

Organic Chemistry

TREND ANALYSIS
3 YEARS

		Average No. of Questions Across all Sets			
		Types of Questions	2023	2020	2019
TOPIC 01	Organic Compounds	1 Mark	3	2	—
		2 Marks	—	—	—
		3 Marks	—	—	—
		5 Marks	—	—	—
TOPIC 02	Nomenclature of Organic Compounds	1 Mark	2	—	—
		2 Marks	1	1	—
		3 Marks	—	1	—
		5 Marks	1	—	—
TOPIC 03	Hydrocarbons-Alkanes, Alkenes and Alkynes	1 Mark	2	—	4
		2 Marks	—	1	—
		3 Marks	1	—	1
		4 Marks	—	1	1
		5 Marks	—	—	1

TOPIC 1 Organic Compounds

All the living beings, plants and animals, are made up of carbon based compounds, which are called organic compounds. Carbon element is present in all living beings. Organic chemistry is essentially the chemistry of carbon compounds. This however excludes oxides of carbon, metallic carbonates and related compounds like metal cyanides, metal carbides etc.

Unique Nature of Carbon Atoms

Carbon shows unique nature due to which carbon forms a large number of organic compounds. The two characteristic properties of carbon element are

- (i) Tetravalency (Four valency) (ii) Catenation (Self-linking)

1. Tetravalency of the Carbon Atom

A carbon atom has 4 electrons in the outermost shell, so it requires 4 more electrons to achieve the stable 8 electrons inert gas electronic arrangement (i.e. octet).

Carbon atom can achieve the inert gas electronic arrangement only by the sharing of electrons, therefore, carbon always forms covalent bonds.

The characteristic of the carbon atom by virtue of which it forms four covalent bonds is called the tetravalency of carbon.



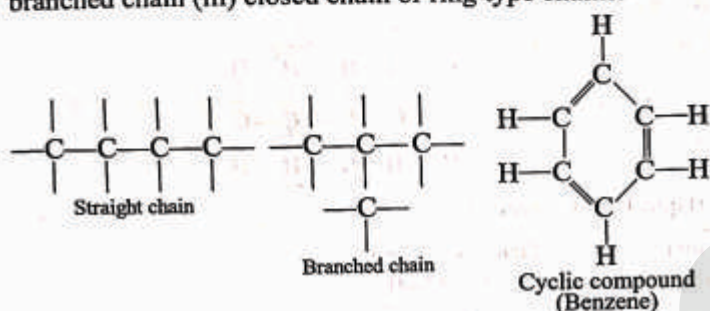
Tetravalency of carbon

2. Catenation

Carbon atoms can link with one another by means of covalent bonds to form long chains (or rings) of carbon atoms. The property of carbon element due to which atoms can join with one another to form long carbon chains is called catenation (self-linking).

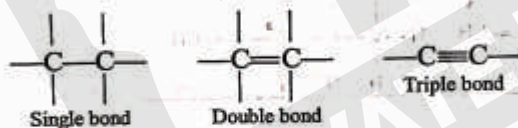
Formation of Straight, Branched and Cyclic Chains of Carbon Atoms

When carbon atoms combine with one another, three types of chains can be formed. These are (i) straight chain (ii) branched chain (iii) closed chain or ring type chains.



Formation of Single, Double and Triple Covalent Bonds

Carbon is tetravalent, i.e. its valency is four. In order to complete its octet, carbon forms single, double and triple covalent bonds by sharing one, two or three pairs of electrons respectively.

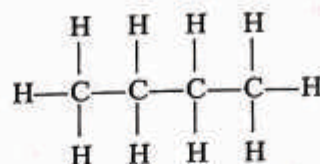


Catenation and tetravalency results in the formation of single, double or triple bonds.

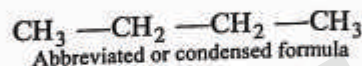
Structural Formulae

Carbon compounds are usually represented by their structural formula. The formula that shows how atoms of different elements are linked together in a molecule is known as structural formula.

e.g. C_4H_{10} can be represented in the following ways



It can also be represented by abbreviated (or condensed) formula.



A structure that shows only the linking of carbon atoms in a molecule is called the carbon skeleton.



Structural Formulae of Alkanes (Upto Five Carbon Atoms)

Name	Molecular formula	Structural Formula
Methane	CH_4	
Ethane	C_2H_6	
Propane	C_3H_8	
Butane	C_4H_{10}	
Pentane	C_5H_{12}	

Structural Formulae of Alkenes (Upto Five Carbon Atoms)

Name	Molecular formula	Condensed formula	Structural formula
Ethene	C_2H_4	$CH_2 = CH_2$	$\begin{array}{c} H & H \\ & \\ H-C & =C-H \end{array}$
Propene	C_3H_6	$CH_3 - CH = CH_2$	$\begin{array}{c} H & H & H \\ & & \\ H-C & -C=C-H \\ \\ H \end{array}$
Butene	C_4H_8	$CH_3 - CH_2 - CH = CH_2$	$\begin{array}{c} H & H & H & H \\ & & & \\ H-C & -C-C=C-H \\ & \\ H & H \end{array}$
Pentene	C_5H_{10}	$CH_3 - CH_2 - CH_2 - CH = CH_2$	$\begin{array}{c} H & H & H & H & H \\ & & & & \\ H-C & -C-C-C=C-H \\ & & & & \\ H & H & H & H & H \end{array}$

Structural Formulae of Alkynes (Upto Five Carbon Atoms)

Name	Molecular formula	Condensed formula	Structural formula
Ethyne	C_2H_2	$CH \equiv CH$	$H-C \equiv C-H$
Propyne	C_3H_4	$CH_3 - C \equiv CH$	$\begin{array}{c} H \\ \\ H-C-C \equiv C-H \\ \\ H \end{array}$
Butyne	C_4H_6	$CH_3 - CH_2 - C \equiv CH$	$\begin{array}{c} H & H \\ & \\ H-C & -C-C \equiv C-H \\ & \\ H & H \end{array}$
Pentyne	C_5H_8	$CH_3 - CH_2 - CH_2 - C \equiv CH$	$\begin{array}{c} H & H & H \\ & & \\ H-C & -C-C-C \equiv C-H \\ & & \\ H & H & H \end{array}$

Functional Group

An 'atom' or 'a group of atoms' which makes a carbon compound (or organic compound) reactive and decides its properties (or functions) is called a functional group. e.g. The alcoholic group $-OH$ present in ethanol C_2H_5OH is an example of a functional group.

