Toppersnotes
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NEET - UG

NATIONAL TESTING AGENCY

Chemistry

Organic Chemistry

SIERRA INNOVATIONS

INDEX

Organic Chemistry

Toppersnotes
Unleash the topper in you

"General Organic Chemistry"

* Urea was the first organic compound synthesized in laboratory by Wohler.

$$NH_4CNO \underset{}{\overset{\Delta}{\rightleftharpoons}} \underset{\text{Urea}}{H_2N-\overset{\overset{O}{\|}}{C}-NH_2}$$

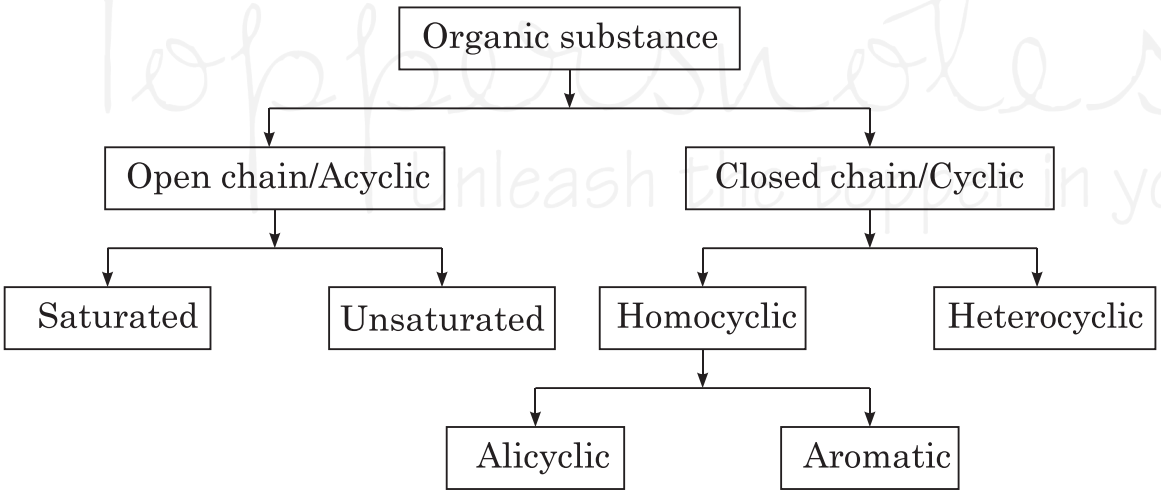
* Hydrocarbons and their derivatives are called organic substances.

$$R\text{—}H \xrightarrow[-H]{\Delta G} R\text{—}G$$

Hydrocarbon Hydrocarbon derivative

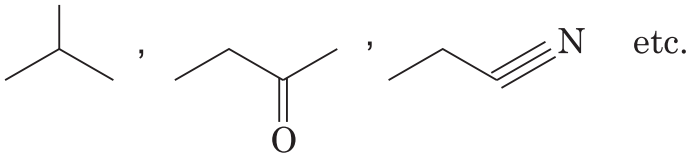
Classification of Organic Substances

A. On the basis of carbon chain

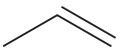
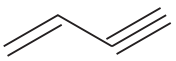
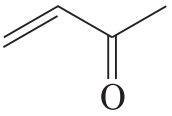


1. Open chain substances

(i) Saturated substances : Substances in which all the carbon atoms are joined by single bonds only.

Eg.  etc.

(ii) Unsaturated compounds : Substances having at least 1 C—C multiple bond.

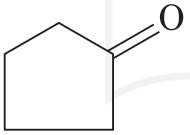
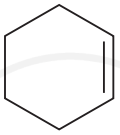
Eg.  ,  ,  etc.

* Multiple bond containing organic substances may be saturated or unsaturated.
* Olefinic bond : Carbon-carbon double bond is also called olefinic bond.
* Acetylenic bond : C—C triple bond is also called acetylenic bond.
* Open chain substances are also called aliphatic substances.

2. Closed chain substances :

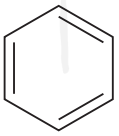
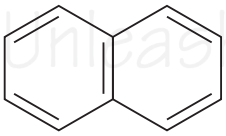
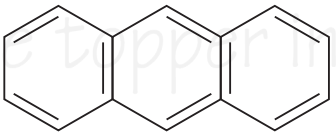
(i) **Homocyclic substances** : [Carbocyclic substances] substances in which ring system is made up of same type of atoms.

