APPENDIX VIII

CONTENT OF ORGANIC COMPOUNDS

In this unit you will learn classification of hydrocarbons into (i) alkanes, (ii) alkenes, (iii) alkynes, and (iv) arenes.

IUPAC nomenclature

Different types of isomerism -

- structural isomerism
- stereo isomerism
- geometric isomerism

Under each subunit there will be set of questions. You have to select the best possible alternative from the given answer. At the end of each unit you shall know your score.

CLASSIFICATION OF HYDROCARBONS

Hydrocarbons are simplest compounds of carbon and hydrogen.

Hydrocarbons
- (a) Aliphatic Hydrocarbons
  - Alkanes
  - Alkenes
  - Alkynes
- (b) Cyclic Hydrocarbons
  - Alicyclic Hydrocarbon
  - Aromatic Hydrocarbon

	ALkane	Alkene	Alkyne
Properties General formula	C_nH_{2n+2}	C_nH_{2n}	C_nH_{2n-2}
Prefix	-ANE	-ENE	-YNE
no.of C-C bonds	SINGLE	DOUBLE	TRIPLE
Class of compounds	SATURATED	UNSATURATED	UNSATURATED
General name	ALKANE	ALKENE	ALKYNE

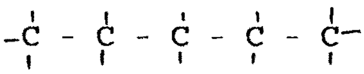
What are the causes for existence of such a large no. of organic compounds ?

1. CATENATION : It is the capacity of carbon to link with other carbon atoms forming chains of identical atoms.

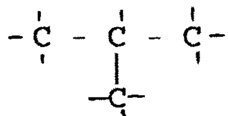
   Carbon exhibits catenation to maximum extent because of

   - Strong C-C bonds
   - Tetracovalency of carbon

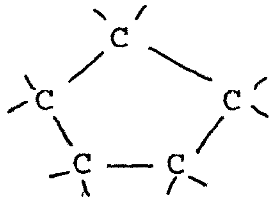
Hence, carbon atoms can form various types of straight chain branched chain and ring structures.



STRAIGHT CHAIN



BRANCHED CHAIN



RING STRUCTURES

2. ISOMERISM : It is the property to have two or more different structures for a particular molecular formula. The different compounds having same molecular formula are called isomers, and the phenomenon is called isomerism.

   e.g. For molecular formula C_4H_{10} two compounds are possible.

   $CH_3-CH_2-CH_2-CH_3$

   n-BUTANE

   $CH_3-CH-CH_3$ (with CH_3 attached to the central CH)

   ISO-BUTANE

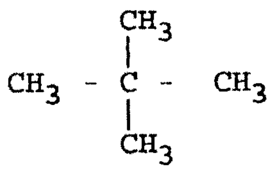
   For pentane having molecular formula C_5H_{12} three compounds are possible.

   $CH_3-CH_2-CH_2-CH_2-CH_3$

   n-PENTANE

   $CH_3-CH-CH_2-CH_3$ (with CH_3 attached to the CH)

   ISOPENTANE



NEO-PENTANE

All these three possible compounds are known as isomers :

3. Formation of multiple bonds due to small size of carbon atom, it is capable of forming multiple bonds with other carbon atoms.

CH_3-CH_2-CH_2	CH_3-CH=CH_2	CH_3-C≡C-H
PROPANE	PROPENE	PROPYNE
C-C SINGLE BOND	C=C DOUBLE BOND	C≡C TRIPLE BOND

Thus, due to the property of -
- Catenation
- Isomerism
- Formation of multiple bonds.

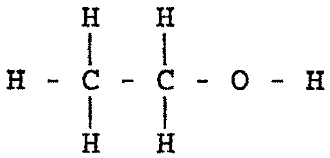
Carbon atom is capable of forming large no. of organic compounds.

TOPIC : FUNCTIONAL GROUP

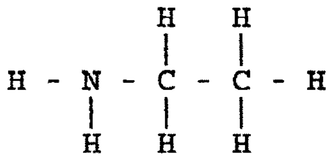
Organic molecules can be divided into two parts, a reactive part which is known as functional group and skeleton of carbon and hydrogen atom known as akly radial.

Properties of the compounds are controlled by the functional group.
e.g.

ETHYL ALCOHOL



ETHYL AMINE



FUNCTIONAL GROUP

-OH(Neutral) -NH_2(Basic)

Thus, functional groups are atoms or group of atoms which largely determines the properties of organic compounds.

CLASSIFICATION OF CARBON ATOMS

Carbon atoms in a molecule are classified as -

(1) **1^o primary carbon atom :**

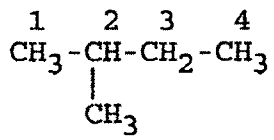
Carbon atom is linked with only one adjacent carbon atom.

$$\overset{1}{CH_3}-\overset{2}{CH_2}-\overset{3}{CH_3}$$

Carbon no.1 and 3 are 1^o carbon atoms as they are attached to only one adjacent carbon atom.

(2) **2^o secondary carbon atom :**

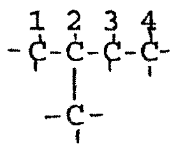
Carbon atom is linked with two adjacent carbon atom.



In the above example carbon no.3 is attached only to two adjacent carbon atom.

(3) **3^o tertiary carbon atom :**

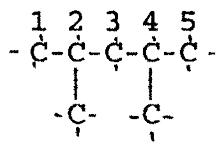
Carbon atom is linked with three adjacent carbon atoms.

e.g. 

Carbon atom no.2 is linked with three adjacent carbon atom.

(4) **4^o quaternary carbon atom :**

Carbon atom is linked with four adjacent carbon atoms.

e.g. 

Here carbon atom no. '2' is linked with 4 other carbon atoms therefore it is quaternary carbon atom.

Homologous series : within a particular family, the compounds are further grouped in a number of series on the basis of structure. These series are known as homologous series.

Homologous series is group similarly constituted compounds in which members possess same functional group and have similar chemical characteristics and two consecutive members differ in their molecular formula by $-CH_2$

CHARACTERISTICS OF HOMOLOGOUS SERIES :

1. All members of series can be represented by same general formula e.g. Alkane, general formula is CnH_{2n+2}

2. Any two consecutive members differ in their formula by a common difference of $-CH_2$

3. All members in the series have a common functional group. e.g. members of alcohol family have -OH group as their functional group.