Some functional groups and their corresponding organic compounds

Functional group	General formulae	Types of organic compounds	Suffix	Examples with common names and IUPAC names	Structural formula
Halide-X (F, Cl, Br, I)	$R-X$	Haloalkanes	ane	C_2H_5Cl Ethyl chloride (Chloroethane)	$\begin{array}{c} H & H \\ & \\ H-C & -C-Cl \\ & \\ H & H \end{array}$
Hydroxyl $-OH$	$R-OH$	Alcohols	ol	CH_3OH Methyl alcohol (Methanol)	$\begin{array}{c} H \\ \\ H-C-OH \\ \\ H \end{array}$
Aldehyde $-CHO$	$\begin{array}{c} H \\ \diagdown \\ C=O \\ \diagup \\ H \end{array}$	Aldehydes	al	$HCHO$ Formaldehyde (Methanal)	$\begin{array}{c} H \\ \\ H-C-H \end{array}$

Functional group	General formulae	Types of organic compounds	Suffix	Examples with common names and IUPAC names	Structural formula
Carboxyl —COOH	$R-\text{C} \begin{matrix} \text{O} \\ // \\ \text{OH} \end{matrix}$	Carboxylic acids	oic acid	$\text{CH}_3\text{CH}_2\text{COOH}$ Propionic acid (Propanoic acid)	$\begin{array}{c} \text{H} & \text{H} & \text{O} \\ & & // \\ \text{H}-\text{C} & -\text{C}- & \text{C}-\text{OH} \\ & & \\ \text{H} & \text{H} & \end{array}$
Keto —C=O—	$R-\text{C}(=\text{O})-R'$	Ketones	one	CH_3COCH_3 Acetone (Propanone)	$\begin{array}{c} \text{H} & \text{O} & \text{H} \\ & & \\ \text{H}-\text{C} & -\text{C}- & \text{C}-\text{H} \\ & & \\ \text{H} & & \text{H} \end{array}$
Ethers —C—O—C—	$R-\text{O}-R'$	Ethers	oxy	$\text{CH}_3-\text{O}-\text{C}_2\text{H}_5$ Ethyl methyl ether (Methoxy ethane)	$\begin{array}{c} \text{H} & \text{H} & \text{H} \\ & & \\ \text{H}-\text{C} & -\text{O}- & \text{C}-\text{C}-\text{H} \\ & & \\ \text{H} & & \text{H} \end{array}$

Characteristics of Functional Group

- Organic compounds containing the same functional group have similar chemical properties. Therefore, these compounds are identified using the same type of test.
- The physical and chemical properties of the compounds of different functional groups are different.

Isomerism

The organic compounds having the same molecular formula but different structural formula are known as isomers and the phenomenon is called isomerism. Isomers have different physical and chemical properties.

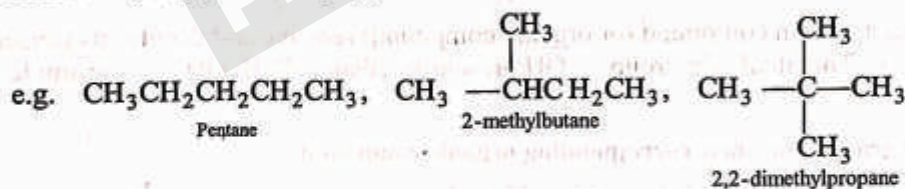
There are two main types of isomerism

1. Structural Isomerism

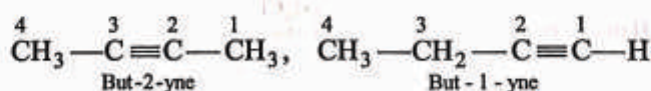
This isomerism is due to the difference in the mode of linking of atoms.

Different types of structural isomerism are as follows

- Chain isomerism** Two or more compounds having a similar molecular formula but are different in the arrangement of carbon atoms in straight or branched chains are known as chain isomers and the phenomenon is termed as chain isomerism, e.g. pentane C_5H_{12} .



- Position isomerism** Two or more compounds having a similar molecular formula but differ in the position of substitute atom or functional group on the carbon atom are termed as position isomers and the phenomenon is called position isomerism.



2. Stereoisomerism

This isomerism is due to the difference in the arrangement of atoms or groups in space. (Will be studied in higher classes).

Homologous Series

A homologous series is a group of organic compounds having similar structure and similar chemical properties in which the successive compounds differ by $-\text{CH}_2$ groups.

Homologous Series of Alkanes

Methane	CH_4	
Ethane	C_2H_6	$(\text{CH}_4 + \text{CH}_2 \longrightarrow \text{C}_2\text{H}_6)$
Propane	C_3H_8	$(\text{C}_2\text{H}_6 + \text{CH}_2 \longrightarrow \text{C}_3\text{H}_8)$
Butane	C_4H_{10}	$(\text{C}_3\text{H}_8 + \text{CH}_2 \longrightarrow \text{C}_4\text{H}_{10})$
Pentane	C_5H_{12}	$(\text{C}_4\text{H}_{10} + \text{CH}_2 \longrightarrow \text{C}_5\text{H}_{12})$

Homologous Series of Alkenes

	General formula	Molecular formula
Alkenes >C=C<	C_nH_{2n}	
	$n=1$	
	$n=2$	C_2H_4
	$n=3$	C_3H_6 ($\text{C}_2\text{H}_4 + \text{CH}_2 \longrightarrow \text{C}_3\text{H}_6$)
	$n=4$	C_4H_8 ($\text{C}_3\text{H}_6 + \text{CH}_2 \longrightarrow \text{C}_4\text{H}_8$)
	$n=5$	C_5H_{10} ($\text{C}_4\text{H}_8 + \text{CH}_2 \longrightarrow \text{C}_5\text{H}_{10}$)

