20 Some Basic Principles of Organic Chemistry

- **Tetravalency of carbon hybridization and shape of molecules**
  - In excited state electonic configuration of c-atom has four unpaired electrons, hence carbon can form four covalent bonds.
  - Formation of same number of orbitals having same properties of various type of orbitals (s and p) of C-atom is called hybridization and orbitals produces are called hybridized orbitals.
  - Hybrid orbitals of carbon form σ- bond and those orbitals which do not take part in hybridisation form pi (π) bond.
  - Single bond is always σ bond. In double bond one σ and one π bonds are present, while in triple bond one σ and two π bonds are present.
  - On the basis of number of σ-bond in carbon atom its hybridization is determined.
- **Remember :**

Type of compound	Type of bond	hybridi -zation of carbon	shape of molecule	bond angle	C–C bond length
Alkane	$-\overset{\vert}{\underset{\vert}{C}}-\overset{\vert}{\underset{\vert}{C}}-$	sp^3	tetrahedral	109° 28’	154 *pm*
Alkene	$>C=C<$	sp^2	trigonal plannar	120°	134 *pm*
Alkyne	$-C\equiv C-$	sp	linear	180°	120 *pm*

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1. In which of the following molecule carbon-carbon bond length is least ?
   (A) ethane (B) ethene (C) ethyne (D) benzene
2. How many σ and π bonds are present in dicyano ethene CN – CH = CH – CN respectively ?
   (A) 7 and 1 (B) 7 and 5 (C) 5 and 7 (D) 3 and 5
3. In but-l-ene-3-yne number of σ and π bonds are ...... respectively.
   (A) 7 and 5 (B) 7 and 3 (C) 6 and 4 (D) 6 and 3
4. In which of the following compound all C-atom have sp^2 hybridization ?
   (A) ethane (B) propene (C) ethyne (D) ethylene
5. What is the type of hybridization of each C in the following compound ?
   $CH_3-CH=CH-CN$
   (A) sp^3, sp^2, sp, sp (B) sp^3, sp^2, sp^2, sp (C) sp, sp^2, sp^3, sp (D) sp^2, sp^2, sp^3, sp
6. What is the expected bond angle in the molecule in which the central atom is sp^3 hybridized ?
   (A) 109° 28’ (B) 120° (C) 90° (D) 180°
7. Which hybrid orbitals are involved in the bond formation between C_2-C_3 in given organic compound ?
   $^1CH\equiv{}^2C-{}^3CH_2-{}^4CH_3$
   (A) sp – sp (B) sp^2 – sp (C) sp^2-sp^2 (D) $sp-sp^3$

8. In the dehydration reaction $CH_3CONH_2 \xrightarrow[\Delta]{P_2O_5} CH_3CN$ hybridization of carbonyl carbon changes to what ?

(A) sp^3 to sp^2 (B) sp^2 to sp^3 (C) sp^2 to sp (D) sp to sp^3

9. What are the changes in hybridization of carbon in addition halogenation reaction of ethene ?

(A) sp^3 to sp^2 (B) sp^2 to sp^3 (C) sp^2 to sp^2 (D) sp to sp^3

10. What is the correct order of C–C bond length ?

(A) $C_2H_6 > C_2H_4 > C_2H_2$ (B) $C_2H_4 > C_2H_6 > C_2H_2$

(C) $C_2H_2 < C_2H_6 < C_2H_4$ (D) $C_2H_6 < C_2H_4 < C_2H_2$

Answers : 1. (C), **2.** (B), **3.** (B), **4.** (D), **5.** (B), **6.** (A), **7.** (D), **8.** (C), **9.** (B), **10.** (A)

- **Classification of organic compounds on the basis of functional group**
  - The atom or group of atom which is responsible for characteristic reactions of organic compunds is called functional group.
  - While writing the structure of organic compounds it is necessary to remember the number of bonds. For example carbon has four bonds, nitrogen has three bonds, oxygen has two bond and for hydrogen and halogen single bond.
  - While writing the name of organic compounds on the basis of number of C atom present in it corresponding word root (Greekword) is used which as follows :

Number of C →	1	2	3	4	5	6	7	8	9	10
word root →	meth	eth	prop	but	pent	hex	hept	oct	non	dec

  - Organic compounds classified into 14 parts based on functional group :

