CHAPTER 11

ORGANIC CHEMISTRY

INTRODUCTION

LONG QUESTIONS

Q.1 What was vital force theory? How it was rejected? ***(Knowledge Base)***

(DGK 2017, GRW 2013, BWP 2016 G-II)

Ans: **VITAL FORCE THEORY**

Introduction:

In early 19th century, Swedish chemist Jacob Berzellius put forward the "Vital Force Theory" in 1815.

Definition:

"According to this theory organic compounds ***could not be prepared in laboratories*** *because they were supposed to be* ***synthesized*** *under the* ***influence of a mysterious force*** *called Vital Force,* ***inherent*** *only in* ***living things".***

Rejection of Vital Force Theory

(i) F. Wohler (1828): **(DGK 2017)**

The Vital Force Theory suffered death blow in 1828 when Wohler synthesized the first organic compound urea from inorganic substance by heating ammonium cyanate (NH_4CNO).

$$NH_4CNO \xrightarrow[\text{Rearrangement}]{\text{Heat}} H_2NCONH_2$$

(Urea)

(ii) Kolbe (1845):

In **1845 Kolbe** also rejected vital force theory, when he **prepared acetic acid in laboratory.**

SHORT QUESTIONS

Q.1 What was early concept of scientists about organic chemistry? ***(Knowledge Base)***

Ans: **EARLY CONCEPT OF SCIENTISTS ABOUT ORGANIC CHEMISTRY**

Initially (before 1828), the name organic chemistry was given for the chemistry of compounds obtained from plants and animals, i.e., from living organisms.

"The word organic signifies life"

Q.2 What was Lavoiser's concept about composition of plants and animals? ***(Knowledge Base)***

Ans: **COMPOSITION OF PLANTS AND ANIMALS**

Plants:

Lavoiser showed that compounds obtained from plants were often made of C, H and O elements.

Animals:

He showed that compounds obtained from animals contain elements C, H, N, O, S, P etc.

Q.3 Give examples of some important organic compounds. ***(Knowledge Base)***

Ans: **IMPORTANT ORGANIC COMPOUNDS**

Some important organic compounds are as follows:

- They range from simple to complex compounds

- They are present in drugs and medicines
- Flavours and fragrances
- Plastics and paints
- Detergents, insecticides and pesticides
- Carbohydrates
- Proteins
- Lipids
- Enzymes
- Vitamins

Q.4 How was vital force theory rejected? ***(Knowledge Base)***

Ans: *Answer given on pg # 110*

MULTIPLE CHOICE QUESTIONS

1. The vital force theory suffered rejection in: ***(K.B)***

(A) 1892 (B) 1882
(C) 1889 (D) 1828

2. Who put forth Vital Force Theory? ***(K.B)***

(A) Berzellius (B) Jabir Bin Hayan
(C) Dalton (D) Wohler

3. Vital Force Theory was further negated by: ***(K.B)***

(A) Kolbe, 1845 (B) Farat, 1545
(C) Divan, 1435 (D) Derek, 348

4. Who rejected Vital Force Theory? ***(K.B)***

(A) Wohler (B) Farat
(C) Divan (D) Derek

5. According to Lavoiser the compounds obtained from plants were often made of: ***(K.B)***

(A) C, H, N, O, S and P (B) C, H and O
(C) H, C, N, and O (D) C and H

11.1 ORGANIC COMPOUNDS

LONG QUESTIONS

Q.1 Explain the types of formulae of organic compounds. ***(Knowledge +Understanding Base)***

(GRW 2014, DGK 2017, MTN 2016 G-I)

Ans: **TYPES OF FORMULAE OF ORGANIC COMPOUNDS**

There are four types of formulae of organic compounds:

(i) Molecular formula
(ii) Structural formula
(iii) Condensed formula
(iv) Dot and cross formula

(i) Molecular Formula:

"The formula which represents the ***actual number of atoms*** *in one molecule of the organic compound is called the molecular formula".*

Example:
Molecular formula of butane is **C_4H_{10}.** It shows:

- **Butane** is made up of **carbon** and **hydrogen atoms**.
- Each molecule of butane consists of **4 carbon** atoms and 10 **hydrogen atoms.**

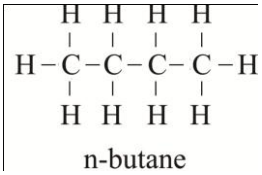
(ii) Structural Formula:
*"Structural formula of a compound represents the **exact arrangement** of the **different atoms** of various elements present in a molecule of a substance".*

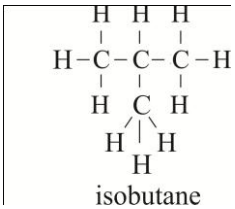
Representation of Bonds:
In a structural formula the bonds between bonded atoms are shown as follows:

- Single bond is represented by a single line (–)
- Double bond by two lines (=)
- Triple bond by three lines (≡)

Organic compounds may have same molecular formulae but different structural formulae.