Homologous Series of Alkynes

	General formula	Molecular formula
Alkynes $-\text{C}\equiv\text{C}-$	$\text{C}_n\text{H}_{2n-2}$	
	$n=1$	
	$n=2$	C_2H_2
	$n=3$	C_3H_4 ($\text{C}_2\text{H}_2 + \text{CH}_2 \longrightarrow \text{C}_3\text{H}_4$)
	$n=4$	C_4H_6 ($\text{C}_3\text{H}_4 + \text{CH}_2 \longrightarrow \text{C}_4\text{H}_6$)
	$n=5$	C_5H_8 ($\text{C}_4\text{H}_6 + \text{CH}_2 \longrightarrow \text{C}_5\text{H}_8$)

Characteristics of a Homologous Series

- All the members of a homologous series can be represented by the same general formula. e.g. The general formula for alkane is $\text{C}_n\text{H}_{2n+2}$.
- Any two adjacent homologous differ by CH_2 group in their molecular formula.
- The difference in the molecular mass of any two adjacent homologous is 14 u.
- All the compounds of a homologous series show similar chemical properties. e.g. All the compounds of alkane series show substitution reactions.
- The members of a homologous series show a gradual change in their physical properties such as melting point etc., with increase in molecular mass.
- All the members of a homologous series can be prepared by the similar methods.

Significance of Homologous Series

The existence of homologous series of organic compounds has simplified the study of organic chemistry because instead of studying a large number of organic compounds separately, we have to study only a few homologous series.

Homologous series helps to predict the properties of even those members of the series that are yet to be prepared. With the help of homologous series, the nature of any member of that family of compounds can be ascertained.

PYQs Previous Years' Questions

1 Mark Questions

1. An example of a cyclic organic compound is **ICSE 2023**
 (a) propene (b) pentene
 (c) butene (d) benzene

2. The general formula of hydrocarbons with single covalent bonds is **ICSE 2023**
 (a) C_nH_{2n+2} (b) C_nH_{2n}
 (c) C_nH_{2n-2} (d) C_nH_{2n-6}

3. Arrange the following according to the instructions given in brackets. **ICSE 2023**
 C_2H_2 , C_3H_6 , CH_4 , C_2H_4 (In the increasing order of the molecular weight)

4. Give one word or a phrase for
 "The tendency of an element to form chains of identical atoms." **ICSE 2023, 2018**

5. Complete the following by choosing the correct answer from the bracket.
 Organic compounds are generally insoluble in.....
 (water / organic solvents). **ICSE Specimen 2023**

6. The organic compound having a triple carbon-carbon covalent bond is **ICSE 2020**
 (a) C_3H_4 (b) C_3H_6 (c) C_3H_8 (d) C_4H_{10}

7. Draw the structure of isomers of pentane. **ICSE 2020**

8. Identify the term or substance based on the description given below. **ICSE 2017**
 The property by virtue of which the compound has the same molecular formula but different structural formulae.

9. Identify the term or substance based on the description given below.

- The compound formed where two alkyl groups are linked by $\begin{matrix} O \\ || \\ -C- \end{matrix}$ group. **ICSE 2017**

10. Name the property of elements by virtue of which atoms of the element can link to each other in the form of a long chain or ring structure. **ICSE 2015**

11. Name the hydrocarbons containing a $\begin{matrix} O \\ || \\ -C- \end{matrix}$ functional group. **ICSE 2014**

12. The number of C—H bonds in ethane molecule are
 (a) four (b) six
 (c) eight (d) ten **ICSE 2011**

13. Define isomerism. **ICSE 2009**

2 Marks Questions

14. Identify the functional group in the following organic compounds. **ICSE Specimen 2023**
 (i) HCHO (ii) C_2H_5COOH

15. Name the following organic compound. **ICSE Specimen 2023**
 (i) The compound with 3 carbon atoms whose functional group is a carboxylic acid.
 (ii) The first homologue whose general formula is C_nH_{2n} .

16. Write the structural formula of the two isomers of butane. **ICSE 2018**

17. Distinguish between the saturated hydrocarbon ethane and the unsaturated hydrocarbon ethene by drawing their structural formulae. **ICSE 2008**

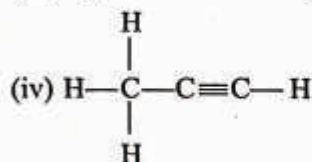
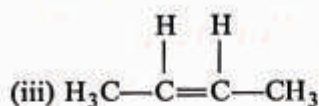
KEY IDEA
 Alkanes have only single bonds between carbon atoms whereas alkenes have at least one carbon-carbon double bond.

3 Marks Questions

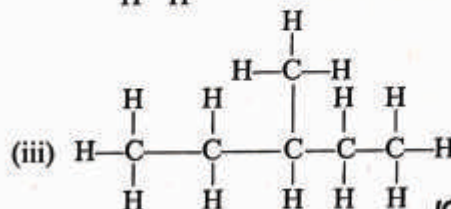
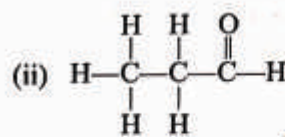
18. Study and complete the following table **ICSE Specimen 2021-22 (Sem-II)**

Homologous series	Alkane	Alkyne
General formula	C_nH_{2n+2}	1.
IUPAC name	2.	Ethyne
Common name	Marsh gas	3.

19. Match the Column I with Column II.
- | Column I (Name) | Column II (Functional group) |
|---------------------|------------------------------|
| (1) A. Aldehyde | 1. —OH |
| B. Carboxylic acids | 2. —CHO |
| C. Alcohol | 3. —COOH |



ICSE 2018



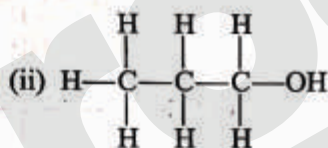
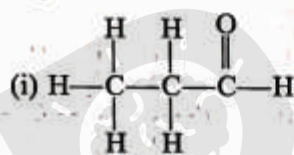
ICSE 2021-22 (Sem-II)

9. Using their structural formulae, identify the functional group by circling them:
- Dimethyl ether
 - Propanone
10. Draw the structural formula for each of the following.
- Ethanoic acid
 - But-2-yne
11. (i) Draw the structural formula of ethyne.
(ii) How is the structure of alkynes different from that of alkenes?
12. Give the correct IUPAC name and the functional group for each of the compounds whose structural formulae are given below

ICSE 2015

ICSE 2010

ICSE 2006



ICSE 2006

13. Give the names and the structural formulae of
- a saturated hydrocarbon.
 - an unsaturated hydrocarbon with a double bond.