(a) Alicyclic substances : Substances having properties similar to aliphatic substances.

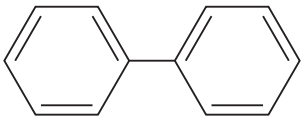
Eg.  ,  , etc.

(b) Aromatic substances :

I. Benzenoyl substances : Aromatic compounds having at least one benzene ring.

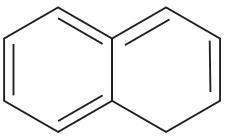
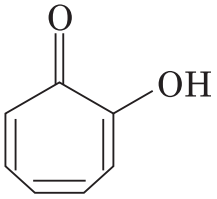
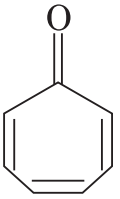
Eg.  ,  , 

Naphthalene (fused BS) Anthracene



Diphenyl

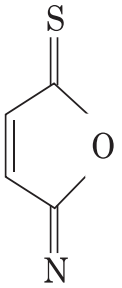
II. Non-Benzenoyl substances : Aromatic substances without benzene ring.

Azulene Tropolone Tropone

(ii) Heterocyclic substances : Substances in which ring system having at least 1 different atom another than C atom, like N, S, etc.

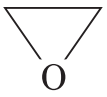
Q. How many heteroatoms are present in given compounds?



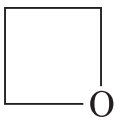
Sol. 1. Heteroatom (0)

(a) Heterocyclic alicyclic substances :

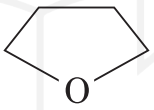
Eg.



Oxirane

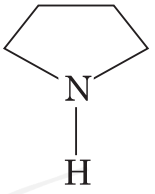


Oxetane



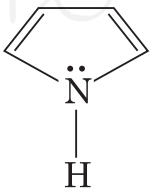
Tetra hydrofuran (THF)

Aziridine

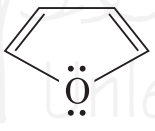


Pyrrolidine

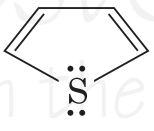
(b) Aromatic heterocyclic substances :



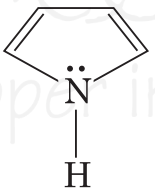
Pyrrole



Furane



Thiophene



Pyrazole

B. Classification based functional group

1. **Homologous series** :

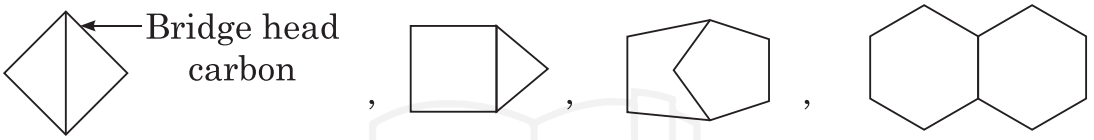
- Series of organic substances having same functional group and difference of at least 1 $-CH_2$ unit 14 mol weight.

2. **Characteristics** :

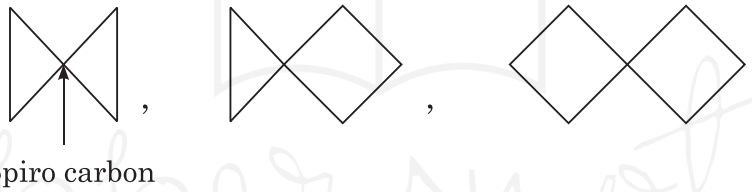
- An individual member of any homologous series is called homologue.
- Homologous have same chemical properties but different physical properties.
- All the members of homologous series can be represented by same general formula.

Homologous series	General formula
(i) Alkane	C_nH_{2n+2}
(ii) Alkene, Cycloalkane	C_nH_{2n}
(iii) Alkyne, Alkandiene, Bicuclo, Spiro	C_nC_{2n-2}

(a) Bicyclo Compounds : The substance in which 2 cyclic rings are fused at 2 common carbon atoms.

Eg. 

(b) Spiro Compounds : The compounds in which 2 cyclic rings are fused at single carbon.

Eg. 