4. Members in family have almost identical chemical properties.

5. The members of any series can be prepared almost by the identical methods.

e.g. Alkane family : General formula CnH_{2n+2}

1.	CH_4	CH_4	Methane
	C_2H_6	CH_3-CH_3	ethane
	C_3H_8	$CH_3-CH_2-CH_3$	propane
	CH_4H_{10}	$CH_3-CH_2-CH_2-CH_3$	butane

Molecular formula		Name
1.	CH_4	Methane
2.	CH_3-CH_3	Ethane
3.	$CH_3-CH_2-CH_3$	Propane
4.	$CH_3-CH_2-CH_2-CH_3$	Butane
5.	$CH_3-CH_2-CH_2-CH_2-CH_3$	Pentane
6.	$CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$	Hexane

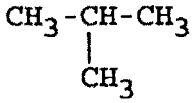
ANSWER THE FOLLOWING QUESTION

Note : * indicates correct answer

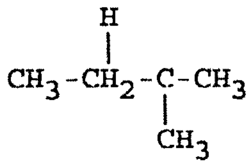
Qus.1 What is the reason for existence of such a large no. of compound of carbon.

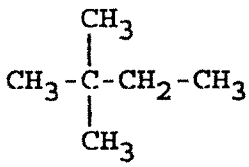
1. Catenation
2. Isomerism
3. Formation of multiple bonds
*4. All the above

Qus.2 Find out which of the following are isomers :

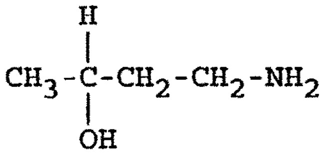
*1. 

*2. $CH_3-CH_2-CH_2-CH_3$

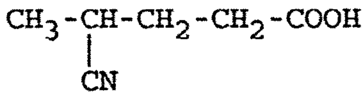
3. 

4. 

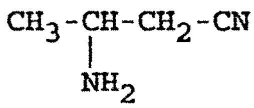
Qus.3 Identify the functional groups in the following compounds.

1. 

Ans : -OH, - NH_2

2. 

Ans : -CN, COOH

3. 

Ans : $-NH_2$, -CN

Qus.4 Which of the following is a characteristic of homogenous series.

a. All members have same molecular formula
b. All members have identical physical properties.
*c. Any two consecutive members differ in their formula by a common difference of $-CH_2$
d. All of above.

Qus.5 What is catenation ?

a. Tetravalency of carbon
b. Property of forming ring structure
*c. Property of `C' forming large no. of C-C bonds.
d. None of the above.

Qus.6 Carbon has catenation property due to -

a. Strong C-H bond
*b. Strong C-C bond
c. High electronegativity.
d. High density of carbon.

Qus.7 Carbon atom is capable for forming multiple bonds with other carbon atoms due to -

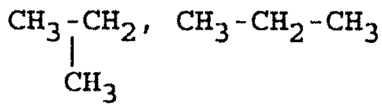
a. Small atomic no. of carbon atom.
b. high electronegativity of carbon atom.
*c. Small size of carbon atom.
d. All of above

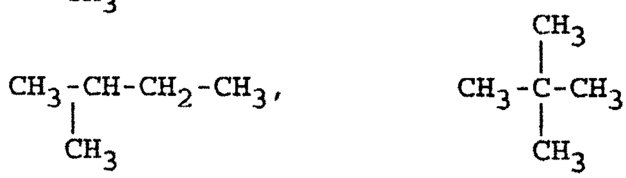
Qus.8 Properties of the organic compound depend largely upon-

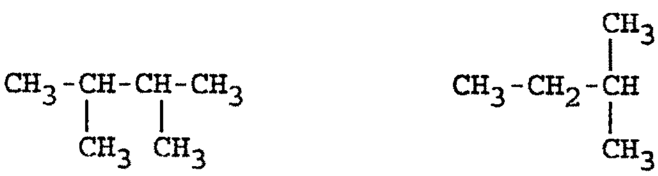
a. no. of bonds
b. size of compound
c. molecular weight
*d. Functional group.

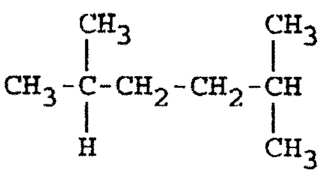
Qus.9 What are isomers ?
a. Compounds having similar functional group
b. Compounds of same homologous series
c. Compounds with similar chemical & physical property
*d. Compounds having same molecular formula but with different structural formula.

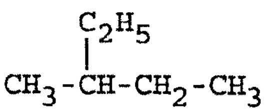
Qus.10 From the following select one pair of isomers.

a. 

*b. 

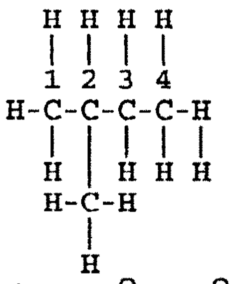
c. 

d.  and



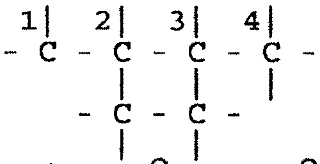
Qus.11 In the following structure indicate 1°, 2°, 3° and 4° carbon atom by indicating the serial no. of carbon.

1.



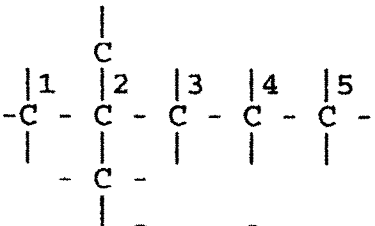
(1,4-1° 2-3°, 3-2°)

2.



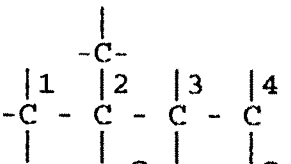
(1,4-1°, 2,3-3°)

3.



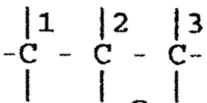
(1,5-1°, 2-4°, 3,4-2°)

4.



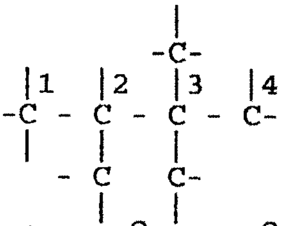
(1,4-1° - 2-3° 3-2°)

5.



(1,3 1°,2-3°)

6.



(1,4-1°, 2,-3°,3-4°)

PART - 2

IUPAC NOMENCLATURE

INTRODUCTION

The term nomenclature means the system of naming of organic compounds. In the early stage of development of organic chemistry. The organic compounds were named after the source from which they were prepared e.g., acetic acid was derived from acetum.

