Chapter = 03

Organic Chemistry

Q1. Define organic compounds

ORGANIC COMPOUND

Organic compounds are those that include one or more carbon atoms that are covalently linked to atoms of other elements, such as hydrogen, oxygen, nitrogen e.t.c

FOR EXAMPLE

Ethane, Alcohol, Amine, Polystyrene, Chloroform, e.t.c

Q2. Give general characteristics of organic compounds

GENERAL CHARACTERISTICS OF ORGANIC COMPOUNDS

1. Organic compounds are obtained from Irving things (animals and plants) and minerals
2. Carbon is the key element in all organic compounds. After carbon, most frequently used element is hydrogen. Organic compounds may also contain halogens, oxygen, sulphur, nitrogen and phosphorus elements.
3. Organic compounds contain both types of covalent bonds-polar and non polar bonds.
4. According to like dissolve like rule, organic compounds are insoluble in water but soluble in organic solvents. Non-polar organic compounds are soluble in benzene, carbon disulphide, ether etc and polar compounds are soluble in alcohols.
5. As covalent bond is weaker than ionic bond, so organic compounds have lower melting and boiling points.
6. The rate of reactivity of organic compound is very slow and need specific conditions.
7. Generally, organic compounds are non-conductors of electricity because they consist of covalent molecules.

8. All organic compounds are more combustible and burn in air due to high percentage of carbon. The common product produced in all cases is carbon dioxide.

9. Organic compounds are less stable on a high temperature as compare to inorganic compounds.

Q3. What is the representation of organic compounds? Also give two example of each.

REPRESENTATION OF ORGANIC COMPOUND

Organic compounds have four different sorts of formulae:

1. Molecular formula
2. Structural formula
3. Condensed formula
4. Dot and cross formula

Molecular Formula

The molecular formula is the formula that indicates the exact number of atoms in one molecule of an organic compound.

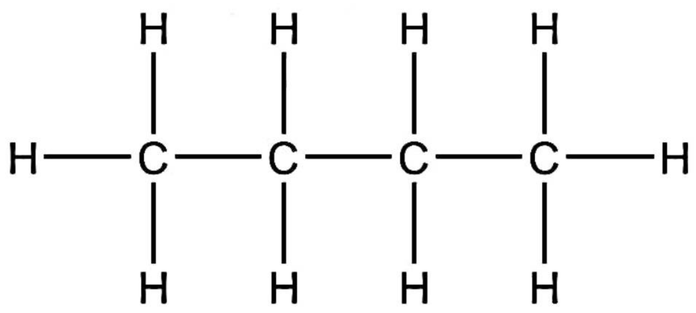
FOR EXAMPLE,

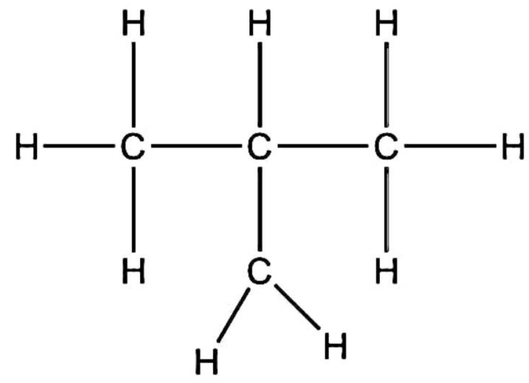
Molecular formula of butane is C_4H_{10}

Structural Formula

The exact arrangement of the individual atoms of various elements contained in a molecule of a substance is represented by the structural formula of a compound. Between the bonded atoms, a single bond is represented by a single line (–), a double bond by two lines (=), and a triple bond by three lines (≡). Organic compounds can have the same molecular formula but various structural formulas, such as butane C_4H_{10},which has two the structural formulae.

EXAMPLE





n- butane iso butane

CONDENSED FORMULA

Condensed formula is the formula in which bond line to each carbon are omitted and each distinct structural unit is written with subscript numbers for multiple substituents including hydrogen.