Homologous series	General formula
(iv) Alcohol, Ether	$C_nH_{2n+2}O$
(v) Carbonyl compounds (Aldehyde, Ketones)	
Unsaturated alcohols & Ether (double bond containing)	$C_nH_{2n}O$
Cyclic alcohol & Cyclic ether	
(vi) Carbocylic acid & Ester	$C_nH_{2n}O_2$
Hydroxy carbonyl compounds	
(vii) Amide oxime	$C_nH_{2n+1}NO$

$$[-\overset{\overset{O}{\|}}{C}-NH_2] \quad (\rangle C=N-OH)$$

(viii) Aromatic alcohol & phenolic compounds $C_nH_{2n-6}O$

(ix) 1°/2°/3° amine $C_nH_{2n+3}N$

$(—NH_2)(—NH—)(—\overset{|}{N}—)$

Q. An alkane can be represented by following general formula.

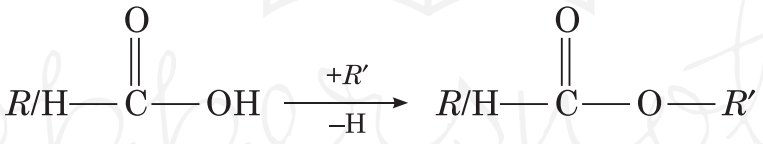
1. C_nH_{2n+2} $n(n-1)$

2. $C_{n-1}H_{2n}$ $C_{n-1}H_{2(n-1)+2}$

3. $C_{n+1}H_{2n+4}(n=0)$ $C_{n-1}H_{2n}-2+2$

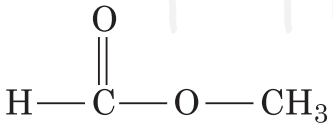
Sol. All $I \rightarrow \boxed{n=2}$

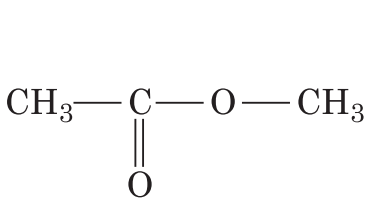
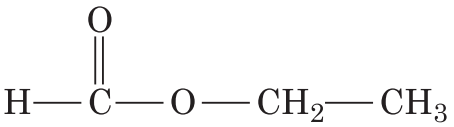
Q. Find minimum required C for the second member of ester series.



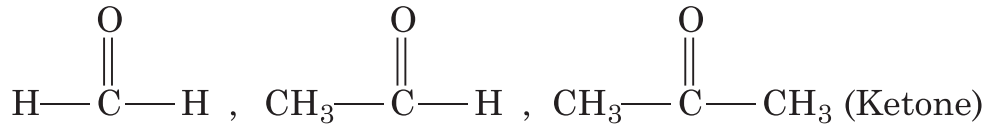
Ester

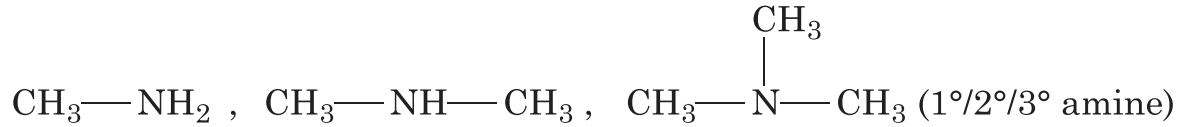
Sol.

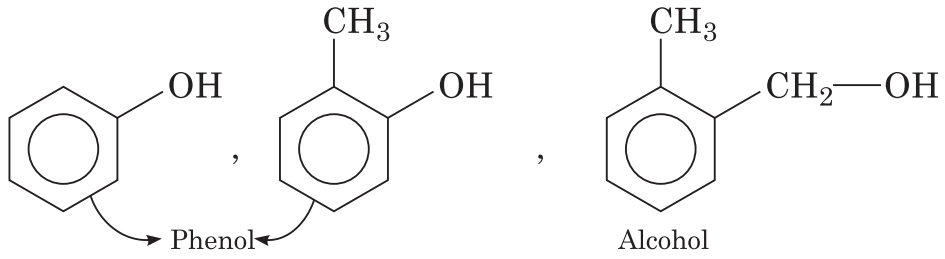
Ist 

IInd  or 

Q. Select triad of Homologous.

(1) 

(2) 

(3) 

(4) None

Sol. (4) None

C. Classification of Carbon & Hydrogen Atoms

1. **Types of Carbon** : Carbon atom is classified on the basis of total next joining carbon atoms.