Towards the end of 19th century the number of organic compounds known were so large in no. that it was difficult to remember individual names of these compounds in 1892, International Congress of Chemists was held in Geneva and the congress developed a system of nomenclature, it was further improved in 1931 by International Union of chemists. It was then revised by International union of pure and applied chemistry in the light of practical difficulties. This revised system of nomenclature has been accepted all over the world & is abbreviated as IUPAC system of nomenclature.

NOMENCLATURE OF ALIPHATIC HYDROCARBON :

1. Straight chain Hydrocarbons.

   The name of a straight chain aliphatic hydrocarbons.

2. e.g.

Chain length	Word root	Chain length	Word root
C1	Meth-	C6	Hex-
C2	Eth-	C7	Hept-
C3	Prop-	C8	Oct-
C4	But-	C9	Non-
C5	Pent	C10	Dec-

3. Branched chain Hydrocarbons :

In branched chain compounds all the carbon atoms are not present in a straight chain. Some of the carbon atoms in these compounds are present as side chains. The carbon atoms in side chain constitute alkyl groups.

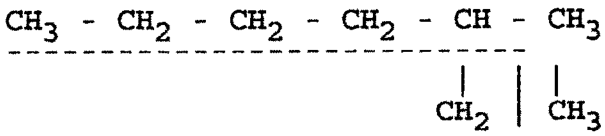
A branched chain hydrocarbon is name using the following general rules :

RULE 1 : Longest chain rule :

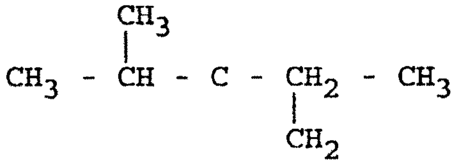
Select longest possible chain of carbon atoms, the selected chain must contain the carbon atoms of multiple bonds.

No. of carbon atoms in the selected chain determine the world root and saturation/unsaturation will determine the primary suffix.

Carbon atoms which are not included in the chain are alkyl substituents and are indicated by prefixes.

e.g. 

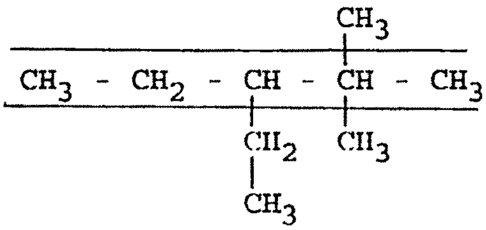
Longest chain
Word root - -hept Suffix - ane
Word root + suffix = + heptane



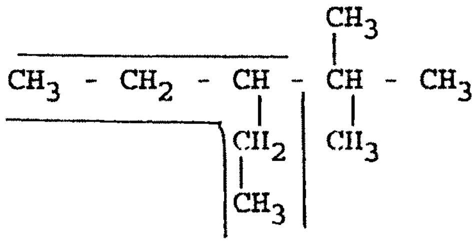
Longest chain including carbon atoms of multiple bonds.

5. Word root - but; suffix - ene.

If the equally long chains are possible, then the chain with maximum number of side chain is selected.



CORRECT

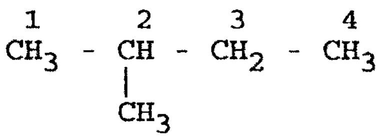


WRONG

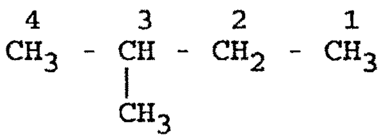
Word root - pent, suffix - ane.

Rule 2 OR lowest number Rule :

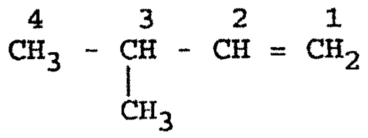
After selecting the longest chain of carbon atoms. The numbering of carbon atoms is done in such a way that the substituted carbon atoms have the lowest possible numbers. If multiple bond is present in the chain, then the carbon atoms involved in multiple bond should get lowest possible no.



RIGHT



WRONG



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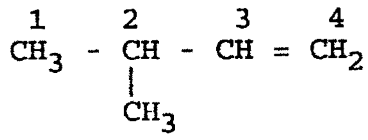
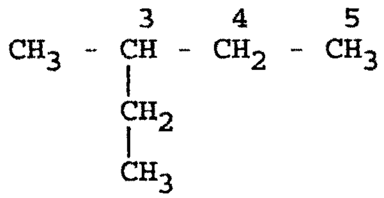


WRONG

The name of the compound, in general, is written in the following sequence :

(Position of substituent) - (Name of substituent) (Word root) (Suffix)

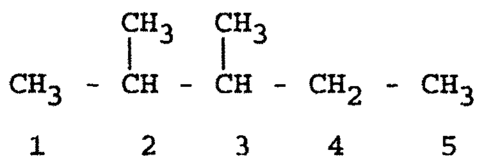
e.g. 

It's name is 3-Methyl pentane

$CH_3 - C = CH - CH_2\ Cl$ 4-Chloro-2-Butene

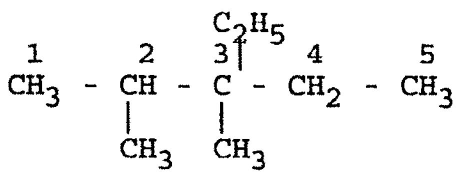
RULE 3 : If compound contains more than one similar alkyl groups their positions are indicated separately and a prefix; di, tri etc. is attached to the name of the substituent. Positions of substituent are separated by comas.

e.g.

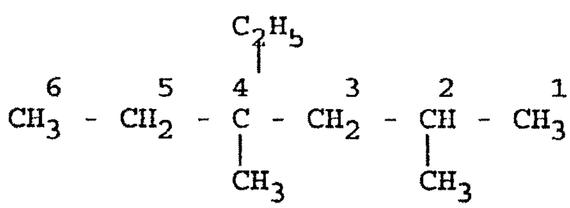


2,3 - Dimethyl pentane

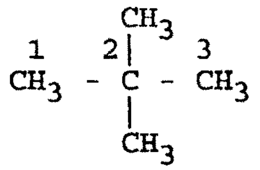
RULE 4 : If there are different alkyl substituent present in the compound, their names are written in the alphabetical order.

1. 

