16. STRUCTURAL ISOMERISM - METAMERISM AND TAUTOMERISM

SOLUTIONS

TEACHING TASK

JEE MAINS LEVEL QUESTIONS

1. Which of the following pairs of compounds are tautomers?

(FA & SA- 5 Marks/8 Marks)

A)Acetaldehyde (CH_3CHO) and Vinyl Alcohol (CH_2=CH-OH)
B) Acetic Acid (CH_3COOH) and Methyl Formate ($HCOOCH_3$)
C)Diethyl Ether ($CH_3CH_2OCH_2CH_3$) and Butanol ($CH_3CH_2CH_2CH_2OH$)
D) Acetone (CH_3COCH_3) and Propionaldehyde (CH_3CH_2CHO)

Answer:A

Solution:

Tautomers = structural isomers that interconvert by proton shift (keto- enol).

A) Acetaldehyde (CH_3CHO) $\rightleftarrows$ Vinyl alcohol (CH_2=CHOH) — Yes, classic keto-enol tautomerism.

B) Acetic acid $\rightleftarrows$ Methyl formate — No (different connectivity, not proton-shift tautomers).

C) Diethyl ether $\rightleftarrows$ Butanol — No.

D) Acetone $\rightleftarrows$ Propionaldehyde — No (same formula but not tautomeric forms of each other).

2. Tautomerism is exhibited by which one of the following compounds?

1. Acetophenone ($C_6H_5COCH_3$) 2. Benzophenone ($C_6H_5COC_6H_5$)
3. Triphenylmethane ($(C_6H5)_3CH$) 4. Formaldehyde (HCHO)

Answer:A

Solution:Acetophenone ($C_6H_5COCH_3$) — Yes (has α-hydrogen $\rightarrow$ keto–enol tautomerism).
Benzophenone (C6H5COC6H5) — No (no α-H).
Triphenylmethane ((C6H5)3CH) — No (not α keto–enol system).
Formaldehyde (HCHO) — No (no α-H).

3. Tautomerism is not exhibited by which of the following compounds?

A)Acetaldehyde (CH_3CHO) B) Acetone (CH_3COCH_C)
C) Formic Acid (HCOOH) D) Acetylacetone ($CH_3COCH_2COCH_3$)

Answer:C

Solution:A) Acetaldehyde — does show keto–enol tautomerism (to vinyl alcohol).
B) Acetone — does show tautomerism.
C) Formic acid (HCOOH) — does NOT show keto–enol tautomerism (no α-H);

also it can't convert to a different tautomeric functional form in the keto–enol sense.

D) Acetylacetone — does show strong tautomerism (stabilized enol)

4. Which organic structure among the following is not an isomer of the compound $CH_3CH_2COCH_2CH_3$ (3-pentanone)?

A) $CH_3CH_2CH_2CH_2CHO$ B) CH_2=CH-O-$CH_2CH_2CH_3$

C) CH_3CH_2OCH=$CHCH_3$ D) Cyclopentanol

Answer:None

Solution:3-pentanone= $C_5H_{10}O$.

A) $CH_3CH_2CH_2CH_2CHO$ (pentanal) $\rightarrow C_5H_{10}O$ $\rightarrow$isomer.

B) CH_2=CH-O-$CH_2CH_2CH_3$ (a vinyl ether) $\rightarrow C_5H_{10}O$ $\rightarrow$isomer.

C)CH_3CH_2OCH=$CHCH_3$ (an enol ether)$\rightarrow$ $C_5H_{10}O$ $\rightarrow$ isomer.

D) Cyclopentanol $\rightarrow C_5H_{10}O$ $\rightarrow$ isomer.

All four have the same molecular formula, so all are constitutional isomers of 3-pentanone.

5. Which organic structure among the following is not an isomer of the compound

$CH_3-CO-CH_2CH_2CH_2CH_3$?

A) $CH_3CH_2OCH=CHCH_2CH_3$ B) $CH_3CH=CHCH_2CH_2CHO$

C) $(CH_3)_2CH-CO-CH_2-CH_3$ D) $CH_3CH_2COCH_2CH_2CH_3$

Answer:B

Solution:B) $CH_3CH=CHCH_2CH_2CHO$ has formula $C_6H_{10}O$ (an unsaturated aldehyde) — not $C_6H_{12}O$. A, C and D all have formula $C_6H_{12}O$ and are constitutional isomers of the ketone.

6. $\bar{C}H_2-\overset{\overset{O}{\|}}{C}-CH_3$ and $CH_2=\overset{\overset{O^-}{|}}{C}-CH_3$ are **(FA & SA- 3 Marks/4 Marks)**

A) Resonating structures B) Tautomers

C) Geometrical isomers D) Optical isomers

Answer:A

Solution:They are the two resonance forms of an enolate (negative charge delocalized between O and the α–C), not tautomers or stereoisomers.