ICSE 2000

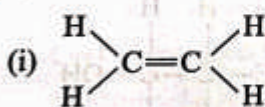
KEY IDEA

In saturated hydrocarbon all carbon atoms are attached to each other by only single covalent bond whereas in unsaturated hydrocarbon there is atleast one double or triple bond between carbon-carbon atoms.

3 Marks Questions

14. Draw the structural diagram of
- pentanal
 - propanol
 - 2-butene
15. Give the IUPAC name for the following.

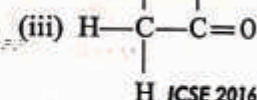
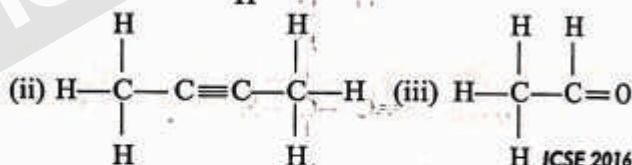
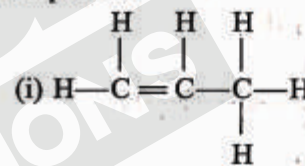
ICSE 2021-22 (Sem-II)



16. Draw the structural formula for each of the following.
- 2, 2-dimethyl pentane
 - Methanol
 - Iso -propane
17. Draw the structural formula for each of the following.
- 2, 3-dimethylbutane
 - Diethyl ether
 - Propanoic acid
18. Write the IUPAC names for each of the following compounds.

ICSE 2020

ICSE 2017



ICSE 2016

19. Give the structural formulae for each of the following
- 2-methyl propane
 - Ethanoic acid
 - Butan-2-ol
20. Give the structural formulae for the following.
- An isomer of n-butane
 - 2-propanol
 - Diethyl ether
21. Draw the structural formula of a compound with two carbon atoms in each of the following cases.
- An alkane with a carbon to carbon single bond.
 - An alcohol containing two carbon atoms.
 - An unsaturated hydrocarbon with a carbon to carbon triple bond.

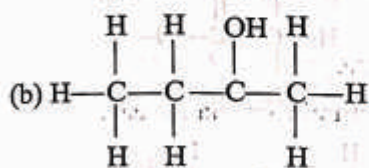
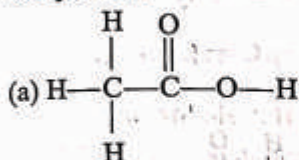
ICSE 2013

ICSE 2005

4/5 Marks Questions

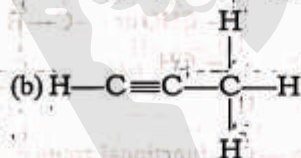
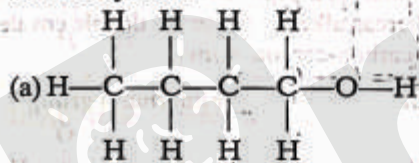
22. (i) Give the structural formula of the following organic compounds. ICSE 2023
 (a) 2-chlorobutane (b) Methanol
 (c) But-2-yne

- (ii) Give IUPAC name of the following organic compounds.



23. (i) Draw the structural formula for the following. ICSE Specimen 2023
 (a) 2-pentanol (b) Ethanal (c) 1-butene

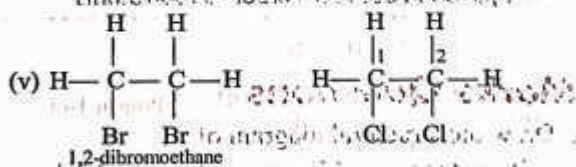
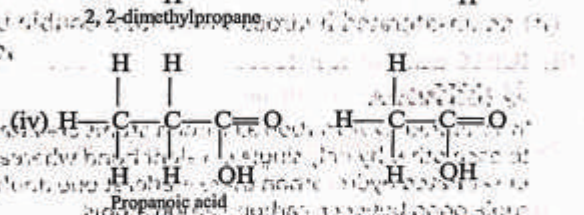
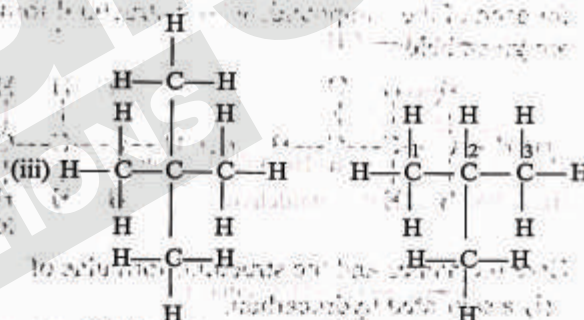
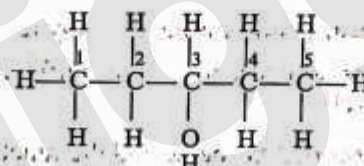
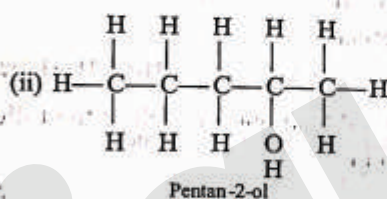
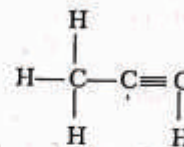
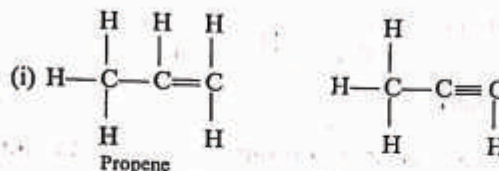
- (ii) Name the following organic compounds in IUPAC system.



24. Give the structural formula for each of the following. ICSE 2014
 (i) Ethanol
 (ii) 1-propanal
 (iii) Ethanoic acid
 (iv) 1,2-dichloroethane

25. Give the structural formula for each of the following. ICSE 2008
 (i) Methanoic acid (ii) Ethanal
 (iii) Ethyne (iv) Acetone

26. Give the IUPAC names of the following compounds numbered (i) to (v). The IUPAC names of the compounds on the left are to guide you into giving the correct IUPAC names of the compounds on the right. ICSE 2007



TOPIC 3 Hydrocarbons-Alkanes, Alkenes and Alkynes

A compound made up of hydrogen and carbon only is called hydrocarbon (Hydrogen + Carbon = Hydrocarbon), e.g. CH₄, C₂H₆, C₂H₂ etc.

