differ from alcohols as;
  1) has shorter C–O bond distance.
  2) more basic hydroxyl Oxygen.
  3) more acidic hydroxyl proton.

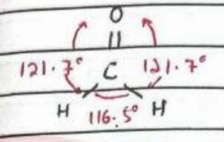
10. Aldehydes	trigonal	→ (C–O) σ	→ 120°	→ C–O	Both 'C'
& Ketones	planner	(linear sp²-sp²)		([illegible] pm)	'O' atom
(formaldehyde)		→ (C–O) π		(120 pm)	are sp²-
		(sidewise p-			hybridiz
		orbital overlap)			↓
		→ C–H			two sp² orbitals
		(sp²-s).			oxygen h
					two unsh e-pairs

+ether.

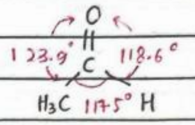
1) C–O bond length of R-OH (142 pm) > C–O bond length of aldehydes & ketones / carbonyl group (120 pm).

- C–O bond length in ether (142 pm) same as R-OH.

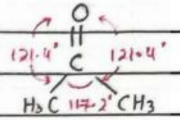
2) Slight deviation from the angle of 120° is observed depending upon the nature of atoms/groups attached to carbonyl carbon.



(formaldehyde)



(acetaldehyde)



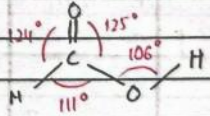
(acetone)

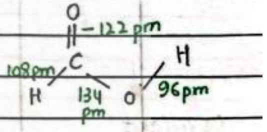
1. carboxylic	planar		↓ 120°	→ C=O	→ sp²-
acids.			approx. at	(122 pm)	hybridization
↓			carbon.	→ C–O	both at 'C'
structural	features		→ H–C=O	(134 pm)	and 'O'
most apparent in			(124°)	→ H–C	
formic acid.			→ H–C–O	(108pm)	
			(111°)	→ O–H	
			→ O–C=O	(96pm)	
			(125°).		

1) C=O (122 pm) < C–O (134 pm).

2) C=O (similar to that of aldehydes and ketones).

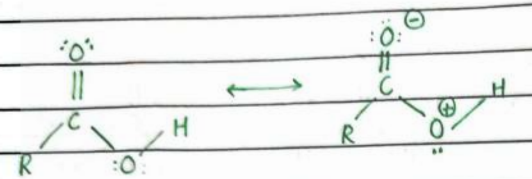
3) sp²-hybridization of hydroxyl oxygen allows one of its unshared ē pair to be delocalized by orbital overlap with the pi system of the carbonyl carbon





- due to sp²-hybridization $\overset{\text{COOH}}{\text{carbon}}$ exhibit trigonal structure.
- the hydroxyl 'O' allows one of its lone pair ēs to conjugate with the pi system of the carbonyl ~~carbon~~ group.

This make the carboxyl group planar and can be represented with the following resonance structures.



CHAPTER : ORGANIC CHEMISTRY

1.

Classification of Organic Compounds :-

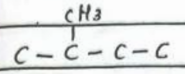
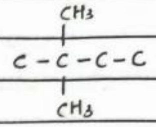
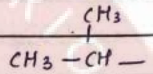
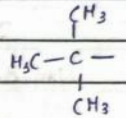
a. Classification On the basis of structure (OLD - CLASSIFICATION)

- Open chain / Acyclic Organic compounds (Aliphatic compounds)
- Closed Chain / Cyclic organic compounds

i. Open chain / Acyclic Organic Compounds

In these compounds, carbon atoms are linked to each other in open chains which may be branched/unbranched

- Straight
  - Saturated (Alkanes/ paraffins)
  - unsaturated
    - i, Alkenes (olefins)
    - ii, Alkynes (acetylenes).
- Branched
  - Iso
  - Neo.

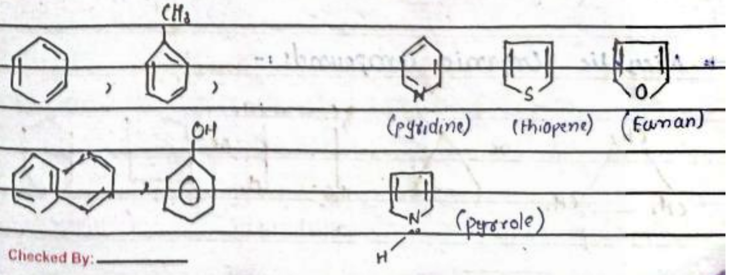
"ISO"	"NEO"
→ having one branch at the 2nd last carbon of a continuous chain.	→ having two branches at the 2nd last carbon of the continuous chain.
	
Representation :- $(CH_3)_2CH-$ ↓	$(CH_3)_3C-$
	

ii, Closed Chain / Cyclic Organic compounds

compounds in which carbon atoms are arranged in the closed chain forms.

- Homocyclic (carbocyclic compounds)
  → those compounds in which cycle/ring is made up of only carbon atoms.
- Heterocyclic
  → those cyclic compounds in which the ring contain at least one atom other than carbon. (N, O, S, P).

e.g



HOMOCYCLIC

AROMATIC — NON-AROMATIC / ALICYCLIC

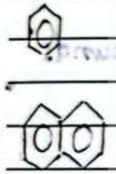
→ those compounds having benzene ring or benzene-like special properties.

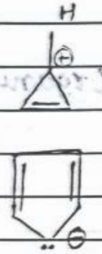
→ they are the cyclic compounds having properties similar to that of open chain alkanes.

→ further divided into;

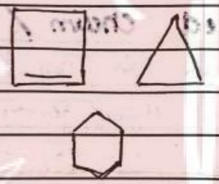
→ may be saturated or unsaturated.

Benzoid — Non-Benzoid





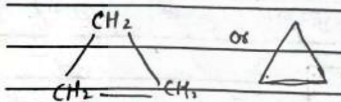
e.g



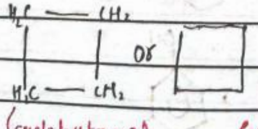
→ **Benzoid** :- aromatic compounds containing rings like benzene e.g naphthalene.

→ **Non-Benzoid** :- compounds are aromatic, they have conjugated systems, planar cyclic structures but they lack benzene rings in their structure.

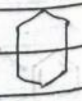
→ Alicyclic Organic compounds :-



(cyclopropane)



(cyclobutane)



(cyclohexane)

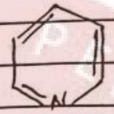
→ Aromatic Homocyclic Organic compounds :-

(Benzene)

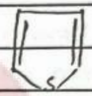
(Toulene)

(Naphthalene)

→ Heterocyclic Organic Compounds :-



(pyridine)



(Thiopene).

b. Classification On the Basis of functional group (modern classification),

2. Functional Group:-

"An atom or group of atoms that gives certain characteristic properties to an organic compound is called a functional group."

Characteristics :-

1) give special chemical properties to a compound.
2) It is the chemically active / functional part [illegible] molecule.
3) Each functional group represents a diff. class of organic compounds.
4) provide a base for classification.
5) provide a base for nomenclature.
6) site of rxn / active part.
7) face of organic compounds.

- A functional group can also be defined as;
"the atom / group of atoms that replace the hydrogen atoms of hydrocarbons."

- the properties of an organic molecule are predominantly determined by the properties of the functional group in that compound.

- **Polyfunctional :-** A molecule can contain more than one functional group. It is then called polyfunctional and the properties of each functional group may be modified by the presence of others.

3. HOMOLOGOUS SERIES :-

- **Definition :-**
"a series of organic compounds in which all the members posses similar structural features & similar chemical characteristics but each member differ from the next one by a methylene ($-CH_2$) group (or by 14 amu by molar mass) is called homologous series."