Type of compound	Functional group	Prefix/suffix in nomenclature	Example	IUPAC Name
(1) Alkane	$-\overset{\mid}{\underset{\mid}{C}}-\overset{\mid}{\underset{\mid}{C}}-$ R – H	–| ane	$CH_3–CH_2–CH_3$	propane
(2) Alkene	>C=C<	–| ene	$CH_3–CH=CH_2$	propene
(3) Alkyne	–C≡C–	–| yne	$CH_3–C≡CH$	propyne
(4) Alcohol	–OH	–| ol	$CH_3–CH_2–CH_2–OH$	propan-1-ol
(5) Ether	–O–	alkoxy |–	$CH_3–O–CH_2–CH_3$	Methoxy ethane
(6) Aldehyde	–CHO	–| al	$CH_3–CH_2–CHO$	propanal
(7) Ketone	–CO–	–| one	$CH_3–CO–CH_3$	propanone
(8) Carboxylic acid	–COOH	–| oic acid	$CH_3–$ $CH_2–COOH$	propanoic acid
(9) Ester	–COOR R=alkyl	–| oate	$CH_3–$ $COOCH_3$	Methyl ethanoate
(10) Amine (a)	$–NH_2$ primary amine	–| amine	$CH_3–CH_2–CH_2–NH_2$	propan-1 -amine

Amine (b)	–NH– secondary amine	–| amine	$CH_3–CH_2–NH–CH_3$	N-Methyl ethanamine
Amine (c)	$-\underset{\vert}{N}-$ tertiary amine	–| amine	$CH_3–CH_2–\underset{\underset{CH_3}{\vert}}{N}–CH_3$	N,N-dimethyl ethanamine
(11) Amide	$–CONH_2$	–| amide	$CH_3CH_2CONH_2$	Propananide
(12) Nitro	$–NO_2$	Nitro |–	$CH_3–CH_2–CH_2–NO_2$	1-nitro propane
(13) Cyanide	–CN	–| nitrile	$CH_3–CH_2–CN$	propane nitrile
(14) Halide	–X X=F, Cl, Br, I	halo |–	$CH_3–CH_2–CH_2–Cl$	1-chloro propane

Note :

(1) In alkane, alkene and alkyne's nomenclature proper suffix is added to wordroot on the basis of number of carbon

eg., $CH_3 - CH = CH_2$ word root + suffix
prop + ene = propene

(2) In other compounds nomenclature appropriate prefix or suffix is added to alkane name.

eg., $CH_3 - \underset{\underset{Cl}{\vert}}{CH} - CH_3$ prefix + alkane
2 - chloro + propane
= 2 - chloro propane

(3) In case of ether, group with less number of carbon atom attached to oxygen is given prefix alkoxy and group with greater number of carbon is taken as alkane.

(4) In ester (–COOR), after writing the name of alkyl group connected in place of R, remaining carbon is taken as alkane and "oate" suffix is added.

(5) In 2° and 3° amine, group with highest number of carbon is taken as alkane, suffix "amine" is added and remaining groups taken as alkyl group.

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11. From which of the following compounds suffix "oate" is added ?
(A) aldehyde (B) ketone (C) ester (D) ether

12. In IUPAC nomenclaure of cyanide compound which suffix is added ?
(A) cyano (B) cyanide (C) cyanate (D) nitrile

13. Compounds with which hybridization of carbon get suffix 'ene' in IUPAC nomenclature ?
(A) dsp^2 (B) sp^2 (C) sp^3 (D) sp

14. Mention the IUPAC name of $CH_3CH_2COOCH_3$.
(A) butanoate (B) ethyl ethanoate (C) Methyl propanoate (D) Methyl propanoate

15. Identify the formula of butane nitrile :
(A) $CH_3CH_2CH_2CN$ (B) $CH_3CH_2CH_2NH_2$
(C) $CH_3CH_2CH_2CH_2CN$ (D) $CH_3CH_2CH_2CH_2NO_2$

16. In which compound having only one functional group, prefix is added in nomenclature ?
(A) alcohol (B) ether (C) amide (D) ketone

Answers : 11. (C), **12.** (D), **13.** (B), **14.** (D), **15.** (A), **16.** (B)

- **Homologous series and isomerism**
  - Series of compounds having difference of $- CH_2 -$ between two successive member is called homologous series. eg. alkane series.

    CH_4, C_2H_6, C_3H_8, C_4H_{10}, C_5H_{12}
  - Compounds having same molecular formula but different properties are called isomers of each other and this phenomenon is called isomerism.
  - Classification of isomerism as follows :

Isomerism

↓

Structural isomerism	**Stereo isomerism**		
↓	↓	↓	↓
(1) chain isomerism	conformational isomerism	geometrical isomerism	optical isomerism
(2) position isomerism	↓	↓	↓
(3) functional isomerism	staggered	as	enantiomers
(4) metamerism	eclipsed	trans	diasteveomers
(5) Tautomerism			meso
(6) ring-chain isomerism			

Chain isomerism : arrangement of carbon atom is linear or branched.

eg., $CH_3 - CH_2 - CH_2 - CH_3$ and $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3$

n – butane ; iso butane

Position isomerism : Position of functional group is different.

eg., $CH_3 - CH_2 - CH_2 - OH$ and $CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$

Propan-1-ol ; propan – 2 – ol

Functional group isomerism : Functional groups are different.

eg., $CH_3 - CH_2 - COOH$ and $CH_3 - COOCH_3$

Propanoic acid ; Methyl ethanoate

This isomerism is observed in ester-acid alcohol-ether, aldehyde-ketone and 1°, 2°, 3° amine.

metamerism : functional group is same but alkyl groups connected on both side have different numbers of carbon atoms.

eg., $CH_3 - O - CH_2CH_2CH_3$ and $CH_3CH_2 - O - CH_2CH_3$

1–methoxy propane ; Ethoxy ethane

This isomerism is observed in ether, ester, 2° and 3° amine.