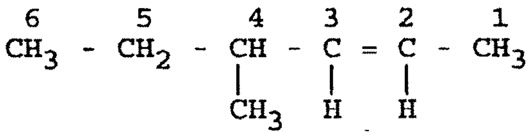
3-Ethyl - 2,3-dimethylpentane

2. 

4-Ethyl-2,4-dimethyl hexane

3. 

2,2-dimethylpropane

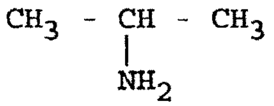
4. 

4-methyl-2-hexyne

In case of some functional group other than C=C and C≡C, it is indicated by adding secondary suffix after the primary suffix. The terminal `e' of primary suffix is removed.

$CH_3 - CH_2 - OH$

Ethanol



2. 2-Amino propane

$\overset{1}{CH_3}-\overset{2}{COOH}$
Ethanoic acid

CH_3CN
Ethanenitrile

All above rules can be summarized as follows :

1. The longest continuous chain of carbon atoms containing the functional group is identified. This gives the word root.
2. To decide primary suffix, the presence of multiple bond is observed.
3. The functional group present is identified. This enables selection or secondary suffix.
4. Functional group is given the lowest no.
5. The name of the compound is arrived at by arranging prefixes and suffixes along with their positions.

Prefix-word root-Primary suffix-secondary suffix

Naming the compound with more than one different functional group :

If the molecule contain more than one dissimilar functional group. The numbering of the parent chain is done in such a way so that the functional group of higher priority gets the lower number. The order of priority of various groups for the sake of numbering is :

Acid > acid derivatives > aldehydes > nitriles > ketones > alcohols > amines > alkenes > alkynes > halo, nitro and alkoxy > alkyls.

The functional group that gets the priority is treated as principal group, and is indicated by suitable secondary suffix. The other functional groups are considered as substituents and are indicated by the appropriate prefixes.

```
4     3   2   1
      CH3
      |
CH3 - C - C - CH3
      |   ||
      OH  O
```

Here, word root is but

> C=0 gets preference over the -OH group for getting the lowest possible number, therefore the parent chain is numbered as shown above.

Primary suffix is -ane. Secondary suffix for principal functional > C=0 is "One".

Therefore name of the compound is 3-Hydroxy-3-Methyl-2-butanone.

```
            CH3
   4        |3   2    1
   CH3  -  CH - C - COOH
                ||
                O
```

3 methyl-2-oxobutanoic acid.

```
      3      2       1
NC - CH2 - CH2 - COOH
```

3 - cyanopropanoic acid

Type of compound	Functional group	Prefix	Example
1. Halide Cl, Br, -I, F	-X	halo-	$CH_3CH_2CH_2Cl$ 1-chloro-propane
2. Alcohol	-OH	- anol	CH_3CH_2-CH_2-CH_2OH 1-Butanol
3. Ether	-OH-	-ether	CH_3-O-CH_2-CH_3 Methyl, ethyl, ether
4. Aldehyde	-CHO	- anal	CH_3-CH_2-CHO Propanal
5. Ketone	-CO-	- anone	CH_3-CO-CH_3 Propanone
6. Carboxylic acid	-COOH-	- anoic acid	CH_3-CH_2-COOH Propanoic acid
7. Ester	-COOR	- anoate	CH_3COOCH_3 methyl ethanoate
8. Amide	-CONH2	- amide	CH_3CONH_2 ethanamide
9. Amine	-NH2	- amino	CH_3CH_2-CH_2NH_2 1-amino propane
10. Nitro	-NO2	- nitro	CH_3-CH_2-CH_2NO_2 1-Nitro propane
11. Cyanide	-C=N	Cyano or nitrile	Cyanoethane OR propane nitrile

RULE 1

ANSWER THE FOLLOWING QUESTIONS

Note : * indicates correct answer

To give ans to the `Q' we will find `-' marks, within marked space for ans. Type, your ans.

Give the IUPAC Names of the following compounds :

1. CH_3 CH_2 CH_2 CH_3
   (with CH_3 attached below the first CH_2)

2-methyl-Butane

2. C_2H_5-CH-CH_3 (with C_2H_5 on the CH) — 2-Ethyl-Butane

3. CH_3 - C = CH_2 (with CH_3 on the C) — 2-Methyl propene

4. CH_3-CH-CH_2-CH_2

3-Methyl-1-chlorobutane.

5. HC_3-CH=CH-CH_2OH

BUT-2-en-1-01.

(Q no. 1 is repeated in all)

6. CH_3-C(=O)-CH_2-CH_2-COOH

4-ketopentanoic acid.

7. CH_3-CH(CHO)-CH_2-CH(CH_3)-COOH

4-formyl-2-methyl pentanoic acid.

8. CH_3-CH(CH_3)-CH(NH_2)-COOH

2-amino-3-methylbutanoic acid.

9. CH_3-CH_2-C(CH_3)(OH)-CH_2-CH_3

3-methyl-3 pentanol

```
                 O
                 ||
10.   CH3-CH-CH2-C-CH3
          |
          OH
```

4-hydroxy-2-pentanone

```
                  CH3
                  |
11.   H3C-CH2-CH-CH-CH2-CH-CH3
              |         |
              CH3       CH3
```

(2,4,5-Tri-Methyl Heptane)

```
12.   H3C-CH-CH2-CH2-CH2-CH-CH3
          |              |
          C2H5           C2H5
```

(2,6-diethyl Heptane)

```
                 (CH3)2
                 |
                 CH
                 |
13.   H3C-CH-CH2-CH-CH2-CH3
          |
          CH
          |
          (CH3)2
```

2,4-di-isopropy Hexane

```
            HC3-CH-CH3
                |
14.   H3C-CH-CH-CH-CH3-CH-CH3
          |            |
          CH3          C2H5
```

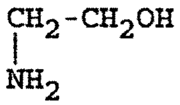
2-ethyl-4-isopropyl-6-methyl Heptane

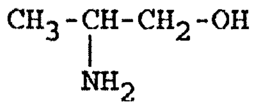
```
15.   H3C-CH-CH2-CH2-CH-CH2-CH2-CH3
          |          |
          C2H5       C3H7
```

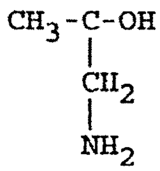
2-ethyl-5-propyl-octane,

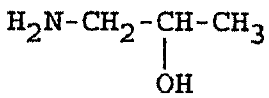
Qus.2 Select the proper structure for the following names of the compounds :

1. 2-Aminoethanol

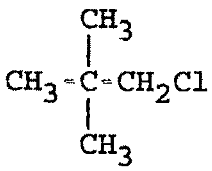
*a. 

