Questions for Major-102, Fundamental Organic Chemistry, Chemistry

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1. How many types of electronic displacement are there in organic chemistry?
2. Define inductive effect. How many types of inductive effect are there?
3. Define +I and -I effect.
4. What are the +I and -I groups? Give two examples of each type.
5. Explain why chloromethane has a dipole moment value of 1.87 D, whereas methane and tetrachloromethane have a dipole moment of zero.
6. Explain the dipole moments of o-dichlorobenzene (μ = 2.30 D), m-dichlorobenzene (μ = 1.48 D), and p-dichlorobenzene (μ = 0 D) based on the concept of inductive effect.
7. Explain the trend of acidic character of the following carboxylic acids based on the concept of inductive effect. a. Acetic acid b. chloroacetic acid c. trichloroacetic acid
8. Which acid is more acidic and why? Chloroacetic acid, fluoroacetic acid, bromoacetic acid.
9. Which acid is more acidic and why? acetic acid or formic acid.
10. Which acid is more acidic and why? Benzoic acid, o-trifluoromethyl benzoic acid.
11. Explain the basic character trend of ammonia, methyl amine, dimethyl amine and aniline based on the concept of inductive effect.
12. Explain the basic character trend of aniline and m-nitroaniline based on the concept of inductive effect.
13. Explain the stability of methyl, ethyl, isopropyl, and tert-butyl carbocations based on the concept of inductive effect.
14. Which carbanion is more stable and why? methyl, ethyl, isopropyl, and tert-butyl carbanions.
15. Which carbanion is more stable and why? methyl, chloromethyl, dichloromethyl, and trichloromethyl carbanions.
16. Define electromeric effect. Explain the +E and -E effect with examples.
17. Write down the differences between the electromeric effect and the inductive effect.
18. Define hyperconjugation. Explain the conditions required for the hyperconjugation effect.
19. Explain different types of hyperconjugations with examples.
20. Explain the stability of 1-pentene and 2-pentene based on the concepts of hyperconjugation.
21. Explain the shortening of the C-C single bond length (1.48 A^0) in propene compared to a normal C-C single bond (1.54 A^0).
22. Explain the stability of methyl, ethyl, isopropyl, and tert-butyl carbocations based on the concept of hyperconjugation.
23. Explain the formation of the major product in the nitration of p-isopropyl toluene based on the concept of hyperconjugation.
24. Why is the experimental dipole moment of nitromethane (3.15 D) more than the calculated value (2.59 D)?
25. Define mesomeric effect. How many types of mesomeric effect are there?
26. Write down and explain the different conditions of resonance.

27. What are +M/+R and -M/-R groups/effects? Explain with examples.
28. Explain the shortening of the C-Cl single bond length in vinyl chloride (1.72 A0) compared to the normal C-Cl single bond length (1.78 A^0).
29. Explain why phenol is acidic, whereas alcohols are practically neutral.
30. Explain why acetic acid is acidic, whereas ethyl alcohol is practically neutral.
31. Explain why phenol is acidic, whereas cyclohexanol is practically neutral.
32. Explain why methyl amine is more basic than aniline based on the concept of resonance.
33. Explain why benzyl carbocation is more stable than propyl carbocation.
34. Give examples of two stable primary carbocations.
35. Why is allyl free radical more stable than n-propyl free radical?
36. Write down a few differences between the inductive effect and resonance.
37. Write down different arrow notations used in organic chemistry.
38. What are electrophiles and nucleophiles? Explain with examples.
39. Write down different reaction intermediates in organic reactions.
40. Explain the shape and hybridisation of a carbocation.
41. Explain the shape and hybridisation of a carbanion.
42. Explain the shape and hybridisation of a carbon-based free radical.
43. Explain the shape and hybridisation of carbenes.
44. Explain the spin values of singlet and triplet carbene.
45. Explain the relative stability of free radicals and carbenes.
46. How many types of organic reactions are there? Write examples of each type.
47. What are pericyclic reactions? Explain with an example.
48. Explain the structures of methane and ethane based on the concepts of VBT, VSEPR theory and hybridisation.
49. What is the Wurtz reaction? Write down the mechanism of the Wurtz reaction.
50. What are the drawbacks of the Wurtz reaction?
51. What is the Wurtz -Fittig reaction? Write down the mechanism of the Wurtz-Fittig reaction.
52. Explain Corey-House synthesis of an alkane with a mechanism.
53. Write down two methods for the synthesis of methane with a mechanism.
54. Write down the mechanism of halogenation of methane.
55. What is the major product of free radical halogenation of 2-methylpropane? Explain with a mechanism?
56. Write down the reactivity of different halogens towards methane.
57. Compare the reactivity and selectivity of chlorine and bromine towards free radical substitution of methane.
58. Explain the structure of ethene and ethyne based on the concepts of VBT, VSEPR theory and hybridisation.
59. State and explain the dehydrohalogenation of an alkyl halide to form an alkene with a mechanism.
60. How can you convert propanol to propene? Explain with a mechanism.
61. Write down the mechanism of conversion of 1,2-dibromoethane to ethene?
62. Explain different types of elimination reactions with their mechanisms.