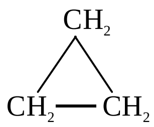
Tautomerism : Isomers form due to migration of α – hydrogen atom.

eg.,

$$\underset{\text{keto form}}{CH_3-\underset{\underset{O}{\|}}{C}-CH_3} \rightleftharpoons \underset{\text{enol form}}{CH_2=\underset{\underset{OH}{|}}{C}-CH_3}$$

Ring chain isomerism : one isomer has cyclic structure and other isomer has linear chain structure.

eg.,



Cyclo propane

and $CH_3-CH=CH_2$

Propene

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17. How do successive members of homologous series differ from each other ?

(A) $-CH_3$ group (B) $-CH_2$ group (C) $-C_2H_5$ group (D) $-CH$ group

18. Between successive members of alkane homologous series, difference between molecular mass is ....

(A) 16 amu (B) 12 amu (C) 14 amu (D) 18 amu

19. Which of the following pair shows functional group isomerisms ?

(A) aldehyde and alcohol (B) alcohol and amine

(C) carboxylic acid and aldehyde (D) alcohol and ether

20. How many isomers does pentane chain contain ?

(A) 2 (B) 3 (C) 4 (D) 6

21. How many isomers of C_3H_9N compound having amine group ?

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

22. How many chain isomers are possible for C_4H_8 ?

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

23. Which of the following compound does not show position isomerism ?

(A) butene (B) butanal (C) but-1-amine (D) butyne

24. How many chain isomers are possible for pentanol ?

(A) 4 (B) 5 (C) 6 (D) 7

25. Which of the following is not isomer of diethyl ether ?

(A) Methyl propyl ether (B) butan-1-ol

(C) 2-Methyl-propan-1-ol (D) diethyl ketone

26. Number of isomers of $C_4H_{10}O$ ....

(A) 7 (B) 8 (C) 5 (D) 6

27. Isomer of ethyl alcohol is ....

(A) diethyl ether (B) dimethyl ether (C) ethanal (D) acetone

28. ...... type of isomerism is observed in urea.

(A) chain (B) position (C) geometrical (D) tautomerism

29. $CH_3–O–C_3H_7$ and $C_2H_5–O–C_2H_5$ shows which type of isomerism.

(A) position (B) chain (C) metamerism (D) tautomerism

30. Pair of Acetone and prop-1-en-2-ol are example of which type of isomerism ?

(A) Position (B) Tautomerism (C) Functonal group (D) Metamerism

31. Which type of isomerism is observed in but-2-ene ?

(A) functional group (B) metamerism (C) geometrical (D) optical

32. Diethyl ether and methyl propyl ether are ....

(A) position isomer (B) functional group isomer

(C) metamers (D) rotamers

33. Cyclo alkene and alkyne are which type of isomers ?

(A) Chain (B) Functional group (C) Metamers (D) Votamers

34. n–propyl alcohol and iso propyl alcohol are examples of which type of isomerism.

(A) position (B) chain (C) geometrical (D) stereo

35. Functional isomers of propionic acids are ....

(A) $HCOOC_2H_5$ and CH_3COOCH_3 (B) $HCOOC_2H_5$ and C_3H_7COOH

(C) C_3H_7OH and CH_3COCH_3 (D) CH_3CH_2COOH and C_3H_7OH

36. How many isomers of C_6H_{14} are possible ?

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

37. Which isomerism is ehibited by $C_5H_{10}O$?

(A) Position (B) Functional group (C) Metamerism (D) All the given

38. Which isomerism is not shown by alkene ?

(A) chain (B) geometrical (C) position (D) metamerism

39. Which type of compounds do not have metamers ?

(A) ketone (B) amine (C) ether (D) alcohol

40. Which isomerism is shown by $R – C \equiv N$ and $R – N^+ \equiv C^-$?

(A) Position (B) Functional group (C) metamerism (D) Tautomerism

Answers : **17.** (B), **18.** (C), **19.** (D), **20.** (B), **21.** (C), **22.** (A), **23.** (B), **24.** (A), **25.** (D), **26.** (A), **27.** (B), **28.** (D), **29.** (C), **30.** (B), **31.** (C), **32.** (C), **33.** (D), **34.** (A), **35.** (A), **36.** (C), **37.** (D), **38.** (D), **39.** (D), **40.** (B)

- **Nomenclature of organic compounds (Common and IUPAC)**

Organic compounds are named on the basis of rules of IUPAC which is called its IUPAC name. Apart from this some organic compounds are known by common name or popular name.

