

# organic Chemistry

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## 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

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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 carbon 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.



#### 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 the toward of the contract of the cont single, double or triple bonds. We have the same  $11(1-e^{-\alpha_1 n_1 n_2}) = C_4 H_{10}^{(4,6)}$ 

## Structural Formulae

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

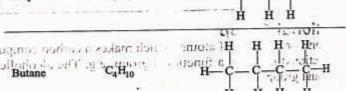
e.g. C4H10 can be represented in the following ways

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 <sub>4</sub>	H-C-H
Ethane	C <sub>2</sub> H <sub>6</sub>	H H H H H H H H H H
Propane	C <sub>3</sub> H <sub>8</sub>	H H H H—C—C—C—H



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Structural F	ormulae o	f Alkenes	(Upto	Five Carbon Atoms)
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Name	Molecular formula	Condensed formula	Structural formula
Ethene	C <sub>2</sub> H <sub>4</sub>	$CH_2 = CH_2$	H H     H—C=C—H
Propene	C <sub>3</sub> H <sub>6</sub>	CH <sub>3</sub> —CH=CH <sub>2</sub>	H H H H   C=C-H
Butene	C <sub>4</sub> H <sub>8</sub>	$CH_3$ — $CH_2$ — $CH=CH_2$	$H - \begin{matrix} -C - C - C - C - H \\ -C - C - C - C - H \end{matrix}$
Pentene	C <sub>5</sub> H <sub>10</sub>	$CH_3 - CH_2 - CH_2 - CH = CH_2$	H H H H H H H C C C C C C C C C C C C C

#### Structural Formulae of Alkynes (Upto Five Carbon Atoms)

Name	Molecular formula	Condensed formula	Structural formula
Ethyne	C <sub>2</sub> H <sub>2</sub>	CH≡CH	H—C≡C—H
Propyne	C <sub>3</sub> H <sub>4</sub>	CH <sub>3</sub> — C≔CH	H-C-C=C-H
Butyne	C <sub>4</sub> H <sub>6</sub>	3	H H H H C C C=C-H
Pentyne	C <sub>5</sub> H <sub>8</sub>	CH <sub>3</sub> - CH <sub>2</sub> - CH <sub>2</sub> - C=	H H H 

**Functional Group** 

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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<sub>2</sub>H<sub>5</sub>OH is an example of a functional group.

#### Some functional groups and their corresponding organic compounds

Functional group	General formulae <sub>H</sub>	Types of organic compounds	Suffix	Examples with common names Olis wo	n and conveyed by any new seconds from
Halide-X (F, Cl, Br, I)	R = X	Haloalkanes	ane	C <sub>2</sub> H <sub>5</sub> Cl Ethyl chloride (Chloroethane)	H—C—C—CI H—H
Hydroxyl — OH	R—OH	Alcohols	ol	CH <sub>3</sub> OH Methyl alcohol (Methanol)	н—с—он н
Aldehyde —CHO	H>c=o	Aldehydes	al	HCHO Formaldehyde (Methanal)	н    н—с—н

1 of Street

Functional group	General formulae	Types of organic compounds	Suffix	Examples with common names and IUPAC names	Structural formula
Carboxyl —COOH	R—C <sup>O</sup> OH	Carboxylic acids	oic acid	CH <sub>3</sub> CH <sub>2</sub> COOH Propionic acid (Propanoic acid)	H H O          H—C—C—C—OH     H H
Keto —C—	R_C_R'	Ketones	one	CH <sub>3</sub> COCH <sub>3</sub> Acetone (Propanone)	н о н        н—с—с—с—н   н н
Ethers	R—O—R'	Ethers	oxy	CH <sub>3</sub> —O—C <sub>2</sub> H <sub>5</sub> Ethyl methyl ether (Methoxy ethane)	H H H H H H H H H H H H H H H H

## **Characteristics of Functional Group**

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

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

(i) 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 C5H12.

e.g. 
$$\text{CH}_3$$
  $\text{CH}_3$   $\text{CH}_3$ 

(ii) 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.

$$\overset{4}{\text{CH}_{3}} - \overset{3}{\text{C}} = \overset{2}{\text{C}} - \overset{1}{\text{CH}_{3}}, \quad \overset{4}{\text{CH}_{3}} - \overset{3}{\text{CH}_{2}} - \overset{2}{\text{C}} = \overset{1}{\text{C}} - \overset{1}{\text{H}}$$
But - 1 - yne

## 2. Stereoisomerism

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



A homologous series is a group of organic compounds having A homoved and similar chemical properties in which the similar properties species of the compounds differ by —CH<sub>2</sub> groups.