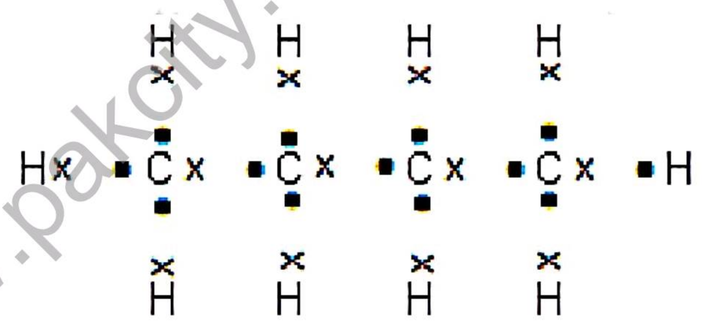
EXAMPLE

$CH_3\ CH_2\ CH_2\ CH_3$ $CH_3\ CH\ (CH_2)\ CH_3$

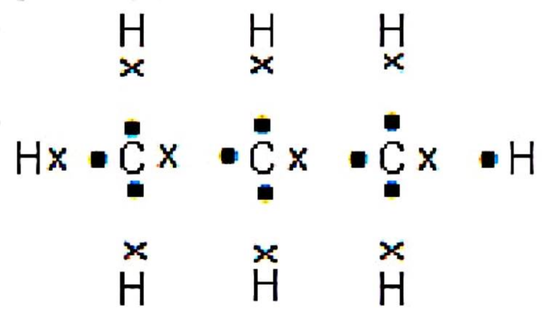
n- Butane isobutane

DOT AND CROSS FORMULA (ELECTRONIC)

The dot and cross formula, also known as the electronic formula, depicts the sharing of electrons between distinct atoms in a single molecule of an organic compound.



Butane



Propane

Q4. Discus the classification of organic compounds

CLASSIFICATION OF ORGANIC COMPOUNDS ORGANIC COMPOUND

OPEN CHAIN COMPOUNDS

The compound which contains atoms linked in open chain are known as open chain compound

FOR EXAMPLE n-pentane, isopentane

STRAIGHT CHAIN

The open chain compound with substituents linked in the straight chain are known as straight chain compound

FOR EXAMPLE n–butane

BRANCHED CHAIN

The open chain compound contains branches are termed as branched chain

FOR EXAMPLE isobutane

CYCLIC COMPOUNDS

The organic compound having a basic nonlinear structure are cyclic compounds

FOR EXAMPLE benzene and phenol cyclobutene

HETEROCYCLIC COMPOUNDS

Those compounds a carbon ring structure that contains at least one other electronegative element

FOR EXAMPLE C_6H_5N, C_6H_5OH,

HOMOCYCLIC COMPOUNDS

Cyclic compounds having atoms of the same elements in ring are Homocyclic compounds

FOR EXAMPLE benzene, cyclobutene.

ALICYCLIC COMPOUNDS

The compounds which have no benzene ring

FOR EXAMPLE cyclobutene.

AROMATIC COMPOUND

The compound which has benzene ring with six carbon atoms are known as aromatic compound

FOR EXAMPLE benzene naphthalene

Q5. Define catenation, isomerism, homologous series, functional group

1. **CATENATION**

The ability of carbon atoms to join with another via covalent bonds to create long chains or rings of carbon atoms is the primary cause for the formation of a vast number of organic compounds.

2. **HOMOLOGOUS SERIES**

A Homologous Series is a group of organic chemical compounds, usually listed in order of increasing size, that have a similar structure (and hence also similar properties).

3. ISOMERISM

The existence of two or more compounds having the same molecular formula but a different arrangement of atoms within the molecule is known as isomerism.

4. FUNCTION GROUP

Functional group can be defined as the atom (or group of atoms) present in a molecule which determines the characteristic properties of that molecule.

Q6. Write short note of sources of organic compounds

COAL:

Coal is made up of a variety of hydrocarbons. It is an important source of solid fossil fuels for us. It can be found at various depths beneath the earth surface. Coal is formed in a variety of ways. Coal is said to have developed in ngtue500 million years ago from the remnants of trees buried deep inside the soil. It was turned to peat as a result of bacterial and chemical processes on the wood. Peat was then converted into coal as a result of high temperature and pressure within the Earth's crust Natural carbonization is the process of converting wood into coal. Wood has a carbon content of 40%.Four varieties of coal are created depending on the degree of carbonization.

China, the United States of America, Russia, the United Kingdom, Germany, Poland, Australia, and Pakistan are the world's top coal producers.

PETROLEUM:

Petroleum is a thick dark brownish or greenish black liquid. It's a complicated combination of solid, liquid, and gaseous hydrocarbons, together with water, salts and earth particles. Organic compounds are mostly derived from petroleum. It is made up of a variety of substances, the majority of which are hydrocarbons. Fractional distillation is used to separate these chemicals (separation of fractions or components from a liquid mixture depending upon their boiling point ranges is called fractional distillation). Each fraction contains single chemical compound, rather than multiple components.

NATURAL GAS

It's a mixture of hydrocarbons with low molecular weight. Methane, together with other gases such as ethane, propane, and butane, makes up around 85% of the mixture. It has a similar origin to coal and

petroleum. As a result, it is discovered with their deposits. Natural gas is utilized as a fuel in both households and industries. Compressed natural gas (CNG) is utilized as a fuel in cars. Carbon black and fertilizers are also made from natural gas.

PLANTS

Macromolecules, such as carbohydrates, proteins, lipids, and vitamins, are synthesized by living plants. Glucose is the fundamental unit of all carbohydrates, and it is produced by plants through photosynthesis. Starch, and cellulose are formed as glucose polymerizes further. Pulses and beans are high in protein. Proteins are made by nitrogen fixing bacteria that live on the roots of plants. Seeds from plants including sunflower, rapeseed, palm, coconut, and groundnut contain oils. Apples and citrus fruits are high in vitamins. Plants provide us with gums, rubber, medications, and other products in addition to these primary food staples.

SYNTHESIS IN LABORATORY

Only plants and animals, it was thought just over two centuries ago, could synthesize organic compounds because they possessed Vital Force,' which is required for organic compound synthesis. However, FM. Wohler's laboratory synthesis of urea (NH_2CONH_2) in 1828 established the area of laboratory synthesis of organic molecules. More than 10 million organic molecules have been synthesized in laboratories till today. They range in complexity from simple to complicated. Drugs and medications, flavourings and scents, plastics and paints, synthetic fibbers and rubber, cosmetics and toiletries, detergents, insecticides and pesticides, and other products include them.

Q7. Give uses of organic compounds

USES OF ORGANIC COMPOUNDS

USES AS FOOD: The foods we eat on a daily basis, such as milk, eggs, meat, vegetables, and so on, are all organic and contain carbohydrates, proteins, lipids, vitamins, and so on.

USES AS CLOTHING: Natural (cotton ilk, wool, etc.) and synthetic (polyester, nylon, etc.) fibers are used in all form of clothing (we wear, we use as bed sheets, etc). (nylon Dacron and acrylic, etc) All these substances are made up of organic components.

USES AS A HOUSE: Wood is made mostly of cellulose (naturally synthesized organic compound). Its used to build anything from buildings to furnishings.

USES AS FUEL: Coal petroleum, and natural gas are the fuels we use in our cars. and in our homes, These are referred to as fossil fuels. These are all organic compounds Medical Applications: We employ a significant variety of organic compounds (naturally generated by plants) as medications. Antibiotics (which suppress or kill bacteria that cause infectious illnesses) and other life-saving medications and treatments are manufactured in laboratories.

Q8. What are Alkane, Alkene and Alkynes

ALKANES

Alkanes are hydrocarbons with only single bonds between the atoms.

They have general formula C_nH_{2n+2}.

The number of carbons in each chain determine the name.

ALKENES

Alkenes are hydrocarbons with at least one double bond.

They have general formula C_nH_{2n}

The number of carbons in each chain determine the name.

ALKYNES

Alkynes are hydrocarbons with at least one triple bond.

They have general formula C_nH_{2n-2}

The number of carbons in each chain determine the name.

Q9. What are alkyl radicals

FORMATION OF ALKYL RADICAL

Alkyl radicals are alkane derivatives. They are created by removing one of an alkane's hydrogen atoms and are symbolized by the letter R. Their name is formed by substituting the letter "ane" in alkane with the letter "yl." Therst10 alkanes and their alkyl radicals are shown in Table. C_nH_{2n+1} is their general formula.

Q10. What are alcoholic group, ether linkage. Aldehydic group, ketonic group, carboxyl group, ester linkage

(I) ALCOHOLIC GROUP

The functional group of alcohol is -OH. Their general formula is ROR Where R is any alkyl group.

EXAMPLES

CH_3— OH	CH_3— CH_2— OH	CH_3— CH_2— CH_2 — OH
Methyl alcohol	Ethyl alcohol	n-Propyl alcohol

(II) ETHER LINKAGE

The functional group of ether is C — 0 — C. Their general formula is R — 0 — R' where R and R' are alkyl groups.

R and R' may be same or different, such as:

EXAMPLES

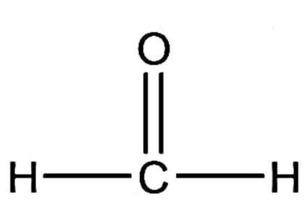
H_3C —O — CH_3	C_2H_5 — O — C_2H_5	H_3C — O — C_2H_5
Dimethyl ether	Diethyl ether	ethyl methyl ether

(II) ALDEHYDIC GROUP

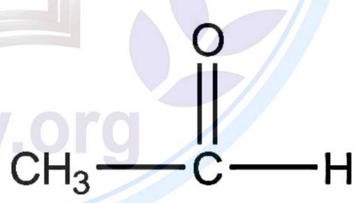
Aldehyde family consists of carbonyl functional group. Their general formula is RCHO

Where R stands for H or some alkyl groups, such as:

EXAMPLES



Formaldehyde



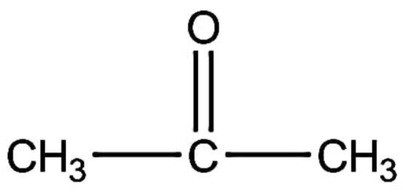
Acetaldehyde

(IV) KETONIC GROUP

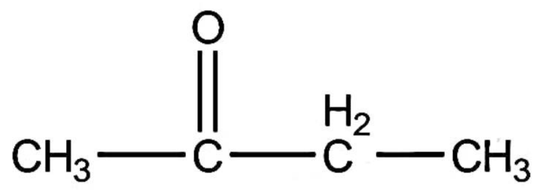
Compounds containing the functional group — CO — are called ketones.

They have the general formula R— CO — R' where R and R' are alkyl groups.

EXAMPLES



Acetone(dimethyl ketone)



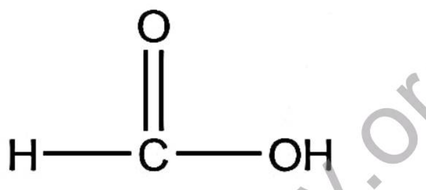
Ethyl methyl ketone

(V) CARBOXYL GROUP

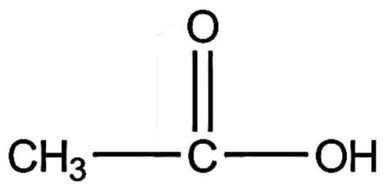
Compounds containing — CO — OH functional group are called carboxylic acids.

Their general formula R — CO — OH is where R and — OH stands for some alkyl groups.

EXAMPLES



Formic acid



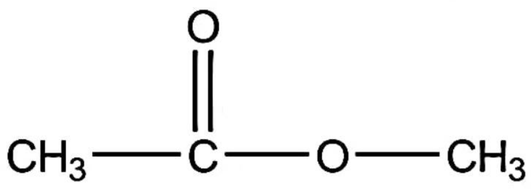
Acetic acid

(VI) ESTER LINKAGE

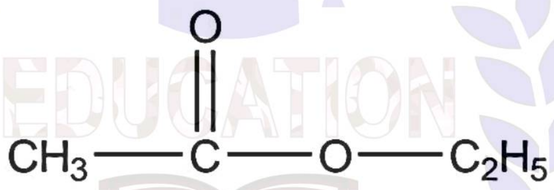
Organic compounds consisting of RCOOR' functional group are called esters

Their general formula is R — CO — O — H

EXAMPLES



Methyl acetate



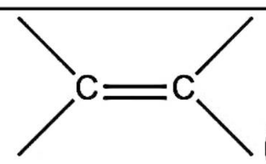
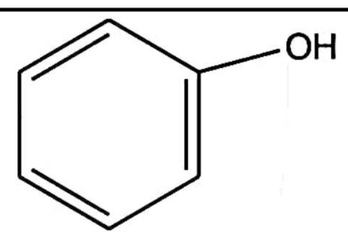
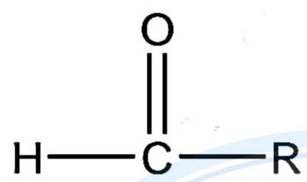
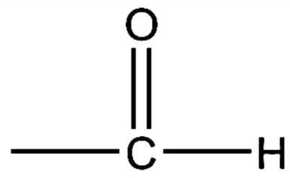
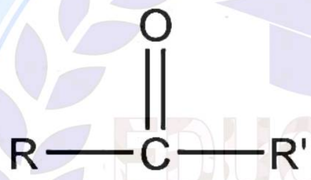
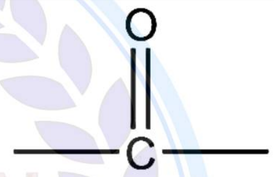
Ethyl acetate

Q11. Differentiate between saturated and unsaturated hydro carbons

SATURATED HYDROCARBON	UNSATURATED HYDRO CARBON
Saturated hydrocarbons contain carbon single bond.	Unsaturated hydrocarbons contain carbon double and triple bonds.
Saturated hydrocarbons are less reactive.	Unsaturated hydrocarbons are more reactive.

The valances of all carbon atoms are fully satisfied through single bond.	The valances of all carbon atoms are fully satisfied through double and triple bond.
Saturated hydro carbon have a less amount of carbon and high amount of hydrogen.	Unsaturated hydrocarbon have a less amount of hydrogen and high amount of carbon as compared to sutured hydrocarbons.
They burns with blue and non-sooty flame in air	They burn with yellow and sooty flame in air.
The compounds of saturated hydrocarbon are alkanes Alkanes are represented by general formula C_nH_{2n+2}	The compounds of unsaturated hydrocarbon are alkenes and alkynes. The general Formula of alkenes (C_nH_{2n}) and alkynes (C_nH_{2n-2})
Examples of alkanes are Ethane ($CH_3—CH_3$), Propane ($CH_3 — CH_2 — CH_3$).	Examples of alkenes are Ethene ($CH_2 = CH_2$), Propene ($CH_2 = CH — CH_3$) and Example of alkynes, Ethyne ($CH \equiv CH$), Propyne($CH_3 — C \equiv CH$)

Q12. Give molecular formula and functional group of following

HOMOLOGUES SERIES	GENERAL FORMULA	FUNCTIONAL GROUP
Alkane	R — H or C_nH_{2n+2}	—
Alkene	R = H or C_nH_{2n}	 (double bond)
Alkyne	R ≡ H or C_nH_{2n-2}	—C≡C— (triple bond)
Haloalkane	R — X (where X = F, Cl, Br, I Or $C_nH_{2n+1}X$	—X (halide group)
Alcohol	R — OH or $C_nH_{2n+1}OH$	— OH (hydroxyl group)
Phenol	 Or R — O —R' or C_6H_5OH	— OH (hydroxyl group)
Ether	R — O —R' or $C_nH_{2n+2}O$	— OR' (alkoxyl group)
Aldehydes		 (carbonyl group or —CHO) aldehyde group
ketone		 (carbonyl group) (Ketonic group)