7. CH_3-C(=NOH)-CH_3 and CH_2=C(NO)-CH_3 are: **(FA & SA- 2 Marks)**

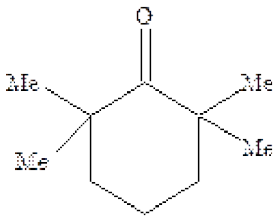
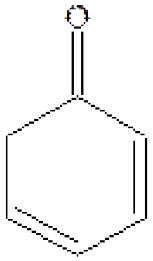
A)Resonating structures B)Tautomers

C)Geometrical isomers D)Functional isomers

Answer:B

Solution:These are tautomeric forms (oxime $\rightleftarrows$ nitroso/related enolic form) — they interconvert by proton shift.

8. Which of the following will not show Tautomerism?

A)$C_2H_5NO_2$ B) Acetoacetic ester C)  *- D) 

Answer:C

Solution:Tautomerism requires the presence of an α-hydrogen atom (a hydrogen on the carbon adjacent to the carbonyl group).

(A) $C_2H_5NO_2$ (nitroethane): Has α-hydrogens and can tautomerize to its aci-form ($CH_2 = CH - NO_2H$).

(B) Acetoacetic ester (ethyl acetoacetate): Has α-hydrogens between the two carbonyl groups and readily undergoes keto-enol tautomerism.

(C) 4,4,6,6-tetramethylcyclohexanone: The carbons adjacent to the carbonyl group (positions 3 and 5) do not have any hydrogen atoms attached to them because all valencies are filled with methyl groups or other ring carbons. Therefore, it cannot undergo tautomerism.

(D) Cyclohex-2-en-1-one: Has α-hydrogens and can tautomerize to a phenol-like enol form.

9. Among the following ketones, which is the correct order of their enol content?
I. $CH_3COCH_2COCH_3$ (Acetylacetone)
II. $CH_3COCH_2CH_3$ (Butanone)
III. $C_6H_5COCH_3$ (Acetophenone)
A)I > II > III B)I > III > II C)II > I > III D)III > II > I

Answer:B

Solution:I (acetylacetone) — a ß-diketone: enol form is strongly stabilized by resonance and intramolecular H-bonding $\rightarrow$highest enol content.

III (acetophenone) — enol stabilized by conjugation with the aromatic ring $\rightarrow$ more enol than a simple aliphatic ketone.

II (butanone) — simple aliphatic ketone, least stabilized enol $\rightarrow$ lowest enol content.

So the order is acetylacetone > acetophenone > butanone.

10. Which of the following compounds can exhibit tautomerism?
A) CH_3-CH_2-OH (Ethanol) B) CH_3-O-CH_3 (Dimethyl ether)
C) CH_3-CH_2-CHO (Propanal) D) H-$COOCH_3$ (Methyl formate)

Answer:C

Solution:A (ethanol) — no keto/enol system; cannot undergo keto–enol tautomerism.

B (dimethyl ether) — no tautomerizable α-H or carbonyl.

C (propanal) — an aldehyde with a-hydrogens; can tautomerize (keto $\rightleftarrows$ enol).

D (methyl formate, $HCOOCH_3$) — the formyl carbon has no a-hydrogen for enolization, so does not show keto–enol tautomerism

JEE ADVANCED LEVEL QUESTIONS

Multicorrect Answer Type

11. Tautomerism is shown by which of the following?
A) CH_3-CH_2-NO_2 B) H-C≡N C) CH_3-COOH D)CH_3-CO-CH_3

Answer:A,B,D

Solution:

A) CH_3–CH_2–NO_2 (nitroethane)

YES — nitro compounds with a-hydrogens show nitro–aci tautomerism:

R–CH_2–NO_2 ⇄ R–CH=NO(OH)

B) H–C≡N (hydrogen cyanide)

YES — H–C≡N ⇄ H–N≡C: cyanide–isonitrile tautomerism (minor but known).

C) CH_3–COOH (acetic acid)

NO — carboxylic acids generally do not show keto–enol tautomerism because the carbonyl carbon has no a-H.(They can show very special "pseudoketo" forms only in highly substituted cases, not here.)

D) CH_3–CO–CH_3 (acetone)

YES — acetone has a-hydrogens → keto–enol tautomerism.

12. Which of the following cannot show tautomerism?
A) $(CH_3)_3$C-COOH B)C_6H_5-CHO C)$CHCl_3$ D)H-COO-C_2H_5

Answer:A,B,C,D

Solution:All four compounds lack the α-hydrogen (or lack the required functional group) needed for keto-enol or other common tautomerism.