#### Homologous Series of Alkanes

Methane Ethane Propane	CH <sub>4</sub> C <sub>2</sub> H <sub>6</sub> C <sub>3</sub> H <sub>8</sub>	$(CH_4 + CH_2 \longrightarrow C_2H_6)$ $(C_2H_6 + CH_2 \longrightarrow C_3H_8)$
Butane	C4H10	$(C_3H_8 + CH_2) \longrightarrow C_4H_{10}$
Pentane	C5H12	$(C_4H_{10}+CH_2 \longrightarrow C_5H_{12})$

#### Homologous Series of Alkenes

	General formula	Molecular formula
Alkenes	C <sub>n</sub> H <sub>2n</sub>	egin par makit sir ancile 1997
\c=c	n=1	Late Nath
10-4	n=2	C <sub>2</sub> H <sub>4</sub>
	n=3	$C_3 H_6  (C_2 H_4 + CH_2 \longrightarrow C_3 H_6)$
	n=4	$C_4 H_8  (C_3 H_6 + CH_2 \longrightarrow C_4 H_8)$
*	n=5	$C_5 H_{10} (C_4 H_8 + CH_2 \longrightarrow C_5 H_{10})$

### Homologous Series of Alkynes

	General formula	Molecular formula
Alkenes —C≡C—	$C_n H_{2n-2}$ $n=1$	THE THE PERSON NAMED IN COLUMN
	n=2	C, H,
	n=3	$C_3 H_4  (C_2 H_2 + CH_2 \longrightarrow C_3 H_4)$
	n=4	$C_4 H_6  (C_3 H_4 + CH_2 \longrightarrow C_4 H_6)$
	n = 5	$C_5 H_8 (C_4 H_6 + CH_2 \longrightarrow C_5 H_8)$

## 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  $C_n H_{2n+2}$ .
- Any two adjacent homologous differ by CH<sub>2</sub> 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.

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# PYQs Previous Years' Questions

1 Mark Questions	12. The number of C—H bonds in ethane molecule are
1. An example of a cyclic organic compound is ICSE 2023	(a) four (b) six (c) eight (d) ten ICSE 2
(a) propene (b) pentene (c) butene (d) benzene	13. Define isomerism. ICSE 2
2. The general formula of hydrocarbons with single covalent bonds is	2 Marks Questions
<ul> <li>(a) C<sub>n</sub>H<sub>2n-2</sub> (b) C<sub>n</sub>H<sub>2n</sub></li> <li>(c) C<sub>n</sub>H<sub>2n-2</sub> (d) C<sub>n</sub>H<sub>2n-6</sub></li> <li>3. Arrange the following according to the instructions given in brackets.  (CSE 2023)  (C<sub>2</sub>H<sub>2</sub>, C<sub>3</sub>H<sub>6</sub>, CH<sub>4</sub>, C<sub>2</sub>H<sub>4</sub> (In the increasing order of the molecular weight)</li> <li>4. Give one word or a phrase for  "The tendency of an element to form chains of identical atoms."  (CSE 2023, 2018)</li> <li>5. Complete the following by choosing the correct answer from the bracket.  Organic compounds are generally insoluble in (water / organic solvents).  (Water / organic solvents).  (ESE Specimen 2023)  6. The organic compound having a triple carbon-carbon covalent bond is  (CSE 2020)  (a) C<sub>3</sub>H<sub>4</sub> (b) C<sub>3</sub>H<sub>6</sub> (c) C<sub>3</sub>H<sub>8</sub> (d) C<sub>4</sub>H<sub>10</sub></li> <li>7. Draw the structure of isomers of pentane.  (CSE 2020)  8. Identify the term or substance based on the description given below.  The property by virtue of which the compound has the same molecular formula but different structural</li> </ul>	14. Identify the functional group in the following organic compounds.  (i) HCHO  (ii) C <sub>2</sub> H <sub>5</sub> COOH  15. Name the following organic compound.  (i) The compound with 3 carbon atoms whose functional group is a carboxylic acid.  (ii) The first homologue whose general formula is C <sub>n</sub> H <sub>2n</sub> .  16. Write the structural formula of the two isomers of butane.  17. Distinguish between the saturated hydrocarbon ethal and the unsaturated hydrocarbon ethene by drawing their structural formulae.  18. Study and complete the following table  19. Study and complete the following table
formulae. ICSE 2017	ICSE Specimen 2021-22 (Sen
<ol><li>Identify the term or substance based on the description given below.</li></ol>	General formula $C_nH_{2n+2}$ 1
The compound formed where two alkyl groups are	IUPAC name C. 2 Ethyne
3. Acceptence [[ (1 - 3)	Common name Marsh gas 3
linked by True Court group, A or gunderen correct set 2017	19. Match the Column I with Column II.
10. Name the property of elements by virtue of which atoms of the element candink to each other in the form of a long chain or ring structure, — array long JCSE 2015	Column I Column II sassis
	(1) A. Aldehyde 11 1. —OH
11. Name the hydrocarbons containing a —C—	B. Carboxylic acids 2. —CHO
functional group. ICSE 2014	C. Alcohol 3. —COOH



## TOPIC 2

## Nomenclature of Organic Compounds

Nomenclature is the system of assignment of names to organic compounds. Organic compounds have two names, common name or trivial system and IUPAC name.