The most important natural source of hydrocarbon is petroleum or crude oil.

Hydrocarbons are further divided into two main groups

- (i) Aliphatic (open) and
- (ii) Cyclic (closed) chain compounds.

The aliphatic compounds are further divided into saturated and unsaturated compounds.

Saturated Compounds (Alkanes or Paraffins)

A hydrocarbon in which the carbon atoms are connected by only single bonds is called a saturated hydrocarbon (also known as alkanes).

Alkanes

An alkane is a hydrocarbon in which the carbon atoms are connected by only single covalent bonds. Saturated hydrocarbons are also called alkanes.

The general formula of saturated hydrocarbons or alkanes is C_nH_{2n+2}, where *n* is the number of carbon atoms in one molecule of the alkane.

Methane and Ethane

Occurrence

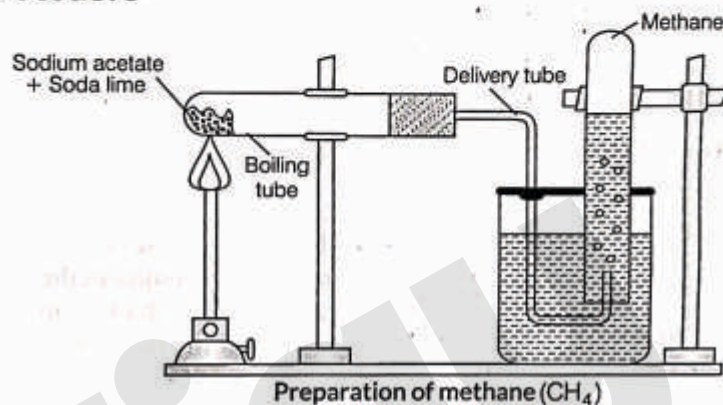
- Widely distributed in marshy lands, air and coal mines.
- Coal pockets contains large amount of methane and are called fire damp.
- Methane is also produced by dry distillation of wood, peat (coal).
- Ethane occurs to the extent of 10-20% along with methane.
- Methane is also considered as greenhouse gas.

The methods of preparation of methane and ethane are given below

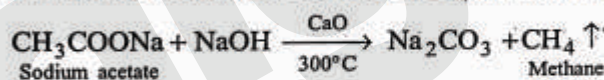
(i) Laboratory Preparation of Methane

Reactants Sodium ethanoate (sodium acetate) and soda lime (a mixture of NaOH + CaO)

Procedure



A mixture of sodium acetate and soda lime is taken in a hard glass test tube as shown in the figure and heat the mixture.



Collection

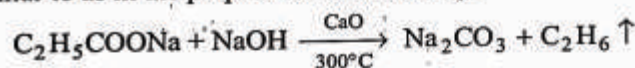
The gas evolved is collected over water by the downward displacement since, it is insoluble in water and is lighter than air.

(ii) Laboratory Preparation of Ethane

Reactants Sodium propionate and soda lime.

Procedure

A mixture of sodium propionate and soda lime is taken in a hard glass test tube and heated with a bunsen burner (apparatus similar to as in the preparation of methane).

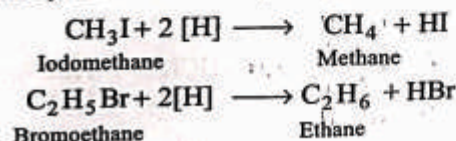


Collection

The evolved gas is collected by the downward displacement of water.

(iii) Preparation of Methane and Ethane from Iodomethane and Bromoethane

Iodomethane and bromoethane are reduced by nascent hydrogen at room temperature to give methane gas. Nascent hydrogen is prepared by the action of Zn powder and dilute HCl.



II. Alkynes

Alkynes are unsaturated aliphatic hydrocarbons which contain a triple bond ($\text{—C}\equiv\text{C—}$), i.e. acetylene bond between two carbon atoms. Alkynes form a homologous series, with the general formula $\text{C}_n\text{H}_{2n-2}$. Most common example is ethyne.

Ethyne (Acetylene)

Molecular formula is C_2H_2 . Ethyne is the first member of the alkyne series. Traces of ethyne are present in coal gas. It is obtained by cracking of alkanes from various fractions of petroleum.

Preparation

The methods of preparation of propagating of ethyne are given below

(a) Form Calcium Carbide

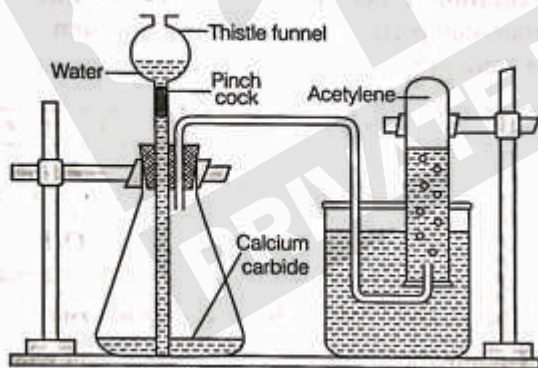
Reactants Calcium carbide and water.

Procedure

Take calcium carbide in a conical flask and add a few drops of water through a thistle funnel as shown in the figure. Acetylene gas is evolved as calcium carbide reacts with water and the reaction is exothermic.



Calcium carbide Calcium hydroxide Acetylene



Laboratory preparation of ethyne

Collection

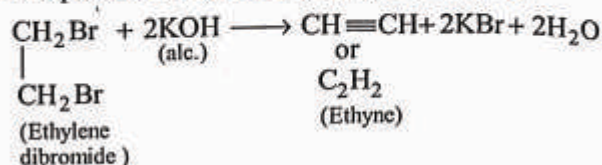
Collected by downward displacement of water, as it is insoluble in water.

Purification

Impurities, i.e. phosphine, H_2S , NH_3 and arsenic are formed. Passing of ethyne through water absorbs all impurities (except phosphine which is absorbed in acidified $\text{K}_2\text{Cr}_2\text{O}_7$.)

