CHEMISTRY

NCERT - NCERT CHEMISTRY(TELUGU)

ORGANIC CHEMISTRY - SOME BASIC PRINCIPLES AND TECHNIQUES

Problem Solution

1. How many σ and π bonds are present in each of the following molecules?

(a) $HC \equiv CCH = CHCH_3$ (b) $CH_2 = C = CHCH_3$

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2. What is the type of hybridisation of each carbon in the following compounds?

(a) CH_3Cl, (b) $(CH_3)_2CO$, (c) CH_3CN,

(d) $HCONH_2$, (e) $CH_3CH = CHCN$

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3. Write the state of hybridisation of carbon in the following compounds and shapes of each of the molecules.

(a) $H_2C = O$, (b) CH_3F, (c) $HC \equiv N$.

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4. Expand each of the following condensed formulas into their complete structural formulas.

(a) $CH_3CH_2COCH_2CH_3$

(b) $CH_3CH=CH(CH_2)_3CH_3$

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5. For each of the following compounds, write a condensed formula and also their bond-line formula.

(a) $HOCH_2CH_2CH_2CH(CH_3)CH(CH_3)CH_3$

(b) $N \equiv C - \overset{OH}{\overset{|}{C}}H - C \equiv N$

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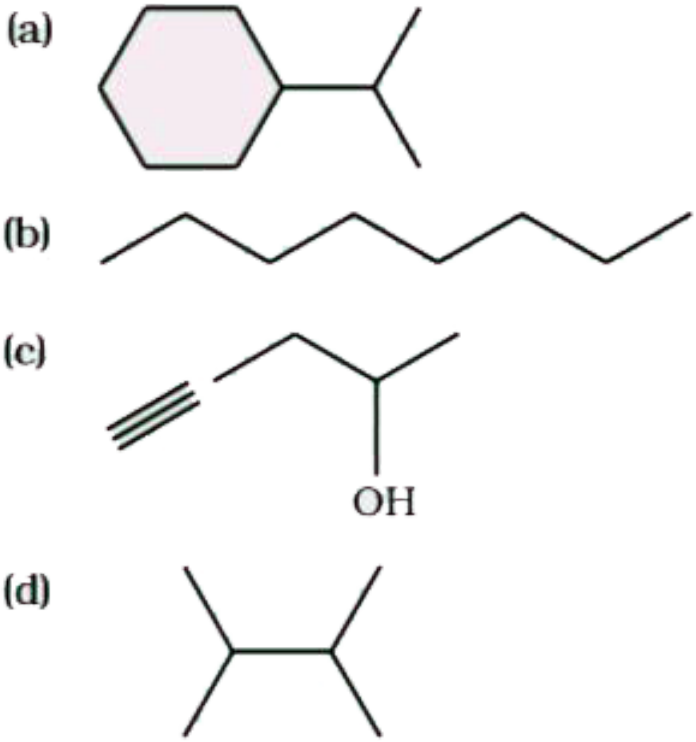
6. Expand each of the following bond-line formulas to show all the atoms including carbon and hydrogen

(a)



(a)

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7. Structures and IUPAC names of some hydrocarbons are given below. Explain why the names given in the parentheses are incorrect.

(a) $CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_2 - \underset{\underset{CH_3}{|}}{CH} - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_3$

2,5,6- Trimethyloctane

[and not 3,4,6-Trimethyloctane]

(b) $CH_3 - CH_2 - \underset{\displaystyle CH_2CH_3}{\underset{|}{CH}} - CH_2 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - CH_3$

3-Ethyl-5-methylheptane

[and not 5-Ethyl-3-methylheptane]

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8. Write the IUPAC names of the compounds i-iv from their given structures.