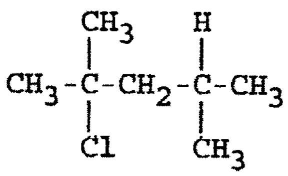
b. 

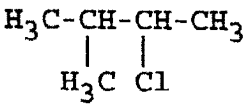
c. 

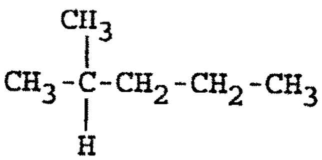
d. 

2. 2-chloro-3-methylbutane

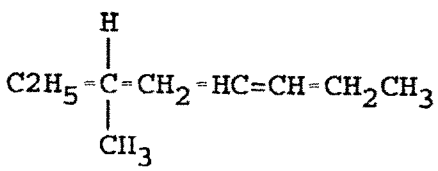
a. 

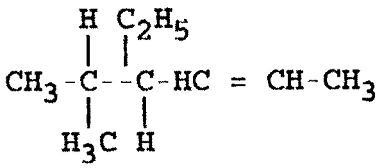
b. 

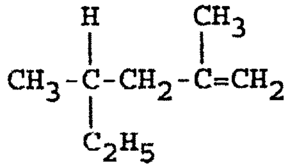
*c. 

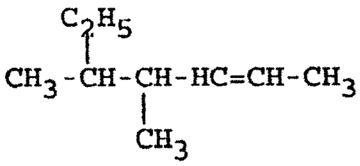
d. 

3. 4-ethyl-5-methyl-2-hexene

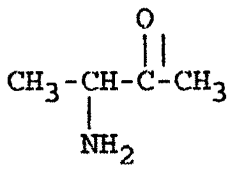
a. 

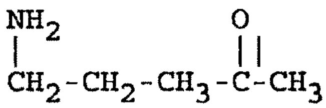
*b. 

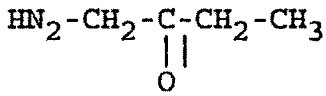
c. 

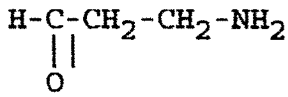
d. 

4. 3-amino-Butanone

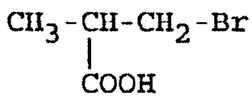
*a. 

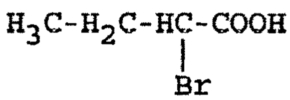
b. 

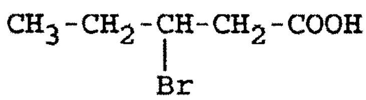
c. 

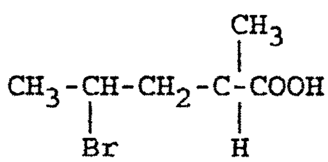
d. 

5. 2-bromo-Butanoic acid

a. 

*b. 

c. 

d. 

PART-III

ISOMERISH

It is defined as the phenomenon by virtue of which two or more compounds having same molecular formula can be assigned different molecular structures.

Isomerism is classified as

I. Structural-Isomerism II. Stereo-Isomerism

I. <u>STRUCTURAL ISOMERISM</u> :

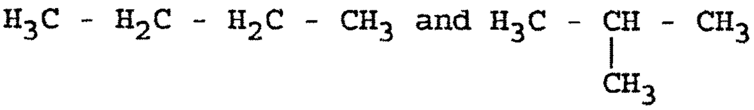
Isomers having different molecular structures due to different arrangement of atoms in their molecules. There are three types -

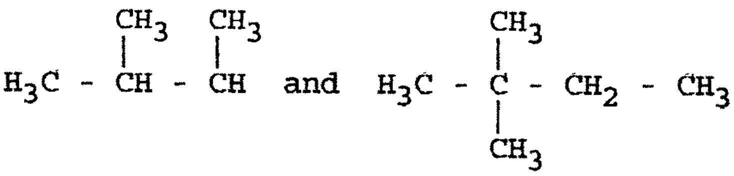
(i) Chain Isomerism
(ii) Position Isomerism
(iii) Functional Isomerism

(i) <u>Chain Isomerism or Skeletal Isomerism</u> :

Here, isomers have different skeleton of carbon atoms.

e.g.,

(1) 

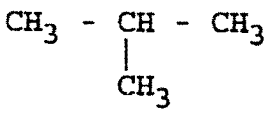
(2) 

are chain isomers. Butane exhibit 2 chain isomers.

<u>n-butane</u>

$H_3C - CH_2 - CH_2 - CH_3$

<u>Iso-butane</u>



(ii) <u>Position Isomerism</u> :

Here, the isomers have different position of functional group or multiple bond.

e.g.,

(1) 4 3 2 1
C - C - C - C (with OH on carbon 2)

-OH group on 2nd carbon atom

4 3 2 1
C - C - C - C - OH

-OH group on 1st carbon atom

(2) 4 3 2 1
$H_3C - CH = CH - CH_3$

"C=C" present between 2 & 3 no. carbon atom
2 - butene

4 3 2 1
$H_3C - CH_2 - CH = CH_2$

"C=C" present between 1 & 2 no. carbon atom
1 - butene

Answer the following questions by selecting the appropriate answer :

(iii) <u>Functional Isomerism</u> :

These types of isomers have different functional groups.

e.g.,

PROPANOIC ACID

$CH_3 - CH_2 - \overset{O}{\overset{||}{C}} - OH$

$- \overset{O}{\overset{||}{C}} - OH$

As functional group

METHYL ETHANOATE

$CH_3 - \overset{O}{\overset{||}{C}} - O - CH_3$

$- \overset{O}{\overset{||}{C}} - OCH_3$

As functional group

QUESTIONS

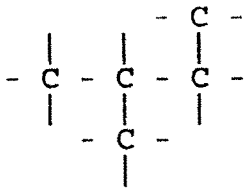
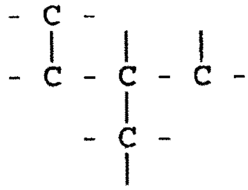
Qus.1 The compounds which can show chain isomerism is

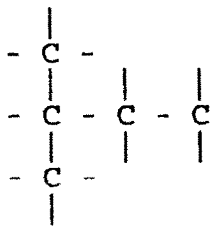
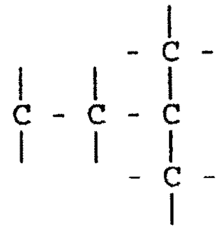
(a) CH_4
(b) $CH_3 - CH_3$
(c) $CH_3 - CH_2 - CH_3$
*(d) $CH_3 = CH_2 - CH_2 - CH_3$