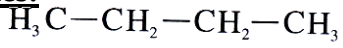
Example:
Structural formulae of butane (C_4H_{10}) are:

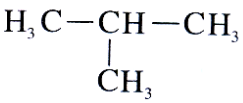

n-butane


isobutane

(iii)Condensed Formula:
*"The formula that indicates the **group of atoms joined together** to each carbon atom in a straight chain or a branched chain is called the condensed formula".*

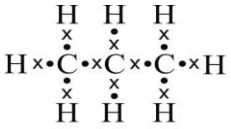
Examples:

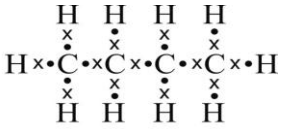

n-Butane


isobutane

iv. Electronic or Dot and Cross Formula:
*"The formula which shows the **sharing of electrons** between various atoms in one molecule of the organic compound is called dot and cross formula or electronic formula".*

Examples:


Propane


n-butane

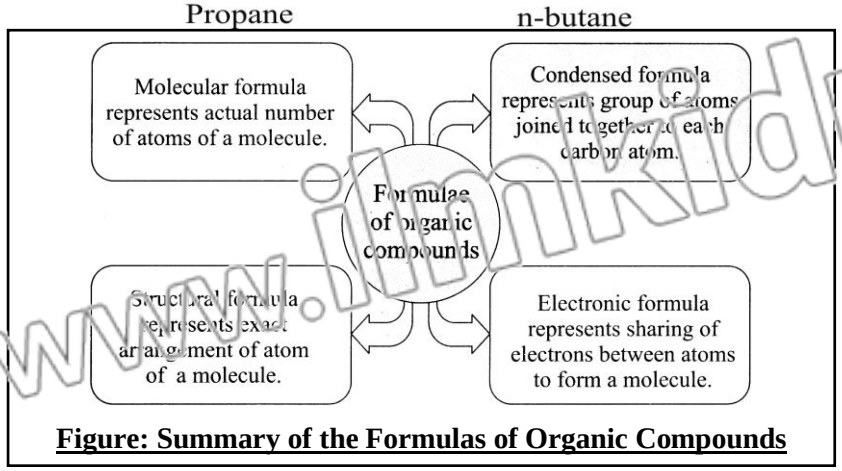


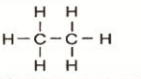
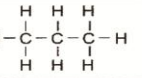
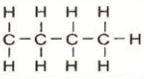
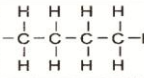
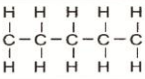
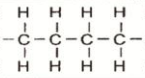
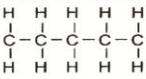
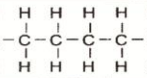
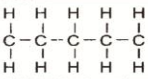
Figure: Summary of the Formulas of Organic Compounds

Q.2 Write the names, molecular, condensed and structural formulae of the first ten hydrocarbons. ***(Knowledge + Understanding Base)***

Ans:

FIRST TEN HYDROCARBONS

Following are the names, molecular, condensed and structural formulae of the first ten hydrocarbons:

Name	Molecular Formula	Condensed Formula	Structural Formula
Methane	CH_4	CH_4	
Ethane	C_2H_6	H_3CCH_3	
Propane	C_3H_8	$H_3CCH_2CH_3$	
Butane	C_4H_{10}	$H_3C(CH_2)_2CH_3$	
Pentane	C_5H_{12}	$H_3C(CH_2)_3CH_3$	
Hexane	C_6H_{14}	$H_3C(CH_2)_4CH_3$	
Heptane	C_7H_{16}	$H_3C(CH_2)_5CH_3$	
Octane	C_8H_{18}	$H_3C(CH_2)_6CH_3$	
Nonane	C_9H_{20}	$H_3C(CH_2)_7CH_3$	
Decane	$C_{10}H_{22}$	$H_3C(CH_2)_8CH_3$	

11.1 ORGANIC COMPOUNDS

SHORT QUESTIONS

Q.1 What are the organic compounds? ***(Knowledge Base)*** **(GRW 2017, SGD 2016 G-I)**

Ans:

ORGANIC COMPOUNDS

Definition:

"Organic compounds are ***hydrocarbons*** *(compounds of carbon and hydrogen) and their derivatives, in which covalently bonded* ***carbon is an essential constituent****".*

Examples:

- Glucose ($C_6H_{12}O_6$)
- Methane (CH_4)
- Alcohol (C_2H_5OH)

Number of Organic Compounds:

Today, there are about ten millions of organic compounds and thousands of new organic compounds are being prepared every year.

Q.2 What is organic chemistry? *(Knowledge Base)* **(LHR 2013, DGK 2016 G-I)**

Ans: **ORGANIC CHEMISTRY**

Definition:

"The branch of chemistry which deals with the study of hydrocarbons and their derivatives is known as organic chemistry".

Scope:

In this branch we study petroleum, petrochemicals, pharmaceuticals etc.

Q.3 Which are inorganic compounds yet they contain carbon? *(Knowledge Base)*

Ans: **INORGANIC COMPOUNDS CONTAINING CARBON**

Following are inorganic compounds yet they contain carbon:

- The oxides of carbon like carbon monoxide and carbon dioxide. (CO, CO_2)
- Carbonates ($CaCO_3$)
- Bicarbonates ($NaHCO_3$)
- Carbides. (CaC_2)

They are not treated as organic compounds because their properties are quite different from those of organic compounds.