(b) Preparation from 1, 2-dibromoethane (Ethylene Dibromide)

When ethylene dibromide (1-2 dibromomethane) is boiled with alcoholic potassium hydroxide, ethyne is formed.



Properties of Acetylene (Ethyne)

Various physical and chemical properties of ethyne are as follow

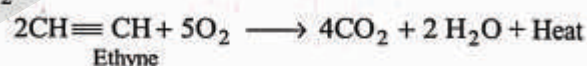
Physical Properties

It is a gas at ordinary temperature, slightly heavier than air. It is colourless and have garlic odour. It is very slightly soluble in water but soluble in organic solvents. Its melting points are -82° and -75°C respectively.

Chemical Properties

- (i) **Oxidation of ethyne (Combustion)** Ethyne burns in air with a very sooty flame, because it has high carbon content.

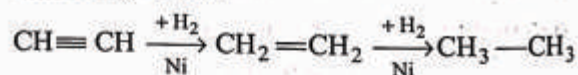
All the carbon of ethyne does not burn completely in air, and some of the carbon particles escape unburnt and make the flame sooty. Ethyne burns in excess air with a brilliant white flame to produce CO_2 and H_2O .



- (ii) **Addition reaction** Alkynes are unsaturated compounds, so they are associated with addition reaction, since triple bond breaks easily.

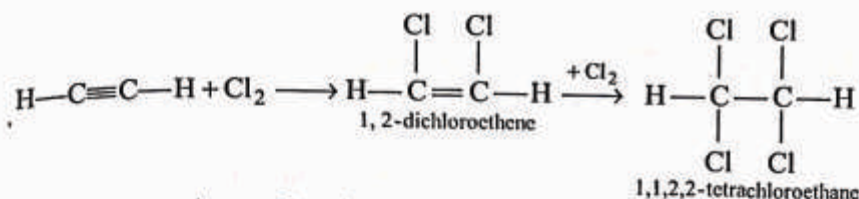
The addition of a reagent to ethyne takes place in two steps

- (a) **Addition of hydrogen (Catalytic hydrogenation)** Ethyne reacts with hydrogen gas in the presence of nickel catalyst to form ethene and finally ethane.



- (b) **Addition of halogens**

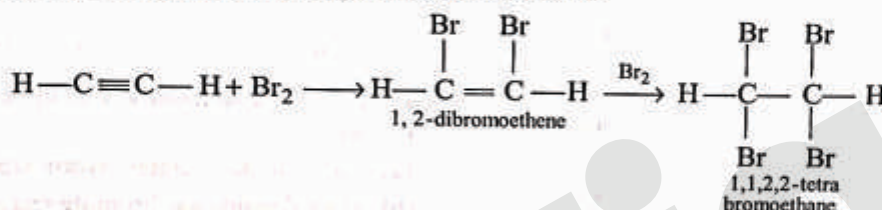
Reaction with chlorine Ethyne first adds one molecule of chlorine to give dichloroethene, which is still unsaturated compound and adds one more molecule of chlorine to form a saturated compound tetra chloroethane.



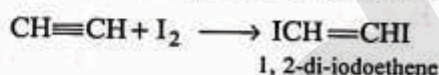
Ethyne reacts vigorously with chlorine gas in the presence of sunlight to give out flames.



Reaction with bromine When bromine water is added to ethyne, the red brown colour of bromine water is discharged rapidly due to the formation of tetrabromoethane.



Reaction with iodine Iodine reacts slowly in the presence of alcohol to form di-iodo derivative.



Uses of Ethyne

- Used for oxy acetylene welding at very high temperature. As an illuminant in oxy acetylene lamp. For artificial ripening and preservation of food.
- Used in the manufacturing of synthetic products like synthetic rubbers and fibres, etc.
- Used in the manufacturing of organic compounds like acetic acid, plastic, rubber, etc.

Chemical Tests to Distinguish between Alkanes, Alkenes and Alkynes

Test	Alkanes (methane and ethane) saturated compound	Alkenes (ethylene) unsaturated compound	Alkynes (acetylene) unsaturated compound
On adding a few drops of bromine solution in carbon tetrachloride to the hydrocarbon.	No change is observed.	The reddish brown colour of bromine solution gets decolorised.	The reddish brown colour gets decolorised.
On adding a few drops of alkaline potassium permanganate (purple colour) to the hydrocarbon.	No change is observed.	The purple colour fades.	The purple colour fades. (Baeyer's test) $\text{CH}\equiv\text{CH} + 4[\text{O}] \xrightarrow[\text{potassium permanganate}]{\text{Alkaline}} \begin{array}{c} \text{COOH} \\ \\ \text{COOH} \\ \text{Oxalic acid} \end{array}$
On adding a few drops of ammoniacal cuprous chloride to hydrocarbon.	No change is observed.	No change is observed.	Red precipitate of copper acetylide is formed.
On adding ammoniacal silver nitrate	No observation	No observation	White precipitate of silver acetylide is formed.