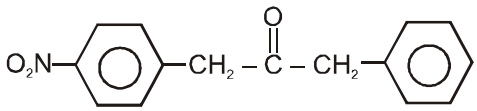
Statement Type

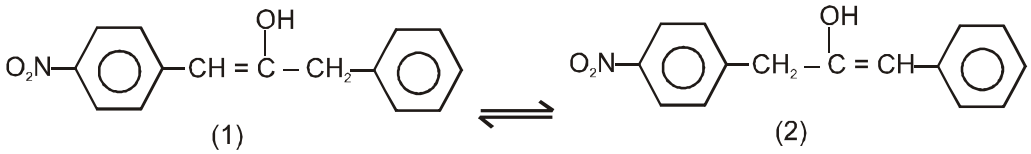
A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1

C) Statement-1 is True, Statement-2 is False

D) Statement-1 is False, Statement-2 is True

13. **Statement I:**  tautomerises as



The enol (A) is more stable than (B).

Statement II: The p - O_2N group extends the delocalisation thus stabilises the enol (A).

Answer:A

Solution:The molecule can give two enolic tautomers depending on which a-CH is involved. The enol where the C=C is conjugated with the p-nitrophenyl ring

(enol A) is more stabilized than the enol conjugated with an unsubstituted phenyl (enol B). So Statement I is true.

The p-NO_2 group is a strong electron-withdrawing, resonance-accepting group; when the double bond is conjugated with the p-nitrophenyl ring, electron density from the enol π system can delocalize into the ring and ultimately into the nitro group, stabilizing that enolic form. There may also be favorable intramolecular H-bonding in that geometry. Thus the p-NO_2 extends delocalization and stabilizes enol A, so Statement II is true and correctly explains I.

Comprehension Type

Comprehension-I

Metamerism :

Compounds having same molecular formula, same polyvalent functional group but unequal distribution of substituents on either side of the functional groups / polyvalent functional group members belong to the some homologous series (class).

Metamerism is exhibited by ethers, ketones, sec- amines, esters and anhydrides

14. Which of the following pairs of compounds are an example of metamerism?

A) CH_3-CH_2-O-CH_2-CH_3 and CH_3-O-CH_2-CH_2-CH_3
B) CH_3-CH_2-CH_2-OH and CH_3-O-CH_2-CH_3
C) CH_3-CH_2-CHO and CH_3-CO-CH_3
D) CH_3-COOH and H-COO-CH_3

Answer:A

Solution:Metamerism $\rightarrow$same molecular formula, same functional group, but different alkyl groups on either side of a functional group (common in ethers, amines, ketones, esters).

A) CH_3CH_2–O–CH_2CH_3 (diethyl ether) and CH_3–O–$CH_2CH_2CH_3$ (methyl propyl ether)

Both ethers, same formula $C_4H_{10}O$, alkyl groups differ $\rightarrow$ metamers

B) $CH_3CH_2CH_2OH$ (propanol) and $CH_3OCH_2CH_3$ (ethyl methyl ether)

Different functional groups (alcohol vs ether) $\rightarrow$functional isomers, not metamers

C) CH_3CH_2CHO (propanal) and CH_3COCH_3 (acetone)

Aldehyde vs ketone $\rightarrow$functional isomers

D) CH_3COOH (acetic acid) and $HCOOCH_3$ (methyl formate)

Acid vs ester $\rightarrow$functional isomers

15. Metamerism is generally not exhibited by which class of compounds?
A) Ethers B) Aldehydes C) Ketones D) Secondary amines

Answer:B

Solution:Metamerism requires a divalent functional group (ethers, ketones, amines, etc.).

Aldehydes have –CHO, which is monovalent, so no chain splitting possible.

16. Which pair represents metamerism?
A) Diethylamine and Methyl-n-propylamine
B) Ethyl alcohol and Dimethyl ether
C) Acetone and Propionaldehyde
D) Acetic acid and Methyl formate

Answer:A

Solution:A) Diethylamine (C_2H_5–NH–C_2H_5) and Methyl-n-propylamine (CH_3–NH–C_3H_7)
Both secondary amines, same formula $C_4H_{11}N$ $\rightarrow$ different alkyl groups $\rightarrow$metamers
B) Ethanol and dimethyl ether $\rightarrow$ different functional groups $\rightarrow$functional isomers
C) Acetone and propanal $\rightarrow$different functional groups
D) Acetic acid and methyl formate $\rightarrow$acid vs ester

17. Identify the pair that does not show metamerism.
A) CH_3-CO-C_2H_5 and CH_3-CH_2-CO-CH_3
B) CH_3-O-C_3H_7 and C_2H_5-O-C_2H_5
C) CH_3-CH_2-COOH and H-COO-C_2H_5
D) $(CH_3)_2$CH-NH-CH_3 and CH_3-NH-C_3H_7

Answer:C

Solution:C) CH_3-CH_2-COOH and H-COO-C_2H_5
Reason:Carboxylic acid vs ester $\rightarrow$ functional isomers, not metamers
Metamerism requires the same functional group, which this pair does not have.
Other options do show metamerism:
A) Both are ketones $\rightarrow$ metamers
B) Both ethers $\rightarrow$metamers
D) Both secondary amines $\rightarrow$ metamers