- **Homologues :-** the members which differ from each other by methylene group ($-CH_2-$).

- **Characteristics of Homologue series :-**

1) each class of organic comp have its own homologous series having general formula.

② all members have similar chemical properties.

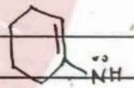
③ members have same
- structural features
- functional group
- general methods of preparation.

④ the Physical properties like (MP, BP, densities etc) inc↑ down the series due to inc↑ in their molecular mass.

4. CONDITIONS FOR AROMATICITY OF ORGANIC COMPOUNDS:

① must be cyclic
② planar (sp^2 hybridized carbon cycle)
③ conjugation (delocalization of pi / non-bonded $\bar{e}$-system

i,


ii,


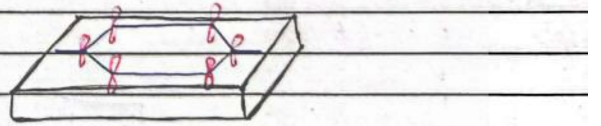
iii, $C \equiv C - \ddot{N}H$

this can be localized

iv, $C - \overset{\oplus}{C} - \ddot{N}H_2$

v, $C - \overset{\ominus}{C} - C = C$

④ parallel pi-orbitals.



A parallel pi-orbital refers to the arrangement of multiple pi orbitals in a parallel orientation. When they are alligned parallel to each other, they can interact and form pi-bond.

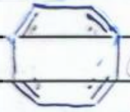
⑥ follow the Huckel Rule (most imp)

$(4n+2)\pi^{\bar{e}s}$ = 2 , 6 , 10 , 14 , 18 , 22
(n=1,2,3, ...) (s) (p) (d) (f) (g) (h)

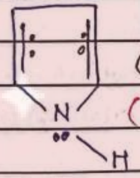
(Aromatic no. of electrons)

= 4 , 8, 12 , 16, 20, ----
(anti-aromatic no. of electrons)

e.g

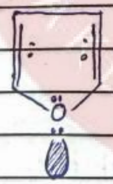


$8\bar{e}s$ (π $\bar{e}s$)
(not an aromatic compound)



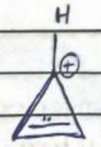
$6\bar{e}s$ (aromatic)
(π $\bar{e}s$)
(nitrogen not involved in double bond, so its lone pair is count

$6\bar{e}s$ (aromatic)
(π $\bar{e}s$)

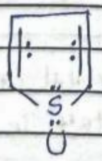


$6\bar{e}s$ (aromatic compound)
($\downarrow\pi$ $\bar{e}s$)

→ nitrogen is involved in double bond, so its lone pair is not counted.



$2\bar{e}s$
(aromatic compound)



$6\bar{e}s$
(aromatic)

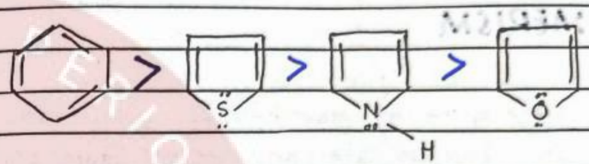
Aromatic Character :-

① Aromatic character $\propto \frac{1}{EN}$

② more delocalization → more aromatic

③ more electronegativity → less delocalization

④ EN decides the aromaticity.

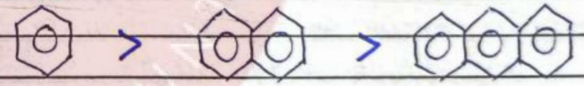


(Benzene) (Thiole) (Pyrrole) (Furan)

→ EN Order :- C < S < N < O

→ Resonance Energy ∝ stability

stable resonating structures
"2" "3" "4"



more stable
↓
more resonance energy

per ring R.E dec↓ as compared to benzene

Ⓜ Ⓣ Ⓦ Ⓣ Ⓕ Ⓢ DATE: 16

MCQ wot is cyclic compound?

Ⓐ cyclobutane Ⓑ cyclohexane Ⓒ Benzene Ⓓ cyclopentane

Ⓔ All.

MCQ wot is cyclic compound but not alicyclic?

Ⓐ cyclobutane Ⓑ cyclohexane Ⓒ Benzene Ⓓ cyclopentane

Ⓔ all.

5. ISOMERISM

" the compounds having the same molecular formula but having diff structure and properties are called isomers and the phenomena is called isomerism.

TYPES :-

①STRUCTURAL ISOMERISM :-

" the type of the isomerism in which the isomers have same molecular formula but (diff. connectivity) in structure is called structural (isomerism)

diff. structure

responsible for great variety of organic comp.

→ also called constitutional isomerism.

→ compounds (same MF and molecular mass)

→ same molecular formula means same ; i, molecular weight, ii, vapour density.

1. Chain Isomerism:

" the isomerism in which there is a difference in the arrangement of the carbon atoms in the main

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→ main condition for isom...
→ same MF (✓)
→ diff. physical and chemical properties.(✓)

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chain of the molecule.

OR

" compounds having the same molecular formula but have different parent chain." (or side chains)

→ skeleton / Nuclear Isomerism

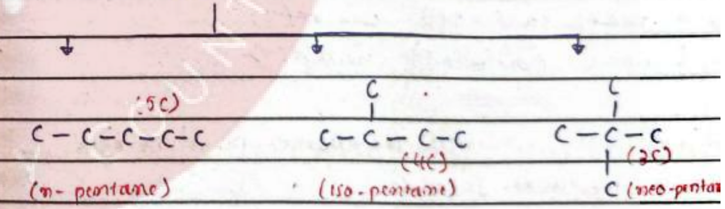
→ diff. in the nature of carbon atoms.

→ mainly shown by "alkanes" which show chain isomerism and conformational isomerism.

→ same :- molecular formula means same
- i, molecular mass
- ii, %age composition and atoms
- iii, functional group (due to this chemical properties are also same).
- iv, homologous series.

→ different :- i, chain and physical properties. ii, IUPAC names

→ example : (C_5H_{12}).



→ To have the chain isomerism:-

1) Alkanes :- 4 or greater no. of C-atoms.
2) Alkenes :- 4 or greater no. of C-atoms.
3) Alkynes :- 5 or greater no. of C-atoms.

Checked By:

ii) ketone :- 5 or greater no. of carbon atoms.

iii) aldehyde :- 4 or greater no. of carbon atoms.

* Alkane: $[C_1 - C_7]$ $\boxed{[2^{n-4} + 1]}$

C_8 $\boxed{(2^{n-4} + 2)}$

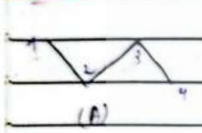
* Alkene: even no. carbon-atoms $\boxed{(2^{n-2} + 1)}$

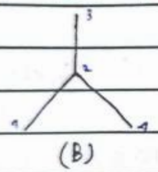
odd no. C-atoms $\boxed{(2^{n-2})}$

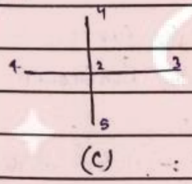
* Alkyne : even no. C-atoms $\boxed{[2^{n} - (2n-1)]}$

odd no. C-atoms $\boxed{[2^{n} - 2n]}$

MCQ WCF are the chain isomers.







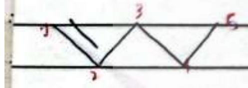
i) A and B (same MF) isomers (✓)

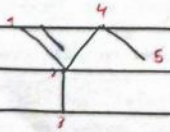
ii, A and C (diff. MF) isomers (✗)

iii, B and C (diff. MF) isomers (✗)

Note :- main condition for isomerism is to have same molecular formula.