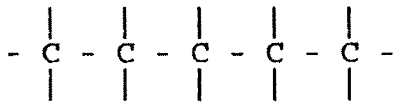
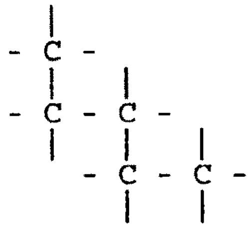
Qus.2 The hybrid state of carbon in propane is

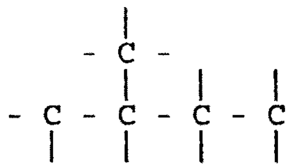
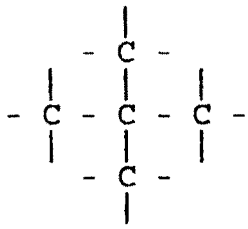
(a) S^2P
*(b) SP^3
(c) SP^2
(d) SP

Qus.3 Which of the following pairs of carbon skeleton do represent chain isomers ?

(a)  and 

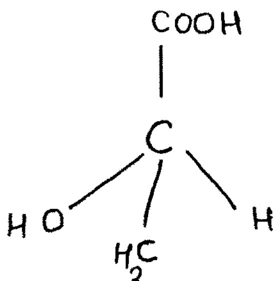
(b)  and 

(c)  and 

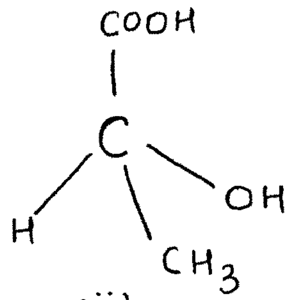
*(d)  and 

II. STEREOISOMERISM :

In stereo-isomerism, isomers have same arrangement of atoms but their orientation in the space is different.
e.g.



(i)



(ii)

Compound (i) and (ii) have same groups attached to carbon atom but their position in the space is different. Therefore they will be known as isomers. This phenomenon is known as stereo-isomerism.

Classification of Stereo Isomerism

Enantiomerism or Optical isomerism	Geometric Isomerism

(A) <u>Enantiomerism/Optical-isomerism</u> :

Optical-isomerism is possible in the compounds which possess "chiral carbon" atom.

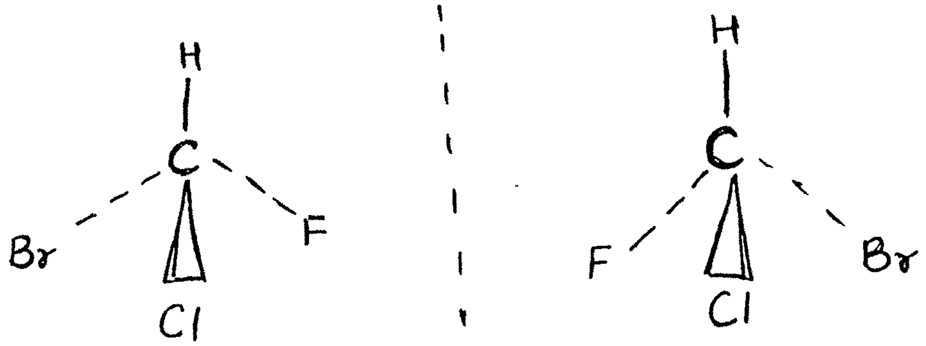
Now, the question is -
"What are chiral carbon atoms" ?
"What is chirality" ?

Chiral carbon atom is obtained when four different atoms or groups are attached to the carbon atom. Such carbon atoms are indicated by * on the carbon i.e. "C*".

Chirality is the property of non-superimposability of a structure on its mirror image.

Common everyday examples of chirality are -
* Pair of hands
* Pair of shoes, etc.

The cause of chirality in organic molecules is the tetrahedral structure of carbon. For example; in fluoro, chloro, bromo methane; F, Cl, Br, H these four atoms are attached to the carbon atom that make it chiral carbon.



In the above example, fluoro, chloro, bromo methane is non-superimposible on it's mirror image. I and II are called enantiomers or optical-isomers.

<u>Properties of Enantiomers</u> :

Similar properties -

* Enantiomers have identical physical properties
* Enantiomers have identical chemical properties

Different properties -

* Their behaviour towards the plane polarized light

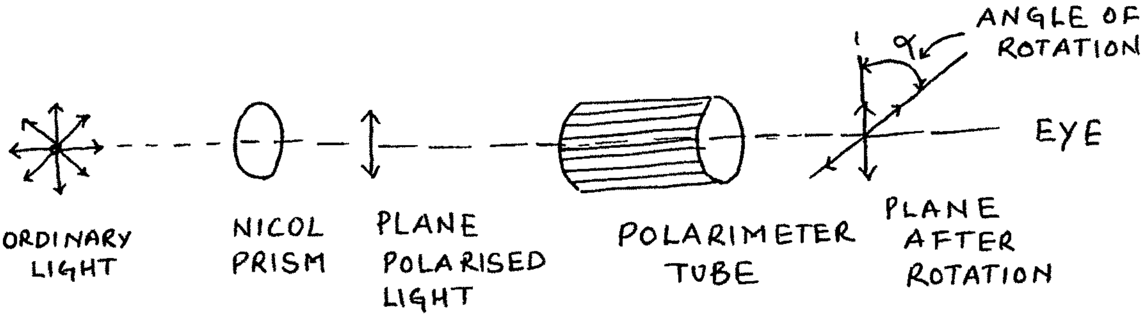
Now question is -

"What is optical activity" ?

Compounds which rotate the plane of polarized light are called optically active compounds and this phenomenon is called optical activity.

"What is plane polarized light" ?

Ordinary light contains light waves of different wavelengths.



By using prism light of single wavelength, known as monochromatic or plane polarized light is obtained.