(i) $\overset{1}{C}H_3 - \overset{2}{C}H_2 - \underset{\displaystyle OH}{\overset{3}{\underset{|}{C}}}H - \overset{4}{C}H_2 - \overset{5}{C}H_2 - \underset{\displaystyle CH_3}{\overset{6}{\underset{|}{C}}}H - \overset{7}{C}H_2 - \overset{8}{C}H_3$

(ii) $\underset{6}{C}H_3 - \underset{5}{C}H_2 - \underset{4}{\overset{\displaystyle O}{\overset{||}{C}}} - \underset{3}{C}H_2 - \underset{2}{\overset{\displaystyle O}{\overset{||}{C}}} - \underset{1}{C}H_3$

(iii) $\underset{6}{C}H_3 - \underset{5}{\overset{\displaystyle O}{\overset{||}{C}}} - \underset{4}{C}H_2 - \underset{3}{C}H_2 - \underset{2}{C}H_2 - \underset{1}{C}OOH$

(iv) $\underset{6}{C}H \equiv \underset{5}{C} - \underset{4}{C}H = \underset{3}{C}H - \underset{2}{C}H = \underset{1}{C}H_2$

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9. Derive the structure of (i) 2-Chlorohexane, (ii) Pent-4-en-2-ol, (iii) 3-Nitrocyclohexene, (iv) Cyclohex-2-en-1-ol, (v) 6-Hydroxy- heptanal.

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10. Write the structural formula of:

(a) o-Ethylanisole, (b) p-Nitroaniline,

(c) 2,3 -Dibromo -1 - phenylpentane,

(d) 4-Ethyl-1-fluoro-2-nitrobenzene.

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11. Using curved-arrow notation, show the formation of reactive intermediates when the following covalent bonds undergo heterolytic cleavage.

(a) $CH_3 - SCH_3$, (b) $CH_3 - CN$, (c) $CH_3 - Cu$

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12. Giving justification, categorise the following moelcules/ions as nucleophile or electrophile:

$HS^-, BF_3, C_2H_5O^-, (CH_3)_3N$:

$C\overset{+}{l}, CH_3 - \overset{+}{C} = O, H_2N\ddot{:}^-, \overset{+}{N}O_2$

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13. Identify electrophilic centre in the following:

$CH_3CH = O, CH_3CN, CH_3I.$

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14. Which bond is more polar in the following pairs of molecules: (a)

$H_3C - H, H_3C - Br$

(b) $H_3C - NH_2, H_3C - OH$ (c) $H_3C - OH, H_3C - SH$

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15. In which C–C bond of $CH_3CH_2CH_2Br$, the inductive effect is expected to be the least?

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16. Write resonance structures of CH_3COO^- and show the movement of electrons by curved arrows.

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17. Write resonance structures of $CH_2 = CH-CHO$. Indicate relative stability of the contributing structures.

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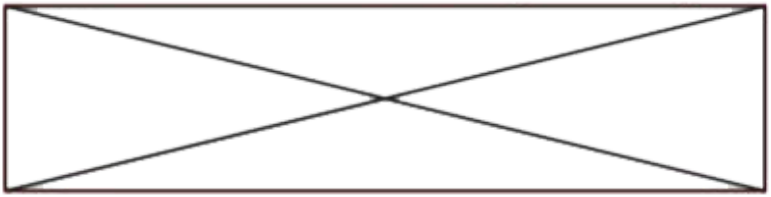
18. Explain why the following two structures, I and II cannot be the major contributors to the real structure of CH_3COOCH_3.



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19. Explain why $(CH_3)_3\overset{+}{C}$ is more stable than $CH_3\overset{+}{C}H_2$ and $\overset{+}{C}H_3$ is the least stable cation.

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20. On complete combustion, 0.246 g of an organic compound gave 0.198g of carbon dioxide and 0.1014g of water. Determine the percentage composition of carbon and hydrogen in the compound.

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21. In Dumas' method for estimation of nitrogen, 0.3g of an organic compound gave 50mL of nitrogen collected at 300K temperature and 715mm pressure. Calculate the percentage composition of nitrogen in the compound. (Aqueous tension at 300K=15 mm)

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22. During estimation of nitrogen present in an organic compound by Kjeldahl's method, the ammonia evolved from 0.5 g of the compound in Kjeldahl's estimation of nitrogen, neutralized 10 mL of $1MH_2SO_4$. Find out the percentage of nitrogen in the compound.

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23. In Carius method of estimation of halogen, 0.15 g of an organic compound gave 0.12 g of AgBr. Find out the percentage of bromine in the compound.

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24. In sulphur estimation, 0.157 g of an organic compound gave 0.4813 g of barium sulphate. What is the percentage of sulphur in the compound?