MCQ WCF are the chain isomers.





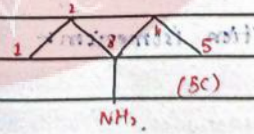
(same MF) isomers (✓)

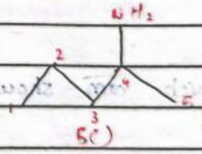
---

2. Positional Isomerism :-

" the compounds having the same molecular formula but different position of the branch or FG (double/triple bond).

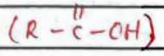
- Branch :- not carbon containing e.g NH_2, OH etc.
- same :- i, FG ii, homologous series iii, chemical properties
  iv, molecular formula
  - molecular mass
  - percentage composition.
- different :- i, position of FG
  ii, structure
  iii, physical properties may or may not be same.
- have the same parent chain.
- example :-





- those which can't show position isomerism.

1) terminal FG e.g i) carboxylic acid


$(R-\overset{O}{\overset{\|}{C}}-OH)$

(M)(T)(W)(T)(F)(S) DATE: 20

ii, cynaides (R – C ≡ N)

iii, 1° - amine $(R-\overset{O}{\overset{\|}{C}}-NH_2)$

iv, acid halides $(R-\overset{O}{\overset{\|}{C}}-Cl)$

v, acid anhydrides $(R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R)$

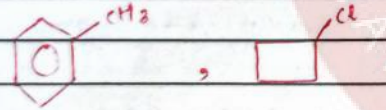
vi, aldehydes $(R-\overset{O}{\overset{\|}{C}}-H)$

vii, ether (R - O - R)

viii, carboxylic acids derivatives except 2° and 3° amides and ester

$(R-\overset{O}{\overset{\|}{C}}-OR)$

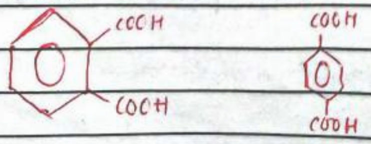
2) monosubstituted cyclo organic compounds;



etc.

→ those which can show position isomerism

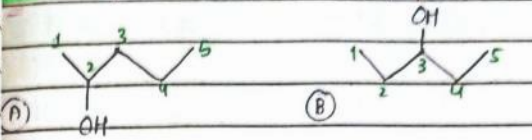
carboxylic acids or derivatives or aldehydes attached to cyclocompounds show position isomerism.



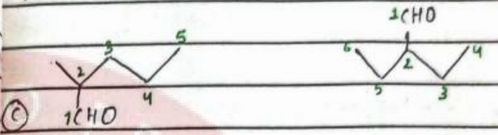
→ ketones can also show P.I

(M)(T)(W)(T)(F)(S) DATE: 21

MCQ the given isomers are chain / position isomers?



→ parent chain, molecular formula (same) P.I (✓)



→ ~~parent chain~~ molecular formula, FG (same) → isomers (✓)

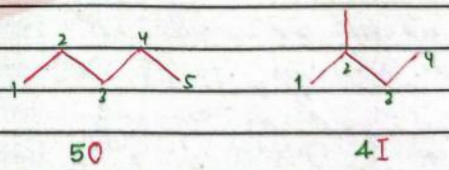
→ parent chain (diff.) so they are Chain isomers not position isomers.

→ Secondly, terminal FG → don't show P.I

→ MAGIC TRICK NO. FOR DIFFERENTIATING CHAIN ISOMERISM & POSITION ISOMERISM:

X → No. of carbon atoms in parent chain

Y → No. of branch of carbon. (means carbon-containing branch)



(chain isomers)

→ magic no. is different (Chain Isomerism)

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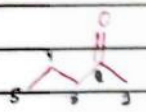
-> magic no same (position isomerism)

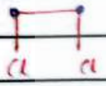
-> position isomers having keto - FG



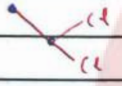
(Pentane-2-one)

(Pentane- 3-one)

MCQ the following two isomers are position isomers / not?



(vic- dihalide)



(gem-dihalide)

applying the magic number trick

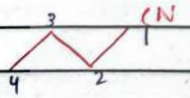
XY (vic-dihalide) = 20 XY (gem-dihalide) = 20

-> Position isomers (✓)

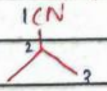
∴ Y = 0 (bcz only branches having C-atom are counted).

∴ Y = Cl = 0.

MCQ Following isomers are chain / position isomers?



4⓪



31 chain isomers (✓)

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3. Metamerism : (meta means in middle / in b/w).

"this type of isomerism is exhibited due to the unequal distribution of carbon atom (or alkyl groups) on either side of the functional group."

OR

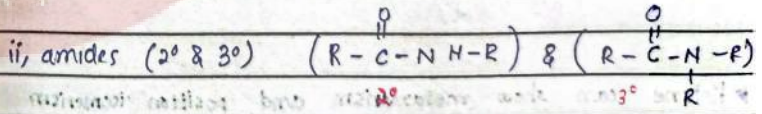
"the isomers having the same MF but diff. arrangement of atoms / groups on either side of the bridging FG. (polyvalent)."

-> same :- i, molecular formula ii, FG iii, homologous series
  - L molecular mass
  - L %age composition

-> different :- i, physical and chemical properties
  - ii, diff. arrangement of carbon atoms on either side of the FG.

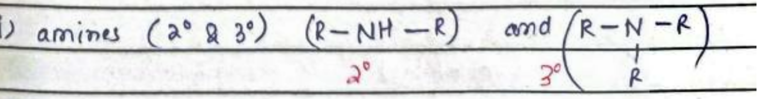
-> compounds which can show metamerism :-

i, ether (R − O − R)



ii, amides (2° & 3°) $\left(R-\overset{\overset{O}{\|}}{C}-NH-R\right)$ & $\left(R-\overset{\overset{O}{\|}}{C}-\underset{\underset{R}{|}}{N}-R'\right)$

2° 3°



iii) amines (2° & 3°) $(R-NH-R)$ and $\left(R-\underset{\underset{R}{|}}{N}-R\right)$

2° 3°

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iv) thioether $(R-S-R)$

v) ketone $(R-\overset{O}{\overset{\|}{C}}-R)$

vi) thioketone $(R-\overset{S}{\overset{\|}{C}}-R)$

vii) anhydride $(R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R)$

viii) ester $(R-\overset{O}{\overset{\|}{C}}-OR)$

→ those which can't show metamerism :-

(terminal FG).

i) acid halide $(R-\overset{O}{\overset{\|}{C}}-Cl)$

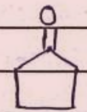
ii) 1°-amide $(R-\overset{O}{\overset{\|}{C}}-NH_2)$

iii) 1°-amine $(R-NH_2)$

iv) COOH $(R-\overset{O}{\overset{\|}{C}}-OH)$

v) nitrile $(R-C\equiv N)$

vi) cyclic ethers



→ ketone can show metamerism and position isomerism at the same time.

(metamers)

$$\underset{(3C)}{C-C-C}-\overset{O}{\overset{\|}{C}}-\underset{(3C)}{C-C-C} \longleftrightarrow \underset{(2C)}{C-C}-\overset{O}{\overset{\|}{C}}-\underset{(4C)}{C-C-C-C}$$

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→ ether can show only metamerism and not the position isomerism.

(metamers)

$$\underset{(2C)}{C-C}-O-\underset{(4C)}{C-C-C-C} \longleftrightarrow \underset{(3C)}{C-C-C}-O-\underset{(3C)}{C-C-C}$$

→ for metamerism 'R' must be present on the both sides of FG.