(i) Primary/1°-carbon : Eg. $\overset{1^\circ}{C}=\overset{1^\circ}{C}-O-\overset{1^\circ}{C}$ (Super 1°)

(ii) Secondary/2°-carbon : Eg. $\overset{1^\circ}{C}-\overset{2^\circ}{C}=\overset{1^\circ}{C}$, $\overset{1^\circ}{C}-\overset{2^\circ}{C}(NH_2)-\overset{1^\circ}{C}$

(iii) **Tertiary/3°-carbon :** Eg. $\overset{1^\circ}{C}-\overset{3^\circ}{C}(\overset{1^\circ}{C})=\overset{1^\circ}{C}$, $\overset{1^\circ}{C}-\overset{3^\circ}{C}(\overset{1^\circ}{C})-OH$

(iv) **Quaternary/4°-carbon :**

Eg. $\overset{1^\circ}{C}H_3-\overset{4^\circ}{C}(\overset{1^\circ}{C}H_3)(\overset{1^\circ}{C}H_3)-\overset{2^\circ}{C}H_2-\overset{3^\circ}{C}H(\overset{1^\circ}{C}H_3)-\overset{1^\circ}{C}H_3$ Isooctane

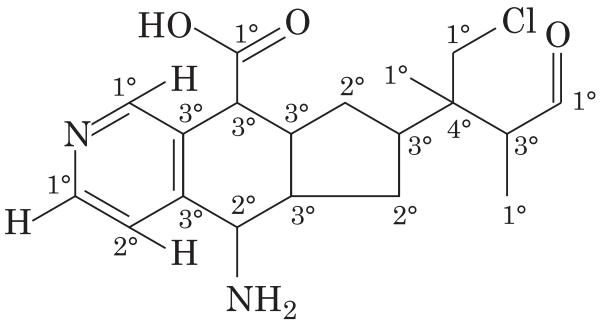
2. **Types of Hydrogen atom** :

(i) H atom is classified on the basis of C atom.

(ii) H which is directly attached to 1°C/2°C/3°C atom is respectively called as primary H/ sec H/ tertiary H.

(iii) 1°/2°/3° Carbon atom may be saturated or unsaturated but quaternary Carbon atom is always saturated.

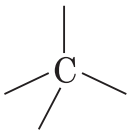
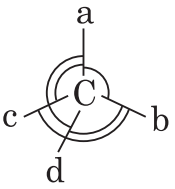
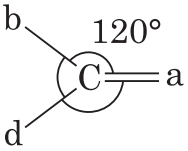
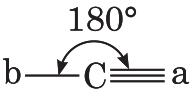
Q.



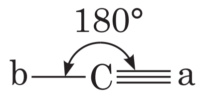
No of 1°C, 2°C, 3°C & 4°C and H = ?

(C)	(H)
1° → 7	1° → 11
2° → 4	2° → 6
3° → 7	3° → 5
4° → 1	

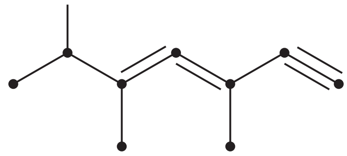
D. State of Hybridisation and Geometry :

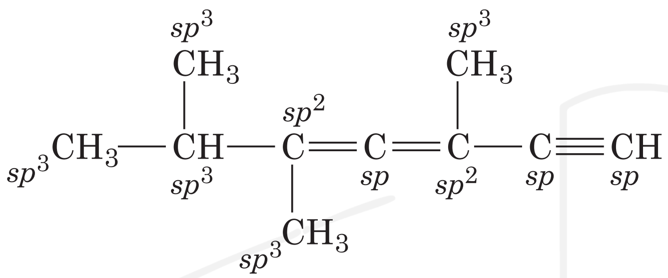
	Structure	Hybridisation	Geometry	Bond angle
1.		$sp^3(4\sigma)$	Tetrahedral  [ab, bd, dc, ac, ad, bc]	109°28' → 6
2.		$sp^2(3\sigma)$	Trigonal planar 	120° → 3
3.	$-C\equiv$	$sp(2\sigma)$	Linear 	180° → 1

4. $=C=$ $sp(2\sigma)$ Linear 180° → (1)



Eg.