Comprehension-II

In tautomerism, an atom changes place but resonance involves a change of position of pi-electrons or unshared electrons.
Tautomers are different compounds and they can be separated by suitable methods but resonating structures cannot be separated as they are imaginary structures of the same compound.
Two tautomers have different functional groups but there is same functional group in all canonical structures of a resonance hybrid. Prepare 3 multiple choice single answer questions

18. The key distinction between tautomerism and resonance is that:
A)Tautomerism involves the movement of pi-electrons, while resonance involves the movement of atoms.
B)Tautomers are imaginary forms of the same compound, while resonating structures are real and separable.
C)Tautomers are different, separable compounds, while resonating structures are imaginary representations of a single compound.

D)Resonance changes the functional group, while tautomerism preserves it.

Answer:C

Solution:Tautomers = real, isolable, interconvertible compounds (differ by movement of H and π-bond).

Resonance structures = imaginary, not separable; they only describe electron delocalization.

19. Which of the following statements is correct regarding the functional groups in tautomers versus resonance structures?

A) Both tautomers and resonance hybrids have the same functional group.

B)Tautomers have different functional groups, while all resonance structures of a compound have the same functional group.

C)Resonance structures have different functional groups, while tautomers have the same functional group.

D) Functional groups are not considered in either phenomenon.

Answer:B

Solution:Functional groups in tautomers vs resonance:

Tautomers: different functional groups (e.g., ketone vs enol).

Resonance structures: same functional group (e.g., carboxylate anion is delocalized but functional group same).

20. What is the fundamental difference in what moves during tautomerism compared to resonance?

A) In both, atoms change position.

B) In tautomerism, an atom (usually H) changes place, while in resonance, only pi-electrons or lone pairs shift.

C)In resonance, atoms change place, while in tautomerism, only electrons shift.

D)Neither involves the movement of any particles.

Answer:B

Solution:Fundamental difference in what moves:

Tautomerism: atom (usually H) changes position between two different molecules.

Resonance: only p-electrons or lone pairs shift within the same molecule; atoms fixed.

Integer Type

21. The number of ether metamers represented by the formula $C_4H_{10}O$ is

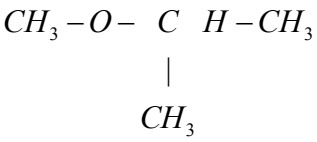
Answer:3

Solution:Ether general formula: R–O–R'

Metamers = same molecular formula, same functional group, but different alkyl group distribution around oxygen, i.e., different R and R' combinations.

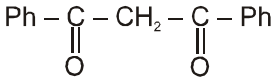
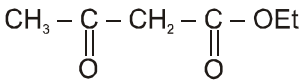
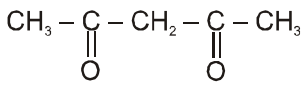
$CH_3 - O - CH_2 - CH_2 - CH_3 \rightarrow$ Methyl propyl ether

$CH_3 - CH_2 - O - CH_2 - CH_3 \rightarrow$ Ethyl ethyl ether — diethyl ether



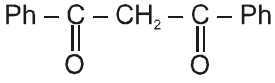
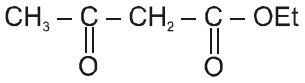
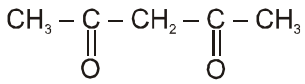
Matrix Matching Type

20. Match the column

Column-I (Keto)	**Column-II (% enol)**
A) $CH_3 - CH = O$	(x) 95 %
B) 	(y) 76 %
C) 	(z) 0.0001 %
D) 	(w) 7.2 %

Answer:A-z,B-x,C-w,D-y

Solution:

A) $CH_3 - CH = O$	(z) 0.0001 %
B) 	(x) 95 %
C) 	(w) 7.2 %
D) 	(y) 76 %

LEARNER'S TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CQU'S)

1. The compound which is not isomeric with methyl propyl ether ($C_4H_{10}O$) is:
   A) Diethyl ether B) Butan-1-ol C) 2-Methylpropan-2-ol D) Butanal

Answer:D

Solution: Butanal is C_4H_8O (an aldehyde), not C4H10O, so it is not isomeric with methyl propyl ether

2. The compound C_3H_8O can show:
   A) Metamerism only
   B) Functional isomerism only
   C) Position isomerism only
   D) Both functional and position isomerism

Answer:D

Solution:C_3H_8O has alcohol and ether functional isomers (functional isomerism) and 1- and 2-propanol are position isomers (position isomerism).

3. The isomers which exist in dynamic equilibrium and differ in the position of a hydrogen atom are called:
   A) Metamers
   B) Tautomers
   C) Chain isomers
   D) Geometrical isomers

Answer:B

Solution:The isomers which exist in dynamic equilibrium and differ in the position of a hydrogen atom are called Tautomers.