MCQ :- the compound which shows metamerism is :-

Ⓐ C_3H_8O Ⓑ C_3H_6O ● $C_4H_{10}O$ Ⓓ C_5H_{12}

$(C_nH_{2n+2}O)$

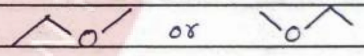
ether alchol

$\underbrace{\text{ether} \quad \text{alchol}}$ show FG isomerism.

Ⓑ ketone, aldehyde

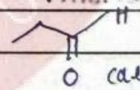
→ alcohol can't show metamerism.

Ⓐ C_3H_8O

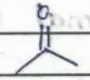


or (same) (no metamerism)

Ⓑ C_3H_6O

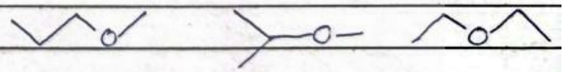


(aldo) or



(keto) (aldo :- no metamerism)

Ⓒ $C_4H_{10}O$



(show metamerism) → ether

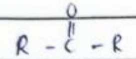
Note :- the minimum no. of carbon atoms in ether to show metamerism is 4.

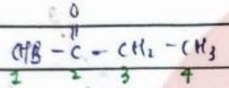
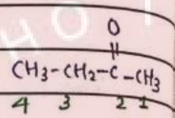
Checked By: ______

(D) C_5H_{12} C_nH_{2n+2} (alkane) and alkanes don't show metamerism.

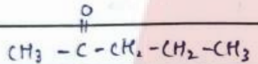
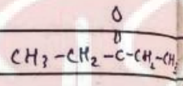
MCQ :- the minimum number of carbon atoms in ketone to show position isomerism

(A) 3 (B) 4 (C) 5 (D) 6

3 - carbon atoms

$R-\overset{O}{\overset{\|}{C}}-R$

4 - carbon atoms

$\underset{1}{CH_3}-\underset{2}{\overset{O}{\overset{\|}{C}}}-\underset{3}{CH_2}-\underset{4}{CH_3}$
or

$\underset{4}{CH_3}-\underset{3}{CH_2}-\underset{2}{\overset{O}{\overset{\|}{C}}}-\underset{1}{CH_3}$

FG at same no. so no position. I possible

5 - carbon atoms

$CH_3-\overset{O}{\overset{\|}{C}}-CH_2-CH_2-CH_3$
or

$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$

[position isomerism (✓).]

Note :- the minimum no. of carbon atoms in ketone is 5 to show position isomerism.

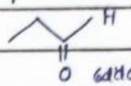
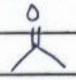
4. Functional Group Isomerism:-

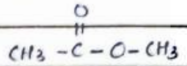
"the isomers having the same molecular formula but different functional groups."

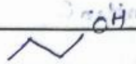
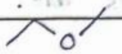
→ same :- molecular formula.
- i, molecular mass
- ii, %age composition. and atoms

→ different :- i, FG ii, chemical properties
iii, physical properties iv, homologous series
V) structural formula

→ some examples of functional group isomers :-

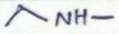
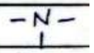
1) aldo and keto

(aldo)

(keto)

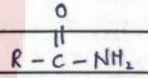
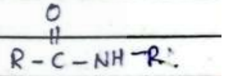
2) acid and ester
CH_3COOH,

$CH_3-\overset{O}{\overset{\|}{C}}-O-CH_3$
[$HCOOCH_3$]

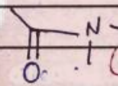
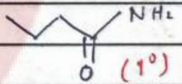
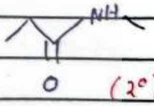
3) alcohol and ether

,


4) cyanide & isocyanide $(R-C\equiv N)$, $(R-\overset{\oplus}{N}\equiv C^{\ominus})$
(iso)

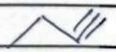
5) 1°, 2°, 3° amines

(1°)

(2°)

(3°)

6) 1°, 2°, 3° amides

$R-\overset{O}{\overset{\|}{C}}-NH_2$

$R-\overset{O}{\overset{\|}{C}}-NH-R$

or

(3°)

(1°)

(2°)

7) diene, yne

(diene)

(alkyne)

→ If no DBE (double bond), all saturated then the possible FG isomers are ether and alcohol.

$\boxed{C_nH_{2n+2}O}$ e.g $C_4H_{10}O \rightarrow CH_3-CH_2-CH_2-OH$
(alcohol)
↓
$CH_3-O-CH_2-CH_2-CH_3$
(ether)

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DBE ($-H_2$ or $2H$)
- by double bond (unsaturated)
- by cyclation (saturated)

→ If 1 DBE, 1 oxygen atom then the possible FG isomers are. $\boxed{C_nH_{2n}O}$

i) ketone and aldehyde

2) unsaturated ether and unsaturated alcohol (alkenol)

($C=C-O-C$) ($C=C-OH$)

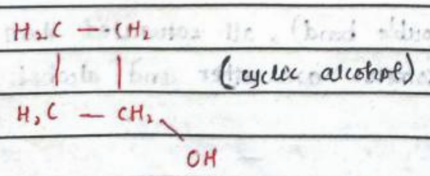
3) cyclic alcohol and cyclic ether. (having 2-H less than n-ether and n-OH).

e.g 1. C_4H_8O — $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$ (ketone)

$CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-H$ (aldehyde)

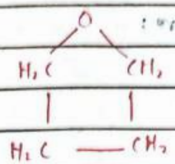
2. $CH_2-CH=\overset{OH}{\overset{|}{C}}-CH_3$ (unsaturated alcohol) (alkenol)

3. $CH_2-O-CH=CH-CH_3$ (unsaturated ether)

4. 

(cyclic alcohol)

DATE: 29

5. 

(cyclic ether)

→ If 1 DBE and 2 oxygen atoms then the possibl FG isomers are; $\boxed{C_nH_{2n}O_2}$

1. carboxylic acid and ester

e.g $C_4H_8O_2$ → $C-C-C-\overset{O}{\overset{\|}{C}}-OH$ (COOH)

↳ $C-C-\overset{O}{\overset{\|}{C}}-O-C$ (ester)

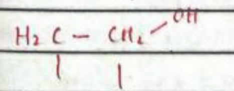
2. hydroxy aldehyde and hydroxy ketone

$C-C-\overset{OH}{\overset{|}{C}}-\overset{O}{\overset{\|}{C}}-H$ (hydroxy aldehyde)

$C-C-\overset{OH}{\overset{|}{C}}-\overset{O}{\overset{\|}{C}}-C$ (hydroxy ketone)

3. unsaturated diether

4. cyclic diol and unsaturated diol.



(cyclic diol)

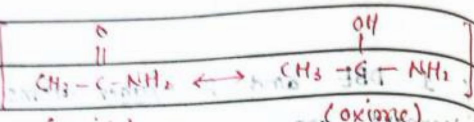
$C-\overset{OH}{\overset{|}{C}}=\overset{OH}{\overset{|}{C}}-C$ (unsaturated diol)

Checked By:

→ Other examples of FG isomers are;

1) glucose (aldo) and fructose (keto)

2) amide – oxime



$$CH_3-\overset{O}{\overset{\|}{C}}-NH_2 \longleftrightarrow CH_3-\overset{OH}{\overset{|}{C}}-NH_2$$

(amide) (oxime)

3) 1°, 2° and 3° amines shows;

i) position isomerism

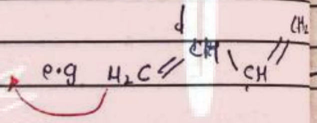
ii) functional group isomerism

iii) metamerism.