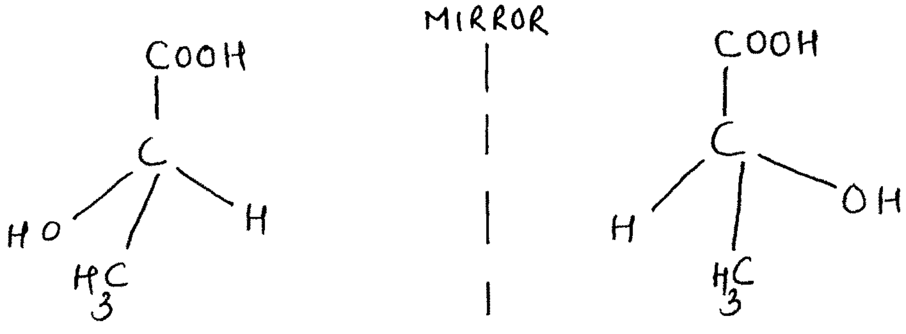
When an optically active compound is placed in the path of a plane of polarized light.

The path of plane of polarized light changes by an angle `a'

Compounds which rotate the plane of polarized light to

Right side	Left side
Compounds are known as	Compounds are known as
Dextro-rotatory	Laevo rotatory
denoted by "d" or "+"	denoted by "L" or "-"

Not super impossible mirror images.
Therefore lactic acid exists as enantiomers or optically active compounds.



NON-SUPERIMPOSABLE : EXIST AS ENANTIOMERS

LACTIC ACID

This compound does not have chiral carbon atom.
This compound does not exist as enantiomers.
Its mirror images are super impossible

<u>Racemic mixture or Racemic modification</u> :

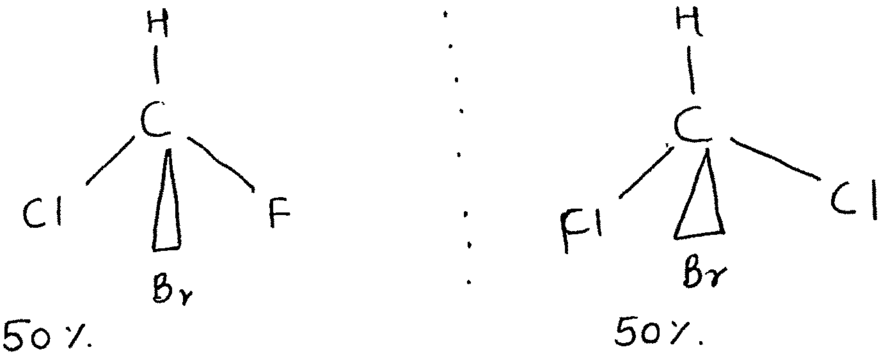
When dextro and laevo rotatory enantiomers are present in equal amount, the compound is known as racemic modification.

- It is denoted as "$\pm$" or "dl".
- It is optically inacitve.

When (-) lactic acid and (+) lactic acid are present in equal quantity, then the compound becomes optically inactive.

Because the rotation caused by (-) lactic acid is cancelled by equal and opposite rotation caused by (+) lactic acid.

This compound will be represented as ($\pm$) lactic acid.



($\pm$) fluoro-chloro, bromo methane racemic resolution, optically inactive.

<u>Resolution</u> :
Process of separating ($\pm$) lactic acid into
(+) lactic acid and
(-) lactic acid, is known as resolution.

Thus, it is a process of separating racemic modification into its enantiomers.

Qus.1 Optical activity of an organic compound means.....

(a) Compound having radioactivity
(b) Compound which is superimposible on its mirror image
(c) Compound which changes direction of light
*(d) Compound which has chiral carbon atom.

Qus.2 What is chiral carbon ?

(a) Carbon atom having multiple bonds
*(b) Carbon atom which is attached to four different groups
(c) Carbon atom having functional group
(d) Carbon atom of a ring.

Qus.3 From the following structures of organic compound, find out the compound with chiral carbon atom.
(Note : indicate your answer by selecting the Sr. no. of the structure)

(a) CH_3 - CH OH - CO OH
(b) CH_3 - CH NH_2 - CH_2 CN
(c) CH_3 - CH_2 - CH Cl_2
(d) CH_3 - CH - Cl - CH_3

(correct answer : a, b)

Qus.4 Which of the following can exhibit enantiomerism ?

(a) n-butylbromide
*(b) sec-butyl bromide
(c) iso-butyl bromide
(b) tert-butyl bromide

Qus.5 Say whether the following statements are true or false? (write `T' for true and `F' for false)

(a) 2-chloropentane can exhibit optical isomerism (True)
(b) Racemic mixture is optically active (False)
(c) Carbon atom attached to four different groups or atoms is called chiral carbon (True)
(d) Light of different wave length is called plane polarized light (False)
(e) Enantiomers have similar effect towards the plane of polarized light (False)
(f) The process of separation of racemic modification into it's enantiomers is called resolution (True)

Qus.6 Which of the following is racemic modification ?

(a) 75% of (+) lactic acid and
25% of (-) lactic acid
(b) 20% of (+) chloro, bromo, iodo methane and
80% of (-) chloro, bromo, iodo methane
*(c) 50% of (-) -2-butene and
50% of (+) -2-butene
(d) 40% of (+) lactic acid and
50% of (-) lactic acid.

II

STEREO ISOMERISM

A
ENANTIOMERISM

B
GEOMETRIC ISOMERISM

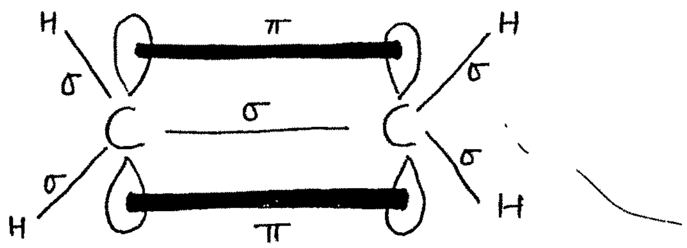
Geometric Isomerism :

Qus. Why geometric isomerism is possible in alkenes ?

To understand this, one must know the structure of alkene.

Let us take the simplest alkene, ethene ($CH_2 = CH_2$)

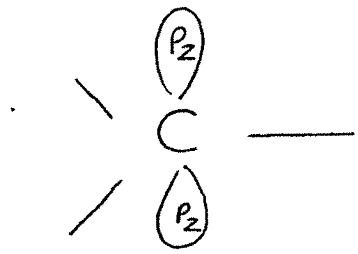
In ethene both `C' atoms are SP^2 hybridized.



The σ and π bond in ethene

In ethene both SP^2 hybrid carbon atoms form C - C double bond

By axial overlaping of SP^2 hybrid orbitals.