## **Trivial System**

The basis of naming organic compounds by the trivial system is its

- (b) Properties (c) Latin or greek origin (a) Source e.g. CH4 was named marsh gas, due to its source, since it was obtained from marshy places. Acetic acid (Latin name-acitum) was obtained from vinegar.
- IUPAC system (International Union of Pure and Applied Chemistry) IUPAC name takes up only one molecular structure of the compound and assigns only one name to the compound According to this system, the name of an organic

compound consist of three parts:

(i) Root word

(ii) Suffix

(iii) Prefix

· Root word The number of carbon atoms in a hydrocarbon (or any other organic compound) is indicated by using the following stems.

Number of carbon atoms		Root word (Greek name)
One carbon atom	(C <sub>1</sub> )	Meth
Two carbon atoms	(C <sub>2</sub> )	Eth
Three carbon atoms	(C <sub>3</sub> )	Prop
Four carbon atoms	(C <sub>4</sub> )	But
Five carbon atoms	(C <sub>5</sub> )	Pent
Six carbon atoms	(C <sub>6</sub> )	Hex
Seven carbon atoms	(C <sub>7</sub> )	Hept
Eight carbon atoms	(C <sub>8</sub> )	Oct
Nine carbon atoms	(C <sub>9</sub> )	Non
Ten carbon atoms	(C10)	Dec

· Suffix A suffix is always added to the word root to indicate whether the carbon chain is single bonded, double then the carbon atoms are numbered in such a or triple bonded, i.e. it is saturated or unsaturated.

Types of carbon chain	Suffix	General name
C-C(single bond)	- ane	Alkane
C=C(double bond)	- ene	Alkene
C=C (triple bond)	- yne	Alkyne
Group R 11	yl	Alkyl

 Prefix Prefix denotes the substituent, alkyl or functional group and its position in the carbon-chain.

2-methyl (Methyl group is attached to second C -atom)

Di, tri, tetra are used for two, three and four groups of the same type respectively.

## Simple Rules for Naming an **Organic Compound**

· Selection of carbon chain The longest chain of carbon atom in the structure of the compound (to be named) is found first. The compound is then named as a derivative of the alkane hydrocarbon.

e.g. 
$$\overset{1}{C} - \overset{2}{C} - \overset{3}{C} - \overset{4}{C} - \overset{5}{C}$$

Longest chain of 5 carbon atoms, so word root is 'pent'.

 The alkyl group present as side chains (branches) are considered as substituents and named separately as methyl (-CH3) or ethyl -C2H5) group.

e.g. 
$$\overset{1}{C} - \overset{2}{C} - \overset{3}{C} - \overset{4}{C} - \overset{5}{C}$$

CH<sub>3</sub>

2- methyl -----

 The carbon atoms of the longest carbon chain are numbered in such a way that the alkyl groups (substituents) get the lowest possible number.

· If the functional group is also present in the chain, way that the functional group gets the smallest



, If different types of substituents are attached in the chain, they are named alphabetically.

$$_{\text{CH}_{3}}^{1}$$
  $_{\text{CH}}^{2}$   $_{\text{CH}_{2}}^{3}$   $_{\text{CH}_{2}}^{4}$   $_{\text{CH}_{2}}^{5}$   $_{\text{CH}_{3}}^{6}$   $+$   $_{\text{CH}_{3}^{6}}^{6}$   $+$   $_{\text{CH}_{3}}^{6}$   $+$   $_{\text{CH}_{3}^{6}}^{6}$   $+$   $_{\text{CH}_{3}}^{6}$   $+$   $_{\text{CH}_{3}^{6}}^{6}$   $+$   $_{\text{CH}_{3}^$ 

. The IUPAC name of the compound is obtained by writing the position and name of alkyl group just before the name of parent 'hydrocarbon'.

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- . Multiple alkyl groups are labelled as di for two, tri for three and tetra for four.
- . If the two alkyl groups are on the same carbon atom, the numeral is repeated.

## Writing Structural Formula from IUPAC Name

Step I According to the word root (carbon skeleton), write the number of carbon atom.

Step II Number the carbon atoms from any end.

C - C - C - C - CWith the help of the suffix (ane, ene or yne) the position of the bond is specified in the parent chain.