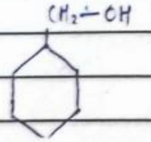
4) C_nH_{2n} (alkene and cycloalkanes)

5) C_nH_{2n-2} (alkene, cyclic-alkene, and alka-diene)

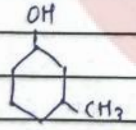
(1,3-Butadiene) e.g



6) Alcohol vs Phenol



(cyclic-alcohol)



(phenol)

5. Ring – Chain Isomerism :-

→ difference in the mode of carbon-atom"

" Molecular formula → same".

→ 1st ring and 2nd chain.

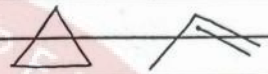
→ special type of functional group isomerism

Ring ⟷ Chain

→ e.g 1. (cyclobutane) $\xleftrightarrow{(C_nH_{2n})}$ (butene)

(cycloalkane) $\xleftrightarrow{(C_nH_{2n})}$ (alkene)

2.



(ring-chain isomers).

6. Tautomerism :-

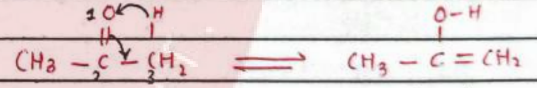
the comp. which are diff. in the position of π - bond or mostly H-atom.

→ dynamic

→ there is intramolecular H^+ transfer

→ has keto-enol system / 1-3 system

→



$$\overset{1}{}CH_3-\underset{2}{\overset{O}{\overset{\|}{C}}}-\underset{3}{\overset{H}{\overset{|}{C}}}H_2 \rightleftharpoons CH_3-\overset{O-H}{\overset{|}{C}}=CH_2$$

(keto) (enol)

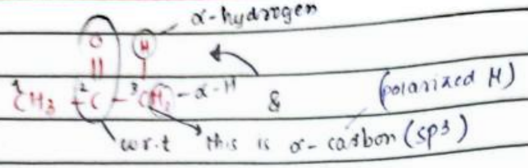
more stable than enol.

'3' transfers to 1 and 1 transfers to two.

(H+) (=)

→ condition for exhibition of tautomerism

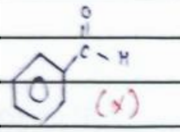
1) 3rd carbon (α-carbon) should be sp^3- hybridized and must have a hydrogen (α-hydrogen)



2) must have C = O, C = S, or C = N
(a compound having multiple heteroatoms)

5 MCQ: WCF show tautomerism.

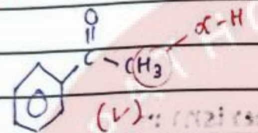
(A)



(x)

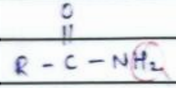
no α-carbon so
no α-H.

(B)



(✓)

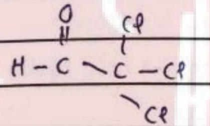
7 (A)



$R-\overset{O}{\overset{\|}{C}}-NH_2$

(✓) α-Hydrogen

(E)

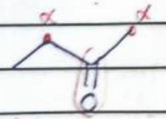


$H-\overset{O}{\overset{\|}{C}}-\underset{Cl}{\overset{Cl}{C}}-Cl$

no α-H (X).

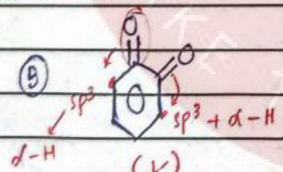
MCQ: WCF exhibits tautomerism?

(A)



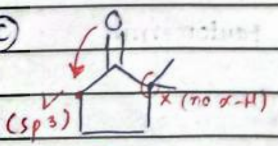
(✓)

(B)



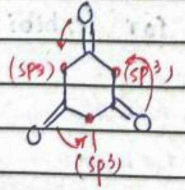
(✓)

(C)



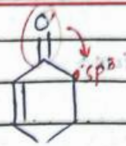
(✓)

(D)



(✓)

(E)



(✓)

(F)

Ph – $\boxed{CH=CH-OH}$

↓

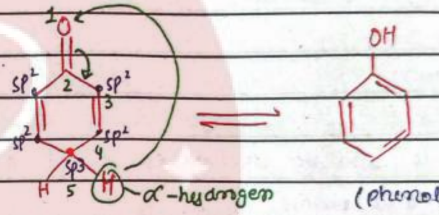
(enol)

↓

→ always remains in equilibrium with its keto form. so it will exhibit tautomerism.

→ 1,5 - system :-

→ (when 1,3 system fails)



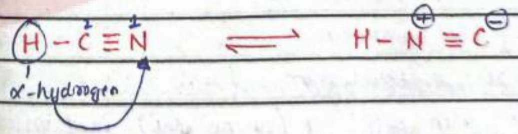
(aromatic ketone)

(phenol)

↓

→ double bond shifts to '2' and α-Hydrogen from sp3 carbon shifts to one.

→ 1,2 - System :-



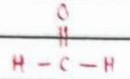
$H-\overset{2}{C}\equiv\overset{1}{N} \rightleftharpoons H-\overset{\oplus}{N}\equiv C^{\ominus}$

→ In the 1,5 system, phenol is more stable so the rxn mostly completes in the forward direction.

→ those which can't show tautomerism :-

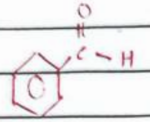
1) which heteroatoms (C=O, C=S, C=N etc). and α - hydrogen.

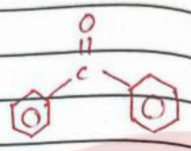
e.g

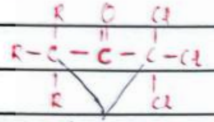


$H-\overset{\overset{O}{\parallel}}{C}-H$

(formaldehyde)







(α - carbon)

2) carboxylic acids and its derivatives except acid anhydride. and acid amides.

$CH_3-\overset{\overset{O}{\parallel}}{C}-NH_2 \longleftrightarrow CH_3-\overset{\overset{OH}{|}}{C}=NH$

(acid amide showing tautomerism)

→ more points about tautomerism :-

1) special type of FG isomerism

2) tautomers exist in equilibrium

3) two compounds with diff FG (same MF) exist in equilibrium.

4) can be catalyzed by acids / bases

5) only exist in liquid and gaseous state.

6) can't exist in solid state

7) chemical process (chemical equilibrium)

→ same :- i, molecular formula
  L molecular mass
  L %age composition and no. of atoms

→ different :- i, functional group
  ii, structural formula
  iii, physical and chemical properties.

→ Calculation of number of structural isomers :-

→ D.U (Degree of unsaturation) or D.B.E (Double. Bond equivalent)

$$\boxed{DU = (C+1) - \frac{(H+X-N)}{2}}$$

where

C = no. of carbon atoms

H = no. of Hydrogen atoms

X = no of halogen atoms

N = no of nitrogen atoms.

→ If DBE / DU = 0 then all single bond.

→ if DU = 1 there will be either a π - bond or a ring not both.

Checked By: ____

→ If DU = 2 then
2π
2 Ring
1 π + 1 Ring

what are the total structural isomers of C_5H_{10}.

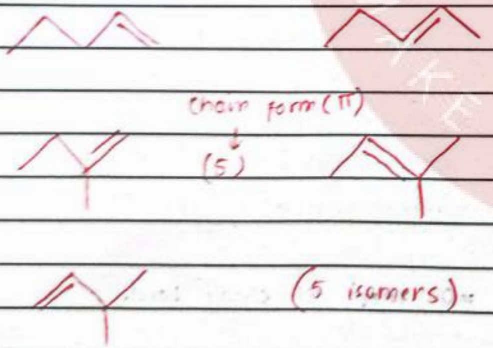
$$DU = (C+1) - \frac{(H+X-N)}{2}$$

$$= (5+1) - \frac{(10+0-0)}{2}$$

$$= 6 - \frac{10}{2} \Rightarrow 6-5 \text{ so } DU = 1$$

1 π or 1 ring

→ there are 5-carbons so 5-carbon parent chain and change the position of π bond in each.