PYQs Previous Years' Questions

1 Mark Questions

- The hydrocarbon formed when sodium propanoate and soda lime are heated together. *ICSE 2023*
 (a) Methane (b) Ethane
 (c) Ethene (d) Propane
- Conversion of ethene to ethane is an example of (hydration/hydrogenation) *ICSE 2023, 2016*
- The organic compound prepared when ethanol undergoes dehydration. *ICSE Specimen 2023*
 (a) Methane (b) Ethane
 (c) Acetylene (d) Ethene
- Carbon to carbon double bond is found in *ICSE Specimen 2021-22 (Sem-I)*
 (a) 2-butylene (b) acetaldehyde
 (c) acetic acid (d) ethyl alcohol
- Substitution reaction is a characteristic property of *ICSE Specimen 2021-22 (Sem-I)*
 (a) alcohols (b) alkanes
 (c) alkenes (d) alkynes
- Name the compound formed when Ethene reacts with hydrogen in the presence of a catalyst. *ICSE Specimen paper 2021-22 (Sem-I)*
- A hydrocarbon which is a greenhouse gas is.
 (a) acetylene (b) ethylene
 (c) ethane (d) methane *ICSE 2019*
- Substitution reactions are characteristic reactions of (alkynes / alkenes / alkanes) *ICSE 2019*
- Ethane, methane, ethene, ethyne. (In the increasing order of the molecular weight) [H = 1, C = 12] *ICSE 2019*
- Name the gas evolved in given reaction.
 Ethene undergoes hydrogenation reaction. *ICSE 2019*
- The organic compound which undergoes substitution reaction is *ICSE 2018*
 (a) C_2H_2 (b) C_2H_4 (c) $C_{10}H_{18}$ (d) C_2H_6
- Fill in the blank from the choice given in bracket.
 The compound formed when ethene reacts with hydrogen is (CH_4 , C_2H_6 , C_3H_8) *ICSE 2017*
- Write a balanced chemical equation for "Preparation of methane from iodomethane." *ICSE 2017*
- Identify the term or substance based on the descriptions given below
 Hydrocarbon containing a triple bond used for welding purposes. *ICSE 2017*
- In the molecular formula of an organic compound is $C_{10}H_{18}$, it is *ICSE 2017*
 (a) alkene (b) alkane
 (c) alkyne (d) not a hydrocarbon
- Identify the statement which does not describe the property of alkenes.
 (a) They are unsaturated hydrocarbons.
 (b) They decolourise bromine water.
 (c) They can undergo addition as well as substitution reactions.
 (d) They undergo combustion with oxygen forming carbon dioxide and water. *ICSE 2015*
- State one relevant observation *ICSE 2015*
 "When the gaseous product obtained by dehydration of ethyl alcohol is passed through bromine water."
- Write balanced equation for "Preparation of ethane from sodium propionate." *ICSE 2014, 2005, 2002*
- Distinguish between the following pair of compound. Ethane and ethene using alkaline potassium permanganate solution. *ICSE 2014, 2013*
- Identify the statement that is incorrect about alkanes.
 (a) They are hydrocarbons.
 (b) There is a single covalent bond between carbon and hydrogen.
 (c) They can undergo both substitution as well as addition reactions.
 (d) On complete combustion, they produce carbon dioxide and water. *ICSE 2013, 2001*
- Give reason for "Hydrocarbons are excellent fuels." *ICSE 2013*
- State one observation for the following.
 Bromine vapours are passed into a solution of ethyne in carbon tetrachloride. *ICSE 2012*
- The unsaturated hydrocarbons undergo
 (a) a substitution reaction
 (b) an oxidation reaction
 (c) an addition reaction
 (d) Both (b) and (c) *ICSE 2011*

24. An organic compound undergoes addition reactions and gives a red colour precipitate with ammoniacal cuprous chloride. Therefore, the organic compound could be ICSE 2010
- (a) ethane (b) ethene
(c) ethyne (d) ethanol
25. Find the odd one out and explain your choice.
 $C_3H_8, C_5H_{10}, C_2H_6, CH_4$ ICSE 2009
26. State how the following conversion can be carried out?
Ethyl chloride to ethene. ICSE 2009
27. The formation of 1, 2-dibromoethane from ethene and bromine is an example of
- (a) substitution reactions
(b) dehydration reactions
(c) dehydrohalogenations
(d) addition reactions ICSE 2008
28. Write the equation for the preparation of carbon tetrachloride from methane. ICSE 2006
29. From the options given : ethane, ethene, ethanoic acid, ethyne, ethanal.
Which is the homologue of homologous series with general formula C_nH_{2n} . ICSE 2005
30. Write the balanced equation for the following.
Ethane is burnt in air. ICSE 2004, 2003
31. Write the equation for the preparation of ethylene from ethyl alcohol. ICSE 2004
32. Write the general formula for a saturated hydrocarbon and give one example of a saturated hydrocarbon with its structural formula. ICSE 2004
33. Name a reagent that can be used to distinguish between ethane and ethene. ICSE 2003
34. Ethylene forms an addition product with chlorine. Name this addition product and write its structural formula. ICSE 2003
35. State what do you observe, when ethene is bubbled through a solution of bromine in tetrachloromethane (carbon tetrachloride). ICSE 2001, 2000
36. Copy and complete the following sentence.
A saturated hydrocarbon will undergo reaction, whereas the typical reaction of an unsaturated hydrocarbon is ICSE 2000

2 Marks Questions

37. Complete and balance the following chemical equations. ICSE Specimen 2021-22 (Sem-I)
- (i) $C_2H_6 + O_2 \longrightarrow$
(ii) $C_2H_2 + I_2 \longrightarrow$
38. Give the involved reaction in following. ICSE 2020
- (i) Producing ethane from bromoethane using Zn/Cu couple in alcohol.

KEY IDEA

The Zn/Cu couple in alcohol is used as a reducing agent. It is used for addition of hydrogen (e.g. reduction of alkyl halide).

- (ii) Complete combustion of ethane. ICSE 2020
39. Give a balanced chemical equation for each of the following. ICSE 2017
- (i) Preparation of ethane from sodium propionate.
(ii) Action of alcoholic KOH on bromoethane.
40. Identify the term/substance in each of the following ICSE 2016
- (i) The catalyst used in the conversion of ethyne to ethane.
(ii) The type of reactions alkenes undergo.
41. Write the balanced chemical equations for each of the following. ICSE 2016
- (i) Burning of ethane in plentiful supply of air.
(ii) Action of water on calcium carbide.
42. Equation for the reaction when compound A is bubbled through bromine dissolved in carbon tetrachloride is as follows ICSE 2016
- $$A \xrightarrow{Br_2/CCl_4} \begin{array}{c} CH_2Br \\ | \\ CH_2Br \end{array}$$
- (i) Draw the structure of A.
(ii) State your observation during this reaction.
43. Select from the list the gas that matches the description given in each case. ICSE 2015
- [ammonia, ethane, hydrogen chloride, hydrogen sulphide, ethyne]
- (i) This gas is used for welding purposes.
(ii) This gas is also as saturated hydrocarbon.
44. Give balanced chemical equations for the following conversions: ICSE 2015
- (i) Calcium carbide to ethyne.
(ii) Sodium ethanoate to methane.

45. State the condition required for the following reactions to take place.

- Catalytic hydrogenation of ethyne.
- Preparation of ethyne from ethylene dibromide.

ICSE 2014

46. Match the Column I with Column II. ICSE 2014, 2009

Column I	Column II
Alkynes	C_nH_{2n+2}
Alkane	C_nH_{2n-2}

47. Give balanced equations for the laboratory preparation of the following organic compounds.

- A saturated hydrocarbon from iodomethane
- An unsaturated hydrocarbon from calcium carbide.

ICSE 2013

48. Give reasons for the following.

- Methane does not undergo addition reactions, but ethene does.
- Ethyne is more reactive than ethane.

ICSE 2012

49. From the following organic compounds given below, choose one compound in each case which relates to the description.

Ethyne, ethanol, acetic acid, ethene, methane

- An unsaturated hydrocarbon used for welding purposes.
- A hydrocarbon which on catalytic hydrogenation gives a saturated hydrocarbon.

ICSE 2012

50. (i) Choose the correct word from the brackets to complete the following sentence.

The catalyst used for conversion of ethene to ethane is commonly (nickel/iron/cobalt).

- Write the equation for the reaction taking place between 1, 2-dibromoethane and alcoholic potassium hydroxide.

ICSE 2011

51. Write balanced chemical equations for the following.

- A mixture of sodalime and sodium acetate is heated.
- Water is added to calcium carbide.

ICSE 2011

52. (i) Write the equation for the complete combustion of ethane.

- Using appropriate catalysts, ethane can be oxidised to an alcohol, an aldehyde and an acid. Name the alcohol, aldehyde and acid formed when ethane is oxidised.

ICSE 2008

53. Addition reactions and substitution reactions are the types of organic reactions. Which type of reaction is shown by

- ethane?
- ethene?

ICSE 2008

54. Write balanced chemical equations for the following reactions.

- Ethane and oxygen in the presence of molybdenum oxide.
- Preparation of methane from anhydrous sodium ethanoate (sodium acetate).

ICSE 2006

55. Write the equations for the following laboratory preparations.

ICSE 2005, 2002, 2001, 2000

- Ethene from iodoethane.
- Ethyne from calcium carbide.

56. Write balanced equation for the preparation of the following.

Ethene from ethanol.

ICSE 2003

57. Choose the correct word.

- The conversion of ethene to ethane is an example of (hydration/hydrogenation).
- The catalyst used in the conversion of ethene to ethane is commonly (iron/cobalt/nickel)

ICSE 2001

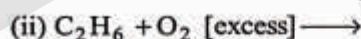
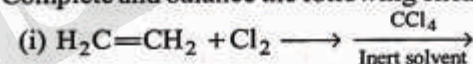
3 Marks Questions

58. Give a balanced chemical equation for the following conversions with conditions.

ICSE 2023

- Ethene from ethanol
- Ethyne from calcium carbide
- Monochloromethane from methane

59. Complete and balance the following chemical equations.



60. Write a balanced chemical equation for the preparation of

- ethene from bromoethane.
- ethyne using calcium carbide.
- methane from sodium acetate.

ICSE 2019

61. Name the following.

- Process by which ethane is obtained from ethene.
- A hydrocarbon which contributes towards the greenhouse effect.
- Reaction when an alkyl halide is treated with alcoholic potassium hydroxide.

ICSE 2015

62. Give the chemical equation for

- the laboratory preparation of methane from sodium acetate.
- the reaction of one mole of ethene with one mole of chlorine gas.
- the preparation of ethyne from 1, 2 - dibromoethane.

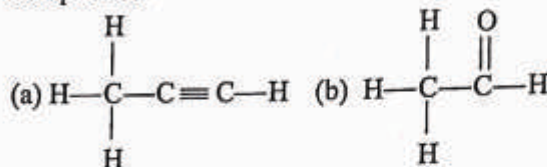
ICSE 2009

4 Marks Questions

63. Copy and complete the following paragraph using the options given in brackets:
Alkenes are a homologous series of (i)
(saturated/unsaturated) hydrocarbons characterised by the general formula (ii) (C_nH_{2n+2} / C_nH_{2n}).
Alkenes undergo (iii) (addition/substitution) reactions and also undergo (iv)
hydrogenation/dehydrogenation) to form alkanes.
ICSE 2020
64. Name the following organic compounds.
(i) The compound with 3 carbon atoms whose functional group is a carboxyl.
(ii) The first homologue, whose general formula is C_nH_{2n} .
(iii) The compound that reacts with acetic acid to form ethyl ethanoate.
(iv) The compound formed by complete chlorination of ethyne.
ICSE 2019
65. Fill in the blanks with the correct choices from the brackets.
Alkenes are the (i) (analogous/homologous) series of (ii) (saturated/unsaturated) hydrocarbons. They differ from alkanes due to the presence of
(iii) (double/single) bonds. Alkenes mainly undergo (iv) (addition/substitution) reactions.
ICSE 2006
66. (i) What is the type of reaction taking place between ethane and chlorine to form monochloroethane?
(ii) The reaction between ethene and chlorine forms only one product. Name the type of this reaction.
(iii) Draw the structural formula of ethene. **ICSE 2002**
(iv) What is the feature of the ethene structure, which allows ethene to react with chlorine in the way it does? **ICSE 2002**

5/6 Marks Questions

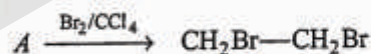
67. (i) Give the IUPAC name of the following organic compounds. **ICSE 2019**



- (ii) What is the special feature of the structure of ethyne?
(iii) Name the saturated hydrocarbon containing two carbon atoms.
(iv) Give the structural formula of acetic acid.
68. Complete the following table, which relates to the homologous series of hydrocarbons. **ICSE 2018**

General formula	IUPAC name of the homologous series	Characteristic bond type	IUPAC name of the first member of the series
C_nH_{2n-2}	(A)	(B)	(C)
C_nH_{2n+2}	(D)	(E)	(F)

69. Compound *A* is bubbled through bromine dissolved in carbon tetrachloride and the product is $\text{CH}_2\text{Br}-\text{CH}_2\text{Br}$.



- (i) Draw the structural formula of *A*.
(ii) What type of reaction has *A* undergone?
(iii) What is your observation?
(iv) Name (not formula) the compound formed, when steam reacts with *A*, in the presence of phosphoric acid.
(v) What is the procedure for converting the product of (iv) back to *A*? **ICSE 2010**