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Exercises

1. What are hybridisation states of each carbon atom in the following compounds ?

$CH_2 = C = O, CH_3CH = CH_2, (CH_3)_2CO, CH_2 = CHCN, C_6H_6$

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2. Indicate the σ and π bonds in the following molecules :

$C_6H_6, C_6H_{12}, CH_2Cl_2, CH_2 = C = CH_2, CH_3NO_2, HCONHCH_3$

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3. Write bond line formulas for : Isopropyl alcohol, 2,3-Dimethyl butanal, Heptan-4- one.

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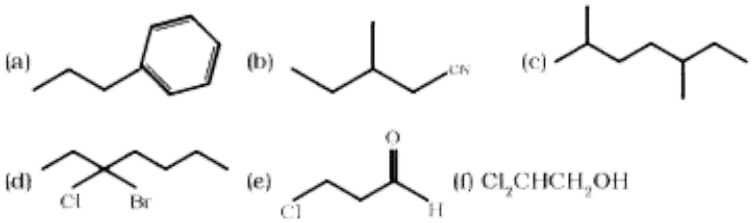
4. Give the IUPAC names of the following compounds :



(a) (b)

Cl_2CHCH_2OH

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5. Which of the following represents the correct IUPAC name for the compounds concerned ? (a) 2,2-Dimethylpentane or 2-Dimethylpentane (b) 2,4,7- Trimethyloctane or 2,5,7-Trimethyloctane (c) 2-Chloro-4-methylpentane or 4-Chloro-2-methylpentane (d) But-3-yn-1-ol or But-4-ol-1-yne.

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6. Draw formulas for the first five members of each homologous series beginning with the following compounds. (a) $H-COOH$ (b) CH_3COCH_3 (c) $H-CH=CH_2$

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7. Give condensed and bond line structural formulas and identify the functional group(s) present, if any, for :

(a) 2,2,4-Trimethylpentane

(b) 2-Hydroxy-1,2,3-propanetricarboxylic acid

(c) Hexanedial

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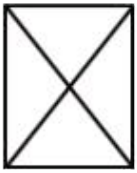
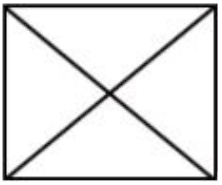
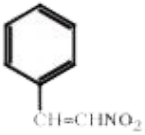
8. Identify the functional groups in the following compounds

(a) 

(b) 

(c) 

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9. Which of the two: $O_2NCH_2CH_2O^-$ or $CH_3CH_2O^-$ is expected to be more stable and why ?

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10. Explain why alkyl groups act as electron donors when attached to a π system.

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11. Draw the resonance structures for the following compounds. Show the electron shift using curved-arrow notation.

(a) C_6H_5OH (b) $C_6H_5NO_2$ (c) $CH_3CH=CHCHO$ (d) C_6H_5-CHO (e) $C_6H_5-\overset{+}{C}H_2$ (f) $CH_3CH=CH\overset{+}{C}H_2$

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12. What are electrophiles and nucleophiles ? Explain with examples.

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13. Identify the reagents shown in bold in the following equations as nucleophiles or electrophiles:

(a) $CH_3COOH+HO^- \rightarrow CH_3COO^- + H_2O$

(b) $CH_3COCH_3+\overset{-}{C}N \rightarrow (CH_3)_2C(CN)(OH)$

(c) $C_6H_5+CH_3\overset{+}{C}O \rightarrow C_6H_5COCH_3$

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14. Classify the following reactions in one of the reaction type studied in this unit.

(a) $CH_3CH_2Br + HS^- \rightarrow CH_3CH_2SH$

(b) $(CH_3)_2C = CH_2 + Hcl \rightarrow (CH_3)_2ClC$

(c) $CH_3CH_2Br + HO^- \rightarrow CH_2 = CH_2 + H_2C$

(d) $(CH_3)_3C - CH_2OH + HBr \rightarrow (CH_3)_2CBrCH_2CF$

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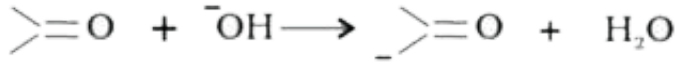
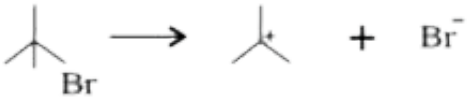
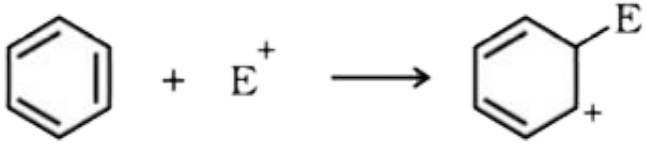
15. For the following bond cleavages, use curved-arrows to show the electron flow and classify each as homolysis or heterolysis. Identify reactive intermediate produced as free radical, carbocation and carbanion.