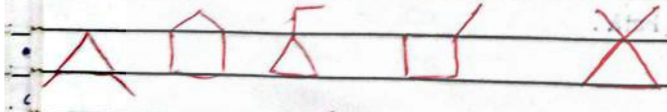


total (10 isomers)

chain form (π)

(5)

(5 isomers)

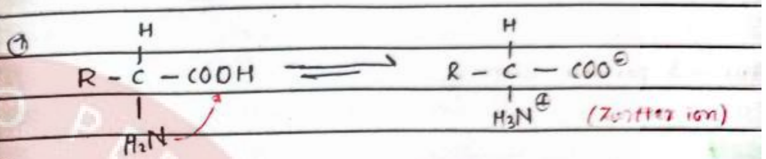


(5 isomers)

→ points of tautomerism:-

→ shifting of proton (H^+) from one atom to another within the same molecule.

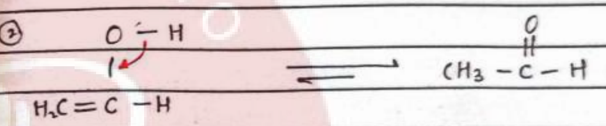
①



$$R-\overset{H}{\underset{H_2N}{C}}-COOH \rightleftharpoons R-\overset{H}{\underset{H_3N^{\oplus}}{C}}-COO^{\ominus}$$

(Zwitter ion)

②



(vinyl-alcohol)

(acetaldehyde)

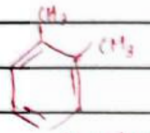
→ at equilibrium anyone of the tautomer can be isolated.

→ two compounds having same general formula will show FG isomerism:-

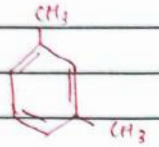
1) alkene and cycloalkanes (C_nH_{2n})
2) alkynes, cycloalkenes and alkadienes (C_nH_{2n-2})
3) alcohols and ethers ($C_nH_{2n+2}O$)
4) aldehydes, ketones, cyclic alcohols, cyclic ethers (also calle epoxides) ($C_nH_{2n}O$)
5) carboxylic acid, esters, hydroxy aldehydes, hydroxy-ketones. ($C_nH_{2n}O_2$)

MCQ. How many position isomers xylene can have?

Ⓐ



o - xylene



m-xylene

p- xylene

Ans - 3 possible isomers.

MCQ :- Alcohols with molecular formula $C_nH_{2n+2}O$ are isomeric with :-

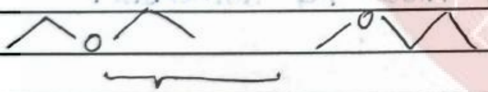
Ⓐ acids [✓ Ⓑ ethers] Ⓒ esters Ⓓ aldehydes

MCQ :- the types of isomerism possible with molecular formula $C_4H_{10}O$ is/are :

Ⓐ FI Ⓑ PI Ⓒ Metamerism [✓ Ⓓ all of these]

$C_4H_{10}O$ (ether) $[C_nH_{2n+2}O]$

①



showing PI + metamerism.

② $CH_3-CH_2-CH_2-OH$ $CH_3-O-CH_2-CH_2-CH_3$

(Butanol) (methyl-propyl ether)

(Functional Group)

---

③ $CH_3-CH_2-CH_2-OH$ $CH_3-CH_2-CH_2-OH-CH_3$

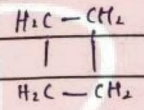
(1-butanol) (2-butanol)

(Position - I)

- FG-I (possible b/w of R-OH and R-O-R)
- PI (possible in -OH)
- metamerism (shown by ethers)

MCQ :- cyclobutane and but-2-ene are the examples of ;

Ⓐ PI [✓ Ⓑ Ring-chain Isomerism] Ⓒ Metamerism Ⓓ Geometrical Isomerism



⟷ $H_3C-HC=CH-CH_3$

(but-2-ene)

→ Isomers Of Alkanes:

Alkanes	No. of isomers
1) Methane, Ethane, Propane	No isomers
2) Butane (C_4H_{10})	2
3) Pentane (C_5H_{12})	3
4) Hexane (C_6H_{14})	5
5) Heptane. (C_7H_{16})	9
6) Octane (C_8H_{18})	18
7) Nonane (C_9H_{20})	35
8) Decane ($C_{10}H_{22}$)	75
9) Isosanes ($C_{20}H_{42}$)	366.319
10) squalane ($C_{30}H_{62}$)	more than 4 billions
11) Tetracontane ($C_{40}H_{82}$)	625 trillions

(b)

STEREOISOMERISM : (in 3D space)

1. CONFORMATIONAL ISOMERISM :-

→ a form of stereoisomerism in which the isomers can be interconverted just by rotations about formally single bonds.

→ alkanes mainly show CI and conformational isomerism.

→ stereo isomers have

i) same :-

i) MF ii, structural formula iii, connectivity of atoms
iv, IUPAC - Names v, FG

ii, Different :-

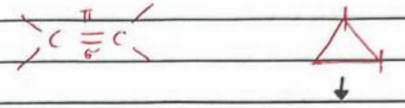
i, 3D - arrangement of atoms (configuration)
ii, physical properties
iii, some chemical properties.

2. GEOMETRIC ISOMERISM

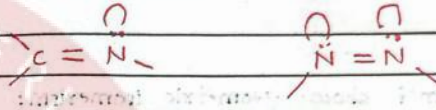
" Geometric isomers have diff. arrangement of atoms/groups when the rotation is restricted in a molecule."

→ Necessary conditions for compounds to show stereoisomerism :-

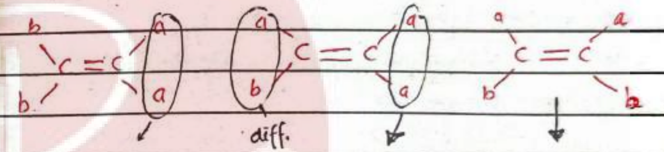
i, Restricted rotation (ensured by the presence of the double bond).



→ cyclic structural arrangement also ensures restricted rotation.



ii, Diff. groups must be attached to restricted atom.

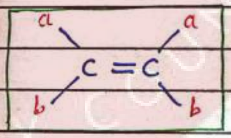


same group. but these are same

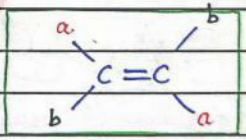
↓

no restricted rotation

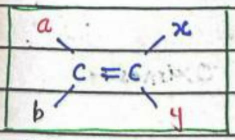
i) presence of π bond (✓)
ii) diff groups (✓)
→ there will be restricted rotation.



(cis-form)



(trans-form)



(E and Z - forms)

→ when all the groups attached to the restricted atoms are diff. group then it is called E and Z form.

Checked By:

MCQ :- Geometric isomerism is usually found in ;

(A) Alkanes ● Alkenes (C) Alkynes
(D) Esters. (presence of π bond)

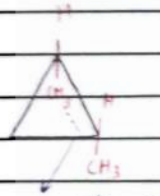
MCQ :- Which compounds will exhibit cis-trans isomerism

● 2-Butene (B) 2-Butyne (C) 2-Butanol (D) Butanal
(alkene)

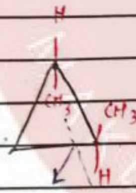
→ Alkynes can't show geometric isomerism;

due to the linear geometry enforced by the triple bond. which doesn't allow for the spatial variation required for cis-trans isomerism.