63. What is Zaitsev rule? Explain with an example. Draw the energy profile diagrams for different transition states formed during Zaitsev elimination for the formation of butene from 2-bromobutane.
64. What is Zaitsev rule? Explain with an example.
65. Explain the formation of the major product from 2-bromo-2-methyl butane using potassium tert-butoxide.
66. State different conditions where Hoffmann elimination takes place.
67. Write down the product from the elimination reaction of 2-bromo-2,4,4-trimethylpentane using potassium tert-butoxide.
68. Write down the rate equations for E1, E2, and the E1CB mechanism.
69. Write down different conditions under which the E1CB mechanism takes place.
70. Write down the mechanism of formation of ethyne from 1,2-dihaloalkane.
71. Write down two methods for the synthesis of propyne and butyne.
72. Write down the reaction for the conversion of calcium carbide to ethyne.
73. How can you convert 1,1,2,2-tetrahaloethane to ethyne?
74. How can you convert 1,2-dihaloethane and 1,1-dihaloethane to ethyne?
75. How can you convert ethyne to propyne, 1-butyne, and 2-butyne?
76. What is the Markovnikov rule? Explain with an example.
77. Explain the formation of 2-halopropane as the major product from propene.
78. What is Anti-Markovnikov addition/Peroxide effect/Kharasch effect? Explain with an example.
79. Explain the formation of the major product for the reaction between propene and HBr in the presence of peroxide.
80. Write down the mechanism of reaction between ethene and bromine.
81. Write down short notes on the following reactions with the mechanism
    a. Oxymercuration-demercuration
    b. Hydroboration-oxidation
    c. Ozonolysis
    d. Diels-Alder reaction
82. Write down the mechanism of 1,2-addition and 1,4-addition to conjugated dienes.
83. Write down the reaction scheme and mechanism for the conversion of an alkene to a syn-diol.
84. Write down the reaction scheme and mechanism for the conversion of an alkene to a trans-diol.
85. Write down two reagents for the conversion of an alkene to a syn-diol.
86. Define the terms stereoselective, stereospecific, regiospecific, and chemoselective.
87. Is the hydroboration-oxidation reaction stereospecific? Justify your answer.
88. How can you convert propene to 1-propanol?
89. How can you convert propene to 2-propanol?
90. How can you convert 2-butene to acetone?
91. What is an epoxidation reaction? Explain with a mechanism.
92. What is the product of the ozonolysis reaction of propene?

93. Write down the product of the reaction between ethyne and $HgSO_4$ and sulphuric acid with a mechanism?
94. Write down the product of the addition of HX to an alkyne with a mechanism.
95. What is Lindlar's catalyst? What is its use?
96. How can you convert an alkyne to a cis-alkene or a trans-alkene?
97. Write down the product of the hydroboration-oxidation reaction of propyne.
98. What is aromaticity? Explain the stability of benzene using the concept of aromaticity.
99. What is Huckel's rule for aromaticity? Explain the aromatic character of the following compounds /ions using Huckel's rule. a. thiophene b. pyrrole c. furan d. pyridine e. indole
100. What is antiaromatic? Explain with an example.
101. Is cyclooctatetraene aromatic, nonaromatic, or antiaromatic? Justify your answer.
102. Describe aromatic characters of [6] annulene, [10] annulene, and [14] annulene,
103. Describe whether cycloheptatrienyl cation. Cycloheptatrienyl anion, cyclopentadienyl cation, cyclopentadienyl anion, cyclopropenyl cation, and cyclopropenyl anion are aromatic or not.
104. Explain the reason behind the electrophilic aromatic substitution reaction of benzene.
105. Explain the following electrophilic aromatic substitution reaction of benzene with a mechanism.
    a. Halogenation
    b. Nitration
    c. Sulphonation
    d. Friedel-Craft alkylation
    e. Friedel-Craft acylation
106. Can you synthesize n-propyl benzene from benzene by Friedel-Craft alkylation?
107. Write a reaction scheme for the synthesis of n-propyl benzene from benzene by the Friedel-Craft reaction.
108. Write two methods for the synthesis of isopropyl benzene from benzene.
109. What do you mean by stereoisomerism? Write down different types of stereoisomerism with examples.
110. What is plane polarized light? Explain with a schematic diagram,
111. What are enantiomers? Write down a few characteristics of enantiomers.
112. What are diastereomers? Write down a few characteristics of diastereomers.
113. What is asymmetric carbon? How is it related to optical isomerism?
114. What are symmetry elements? Explain with examples.
115. Is meso-tartaric acid optically active or not? Justify your answer.
116. Write short notes on a. Newmann projection b. Saw horse projection c. Fischer projection
117. Differentiate between d and l notation from D and L notation.
118. What are geometrical isomers? Explain with example.
119. Write the E and Z configurations for the following compounds.
    a) 1-Bromo-2-chloro-2-fluro ethene b) 2-Butene c) 2chloro-3-methyl-2-pentenoic acid d) 2-pentene e) Benzaldoxime f) 1-bromo-1-chloropropene g) 1-bromo-1,2-dichloroethene

120. Draw R and S configuration of the following: a) Bromo-chloro-iodo methane, b) Deutero ethyl bromide c) 1-chloro ethyl amine d) Glyceraldehyde e) Lactic acid, f) 1,2-dichloro-3-methyl butane g) Alanine ($HOOC\text{-}CH\text{-}CH_3\text{-}NH_2$)
121. Write down a short note on the chirality of 1,1-dichlorocyclopropane and 1,1,2-trichlorocyclopropane.
122. In how many stereoisomeric forms can 1,2-dimethylcyclopentane exist? Is there any meso compound?
123. What is a racemic mixture? Discuss methods for the resolution of chiral compounds.
124. What do you mean by specific rotation? Write down the formula for the calculation of specific rotation.
125. Write down the R and S notation for chiral carbons in D-glucose.
126. What are conformational isomers? Write with an example.
127. Explain conformational isomerism in the case of a. ethane b. n-butane c. cyclohexane.
128. Draw the energy profile diagrams of different conformers of ethane, n-butane, and cyclohexane.
129. Explain erythro and threo isomers with examples.
130. What is Baeyer strain theory? Explain with examples. What are its drawbacks?