σ bonds = 23 and π bonds = 4

$sp^3 - 5sp^3 = 2$	$sp^3 - s = 13$	$< 109°28' = 5 \times 6 = 30$
$sp^3 - sp^2 = 3$	$sp^2 - s = 0$	$< 120° = 2 \times 3 = 6$
$sp^2 - sp = 3$	$sp - s = 1$	$< 180° = 3 \times 1 = 3$
$sp - sp = 1$		

Nomenclature of Organic Substances :

[IUPAC/Geneva System]

A. Format for IUPAC Name

2°-**prefix** + 1°-**Prefix + Root word +** 1°-**suffix** + 2°-**suffix**

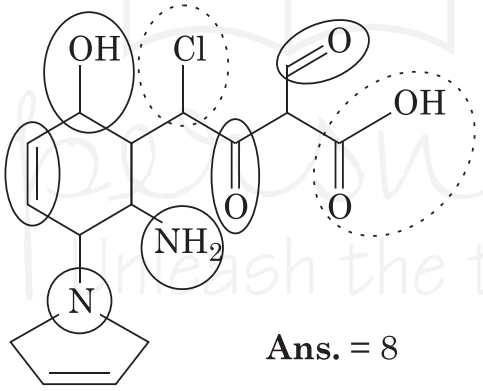
(1) 2°-Prefix → It is used according to substituent

Substituent	**2°-Prefix**
—X(—F, —Cl, —Br, —I)	Halo
$—NO_2$	Nitro
—NO	Nitroso

$—OR$	Alkoxy
O	Epoxy
$—R$	Alkyl
$—CH_2—X$	Halomethyl
$—O—\overset{\overset{O}{\|}}{C}—R$	Alkanoyloxy
$—NH—\overset{\overset{O}{\|}}{C}—R$	Alkanoylamino

Note According to IUPAC system for naming $—X, —OR$ $—NO_2, —NO$, O → All are considered as a substituent.

Q. Identify the total types of functional group.



Ans. = 8

2. **1°-prefix** : It is a cyclo & used only for cyclic substance.
3. **Word Root** : It is used according to total no. of carbon atoms present in parent carbon chains.
4. **1°-Suffix** : It is used according to saturation or unsaturation.

$$C—C \rightarrow \text{ane}$$

$$C = C \rightarrow \text{ene}$$

$$C \equiv C \rightarrow \text{yne}$$

$$2C = C \rightarrow \text{adiene}$$

$$2C \equiv C \rightarrow \text{adiyne}$$

Eg. $\overset{1}{C}=\overset{2}{C}-\overset{3}{C}\equiv\overset{4}{C}$

But-1-ene-3-yne ✗

But-1-en-3yne or 1, 3-Butenyne ✓

5. 2°-suffix : It is used according to principal functional group.

Note In any compound, when more than one different functional groups are possible, then according to priority series, only one of them (having comparatively top rank in priority series) is considered as main functional group, while remaining are considered as substituent.

B. Rules for IUPAC System

1. Selection of parent carbon chain :

* We select that carbon chain as a parent including functional group, multiple bond & substituent.

Priority order :

Functional group > Multiple bond > No of C atoms > No of substituents

Symmetry

Double bond > Triple bond

2. Numbering in parent carbon chain :

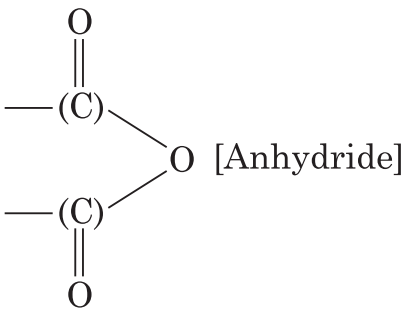
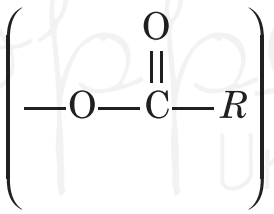
(i) In parent carbon chain, numbering can be done from that side from which multiple bond, substituent and functional group gets lowest number.