→ Cis-trans Isomerism In Cycloalkanes :-



same side, same groups
⇓
(cis-form)



same side, diff. groups
⇓
(trans-form)

→ Anti- Syn form Isomerism In Oximes :-

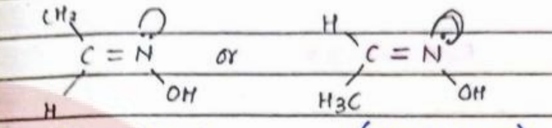
Oxime :-

the compounds synthesized by the condensation rxn b/w hydroxylamine and a carbonyl compound.

→ For an aldehyde :-

$RCHO + NH_2-OH \longrightarrow RCH=NOH + H_2O$

↓

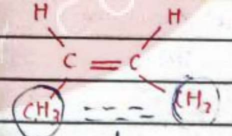
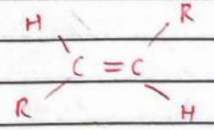


(syn-form) (anti-form)

→ Syn- form :- H and OH present on same side of the π bond.

→ anti - form :- H and OH present on opposite side of the π bond.

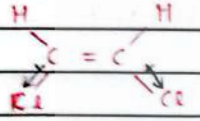
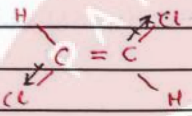
→ Comparison of Different properties of Cis- trans form.

Cis- form	Trans - form
1. Reactivity	
 H H C = C CH_3 CH_3 ↓ steric repulsion	 H R C = C R H
→ more bulky groups on same side, steric repulsion inc↑ and its becomes unstable.	→ more bulky groups on opp. side so less steric repulsion.

Cis- form	Trans- form
→ more reactive (less stable)	→ less reactive (more stable)

2. Dipole Moment

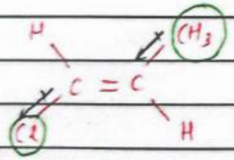
μ ∝ polarity

$\mu = 0$	$\mu \neq 0$
(polar)	(non-polar)
	
$\mu = 1.89D$	$\mu = 0.00 D$
→ polar (due to unsymmetrical shape).	→ non-polar (due to symmetrical shape)

→ EXCEPTION :-

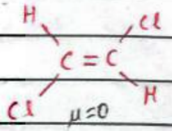
there are some trans-forms which are not non-polar.

e.g

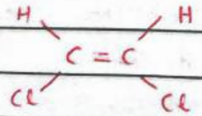


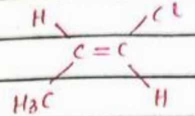
→ here 'μ' has some but still it is less than cis-form.

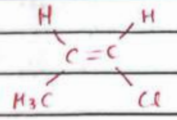
MCQ :- WOF has the highest dipole moment?

(A) 

$\mu = 0$

(B) 



(D) 

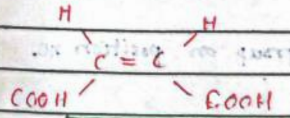
3. Melting Point & Boiling Point

→ Melting Point (solids) and → BP (liquids)

→ BP is concerned with the strength of intermolecular forces.

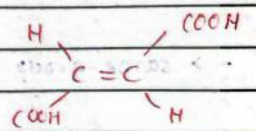
cis-form	trans-form
→ polar → strong attractive force	→ non-polar → weak attractive force
→ So, have high BP.	→ So, have Low BP.
→ poor packing due to unsymmetrical arrangement.	→ good packing due to symmetrical arrangment
→ so have Low MP.	→ so have high MP.

Examples:



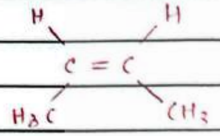
Maleic acid (cis-isomer)

MP = 130°C



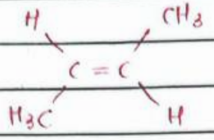
Fumaric acid (trans-isom

MP = 286 °C



(cis - 2 - Butene)

BP = 4 °C



(trans- 2-Butene)

BP = 1 °C

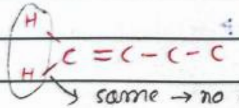
4. Solubility, Density, Refractive Index

polarity ∝ solubility, density, refractive index

→ cis - form (has more viscosity)

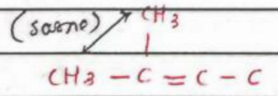
→ those alkenes which can't show cis-trans isomerism :-

1) 1 -ene :



same → no cis-trans isomerism.

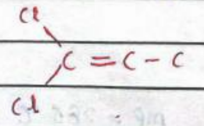
2) 2- methyl - 2-ene :



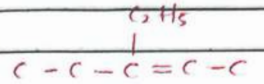
(same)

$CH_3-C=C-C$

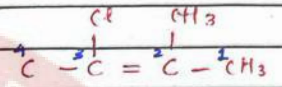
3) 1, 1 ⟶ same group i.e same group on position no. 1.



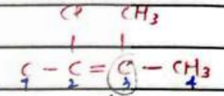
4) 3- ethyl - 3-ene :-



5) 2nd last methyl and 2nd last ene :-



or

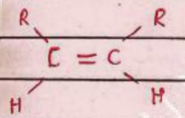


2nd last methyl + ene.

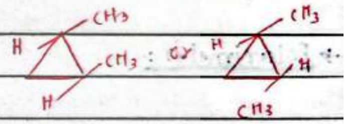
→ Compounds which can have cis-trans isomers :-

→ cis-trans isomerism (bcz of frozen bond which can't rotate).

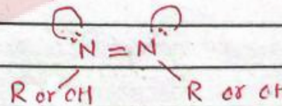
i, substituted alkene



ii, substituted cycloalkane

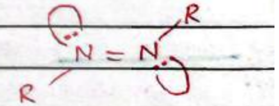


iii, Azo - compounds



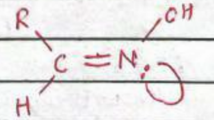
(cis-form)

⟷



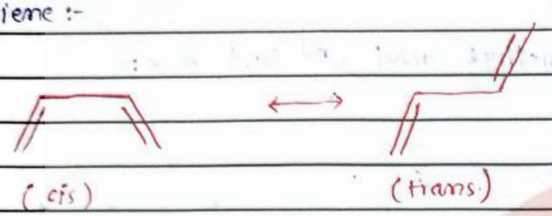
(trans-form)

iv) Oximes (Imines) :-



→ lone-pair is also considered as a separate group/ substituent.

v) Diene :-



3. OPTICAL ISOMERISM :

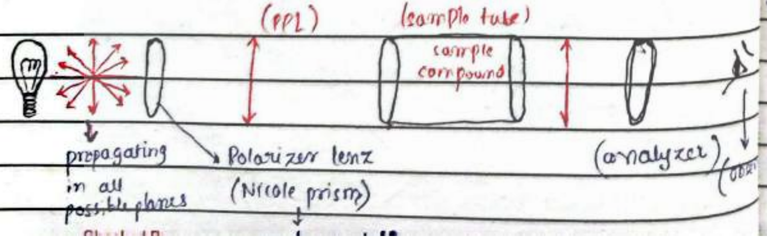
→ **Optical Active:-**
the compounds which can rotate the plane of the polarized light.

→ **Optical Activity :-**
the property of the optically active compounds.

→ **Polarimeter :-**
identify and measure the optical rotation

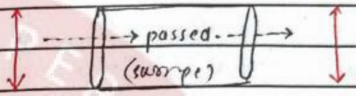
identify whether a compound is optically active or not.
in (Polarimeter)

→ **source of light** :- produces EM-waves, that oscillate in all possible planes.