4. The type of isomerism found in the nitromethane molecule (CH_3NO_2) is:
   A) Chain isomerism
   B) Position isomerism
   C) Tautomerism
   D) Geometrical isomerism

Answer:C

Solution:Nitromethane $\rightleftharpoons$ aci-nitromethane (CH_2=NOOH) $\rightarrow$ tautomerism.

5. Which of the following compounds will show metamerism with diethyl ketone ($CH_3CH_2COCH_2CH_3$)?
   A) $CH_3COCH_2CH_2CH_3$
   B) $(CH_3)_2CHCOCH_3$
   C) $CH_3CH_2CH_2COCH_3$
   D) Both 1 and 3

Answer:D

Solution:Diethyl ketone (pentan-3-one) has isomeric ketones where alkyl groups differ (e.g., $CH_3COCH_2CH_2CH_3$ and $CH_3CH_2CH_2COCH_3$ are other constitutional isomers of formula $C_5H_{10}O$).

6. The compound that does NOT exhibit tautomerism is:
   A) Acetone B) Acetaldehyde C) Formic acid D) Acetylacetone

Answer:C

Solution: Tautomerism requires the presence of an alpha hydrogen, which is a hydrogen atom on a carbon adjacent to a carbonyl group. Formic acid (HCOOH) only has one hydrogen, and it is directly attached to the carbonyl carbon, making it unable to participate in tautomerism.

7. The type of isomerism shown by R–O–R' and R–S–R' is:
   A) Metamerism
   B) Functional isomerism
   C) Position isomerism
   D) They are not isomers

Answr:A

Solution:Metamerism is a type of structural isomerism where isomers have the same molecular formula and the same polyvalent functional group but differ in the nature or size of the alkyl groups attached to the functional atom.

R–O–R' is an ether, where the oxygen atom is a polyvalent functional group. R–S–R' is a thioether (sulfide), where the sulfur atom is a polyvalent functional group.

When different compounds have the general formulas R–O–R' and R–S–R' but the same overall molecular formula, they are metamers because the distribution of carbon atoms around the oxygen or sulfur atom can be varied (e.g., diethyl ether $CH_3CH_2OCH_2CH_3$ and methyl n-propyl ether $CH_3OCH_2CH_2CH_3$ are metamers). The key is the variation in the alkyl groups flanking the same type of functional link (ether, sulfide, ketone, etc.).

8. Which compound exhibits both position and functional isomerism with $C_3H_6O_2$?
A) Propanoic acid B) Methyl acetate C) Ethyl formate D) All of the above

Answer:D

Solution: Propanoic acid, methyl acetate and ethyl formate are all isomers of $C_3H_6O_2$ (they represent the acid and different ester forms)

9. The phenomenon where compounds have the same molecular formula and functional group but different alkyl chains on either side of it is called:
A) Tautomerism B) Metamerism
C) Chain isomerism D) Functional isomerism

Answer:B

Solution:Metamerism refers to a type of structural isomerism where compounds have the same molecular formula and functional group but different alkyl groups attached to the functional group on either side.

10. Which of the following pairs are tautomers?
A) Acetone and Propanal B) Nitromethane and Methyl nitrite
C) Acetone and Propylene glycol D) Acetone and 1-Propen-1-ol

Answer:D

Solution: Tautomers are isomers that exist in rapid equilibrium with each other by the migration of a proton (hydrogen atom) and the rearrangement of single and double bonds.

Acetone ($CH_3C(=O)CH_3$) is a ketone, which is the keto form in keto-enol tautomerism.

1-Propen-1-ol ($CH_3CH=CHOH$)is an enol (a compound with a hydroxyl group attached to a carbon-carbon double bond).

These two compounds have the same molecular formula (C_3H_6O) and can interconvert through the movement of a hydrogen atom and the shift of a double bond, making them a tautomeric pair.

JEE MAINS LEVEL QUESTIONS

1. Tautomerism is not exhibited by:
A) $CH_3COCH_2COCH_3$ B) $C_6H_5COCH_3$

C) C_6H_5CHO D) $CH_3CH_2NO_2$

Answer:C

Solution:benzaldehyde has no a-hydrogen, so it cannot undergo keto–enol tautomerism

2. Which of the following is not an isomer of C_4H_8O? **(FA & SA- 5 Marks/8 Marks)**

A) Butanal B) Butan-2-one C) Ethoxyethane D) Cyclobutanol

Answer:C

Solution: Ethoxyethane (an ether, $C_4H_{10}O$) has formula $C_4H_{10}O$, not C_4H_8O, so it is not an isomer of C_4H_8O

3. The molecules CH_3COCH_3 and CH_2=C(OH)CH_3 are: **(FA & SA- 2 Marks)**

A) Position isomers B) Tautomers

C) Functional isomers D) Chain isomers

Answer:B

Solution: CH_3COCH_3 (acetone, keto form) and CH_2=C(OH)CH_3 (the enol) are keto–enol tautomers.

4. Keto-enol tautomerism is observed in: **(FA & SA- 3 Marks/4 Marks)**

A) HCOOH B) $(CH_3)_3CCHO$ C) $CH_3COCH_2COCH_3$ D) $C_6H_5COC_6H_5$

Answer:C

Solution: $CH_3COCH_2COCH_3$ (acetylacetone) — β-diketones (like acetylacetone) show strong keto–enol tautomerism

5. The tautomeric pairs are:

A) CH_3CH_2OH and CH_3OCH_3 B) $CH_3CH_2NO_2$ and CH_2=CHNOOH

C) CH_3CN and CH_2=C=NH D) CH_3COOH and $HCOOCH_3$

Answer:B

Solution: $CH_3CH_2NO_2$ and CH_2=CHNOOH.

This corresponds to the nitro $\rightleftarrows$ aci-nitro tautomerism (nitroalkane $\leftrightarrow$ aci-nitro form). (The other pairs are not tautomeric relationships.)

6. Which compound exhibits both tautomerism and metamerism?

A) $CH_3OCH_2CH_3$ B) $CH_3COCH_2CH_3$

C) CH_3CH_2COOH D) $CH_3CH_2CH_2CHO$

Answer:B

Solution:$CH_3COCH_2CH_3$ — a ketone of this type can undergo keto–enol tautomerism (tautomerism) and, by changing how alkyl groups are partitioned around the C=O in constitutional isomers, can be considered in metameric relationships

7. The type of isomerism shown by $(CH_3)_2CHNO_2$ and $CH_3CH_2CH_2NO_2$ is:

A) Chain isomerism B) Position isomerism

C) Metamerism D) Functional isomerism

Answer:A

Solution:Isopropyl-nitro vs n-propyl-nitro differ by branching of the carbon chain

→chain (skeletal) isomers.

8. Which of the following will show geometrical isomerism but not tautomerism?
   A) $CH_3CH=CHCHO$ B) CH_3COCH_3
   C) $C_6H_5CH=CHC_6H_5$ D) $CH_2=CHCH_2OH$

Answer:C

Solution: $C_6H_5CH=CHC_6H_5$ (stilbene) — shows E/Z (geometrical) isomerism; it does not undergo keto–enol tautomerism.

9. The compound that can show ring-chain tautomerism is:**
   A) Glucose B) Fructose C) Both 1 and 2 D) Sucrose

Answer:C

Solution:Both glucose and fructose exist in open-chain and cyclic (hemiacetal/ hemiketal) forms — ring ↔chain tautomerism.

10. Which pair represents functional isomers?
   A) Diethyl ether and methyl propyl ether
   B) Acetone and propionaldehyde
   C) 1-Butene and 2-butene
   D) Ortho-xylene and para-xylene

Answer:B

Solution:Acetone and propionaldehyde — ketone vs aldehyde: functional isomers.

11. Which of the following is not isomer of $C_5H_{10}O$
   A) 3-Pentanone B) 3-Ethoxy propane
   C) 2-Pentanone D) Pentanal

Answer:B

Solution:Ethoxypropane (an ether) would be $C_5H_{12}O$, not $C_5H_{10}O$. The other three (3-pentanone, 2-pentanone, pentanal) are isomers of $C_5H_{10}O$.

12. The molecules $CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-O-C_2H_5$ and $CH_3-\overset{OH}{\overset{|}{C}}=CH-\overset{O}{\overset{\|}{C}}-O-C_2H_5$ are
   A) Geometrical isomers B) Tatutomers
   C) Diastereomers D) Metamers

Answer:B

Solution:
The structures shown are:

$CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-O-C_2H_5$ (a ß-keto ester: ethyl acetoacetate — keto form)

$CH_3-\overset{OH}{\overset{|}{C}}=CH-\overset{O}{\overset{\|}{C}}-O-C_2H_5$ (its enol form)

These two forms differ by:Migration of a hydrogen atom
Shift of a double bond

Keto $\rightleftarrows$ enol interconversion

This is the classic keto–enol tautomerism.

JEE ADVANCED LEVEL QUESTIONS

Multicorrect Answer Type

1. Metamerism is shown by

A) Diethylether B) Diethylketone C) Diethylamine D) Dimethylether

Answer:A,B,C

Solution:Metamerism occurs when compounds have the same molecular formula and the same functional group, but different alkyl chains on either side of the functional group (common for ethers, ketones, amines, esters).

A) Diethyl ether ($CH_3–CH_2–O–CH_2–CH_3$) — ether $\rightarrow$ has metamer with methyl propyl ether

B) Diethyl ketone ($CH_3CH_2–CO–CH_2CH_3$) — ketone $\rightarrow$ has metamer with methyl propyl ketone

C) Diethylamine ($CH_3CH_2–NH–CH_2CH_3$) — 2° amine $\rightarrow$ has metamer with methyl propyl amine

D) Dimethyl ether ($CH_3–O–CH_3$) — ether $\rightarrow$ formula C_2H_6O; no alkyl variation possible on either side (both methyl) $\rightarrow$ no metamerism

2. Which of the following compounds can exhibit metamerism?

A) Methyl propyl ether B)Dipropyl ketone

C)Ethyl methyl amine D)Butanoic acid

Answer:A,B,C

Solution:Methyl propyl ether: Yes, ethers show metamerism (different alkyl groups attached to oxygen).

Dipropyl ketone (Pentanone): Yes, ketones show metamerism (different alkyl groups attached to carbonyl).

Ethyl methyl amine: Yes, secondary amines show metamerism (–NH– between two alkyl groups).

Butanoic acid: No, carboxylic acids have a terminal –COOH group, so no metamerism.

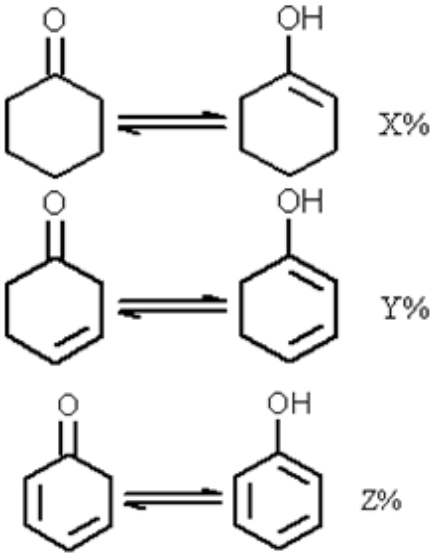
Comprehension Type

Tautomerism is the phenomenon in which two structural isomers differing in the relative positions of their atoms are spontaneously interconvertible and can exist in dynamic equilibrium.

$$\underset{(I)}{CH_3-\overset{\overset{O}{\|}}{C}-CH_3} \rightleftharpoons \underset{(II)}{CH_3-\overset{\overset{OH}{|}}{C}=CH_2}$$

Tautomers I and II are structural isomers that are related only by the shift of a hydrogen atom and one or more Pi bond.

3.



The relation between the enol contents X, Y, Z should be

A)X > Y > Z B)Z > Y > X C)Y > X > Z D)Y > Z > X

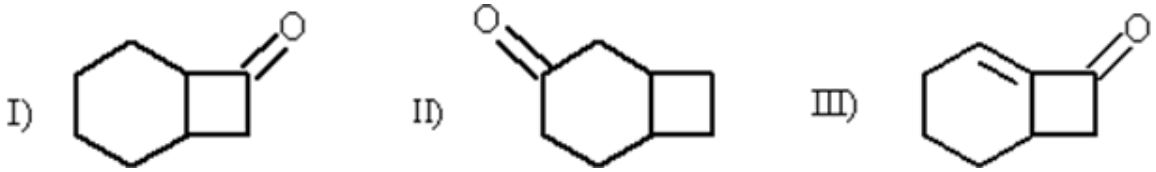
Answer:B

Solution:Compound X: Cyclohexanone with a non-conjugated enol form. The enol lacks resonance stabilization, so enol content is expected to be low.

Compound Y: Cyclohexanone with a conjugated double bond in the enol form. Conjugation with the carbonyl increases enol stability, so enol content is moderate.

Compound Z: Phenyl ketone (likely acetophenone) with aromatic stabilization in the enol form. The enol is stabilized by extended conjugation with the aromatic ring, making it the most stable among the three.

4.