 $C \longrightarrow C \longrightarrow C \longrightarrow C$ 5 4 3 2 1

Step IV Attach the functional group or substituent at the given carbon atom.

$$CH_3$$
 Br  $C - C - C - C - C$ 

Satisfy the four valencies of carbon atom by Step V attaching hydrogen atom.

e.g. 2-bromo-4-methyl pent-2-ene

#### 2-Bromo-4-methyl pent-2-ene

## **Previous Years' Questions**

## 1 Mark Questions

- 1. The IUPAC name of methyl acetylene is
  - (a) propyne
- (b) ethene ICSE Specimen 2023

Why he have getted

- (c) propane
- (d) ethyne
- ICSE Specimen 2023 2. The IUPAC name of ethylene is
  - (a) propane
- (b) propyne

- (a) ethoxy methane
- (c) methoxy ethane (d) ethoxy ethane
- (b) methoxy methane
- 4. The TUPAC name of acetylene is (H) ICSE 2014

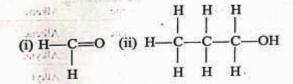
- - (a) propane (b) propyne (a)
- (c) ethene (d) ethyne (iii)
- stra bala 5. Give the IUPAC name of the isomer C<sub>4</sub>H<sub>10</sub>, which has a branched chain.

## 2 Marks Questions

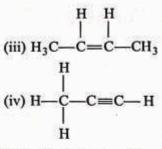
6. Name the following.

- ICSE 2023
- (i) Organic compounds with same molecular formula but different structural formula.
- (ii) Group of organic compounds where the successive members follow a regular structural pattern successive compounds differ by a 'CH2' group.
- 3. The IUPAC name of dimethyl ether is ICSE 2018 7. Write the IUPAC name for the following compounds:

- 8. Give the IUPAC name for each of the following. ICSE 2018







**ICSE 2018** 

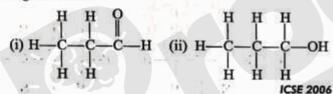
- Using their structural formulae, identify the functional group by circling them:
  - (i) Dimethyl ether
  - (ii) Propanone

ICSE 2015

- 10. Draw the structural formula for each of the following.
  - (i) Ethanoic acid
  - (ii) But-2-yne

**ICSE 2010** 

- 11. (i) Draw the structural formula of ethyne.
  - (ii) How is the structure of alkynes different from that of alkenes? ICSE 2006
- Give the correct IUPAC name and the functional group for each of the compounds whose structural formulae are given below



13. Give the names and the structural formulae of

- (i) a saturated hydrocarbon.
- (ii) an unsaturated hydrocarbon with a double bond.

**ICSE 2000** 

#### **WEYIDEA**

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
  - (i) pentanal
- (ii) propanol
- (iii) 2-butene

ICSE 2021-22 (Sem-II)

15. Give the IUPAC name for the following.

(i) 
$$^{H}_{H}$$
 C=C $^{H}_{H}$ 

- 16. Draw the structural formula for each of the following
  - (i) 2, 2-dimethyl pentane
  - (ii) Methanol

(iii) Iso -propane

ICSE 2020

- 17. Draw the structural formula for each of the following.
  - (i) 2, 3-dimethylbutane
  - (ii) Diethyl ether
  - (iii) Propanoic acid

ICSE 2017

Write the IUPAC names for each of the following compounds.

- 19. Give the structural formulae for each of the following
- (i) 2-methyl propane

ICSE 2016

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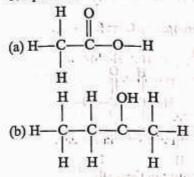
- (ii) Ethanoic acid
- (iii) Butan-2-ol
- 20. Give the structural formulae for the following.
  - (i) An isomer of n-butane

21'. 9 ICSE 2013

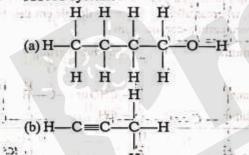
- (ii) 2-propanol
  - (iii) Diethyl ether
- Draw the structural formula of a compound with two carbon atoms in each of the following cases.
  - (i) An alkane with a carbon to carbon single bond.
  - (ii) An alcohol containing two carbon atoms.
  - (iii) An unsaturated hydrocarbon with a carbon to carbon triple bond. 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.



- (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.
  - (i) Ethanol

ICSE 2014

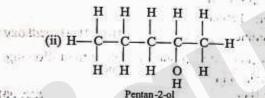
- (ii) 1- propanal
- (iii) Ethanoic acid
- (iv) 1, 2 dichloroethane
- 25. Give the structural formula for each of the following.
  - (i) Methanoic acid (ii) Ethanal PRECEIT-S PICSE 2008

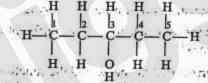
- (iii) Ethyne
- (iv) Acetone by his (iii)
- (v) 2-methylpropanelimin in animate odd wall wing case two carbon atoms in a ich of the (i) An alkane with brarbon to en single b
  - (ii) An alcohol cil daning two on cloms.
- (iii) Au ansatured: Avdrocarbo (iii) a carbor carbon nigla bead and

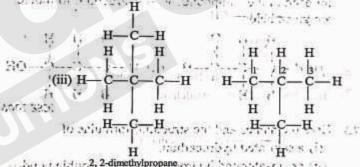
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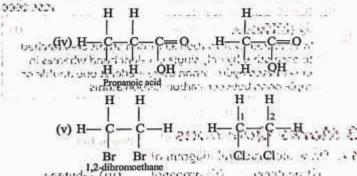
26. Give the IUPAC names of the following compounds numbered (i) to (v). The IUPAC names of the compounds on the left are to guide you into giving the correct IUPAC names of the compounds on the ICSE 2007

**ICSE** 









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23.



## 10PIC 3 Hydrocarbons-Alkanes, Alkenes and Alkynes

A compound made up of hydrogen and carbon only is called hydrocarbon (Hydrogen + Carbon Hydrocarbon), e.g. CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>2</sub>H<sub>2</sub> 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  $C_n H_{2n+2}$ , where n is the number of carbon atoms in one molecule of the alkane.

#### Methane and Ethane

#### Occurrence

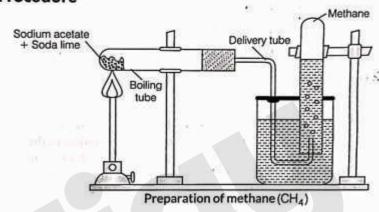
- · Widely distributed in marshy lands, air and coal Harrison of the second section of the
- · Coal pockets contains large amount of methane and are called fire damp.
- wood, peat (coal).
- · Ethane occurs to the extent of 10-20% along with H-12- 1 ... 2 ...
- Methane is also considered as greenhouse gas.

The methods of preparation of methane and ethane are

## (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).

$$C_2H_5COONa + NaOH \xrightarrow{CaO} Na_2CO_3 + C_2H_6 \uparrow$$

#### 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.

$$\begin{array}{ccc} CH_3I + 2 \ [H] & \longrightarrow & CH_4 + HI \\ Iodomethane & & Methane \\ C_2H_5Br + 2[H] & \longrightarrow & C_2H_6 + HBr \\ Bromoethane & & Ethane \end{array}$$

#### **Properties**

Various physical and chemical properties of methane and ethane are as follow

#### **Physical Properties**

- Methane Methane is colourless and odourless gas, its melting point is -183°C and boiling point = -162°C and it is insoluble in water but soluble in organic solvent.
- Ethane It is colourless, odourless gas. Its boiling point is -89°C and melting point is -172°C. It is insoluble in water but soluble in organic solvents.

#### **Chemical Properties**

(i) Reaction with halogens (Substitution reaction) Alkanes react with chlorine, bromine or iodine in the presence of sunlight. Methane reacts with chlorine in the presence of sunlight to form chloromethane and hydrogen chloride.

$$CH_4 + Cl_2 \xrightarrow{\text{Sunlight}} CH_3Cl + HCl$$

$$Chloromethane$$

In this reaction, one H-atom of methane has been substituted by a Cl atom converting CH<sub>4</sub> into CH<sub>3</sub>Cl. By supplying more chlorine, it is possible to replace all the hydrogen atoms of methane by chlorine, one. by one.

$$\begin{array}{c} \text{CH}_3\text{Cl} + \text{Cl}_2 & \xrightarrow{\text{Sunlight}} & \text{CH}_2\text{Cl}_2 + \text{HCl} \\ & \xrightarrow{\text{Dichloro}} & \text{Dichloro} \\ & \text{CH}_2\text{Cl}_2 + \text{Cl}_2 & \xrightarrow{\text{Sunlight}} & \text{CHCl}_3 + \text{HCl} \end{array}$$

CHCl<sub>3</sub> + Cl<sub>2</sub> 
$$\xrightarrow{\text{Sunlight}}$$
 CCl<sub>4</sub> + HCl
Tetrachloro
methane
(or carbon
tetrachloride)

Ethane also reacts with chlorine in the same way.

(ii) Combustion of methane and ethane (Reaction with a oxygen) Methane and ethane burns in air with a bluish flame forming carbon dioxide and water vapour, and a large amount of heat is produced.

**ICSE** 

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + Heat$$
  
 $2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O + Heat$ 

Insufficient supply of air (Slow combustion)

$$2CH_4 + 3 O_2 \longrightarrow 2CO + 4H_2O$$

$$2C_2H_6 + 5O_2 \longrightarrow 4CO + 6H_2O$$

$$CH_4 + O_2 \longrightarrow C + 2 H_2O$$
(Soot)

Soot is used in the manufacture of printing inks and tyres.

#### Uses

- Methane It is a source of carbon monoxide (CO) and hydrogen H<sub>2</sub>. Used in the preparation of ethyne, methanol, methanal, carbon tetrachloride.
- Ethane Used in the preparation of ethane, ethanol, ethanal and ethanoic acid. It forms ethyl chloride, which is used to make tetra ethyl lead (anti-knocking agent). It is also a good fuel.

## **Unsaturated Compounds**

A hydrocarbon in which two carbon atoms are connected by a 'double bond' or a triple bond is called an unsaturated hydrocarbon. These compounds generally **undergo addition reactions.** Unsaturated compounds are further divided into following two cases

## I. Alkenes

Alkenes are unsaturated aliphatic hydrocarbons, which contain one double bond. Alkenes are also called olefins (oil forming). Alkene form a homologous series having the general formula  $C_nH_{2n}$  The most common alkene is ethene.

## Ethene (Ethylene) C2H4

It is the first member of the alkene series. It is present in natural gas and in small amount, it occurs as a plant hormone. It is responsible for the ripening of fruits.

## Preparation of Ethene (Ethylene)

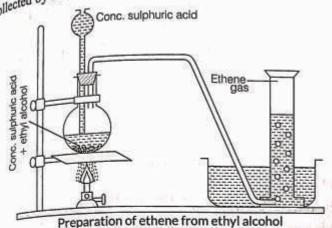
(i) Laboratory Preparation By Dehydration of Ethyl Alcohol

Reactants Ethanol (C<sub>2</sub>H<sub>5</sub>OH) and concentrated sulphuric acid (H<sub>2</sub>SO<sub>4</sub>).

Procedure Take 1 part of ethyl alcohol and 2 parts of concentrated sulphuric acid in a flask and heat the mixture



gradually at about 170°C. Ethylene gas is evolved, which is gradually at the downward displacement of water.



$$C_2H_5OH \xrightarrow{Conc. H_2SO_4} C_2H_4 + H_2O$$

Collection The ethane gas is collected by the downward displacement, because it is insoluble in water and it is an inflammable gas.

(ii) By Dehydration (Industrial Preparation) Ethyl alcohol vapours passed through a tube containing alumina (Al2O3) at 300°C.

$$C_2H_5OH \xrightarrow{Al_2O_3} C_2H_4 + H_2O$$

By dehydrohalogenation Dehydrohalogenation involves the elimination of hydrogen halide.

$$\begin{array}{ccc} \mathrm{C_2H_5}X + & \mathrm{KOH} & \longrightarrow & \mathrm{C_2H_4} + \mathrm{K}X + \mathrm{H_2O} \\ \mathrm{Ethyl\ halide} & & \mathrm{(Alcoholic)} & & \mathrm{(}X = \mathrm{Cl,\ Br\ or\ I)} \end{array}$$

### Properties of Alkenes

Various physical and chemical properties of alkenes are as

## Physical Properties

- · It is a colourless, pleasant odour gas.
- It is slightly soluble in water, soluble in organic solvents.
- · It is slightly less dense than air.
- Its melting and boiling points are -169°C and -104°C.

## Chemical Properties of Ethene Todar elan

(i) Addition of hydrogen (Hydrogenation) Vapours of ethene mixed with hydrogen are passed over a finely divided catalysts such as platinum or palladium or nickel at 200°C.

$$C_2H_4 + H_2 \xrightarrow{200^{\circ}C} C_2H_6$$
Ethane

**ICSE** 

(ii) Addition of halogens (Halogenation) Chlorine, bromine and iodine are added to the double bond of ethene to form saturated ethylene chloride, ethylene bromide and ethylene iodide respectively.

$$\begin{array}{cccc} \operatorname{CH}_2 = \operatorname{CH}_2 + \operatorname{Cl}_2 & \longrightarrow & \operatorname{CH}_2 & \longrightarrow & \operatorname{CH}_2 \\ & & & & | & & | \\ & & & \operatorname{Cl} & & \operatorname{Cl} \\ & & & & \operatorname{Dichlerosethage} \end{array}$$

Bromine solution in CCl4 has an orange colour. When added dropwise to ethene, the orange colour of bromine disappears due to the formation of colourless ethylene bromide.

(iii) Addition of water Alkenes reacts with water in the presence of acids to form alcohols.

$$CH_2 = CH_2 + H_2O \xrightarrow{H^+} C_2H_5OH$$
Ethanol

(iv) Addition of HCl Ethene reacts with HCl to form chloroethane.

$$\begin{array}{c} \operatorname{CH}_2 = \operatorname{CH}_2 + \operatorname{HCl}(aq) \longrightarrow \operatorname{CH}_3\operatorname{CH}_2\operatorname{Cl} \\ \operatorname{Ethene} & \operatorname{Chloroethane} \\ \cdot \operatorname{CH}_3\operatorname{CH}_2\operatorname{Cl} + \operatorname{KOH} \longrightarrow \operatorname{CH}_3\operatorname{CH}_2\operatorname{OH} + \operatorname{KCl} \\ \operatorname{Chlorethane} & \operatorname{Ethyl alcohol} \\ (\operatorname{Conversion of ethene to ethanol}) \end{array}$$

(v) Oxidation Ethene is oxidised with alkaline potassium permanganate, KMnO<sub>4</sub> at room temperature.

The purple colour of KMnO4 decolourises.

(vi) Combustion reaction Ethene burns in air with a sooty flame, but if sufficient supply of air is present then it burns with a pale blue flame to produce A large amount of heat is also produced.

$$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O + Heat$$

#### **Uses of Ethene**

Production of oxy-ethylene torch for welding and cutting metals. Used for artificial ripening and preservation of fruits. Used in making polythene.

Used in hardening of oils. Used in the manufacturing of synthetic chemicals.

## II. Alkynes

Alkynes are unsaturated aliphatic hydrocarbons which contain a triple bond (—C=C—), i.e. acetylene bond between two carbon atoms. Alkynes form a homologous series, with the general formula  $C_nH_{2n-2}$ . 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.

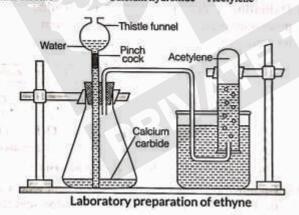
#### Procedure

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.

$$CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2 \uparrow$$

Calcium carbide

Calcium hydroxide Acetylene



#### Collection

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

#### Purification

Impurities, i.e. phosphine, H<sub>2</sub>S, NH<sub>3</sub> and arsenic are formed. Passing of ethyne through water absorbs all impurities (except phosphine which is absorbed in acidified K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>.)

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

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

$$CH_2Br$$
 + 2KOH  $\longrightarrow$   $CH \Longrightarrow CH + 2KBr + 2H_2O$  or  $C_2H_2$  (Ethylene dibromide)

## 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<sub>2</sub> and H<sub>2</sub>O.

$$\begin{array}{c} \text{2CH} \Longrightarrow \text{CH} + 5\text{O}_2 & \longrightarrow 4\text{CO}_2 + 2\text{ H}_2\text{O} + \text{Heat} \\ \text{Ethyne} \end{array}$$

 (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.

$$CH = CH \xrightarrow{+H_2} CH_2 = CH_2 \xrightarrow{+H_2} CH_3 - CH_3$$

(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.

$$H-C = C-H+Cl_2 \longrightarrow H-C=C-H \xrightarrow{+Cl_2} H-C-C-H$$

$$1, 2-dichloroethene \qquad Cl Cl Cl$$

$$1, 1, 2, 2-tetrachloroethane$$

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

$$C_2H_2 + Cl_2 \xrightarrow{Sunlight} 2C + 2HCl$$
Ethyne

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.

$$H-C = C-H+Br_2 \longrightarrow H-C = C-H \xrightarrow{Br_2} H-C-C-H$$

$$\xrightarrow{Br} Br Br Br C-C-C-H$$

$$\xrightarrow{Br} Br Br C-C-C-H$$

$$\xrightarrow{Br} Br Br C-C-C-H$$

$$\xrightarrow{Br} Br Br C-C-C-H$$

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 illuminent 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 44 AC	Alkanes (methane and ethane) saturated compound	Alkenes (ethylene) unsaturated compound	Alkynes (acctylene) 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 decolourised.
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)  CH=CH+ 4[O] Alkaline potassium permangante COOH COOH Oxalic acid
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.



## **PYes** 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
- The organic compound prepared when ethanol undergoes dehydration.

  ICSE Specimen 2023
  - (a) Methane
- (b) Ethane
- (c) Acetylene
- (d) Ethene
- 4. 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
- 6. Name the compound formed when

ICSE Specimen paper 2021-22 (Sem-I)

Ethene reacts with hydrogen in the presence of a catalyst.

- 7. A hydrocarbon which is a greenhouse gas is
  - (a) acetylene
- (b) ethylene
- (c) ethane
- (d) methane

ICSE 2019

- Ethane, methane, ethene, ethyne. (In the increasing order of the molecular weight) [H = 1, C = 12] ICSE 2019
- 10. Name the gas evolved in given reaction.

Ethene undergoes hydrogenation reaction. ICSE 2019

- The organic compound which undergoes substitution reaction is ICSE 2018
  - (a) C2H2
- (b) C2H4
- (c) C<sub>10</sub>H<sub>18</sub>
- (d) C2H6
- 12. Fill in the blank from the choice given in bracket.
  The compound formed when ethene reacts with hydrogen is ........... (CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>3</sub>H<sub>8</sub>) ICSE 2017
- 13. Write a balanced chemical equation for
  - "Preparation of methane from iodomethane." ICSE 2017

- 14. Identify the term or substance based on the descriptions given below
  Hydrocarbon containing a triple bond used for welding purposes.
  ICSE 2017
- 15. In the molecular formula of an organic compound is C<sub>10</sub>H<sub>18</sub>, 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
- 17. State one relevant observation

ICSE 2015

- "When the gaseous product obtained by dehydration of ethyl alcohol is passed through bromine water."
- 18. Write balanced equation for
  - "Preparation of ethane from sodium propionate."
    ICSE 2014, 2005, 2002
- 19. Distinguish between the following pair of compound.

  Ethane and ethene using alkaline potassium permanganate solution.

  ICSE 2014, 2013
- 20. 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
- 21. Give reason for
  - "Hydrocarbons are excellent fuels."

ICSE 2013

- 22. State one observation for the following.
  Bromine vapours are passed into a solution of ethyne in carbon tetrachloride.
  ICSE 2012
- 23. 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 2016
  - (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
- From the options given: ethane, ethene, ethanoic acid, ethyne, ethanal.
   Which is the homologue of homologous series with general formula C<sub>n</sub>H<sub>2n</sub>.
- Write the balanced equation for the following.
   Ethane is burnt in air.
- 31. Write the equation for the preparation of ethylene from ethyl alcohol. ICSE 2004
- Write the general formula for a saturated hydrocarbon and give one example of a saturated hydrocarbon with its structural formula.
- Name a reagent that can be used to distinguish between ethane and ethene. ICSE 2003
- Ethylene forms an addition product with chlorine.
   Name this addition product and write its structural formula.
- 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 ........

#### 2 Marks Questions

- 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
  - Producing ethane from bromoethane using Zn/Cu couple in alcohol.

#### S KENIDEA

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

- Give a balanced chemical equation for each of the following.
  - (i) Preparation of ethane from sodium propionate.
  - (ii) Action of alcoholic KOH on bromoethane.
- 40. Identify the term/substance in each of the following
  - (i) The catalyst used in the conversion of ethyne to ethane.
  - (ii) The type of reactions alkenes undergo.
- 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

$$A \xrightarrow{\operatorname{Br}_2/\operatorname{CCl}_4} \begin{matrix} \operatorname{CH}_2\operatorname{Br} \\ | \\ \operatorname{CH}_2\operatorname{Br} \end{matrix}$$

- (i) Draw the structure of A.
- (ii) State your observation during this reaction.
- Select from the list the gas that matches the description given in each case.

[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.
  - (i) Catalytic hydrogenation of ethyne.
  - (ii) 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	$C_n H_{2n-2}$	

- 47. Give balanced equations for the laboratory preparation of the following organic compounds.
  - (i) A saturated hydrocarbon from iodomethane
  - (ii) An unsaturated hydrocarbon from calcium ICSE 2013 carbide.
- 48. Give reasons for the following.
  - (i) Methane does not undergo addition reactions, but ethene does.
  - (ii) 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

- (i) An unsaturated hydrocarbon used for welding purposes.
- (ii) 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).
  - (ii) 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.
  - (i) A mixture of sodalime and sodium acetate is heated.
  - (ii) Water is added to calcium carbide.
- 52. (i) Write the equation for the complete combustion of ethane.
  - (ii) 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
  - (i) ethane?
- (ii) ethene?

**ICSE 2008** 

54. Write balanced chemical equations for the following reactions.

ICSE

- (i) Ethane and oxygen in the presence of molybdenum oxide.
- (ii) Preparation of methane from anhydrous sodium ethanoate (sodium acetate).
- 55. Write the equations for the following laboratory ICSE 2005, 2002, 2001, 2000 preparations.
  - Ethene from iodoethane.
  - (ii) Ethyne from calcium carbide.
- 56. Write balanced equation for the preparation of the following.

Ethene from ethanol.

ICSE 2003

- Choose the correct word.
  - (i) The conversion of ethene to ethane is an example of ...... (hydration/hydrogenation).
  - (ii) 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.
  - (i) Ethene from ethanol
  - (ii) Ethyne from calcium carbide
- 59. (iii) Monochloromethane from methane Complete and balance the following chemical equations.

(i) 
$$H_2C = CH_2 + Cl_2 \longrightarrow \frac{CCl_4}{Inert solvent}$$

- (ii)  $C_2H_6 + O_2$  [excess]  $\longrightarrow$
- (iii) CH<sub>4</sub> +O<sub>2</sub> [excess] →

ICSE 2021-22 (Sem-II)

- **60.** Write a balanced chemical equation for the preparation of
  - (i) ethene from bromoethane.
  - (ii) ethyne using calcium carbide.
  - (iii) methane from sodium acetate.

ICSE 2019

- Name the following.
  - (i) Process by which ethane is obtained from ethene.
  - (ii) A hydrocarbon which contributes towards the greenhouse effect.
  - (iii) Reaction when an alkyl halide is treated with alcoholic potassium hydroxide. ICSE 2015
- Give the chemical equation for
  - (i) the laboratory preparation of methane from sodium acetate.
  - (ii) the reaction of one mole of ethene with one mole of chlorine gas.
  - (iii) 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:

**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<sub>n</sub>H<sub>2n</sub>.
  - (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

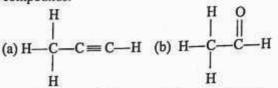
(iii) ...... (double/single) bonds. Alkenes mainly undergo (iv) ....... (addition/substitution) reactions.

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?

## 5/6 Marks Questions

(i) Give the IUPAC name of the following organic compounds.



- (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
С"Н2л-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 CH<sub>2</sub>Br—CH<sub>2</sub>Br.

$$A \xrightarrow{Br_2/CCl_4} CH_2Br - CH_2Br$$

- (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?