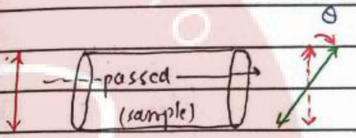


→ soln of the compound placed in the sample tube is made with a compound which is not optically active
e.g
= (H_2O, CCl_4, $CHCl_3$)

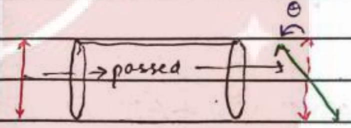
→ Results :-

i)


- same plane
- no rotation
- compound is optically inactive

ii)


- clockwise rotation
- dextrorotatory, d (+)

iii)


- anticlockwise rotation.
- levorotatory, l (−)

→ θ (degree of rotation) depends upon;

i/ length of sample tube, ii/ conc. of sample soln
iii/ temperature iv/ λ of light used.

→ Specific Rotation (α):-

→ a physical property just like MP, BP etc.

$$[\alpha]_{\lambda}^{°C} = \frac{\alpha_{obs}}{c \times l}$$

Checked By:

where c = conc. of sample soln in g/ml.

λ = wavelength (usually Na - light is used so its $\boxed{\lambda = 589\ pm}$)

l = length = $\boxed{1\ deci.meter = 10\ cm}$

→ Chirality :

→ a compound which shows optical activity must have;

i, non-superimposable mirror images

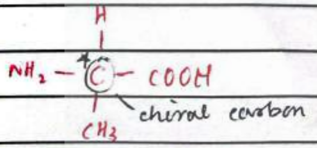
ii, stereogenic centre [chiral atom (carbon), stereo-centre, chiral centre]

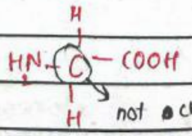
iii, do not have element of symmetry.

→ (left hand, right hand); (right foot - left foot) and (left ear - right ear) are optical isomers / non-superimposable mirror images of each other. or enantiomers.

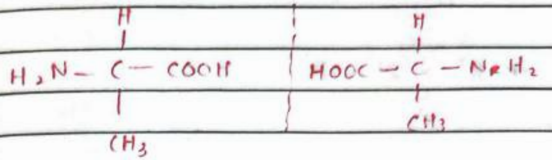
→ Optically Active Centre

CHIRAL	A - CHIRAL
→ four diff groups/atoms are attached.	→ doesn't have four diff. attached groups.
e.g amino acid (alanine)	e.g amino acid (glycine)





not chiral carbon

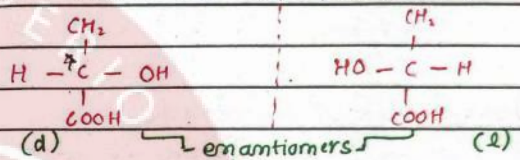


(non-superimposable mirror-images)

↓

(enantiomers)

② Lactic acid (2-hydroxypropanoic acid) → has 2 enantiomers



i, chiral carbon (✓) | ii, no plane of symmetry

→ optically active

→ same specific rotation [α] = 2.67 at 15°C.

→ same physical properties.

↓

e.g solubility, refractive index, mp, BP etc.

→ formula to calculate the no. of enantiomers

when different groups are present at the opposite ends;

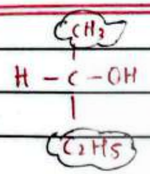
$\boxed{No.\ of\ enantiomers = 2^n}$

→ when same groups are present at the opposite ends.

$\boxed{No.\ of\ enantiomers = 2^{n-1}}$

where n = no. of stereogenic centres

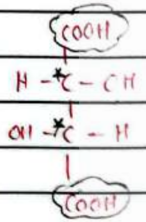
Checked By:



→ different groups at both ends

→ $2^n = 2^1 = 2$

(2-Butanol)

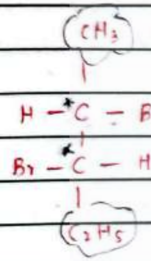


→ same groups at both ends

→ 2 chiral centers

→ $2^{n-1} = 2^{2-1} = 2$

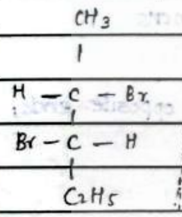
(tartaric acid)



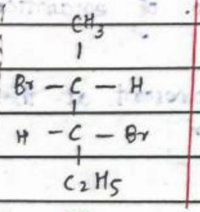
→ $2^n = 2^2 = 4$

→ 4 possible enantiomers.

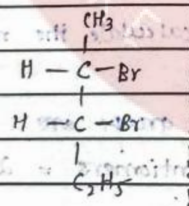
(2,3-dibromopentane)



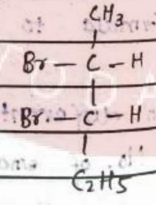
(A)



(B)



(C)



(D)

(A) (B) enantiomers

(C) (D) enantiomers

But

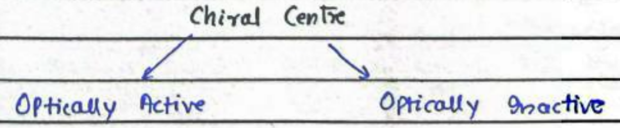
A and C or A and D → Diastereomers.

→ A and C or B and C are not superimposible images of each other. (Diastereomers)

ENANTIOMERS	DIASTEREOMERS
→ mirror images	→ non-mirror images
→ non-superimposible	→ superimposible
→ at least one chiral centre	→ two / more than two chiral centres
→ optically active	→ may / may not be optically active
→ same physical properties (except behaviour towards plane polarized light).	→ diff. physical properties
may / may not have same chemical properties.	→ may / may not have the same chemical properties.
→ 2 forms of the same molecule (exist in pairs.)	→ they may have more than two forms of the same molecule.

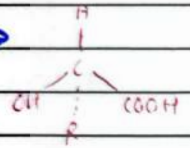
Racemic Mixture :-

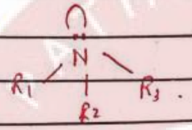
- 50%. D-Isomer and 50%. L isomer
- mixture is optically inactive bcz both the isomers rotate ppl in diff. directions to the same degree
- have diff. physical properties than the enantiomers

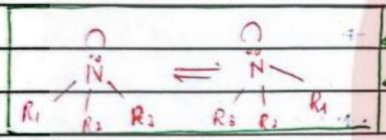


Checked By:

Optically Active	Optically Inactive
→ 4 diff. atoms / groups of atoms attached.	→ 3 diff. atoms / groups of atoms and 1 - lone.
→ asymmetrical	→ may be symmetrical (having plane of symmetry).
→ stereogenic	→ non-stereogenic

→ 

→ 



← Due to lone pair presence, group can flip at RTP, so l and d isomers.

Other Points:

→ Only glycine (having H) is optically inactive.

→ Rest of the 19 essential amino acids are optically active due diff. R group.

→ amino acids form proteins so proteins are also optically active.

→ enzymes are specific in action due to the optical activity.

→ D-glucose after metabolisis produces energy.

→ L-glucose (present in artificial sweetners) doesn't produce energy and is exereted through the urine out of the body.

(ISOMERISM)

[Different compounds with same molecular formula]

Structural / Constitutional Isomerism

i, Chain Isomerism
ii, PI
iii, FG Isomerism
iv, Metamerism
V, Tautomerism

Stereoisomerism

i, Conformational
ii, Configurational

Geometric Isomerism
- cis-Trans
- E and Z
- Syn and anti
- Exo and Endo

Optical Isomerism
- Enantiomerism
- Diastereoismerism

→ Priority order for Structural Isomerism:-

1) Position 2) [illegible] 3) Metamerism
4) Functional Group Isomerism 5) Tautomerism
6) Ring-chain Isomerism

Checked By: