SEMESTER-I (Hons)

CEMACOR01T: ORGANIC CHEMISTRY-I

Basics of Organic Chemistry Bonding and Physical Properties

1. What are hybrid orbitals?

2. What is the difference between sp, sp^2 and sp^3 hybridization?

3. What is the percentage of s and p character in sp, sp^2 and sp^3 hybrid orbital?

4. Why Formic acid is stronger than acetic acid? Explain

5. Arrange the acidity order among the CH_3COOH, HCOOH, $ClCH_2COOH$ and $ClCH_2CH_2COOH$

6. Compare the basicity of the following compounds:

H_3C-NH_2, $(CH_3)_2NH$, $(CF_3)_3N$

7. Carboxylic acid is stronger than alcohol. Explain

8. Aniline is a weaker base than primary aliphatic amine. Explain

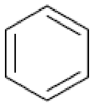
9. Compare the acidity between 3,5- dimethyl-4-nitro phenol and 3,5- dimethyl-4-cyano phenol.

10. Calculate the dipole moment, μ for HCl. The magnitude of the fraction charge d is 0.17 and the bond distance, r_{HCl}, is 1.27 Å.

11. How do you find the dipole moment of CO_2?

12. Compare dipole moment of ethyl chloride and vinyl chloride.

13. Which compound below is not aromatic?



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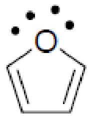

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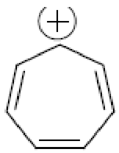

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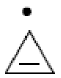

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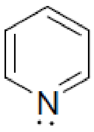

V

14. o-Nitrobenzoic acid is stronger acid than 3,5-dinitrobenzoic acid---Explan

15. Construct hybridized structures for:

(i) $CH_2=C=CH_2$ (ii) $CH_2=CH-CH=O$

16. Arrange the following groups in the order of decreasing (+I) effect.

$C_6H_5O^-$, COO^-, CR_3, CHR_2, H

17. Explain

Barrier for rotation of Ar-NHMe bond in N-methyl-4-nitroaniline is higher than that in N-methyl aniline itself.

18. Compare dipole moment of NH_3 and NF_3.

19. Explain resonance effect

20. Dipole moment of trans-dichloroethylene is zero while that of dimethyl fumarate is finite.

21. Compare the stability of 1,3- and 1,4-pentadine.

22. Justify heat of hydrogenation of isopropene is higher than that of 1-butene.

23. Define the terms: (a) Aromaticity (b) Nonaromatic (c) Antiaromatic and (d) Homoaromatic compounds.

24. Assess whether the following species are aromatic antiaromatic/nonaromatic:

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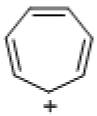
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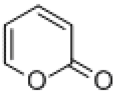
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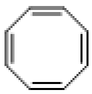
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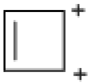
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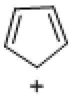
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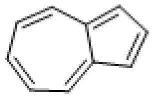
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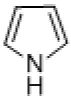
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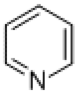


25. HCl is stronger acid in water but not in gas phase-----why

26. p-Nitrophenol boils at higher temperature than o- Nitrophenol----Explain

27. C=O bond length in CF_3CHO is smaller than that in CH_3CHO ----Justify

28. Cyclopentadine forms salt when reacts with $NaNH_2$ but cycloheptatriene does not---Explain

29. Nearly all ortho substituted benzoic acids are stronger than benzoic acid irrespective of electronic nature of the group---Explain

30. Compare basicities of the following (in aqueous media)

CH_3NH_2, $CH_2=NH$, $CH\equiv N$

General Treatment of Reaction Mechanism I

1. Define homolytic cleavage and heterolytic cleavage of bond.

2. What is fish hook arrow?

3. What is ionic reaction?

4. What is free radical reaction?
5. Define pericyclic reaction.
6. Give one example of pericyclic reaction.
7. Define electrophile and nucleophile. Give examples of each.
8. What is addition reaction? Give example.
9. What is SN2 reaction. Explain the mechanism
10. Describe the mechanism of SN1 reaction.
11. What is E2 reaction. Explain the mechanism.
12. Describe the mechanism of E1 reaction.
13. Why tertiary carbocation is highly stable?
14. Compare the stability of primary, secondary and tertiary carbanions,
16. Why benzyl radicals are stable?
17. Explain the stability of allyl carbocation.
18. What is carbene?
19. What is ambidend nucleophile?
20. Give one example of nonclassical carbocation.
21. Write down the mechanism of hydration of prop-1 ene. Explain formation of major and minor products.
22. Write the product of Diels Alder reaction between but-1,3-diene and ethene.
23. Explain Markovnikov's rule with mechanism providing a suitable example.
24. State Sayt Zeff rule and illustrate formation of Sayt zeff product.
25. What is Hofmann product? Explain with example.
26. Compare substitution vs elimination reaction.
27. Arrange the following halides in the decreasing order of their SN1 reactivity with proper reasoning:

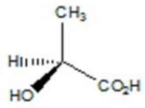
$$CH_3CH_2CH_2Cl;\ \ CH_2=CH-CH(Cl)CH_3;\ \ CH_3CH_2CH(Cl)CH_3$$

28. Explain the change in stereochemistry during an SN2 reaction.
29. What is the stereochemical outcome of a SN1 reaction of a chiral substrate.
30. Describe the orbital picture of singlet and triplet carbene.

Stereochemistry

Determine R/S nomenclature for the below compound:

1.



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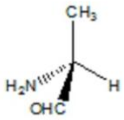

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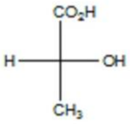

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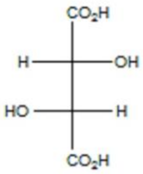


5. Differentiate between enantiomers and diastereoisomers.

6. What is meso compound? Give one example.

7. When a carbon compound becomes optically active?

8. Define specific rotation.

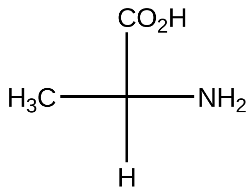
9. How can measure the optical purity of a mixture of enentiomers?

10. What is racemization.

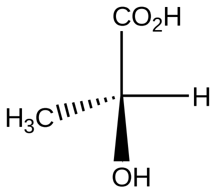
11. Define resolution in terms of stereochemistry.

12. Write down the structure of a D and L isomers.

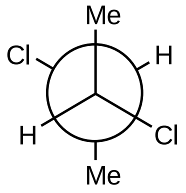
13. Assign R/S nomenclature for the below compound



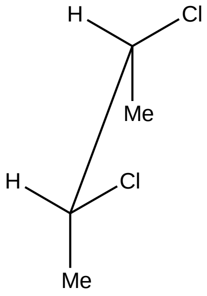
14. Convert following flying wedge formula to Fischer projection



15. Convert Newmann projection into Fisher projection



15. Convert Sawhorse projection into Fisher projection



16. Explain erythro and threo isomers with examples.

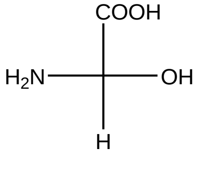
17. What is plane polarized light?

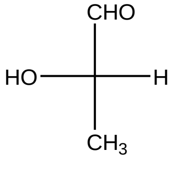
18. Draw a diagram to show the functioning of a polarimeter.

19. What is CIP rule.

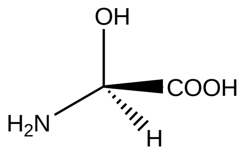
20. Write down the structure of meso tartaric acid.

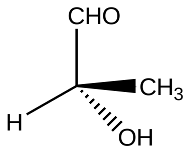
21. Convert following Fisher projections into flying wedge projections.



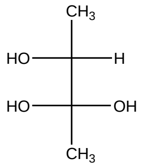


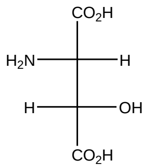
22. Convert following flying wedge projections into Fisher projections.



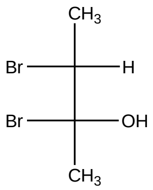


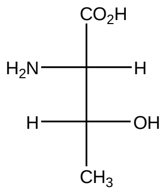
23. Convert following Fisher projections into sawhorse projections.



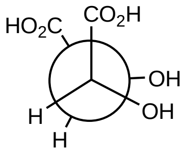


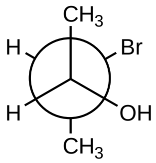
24. Convert following Fisher projections into Newman projections.





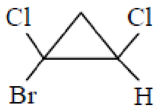
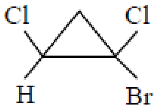
25. Convert following Newman projections into Fisher projections.

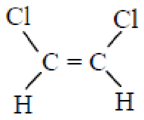
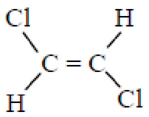


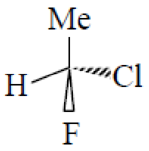
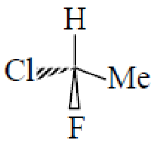


26. How many stereoisomers are possible for the compound hepta-2,5-diene-4-ol? How many of them are optically active? Draw any of the active isomers in flying wedge representation and assign R/S descriptor to it.

27. Label the following pairs of molecule as homomers, enantiomers or diastereomers

(i)  and 

(ii)  and 

(iii)  and 

28. Differentiate configuration and conformation with suitable examples.

29. Define plane of symmetry, center of symmetry and alternating axis of symmetry with examples.

30. Write down different conformations of ethane with energy profile diagram.