Study IUPAC rules appropriately from text book.

- **Simple method to write IUPAC name.**

attach prefix of substituted group or branch $\Leftarrow$ 1st determine longest hydrocarbon root (alkane, alkene, alkyne) $\Rightarrow$ attach suffix of principal functional group

Priority order of principal functional group is as follows :

$-COOH > -COOR > -CONH_2 > CN > CHO > -CO > -OH >$
$-NH_2 > C = C > C \equiv C >$ Substituted groups ($-OR$, $-X$, $-NO_2$, $-R$)

Substituded group or branch means which is not included in chain of hydro carbon root.

- **Examples of IUPAC nomenclature**

(1)
$$\begin{array}{ccccccccc} & & CH_3 & & & & & & \\ & & | & & & & & & \\ {}^1CH_3 & - & {}^2C & - & {}^3CH_2 & - & {}^4CH & - & {}^5CH_3 \\ & & | & & & & | & & \\ & & CH_3 & & & & CH_3 & & \end{array}$$

2, 2, 4 – trimethyl pentane
↓ prefix ↓ hydrocarbon root

(2) $^4CH_2 = {}^3CH - {}^2CH_2 - {}^1CH_2 - OH$

But – 3 – en – 1 –ol
↓ hydro carbon root ↓ suffix

(3)
$$\begin{array}{ccccccccccccc} {}^7CH_3 & - & {}^6CH & - & {}^5CH_2 & - & {}^4CH & - & {}^3CH_2 & - & {}^2CH & - & {}^1CH_3 \\ & & | & & & & | & & & & | & & \\ & & Br & & & & CH_2{-}CH_3 & & & & OH & & \end{array}$$

6–Bromo–4–ethyl heptan – 2 – ol
↓ prefix ↓ Hydro carbon root ↓ suffix

(4)
$$\begin{array}{ccccccc} {}^4CH_3 & - & {}^3CH & - & {}^2CH_2 & - & {}^1COOH \\ & & | & & & & \\ & & OH & & & & \end{array}$$

3–hydroxy butanoic acid
↓ prefix ↓ hydro carbon root + suffix

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41. Correct IUPAC name of $CH_3CH_2CH(CH_3)CH(C_2H_5)_2$ is ....

(A) 4–ethyl 3–Methyl hexane
(B) 3–ethyl 4–Methyl hexane
(C) 4–Methyl 3–ethyl hexane
(D) 2, 4–diethyl pentane

42. Give IUPAC name of following compound :

$$\begin{array}{ccccccccc} CH_3 & - & CH & - & C & - & CH_2 & - & CH_3 \\ & & | & & \| & & & & \\ & & CH_3 & & CH_2 & & & & \end{array}$$

(A) 2–ethyl 3–Methyl but-l-ene
(B) 2–iso propyl but-1-ene
(C) 2–Methyl 3–ethyl but-3-ene
(D) 2–(1–Methyl ethyl) but-l-ene

43. What is correct IUPAC name of $CH_2 = CH - CH_2 - CH_2 - CH_2 - Cl$?

(A) 1–chloro pent-4-ene
(B) Pent-4-ene chloride
(C) 5–chloro pent-1-ene
(D) 1–chloro pentene

44. IUPAC name of $CH_2 = CH - CH_2 - CH_2 - OH$ is ....

(A) But-3-en-1-ol
(B) but-1-en-3-ol
(C) 4-hydroxy but-1-ene
(D) butenol

45. Give IUPAC name of the following compound : $CH_3 - \underset{OH}{\underset{|}{CH}} - CH = \underset{CH_3}{\underset{|}{C}} - CHO$

(A) 4–hydroxy-1-Methyl pentenal (B) 4-hydroxy-2-Mehtyl-pent-2-enal

(C) 2-hydroxy-4-Methyl pent-3-en-5-al (D) 2-hydroxy-3-methyl pent-2-enal

46. IUPAC name of urea is ....

(A) diamino ketone (B) amino methanamide (C) amino ethanamide (D) amino acetamide

47. IUPAC name of $CH_3 - CH = CH - C \equiv CH$ is ....

(A) Pent-2-en-4-yne (B) Pent-2-yn-3-ene

(C) Pent-3-en-1-yne (D) Pent-2-en-5-yne

48. Mention IUPAC name of $NC - CH_2 - \underset{CH_2CN}{\underset{|}{CH}} - CH_2 - CN$

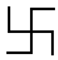
(A) iso butane tri nitrile (B) 3–cyano methyl pentane dinitrile

(C) 2, 2–Bis (Cyano methyl) enthane nitrile (D) tri ethane nitrile methane

49. IUPAC name of $HOOC - CH = CH - COOH$ is ....

(A) but-2-en-oic acid (B) butene di oic acid

(C) butene–1, 4–dioic acid (D) but-2-ene dioic acid

50. Mention IUPAC Name of  :

(A) Nonane (B) etetra ethylmethane

(C) 3–ethyl pentane (D) 3, 3–diehtyl pentane

Answers :	**41.** (B), **42.** (A), **43.** (C), **44.** (A), **45.** (B), **46.** (B), **47.** (C), **48.** (B), **49.** (D), **50.** (D)

- **Electronic transfer in covalent bond**

In organic compounds electron pair of covalent bond transfer by four different ways.