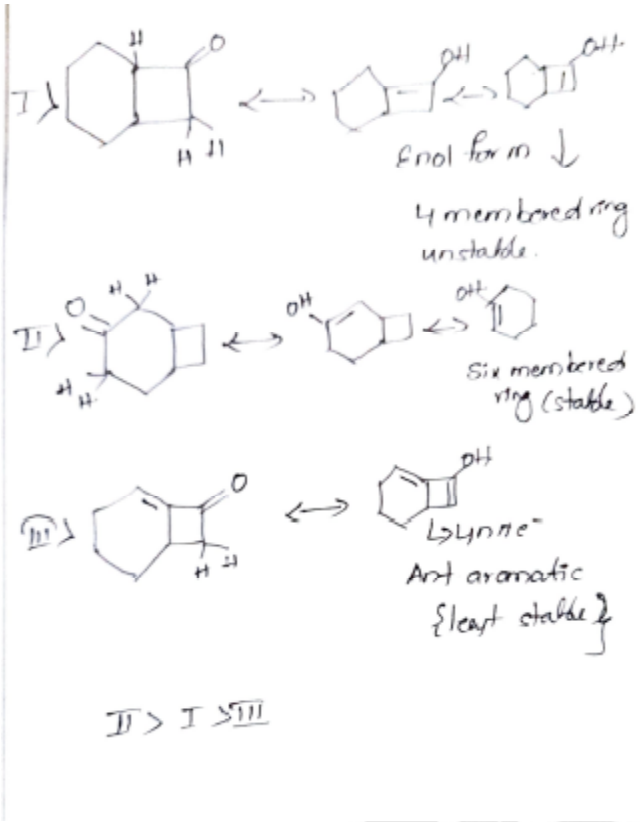


Among these compounds, the order of enol contents should be

A)I > II > III B)III > II > I C)III > I > II D)II > I > III

Answer:D

Solution:



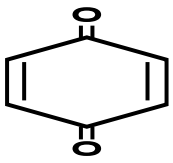
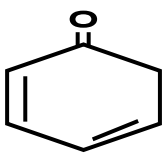
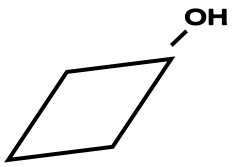
Comprehension-II

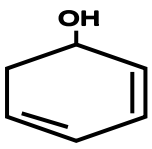
The structural isomerism occurring due to the reversible interconversion of functional group is known as tautomerism and the compounds are called tautomers.

The tautomers exists in dynamic equilibrium therefore the tautomers are also called dynamic isomers and the isomerism is also known as dynamic isomerism

The tautomerism may be called a special case of functional group isomerism.

5. Compound that exhibit tautomerism is

A) 
B) 
C) 

D) 

Answer:B

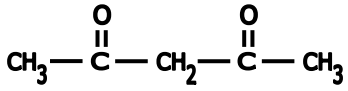
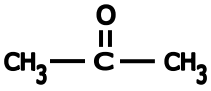
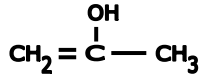
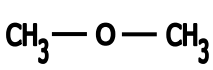
Solution: Compound that exhibits tautomerism:B)the cyclohexenone

Reason: an a-hydrogen next to the C=O allows keto $\rightleftarrows$ enol (keto–enol) tautomerism.

(A) p-benzoquinone $\leftrightarrow$ hydroquinone is a redox-type change (not the usual prototropic keto–enol tautomerism).

(C) an alcohol on a saturated cyclobutane does not tautomerize.
(D) phenol has a theoretically possible keto form but that would destroy aromaticity and is negligible — not the typical tautomerism asked here.

6. Compound which does not exhibit tautomerism

A) 
B) 
C) 
D) 

Answer:D

Solution:Ethers lack the acidic α-hydrogen / proton migration required for prototropic tautomerism. (A = acetylacetone, B = acetone, C = the enol form — all related to keto–enol tautomerism.)

7. Uncommon name of tautomerism is

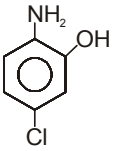
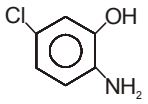
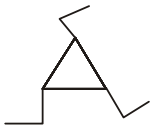
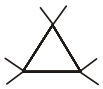
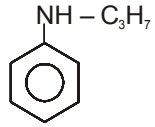
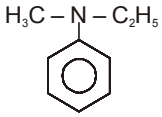
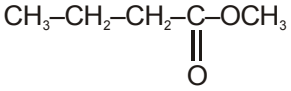
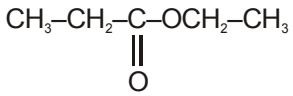
A) Metomerism
B)kryptomerism
C) positional isomerism
D) Ring chain isomerism

Answer:B

Solution:Kryptomerism is an older, less common term for tautomerism, particularly referring to cases where the different forms (tautomers) are not easily isolated or detected under normal conditions.

Matrix Matching Type

8. Which of the following pair represents the correct relationship

	I	II	Relationship
A)			Positional Isomers
B)			Chain Isomer
C)			Functional Isomers
D)			Metamers

Answer:A

Solution:I and II both contain –OH, –NH2, –Cl on benzene.
Only the positions are changed $\rightarrow$Correct.

KEY

				TEACHING TASK					
			JEE MAINS LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
A	A	C	NONE	B	A	B	C	B	C
			JEE ADVANCED LEVEL QUESTIONS						
11	12	13	14	15	16	17	18	19	20
A,B,D	A,B,C,D	A	A	B	A	C	C	B	B
21	22								
3	A-z,B-x,C-w,D-y								
				LEARNER'S TASK					
1	2	3	4	5	6	7	8	9	10
D	D	B	C	D	C	A	D	B	D
			JEE MAINS LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
C	C	B	C	B	B	A	C	C	B
11	12								
B	B								
			JEE ADVANCED LEVEL QUESTIONS						
1	2	3	4	5	6	7	8		
A,B,C	A,B,C	B	D	B	D	B	A		