Priority order :

Functional group > Multiple bond > Substituents

Symmetry

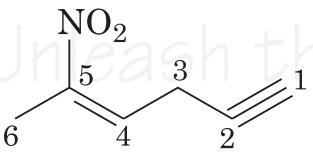
Double bond > Triple bond

S.No.	Functional Group	Prefix	Suffix
1.	(c) OOH [Carboxylic acid] —COOH	× Carboxy	Oic acid carboxylic acid
2.	—SO_3H [Sulphonic acid]	Sulpho	Sulphonic acid
3.	 [Anhydride]	×	Oic Anhydride
4.	—(C)OOR [Ester] —COOR	× Alkoxy	Alkyl.....oate Alkyl.....
	Alkanoyloxy 	Carbolkoxy	Carboxylate
5.	—(C)OX [Acid halide) —COX	× Halo formyl	Oyl halide Carbonyl halide
6.	—(C)ONH_2 [Amide] —$CONH_2$	× Carbomoyl	Amide Carbocamide
7.	—(C)N [Cyanide] —CN	× Cyano	Nitrile Carbonitrile
8.	—N$\overset{\rightarrow}{=}$(C) [Isocyanide] —NC	× Isocyano/Carbyl amino	Isonitrile ×

S.No.	Functional Group	Prefix	Suffix
9.	—(C)HO [Aldehyde]	formyl	al, Carbaldehyde, one
10.	—(C)— [Ketone] || O	keto/oxo	one
11.	—OH [Alcohol]	Hydroxy	Ol
12.	—SH [Thio alcohol]	mercapto	Thiol
13.	$-NH_2$ [Amine]	Amino	Amine
14.	$-OR$ [Ether]	Alkoxy	×

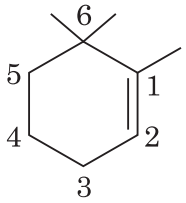
* When 2 different substituents are present at symmetric positions, then numbering can be done acc. to alphabet rule.
* If more than 2 substituents are present in parent Carbon chain, then we follow lowest locant rule.

Q. 1

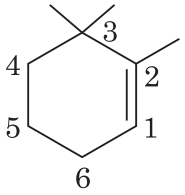


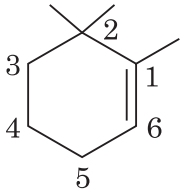
5-Nitrohex-4-en-1-yne or 5-Nitro-4, 1-Hexenyne

Q. 2



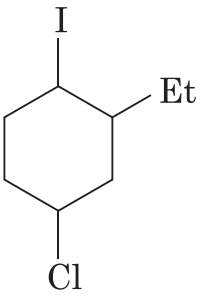
1, 6, 6-Trimethylcyclohex-1-ene

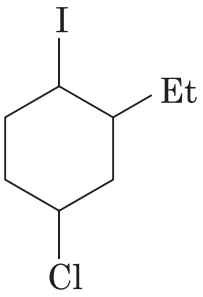




2, 3, 3

Q. 3



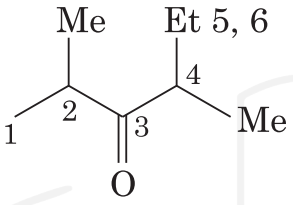


4-Chloro-2-Ethyl-
1-iodo-cyclohexane

(Lowest locant rule)

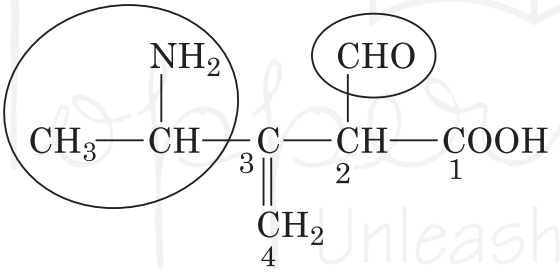
(Lowest locant Rule)

Q. 4



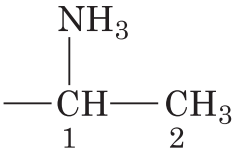
2, 4-Dimethyl-hexan-3-one

Q. 5



—COOH → Pfg

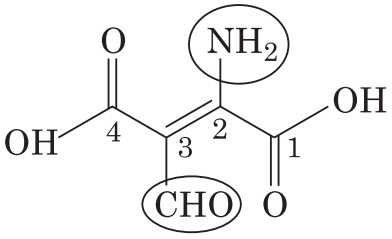
—COHO
—NH2
Substituent

☑ 

(1-amino-ethyl)

Sol. 3-(1-Aminoethyl)-2-formyl but-3-enoic acid

Q. 6.



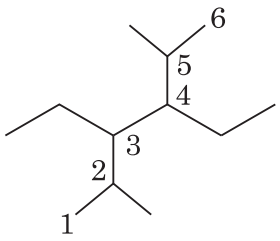
-COOH → Pfg

-CHO → Substitute

-NH_2 → Substitute

Sol. 2-Amino-3-formyl-but-2-en-1, 4-dioic acid

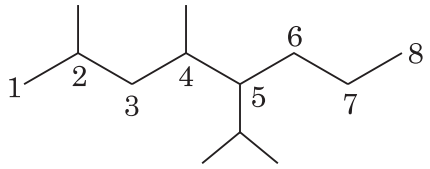
Q. 7.