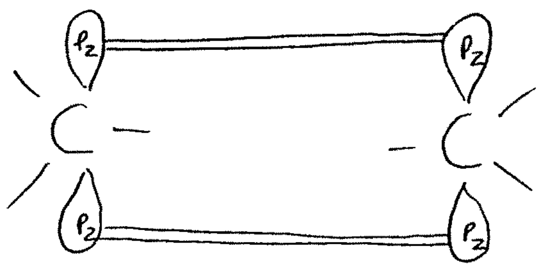


SP^2 hybrid Carbon atom

Other two SP^2 hybrid orbitals of each carbon atom overlap with half filled 1s orbital of hydrogen atom to form C - H bond.

Unhybrid 2Pz - orbitals on each carbon lies perpendicular to the plane of these atoms.

These Pz orbitals overlap sideways to form - bond between the two carbon atoms.



SIDEWAYS OVERLAP OF PZ ORBITALS

A bond is sufficiently strong to prevent free rotation of two carbon atoms.

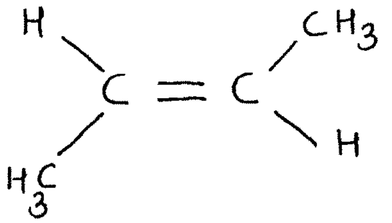
<u>Isomerism in Alkenes</u> :

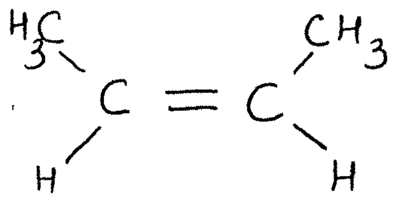
The simplest acyclic alkene is butene which can exhibit isomerism.

$CH_2 = CH - CH_2 - CH_3$	$CH_3 - CH = CH - CH_3$
1-butene	2-butene

Above are structural isomers, experimentally four isomers having different properties were found.

For 2-butene two isomers having different orientation of groups doubly bonded carbon atoms were possible, known as stereoisomers.



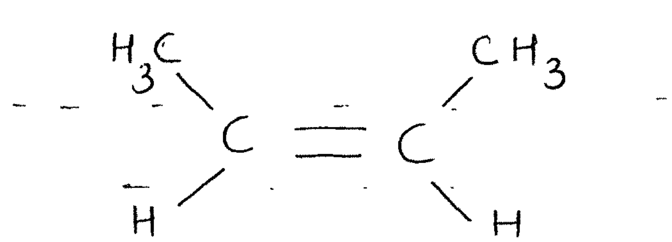


I	II
Trans-2-butene	CIS-2-butene
Trans- means bulky groups are oriented opposite to double bond	CIS - means bulky groups on the same side of double bond

Thus, geometrical isomerism is due to different spatial arrangement of groups about the doubly bonded carbon atoms.

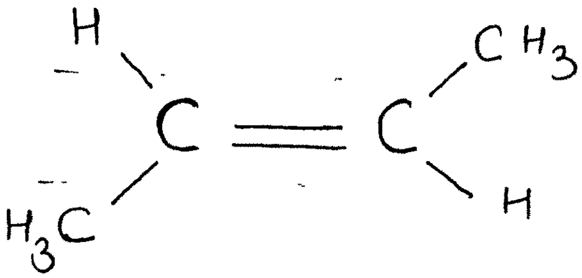
Structure I and II are not interconvertible because - rotation about `C - C' bond hindered.

CIS - isomer - similar groups are on the same side of the double bond.



TWO METHYL GROUPS ON THE SAME SIDE OF DOUBLE BOND.

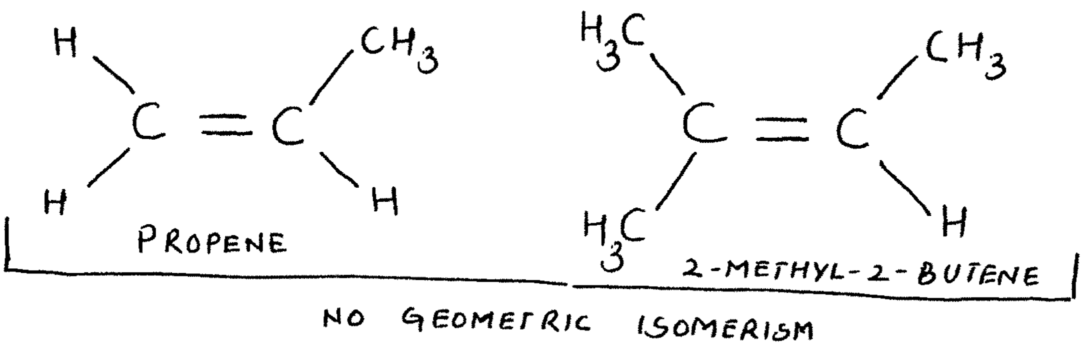
Trans - isomer - similar groups are on the opposite side of the double bond.



<u>Conditions for geometric isomerism</u> :

1. There should be a double bond in the molecules.
2. The two atoms or groups attached to each doubly bonded carbon atom should be different.

If one of the two doubly bonded carbon atoms carries two identical groups then the molecule does not exhibit geometric isomerism.



<u>Physical and Chemical Properties</u> :

- Geometric isomers possess different physical properties.
- Their chemical properties are similar but not identical.

1. Which of the following compounds can exist as geometric isomers.
   (a) 1-pentene
   *(b) 2-pentene
   (c) 3-methyl-2-butene
   (d) 3-methyl-1-butene

2. What is the hybrid state of carbon number 2 and 3 in the following compound

$\overset{1}{CH_2} = \overset{2}{CH} - \overset{3}{CH_3}$

*(a) SP_2 and SP_3
(b) SP and SP_2
(c) SP_3 and SP
(d) SP and SP

3. Which of the following isomerism is not exhibited by ethene ?

(a) Conformational
(b) Chain
(c) Position
*(d) none of the above

4. Which of the following can exhibit geometric isomerism?

(a) 1-pentene
*(b) 2-pentene
(c) 2-methyl-2-butene
(d) 1-butene

5. Which of the following can exhibit geometric isomerism?

(a) $CH_3 - CH = CH_2$

(b) $CH_3 - C(CH_3) = CCl_2$

(c) $CH_3 - CH = C(CH_3) - CH_3$

*(d) $CH_3 - C(C_2H_5) = CH - CH_3$

6. Alkenes can not exhibit stereo isomerism, because

(a) Alkenes do not have chiral carbon atom
(b) Alkenes are very reactive
(c) Rotation about C-C bond is hindered due to π-bond
(d) None of the above