(a) $CH_3O - OCH_3 \rightarrow CH_3\dot{O} + \dot{O}CH_3$

(b) 

(c) 

(d) 

(b)

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16. Explain the terms Inductive and Electromeric effects. Which electron displacement effect explains the following correct orders of acidity of the carboxylic acids?

(a) $Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH$

(b) $CH_3CH_2COOH > (CH_3)_2CHCOOH > (CH_3)_2C.COOH$

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17. Give a brief description of the principles of the following techniques taking an example in each case.

(a) Crystallisation (b) Distillation (c) Chromatography

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18. Describe the method, which can be used to separate two compounds with different solubilities in a solvent S.

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19. What is the difference between distillation, distillation under reduced pressure and steam distillation ?

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20. Discuss Lassigne's test.

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21. Differentiate between the principal of estimation of nitrogen in an organic compound by (i) Kjeldehl's method and (ii) Dumas method.

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22. Explain the estimation of phosphorus and sulphur present in the organic compound

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23. Explain the principle of chromatography.

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24. Why is nitric acid added to sodium extract before adding silver nitrate for testing halogens?

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25. Explain the reason for the fusion of an organic compound with metallic sodium for testing nitrogen, sulphur and halogens.

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26. Name a suitable technique of separation of the components from a mixture of calcium sulphate and camphor.

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27. Explain why an organic liquld vaporizes at a temperature below its bolling point in Its steam distillation.

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28. Will CCl_4 give white precipitate of AgCl on heating it with silver nitrate? Give reason for your answer.

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29. Why is a solution of potassium hydroxide used to absorb carbon dioxide evolved during the estimation of carbon present in an organic compound?

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30. Why is it necessary to use acid and not sulphuric acid for acidification of sodium extract for testing sulphur by lead acetate test?

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31. An organic compound contains 69% carbon and 4.8% hydrogen, the remainder being oxygen. Calculate the masses of carbon dioxide and water produced when 0.20 g of this substance is subjected to complete combustion.

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32. A sample of 0.50 g of an organic compound was treated according to Kjeldahl's method. The ammonia evolved was absorbed in 50 ml of $0.5MH_2SO_4$. The residual acid required 60 mL of 0.5 M

solution of NaOH for neutralisation. Find the percentage composition of nitrogen in the compound.

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33. 0.3780 g of an organic chloro compound gave 0.5740 g of silver chloride in Carius estimation. Calculate the percentage of chlorine present in the compound.

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34. In the estimation of sulphur by Carius method, 0.468 g of an organic sulphur compound afforded 0.668 g of barium sulphate. Find out the percentage of sulphur in the given compound.

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35. In the organic compound $CH_2 = CH - CH_2 - CH_2 - C \equiv CH$, the pair of hydridised orbitals involved in the formation of: $C_2 - C_3$ bond is:

(a) $sp - sp^2$ (b) $sp - sp^3$ (c) $sp^2 - sp^3$ (d) $sp^3 - sp^3$

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36. In the Lassaigne's test for nitrogen in an organic compound, the Prussian blue colour is obtained due to the formation of:

(a) $Na_4[Fe(CN)_6]$ (b) $Fe_4(CN_6]_3$ (c) $Fe_2[Fe(CN)_6]$ (d) $Fe_3[Fe(CN)_6]_4$

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37. Which of the following carbocation is most stable ?

(a) $(CH_3)_3C.\overset{+}{C}H_2$ (b) $(CH_3)_3\overset{+}{C}$ (c) $CH_3CH_2\overset{+}{C}H_2$ (d)

$CH_3\overset{+}{C}HCH_2CH_3$

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38. The best and latest technique for isolation, purification and separation of organic compounds is:

(a) Crystallisation (b) Distillation (c) Sublimation (d) Chromatography

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39. The reaction:

$CH_3CH_2I + KOH(aq) \rightarrow CH_3CH_2OH + KI$

is classified as :

(a) electrophilic substitution (b) nucleophilic substitution (c) elimination (d) addition

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