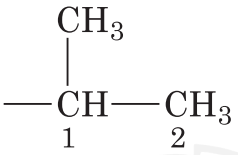


Sol. 3, 4-Diethyl-2, 5-Dimethyl hexane

* If no. of C-atoms are same go for more number of substitutes.

Q. 8.

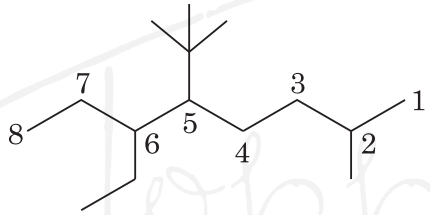




Methyl ethyl

Sol. 2, 4-Dimethyl-5-(methyl ethyl) octane.

Q. 9.



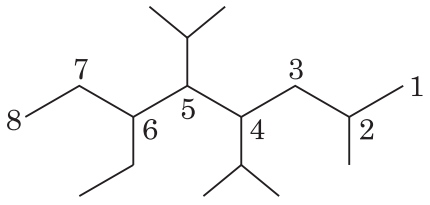
Sol. 5-(Dimethylethyl)-6-ethyl-2-methyl octane

* When Di Tri, Tetra are part of a name (like here then considered alphabetically.

Note Primary letter of extra prefix di, tri, tetra etc are not considered alphabetically, but whenever they are part of name, then we consider alphabetically.

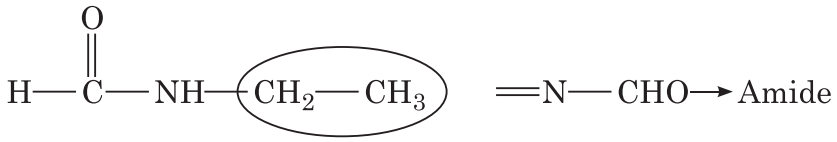
* In Hydrocarbon group or substituted substituents minimum number goes to that carbon which have free valency.
* To indicate the total number of substituted substituents, we use some extra prefix like bis, tris, tetrakis etc.

Q. 10.



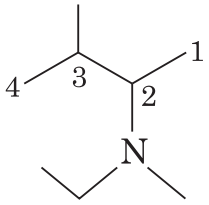
Sol. 6-Ethyl-2-Methyl-4, 5-bis-(Methyl ethyl) octane

Q. 11.



Sol. N-ethyl methanamide

Q. 12.



Sol. N-ethyl-N, 3-dimethyl butan-2-amine

⇒ **Note** Whenever ester group is present as a main functional group, then we always write the name of Alkyl group.

Format → **Alkyl……oate.**

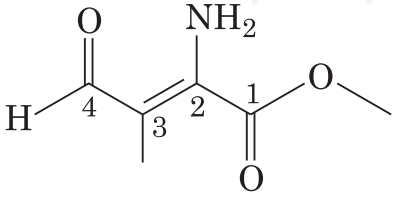
or

Alkyl ……carboxylate

↓

$(2° p + 1° - p + wR + 1° - 5$

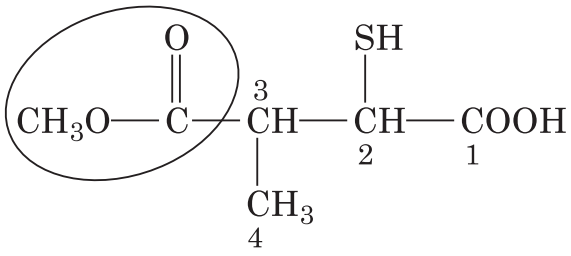
Q. 13.



—$COOCH_3$ → Pfg
—CHO
—NH_2 } Substituent

Sol. Methyl-2-amino-3-methyl-4-oro but-2-enoate.

Q. 14.



—COOH → Pfg
—$COOCH_3$
—SH } Substituent

Sol. 2-mercapto-3-methoxy carbonyl-butanoic acid