(1) Inductive Effect :

σ – electron pair present in carbon chain transfer to more electronegative atom or group.

On moving away from electronegative atom to carbon atom away from it this effect reduces.

This effect is permanent

eg., $C \rightarrow C \rightarrow\rightarrow C^{\delta+} \rightarrow\rightarrow\rightarrow C^{\delta-}$

Inductive effect (I–effect) are of two types : (1) If electron attracting group is connected at the end of chain, then it is called – I effect. Decreasing order of – I effect is as follows :

$R_3N^+ > {}^+NH_3 > -NO_2 > CN > SO_3H > CHO > CO > COOH > COCl > COOR > CONH_2 > F > Cl > Br > I > OH > NH_2 > C_6H_5 > H$

If electron donor group is attached at the end of chain then it is called + I effect. Decreasing order of + I effect :

$R_3{}^+C > R_2{}^+CH > R - {}^+CH_2 > {}^+CH_3$

3° 2° 1° methyl

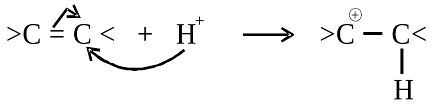
(2) Electromeric Effect :

• π-electron pair connected by double or triple bond transfer to one of the atom (mainly electronegative atom) due to contact of attacking reagent.

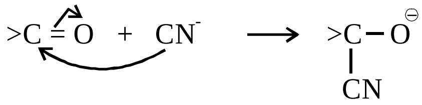
• This effect is temporary.

• Electromeric effect is of two types :

(i) If π electron pair displaces towards the attacking reagent then it is called +E effect

eg. 

(ii) If π electron pair displaces away from the attacking reagent then it is called –E effect.

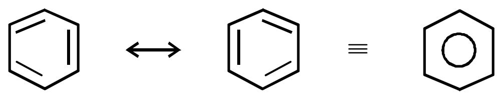
eg. 

(3) Mesomeric effect or Resonance effect :

• In some organic compounds, two or more than two structures are in vibration state. Such structures are called resonating structures. Their real structure is shown by intermediate state between two or more than two structures. Such structures are called resonance hybrid structure. This effect is known as mesomeric or resonance effect.

• This effect is observed in the system having alternate σ and π bond.

eg., benzene C_6H_6



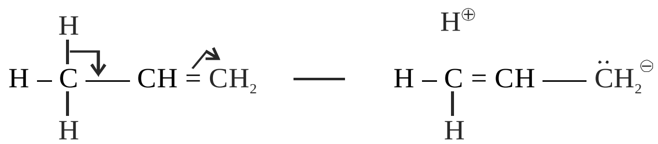
• Molecules having resonance structure have greater stability.

• e^- donor groups have +R effect and

e^- attracting groups have –R effect.

(4) Hyper conjugation :

• When C – C single bond is directly bonded with C = C or benzene ring, then σ e^- pair of C – H bond is attracted towards double bond. This effect called hyper conjugation.



• Order of + I effect of alkyl group is $3^o > 2^o > 1^o >$ methyl but when alkyl group is connected with double bond or benzene ring this order is reversed as methyl $> 1^o > 2^o > 3^o$ this is hyper-conjugation.

• Importance of hyper conjugation is as follows :

(i) Greater the number of $-CH_3$ group bonded with C = C greater is the stability of alkene.

(ii) Stability order of carbocation and free radical is $3^o > 2^o > 1^o >$ methyl.

(iii) Bond length of C – C bond adjacent to C = C decreases.

51. Which of the following group has least – I effect ?

(A) $-NO_2$ (B) $-COOH$ (C) $-F$ (D) $-N^+R_3$

52. Which of the following group has highest + I effect ability ?

(A) $(CH_3)_3C-$ (B) $(CH_3)_2-CH-$ (C) CH_3-CH_2- (D) $-CH_3$

53. Which group has maximum hyper conjugative effect ?

(A) R_3C- (B) R_2CH- (C) $R-CH_2-$ (D) $-CH_3$

54. In which of the following compound electromeric effect is not observed ?

(A) alkene (B) ether (C) aldehyde (D) ketone

55. In which of the following molecule resonance (delocalized electrons) is observed ?

(A) methane (B) ethane (C) benzene (D) cyclohexane

56. Which group has +R effect ?

(A) $-CN$ (B) $-CHO$ (C) $-NH_2$ (D) $-NO_2$

57. Which of the following alkene is the most stable ?

(A) $CH_3-CH=CH-CH_3$ (B) $(CH_3)_2C=CH_2$

(C) $(CH_3)_2\ C=CHCH_3$ (D) $(CH_3)_2C=C(CH_3)_2$

58. Which carbo cation is the most stable ?

(A) $CH_3CH_2^+$ (B) $CH_2=CH^+$ (C) $CH\equiv C^+$ (D) $C_6H_5^+$

59. Which type of conjugation is hyper conjugation ?

(A) $\sigma-\pi$ (B) $\sigma-\sigma$ (C) $\pi-\pi$ (D) $\pi-\sigma$

60. Which of the following free radical is the most stable ?

(A) $C_6H_5CH_2-\dot{C}H_2$ (B) $C_6H_5\dot{C}HCH_3$ (C) $CH_3\dot{C}H_2$ (D) $CH_3\dot{C}HCH_3$

Answers :	**51.** (C), **52.** (A), **53.** (D), **54.** (B), **55.** (C), **56.** (C), **57.** (D), **58.** (A), **59.** (A), **60.** (B)

- **Fission of covalent bond**

Fission of covalent bond is done in two different ways.

(1) Homolytic fission : Two atoms bonded by covalent bond are separated by gaining one electron each and as a result free radical is formed.

eg., $Cl-Cl \xrightarrow{h\upsilon} Cl\cdot + Cl\cdot$ free radicals

(2) heterolytic fission : If during fission of covalent bond more electronegative atom separated by gaining two electrons and as a result positive and negative ion are formed.

eg., $CH_3-Cl \rightarrow {}^+CH_3 + Cl^-$:

Positive ion negative ion

Positive ion or some neutral molecules which have capacity to accept electrons are called electrophiles.

eg., ${}^+NO_2$, ${}^+Cl$, ${}^+CH_3$, BF_3, $AlCl_3$, $SnCl_2$

- Negative ion or some neutral molecules which have capacity to donate electrons are called nucleophile.

  eg., X^-, OH^-, NH_2^-, $\ddot{N}H_3$, $H_2\ddot{O}$
- Chemical species having positively charged carbon is called carbocation or carbonium ion. eg., $\overset{\oplus}{C}H_3$
- Chemical species having negatively charged carbon is called carbanion eg. $\overset{\ominus}{C}H_3$
- Stability order of carbanion : methyl $> 1^o > 2^o > 3^o$

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61. What is called positive ion formed by heterolytic fission of covalent bond ?

(A) Electrophile (B) Nucleophile (C) Lewis acid (D) Both (A) and (C)

62. Which carbanion has the least stability ?

(A) $\overset{\ominus}{C}H_3$ (B) $CH_3-\overset{\ominus}{C}H_2$ (C) $(CH_3)_2\overset{\ominus}{C}H$ (D) $(CH_3)_3\overset{\ominus}{C}$

63. Which of the following is nucleophile ?

(A) H_2O (B) BF_3 (C) $AlCl_3$ (D) SO_3

64. Which particles are obtained by homolytic fission of A – B bond ?

(A) One positive and one anion (B) two carbocation

(C) one carbocation and one carb anion (D) two free radicals

65. Which sentence is incorrect with reference to free radical ?

(A) They are paramagnetic species having unpaired electrons.

(B) They are electrically neutral and highly reactive.

(C) Carbon atom of free radical has 7 electron in valence orbital.

(D) They are highly stable and long lasting.

Answers : 61. (D), **62.** (D), **63.** (A), **64.** (D), **65.** (D)

- **Types of organic reactions**

Substitution reaction : Atom or group atom present in organic compound is substituted by another atom or group of atom.

eg., $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$

Addition reaction : π bond of double or triple bond is broken and another molecule is added.

eg., $CH_2 = CH_2 + Cl_2 \longrightarrow Cl - CH_2 - CH_2 - Cl$

Eliminaton reaction : From adjacent carbon atoms, a group of atoms is removed as molecule and as a result between two carbon new π–bond forms. eg., $CH_3 - CH_2 - OH \xrightarrow[350-400^oC]{[Al_2O_3]} CH_2 = CH_2 + H_2O$

Rearrangement reaction : Displacement of atom or group of atoms to other place within the same molecule.

eg., $\underset{\text{n–butane}}{CH_3 - CH_2 - CH_2 - CH_3} \xrightarrow{[AlCl_3]} CH_3 - \underset{\substack{| \\ CH_3}}{CH} - CH_3$

iso-butane

66. Mention the type of the following reaction :

$CH_3 - CH_2 - Cl + KOH \xrightarrow{\text{alcohol}} CH_2 = CH_2 + KCl + H_2O$

(A) substitution (B) addition (C) elimination (D) rearrangement

67. Identify the type of reaction : CH_3CH_2I + acqueous KOH $\rightarrow$ $CH_3CH_2OH + KI$.

(A) substitution (B) addition (C) elimination (D) halogenation

68. Which product is obtained by hydrogenation of ethene in presence of nickel catalyst ?

(A) ethanol (B) ethyne (C) ethane (D) methane

69. In which reaction new π– bond is formed ?

(A) substitution (B) addition (C) elimination (D) rearrangement

70. Which of the following is elimination reaction ?

(A) Chlorination of ethene (B) Hydration of ethene

(C) Conversion of But-1-ene into But-2-ene (D) Dehydration of ethanol

71. Number of σ and π bonds in pent-l-en-4-yne is ....

(A) 3, 10 (B) 9, 4 (C) 4, 9 (D) 10, 3

72. In buta-1,2 – diene compound ....

(A) Only sp hybridized carbon atoms (B) Only sp^2 hybridized carbon atoms

(C) sp and sp^2 hybridized carbon atoms (D) sp, sp^2 and sp^3 hybridized carbon atoms

73. Which of the following IUPAC name is incorrect ?

(A) $CH_3 - \underset{\underset{O}{\|}}{C} - \underset{\underset{CH_3}{|}}{CH} - CH_3$ 2–Methyl butan-3-one

(B) $CH_3 - \underset{\underset{CH_3}{|}}{CH} - \underset{\underset{CH_2 - CH_3}{|}}{CH} - CH_3$ 2, 3 – di methyl pentane

(C) $CH_3 - C \equiv C{\cdot}CH\ (CH_3)_2$ 4 – Methyl pent – 2 – yne

(D) $CH_3 - \underset{\underset{Cl}{|}}{CH} - \underset{\underset{Br}{|}}{CH} - CH_3$ 2 – bromo 3 – chlorobutane

74. Match the column X with column Y and choose correct option :

Column -X	**Column-Y**
(i) free radical	(A) Lewis base
(ii) electrophile	(B) Electrically neutral
(iii) nucleophile	(C) Complete octet in valence orbit
	(D) Lewis acid
	(E) Electron octet is incomplete and in valence orbit single e^-
	(F) Electron octet incomplete

(A) (i)-(B),(E), (ii)-(D),(F), (iii)-(A),(C) (B) (i)-(A),(C), (ii)-(D),(F), (iii)-(B),(E)

(C) (i)-(D),(F), (ii)-(B),(E), (iii)-(A),(C) (D) (i)-(B),(E), (ii)-(A),(C), (iii)-(D),(F)

75. From the given sentences select the number of correct sentences and choose appropriate option.

(1) IUPAC name of propyl cyanide is propane nitrile.

(2) IUPAC name of diethyl ether is ethoxy ethane.

(3) Ethanol and vinyl alcohols are tautomers.

(4) Methoxy propane and ethoxy ethane are metamers.

(5) Stability of 2, 3–dimethyl but-2-ene is more than 2–methyl but-2-ene.

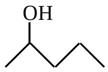
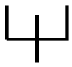
(6) Stability order of carbo cation is $1^o < 2^o < 3^o$.

(7) In Elimination reaction hybridization of carbon atom do not change.

(8) Nucleophites are Lewis acid.

(A) (1), (3), (5), (7) (B) (2), (4), (6), (8) (C) (2), (4), (5), (6) (D) (2), (4), (6), (7)

76. In column I bondline structures and in column II IUPAC names are given. Match them and select correct option.

Column-I	Column-II	
(1) 	(p) but-1-ene	(A) (1)–(q), (2)–(p), (3)–(t)
(2) 	(q) 2–hydroxy butane	(B) (1)–(s), (2)–(r), (3)–(u)
(3) 	(r) but-2-ene	(C) (1)–(q), (2)–(r), (3)–(u),
	(s) pentan-2-ol	(D) (1)–(q), (2)–(p), (3)–(u),
	(t) 3, 3–dimethyl butane	
	(u) 3, 3–dimethyl pentane	

77. On matching common name in column-I with structural formula of column II which of the following pair is correct :

Column-I	Column-II	
(P) formic anhydride	(W) CH_3CHO	(A) (P)-(X), (Q)-(W), (R)-(Y), (S)-(Z)
(Q) methyl acetate	(X) $CH_3 - COOCH_3$	(B) (P)-(Z), (Q)-(Y), (R)-(W), (S)-(X)
(R) acetamide	(Y) $(HCO)_2O$	(C) (P)-(Y), (Q)-(X), (R)-(Z), (S)-(W)
(S) acetaldehyde	(Z) CH_3CONH_2	(D) (P)-(W), (Q)-(Z), (R)-(X), (S)-(Y)

78. Match the column X with column Y and mention correct option :

Column X (Hydrocarbon group)	Column Y (Common name)	
(a) $(CH_3)_2\ CH-$	(p) tertiary butyl	(A) (a)-(t), (b)-(q), (c)-(t), (d)-(u)
(b) $CH_3CH_2 - \underset{\displaystyle CH_3}{\underset{\mid}{CH}} -$	(q) iso butyl	(B) (a)-(r), (b)-(q), (c)-(t), (d)-(u)
(c) $(CH_3)_3\ C-$	(r) vinyl	(C) (a)-(r), (b)-(s), (c)-(t), (d)-(u)
(d) $CH_2 = CH-$	(s) secondary butyl	(D) (a)-(t), (b)-(s), (c)-(p), (d)-(r)
	(t) iso propyl	
	(u) ethyl	

Answers : **66.** (C), **67.** (A), **68.** (C), **69.** (C), **70.** (D), **71.** (D), **72.** (D), **73.** (A), **74.** (A), **75.** (C), **76.** (B), **77.** (C) **78.** (D)

- **Read the paragraph carefully and answer the questions given below paragraph :**
- **Paragraph :** While giving IUPAC names of the organic compounds having more than one functional group the functional group with highest priority is considered as principal functional group and other functional groups are considered as substituted group. Carbon chain is given numbers in such away that principal functional group gets least number. (Que. No. 79 80)

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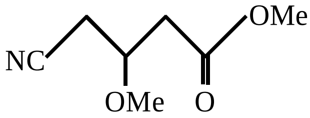
79. Give IUPAC name of the following compound :

$$CH_3 - CH = \underset{\substack{| \\ CONH_2}}{C} - CH_2 - COOH$$

(A) 2–ethyledene–3–carboxy propanamide (B) 3–ethyl-3-carbyl, propanoic acid

(C) 2-carboxymethyl but-2-en-1-amide (D) 3-carbamoyl pent-3-en-1-oic acid

80. IUPAC name of following compound is ....



(A) Methyl 4-cyano-3-methoxy pentanoate

(B) 4-methoxy-carbonyl-1-methoxy butanenitrile

(C) Methyl-4-cyano-3-methoxy butanoate

(D) 4-carbmethoxy-2-methoxy butanenitrile

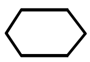
Instruction : Question no. 81 to 90 are assertion (A) and reason (R) types. Their four options are as follows. Select correct option :

(A) Assertion (A) and reason (R) both are correct and reason (R) is correct explanation of assertion (A).

(B) Assertion (A) and reason (R) both are correct but reason (R) is not correct explanation of assertion (A).

(C) Assertion (A) is correct while reason (R) is incorrect.

(D) Assertion (A) is incorrect while reason (R) is correct.

81. **Assertion (A) :** –CN is called cyclohexane carbonitrile.

Reason (R) : Suffix nitrile is given to alicyclic ring.

82. **Assertion (A) :** IUPAC name of CH_3 CH = CH – C ≡ CH is pent – 2 – en – 4 – yne.

Reason (R) : While determining the position of functional group rule of least set of locant is applied.

83. **Assertion (A) :** IUPAC name of $C_2H_5 - \underset{\substack{\| \\ CH_2}}{C} - CH_2 - OH$ is 2 – ethyl prop-2-en-1-ol

Reason (R) : Instead of methylene ethyl is accepted as substituted group because alphabatically ‘e’ of ethyl comes before ‘m’ of methylene.

84. Assertion (A) : Solubility of maleic acid in water is more than fumaric acid while melting point of fumaric acid is more than maliec acid.

Reason (R) : Molecules of fumaric acid are more symmetric hence they can arrange more closely packed in crystal structure.

85. Assertion (A) : In styrene geometrical isomerism is not observed.

Reason (R) : All the atoms in styrene molecule are in one plane

86. Assertion (A) : free radicals are paramagnetic.

Reason (R) : Free radicals have unpaired electrons.

87. Assertion (A) : Stability order of carbocation is $3^o > 2^o > 1^o$.

Reason (R) : As distance between alkyl group and reaction site increases +I effect decreases.

88. Assertion (A) : Boiling point of cis isomer is more than trans isomer.

Reason (R) : Dipole moment of cis isomer is more than trans isomer.

89. Assertion (A) : Allyl free radicals are more stable than alkyl free radical.

Reason (R) : Due to resonance allyl free radicals are more stable.

90. Assertion (A) : $CHBr = CHCl$ has geometrical isomers but $CH_2Br - CH_2Cl$ has no geometrical isomers.

Reason (R) : For geometrical isomers presence of $C = C$ is essential..

Answers :	**78.** (D), **79.** (D), **80.** (C), **81.** (C), **82.** (D), **83.** (C), **84.** (A), **85.** (B), **86.** (A), **87.** (B), **88.** (A), **89.** (A), **90.** (C).

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