Q.4 Define molecular formula? *(Knowledge + Understanding Base)* (LHR 2013, FSD 2017, SGD 2016 G-I, DGK 2016 G-I)

Ans: *Answer given on Page # 111*

Q.5 What is electronic or dot and cross formula? *(Knowledge + Understanding Base)* **(SWL 2017)**

Ans: *Answer given on Page # 112*

Q.6 Define structural formula. Draw the structural formulae of n-butane and isobutane. *(Knowledge + Understanding Base)* **(MTN 2017, SWL 2016 G-II)**

Ans: *Answer given on Page # 112*

Q.7 Define condensed formula. *(Knowledge + Understanding Base)* **(FSD 2016 G-II, MTN 2016 G-I)**

Ans: *Answer given on Page # 112*

Q.8 What are characteristics of naphthalene? Give its uses. *(Knowledge Base)* **(Interesting Information Book Pg. # 53)**

Ans: **CHARACTERISTICS OF NAPHTHALENE**

Naphthalene is an organic compound. It decomposes at room temperature giving out very strong smell.

Uses:

It is used in moth balls to keep insects away from clothes.

11.1 ORGANIC COMPOUNDS
MULTIPLE CHOICE QUESTIONS

1. The branch of chemistry which deals with hydrocarbons and their derivatives is called: *(K.B)*

(A) Inorganic Chemistry (B) Analytical Chemistry

(C) Organic Chemistry (D) Biochemistry

2. The chemical formula of octane is: *(K.B)*

(A) C_5H_{12} (B) C_3H_8

(C) C_2H_6 (D) C_8H_{18}

3. Organic compounds have: *(K.B)*

(A) Ionic bond (B) Covalent bond

(C) Electrovalent bond (D) Coordinate covalent bond

4. How many types of formula of organic compound? *(K.B)*

(A) 4 (B) 5

(C) 3 (D) 2

5. Formula which represents the actual number of atoms in one molecule of organic compound is: *(U.B)*

(A) Structural formula (B) Condensed formula

(C) Dot and cross formula (D) Molecular formula

6. Condensed formula of propane is: *(U.B)*

(A) H_3CCH_3 (B) $H_3C(CH_2)_2CH_3$

(C) $H_3CCH_2CH_3$ (D) CH_4

7. It represents group of atoms joined together to each carbon atom: *(U.B)*

(A) Molecular formula (B) Structural formula

(C) Condensed formula (D) Electronic formula

8. The molecular formula of pentane is: *(K.B)*

(A) CH_4 (B) C_3H_3

(C) C_5H_{12} (D) C_4H_{10}

9. Naphthalene is an. *(K.B)*

(A) Organic compound (B) Inorganic compound

(C) Covalent compound (D) Ionic compound

11.1.1 CLASSIFICATION OF ORGANIC COMPOUNDS

LONG QUESTIONS

Q.1 Write a detailed note on classification of organic compounds.
(Knowledge +Understanding Base) **(Ex Q.14)**

OR

How organic compounds are classified? Explain with the help of examples.

Ans: Classification of Organic Compounds:

All known organic compounds have been broadly divided into two categories depending upon their carbon skeleton. These are:

(i) Open chain or acyclic compounds
(ii) Closed chain or cyclic compounds

(i) Open Chain or Acyclic or Aliphatic Compounds: **(SWL 2017)**

"*Open chain compounds are those in which the* ***end carbon atoms are not joined*** *with each other in this way they form a long chain of carbon atoms".*

Open chain compounds are also called aliphatic compounds.

Types of Open Chain Compounds:

There are two types of open chain compounds.

a. Straight chain compounds
b. Branched chain compounds

a. Straight Chain Compounds:

"Straight chain compounds are those in which carbon atoms link with each other through a ***single, double or triple bond*** *forming a straight chain*".

Examples:

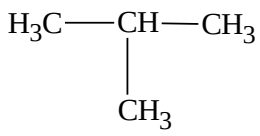
$$H_3C-CH_2-CH_2-CH_3$$

$$\text{Straight chain}\left(n-\text{Butane}\right)$$

b. Branched Chain Compounds:

"Branched chain compounds are those in which there is a ***branch along straight chain****".*

Examples:



Branched chain (isobutane)

(ii) Closed Chain or Cyclic Compounds: **(GRW 2014, 2013, LHR 2014)**

"Closed chain or cyclic compounds are those in which the carbon atoms at the ***end of chain are not free****. They are linked to form a ring.*

Types of Closed Chain Compounds:

They are further divided into two classes

a. Homocyclic or carbocyclic compounds.
b. Heterocyclic compounds.

a. Homocyclic or Carbocyclic Compounds: **(LHR 2014, GRW 2013, 15)**

"Homocyclic or carbocyclic compounds contain rings which are made up of ***only one kind of atoms, i.e., carbon atoms*** *are called homocyclic compounds".*

These are further divided into two classes:

- Aromatic compounds
- Alicyclic compounds

Aromatic Compounds:

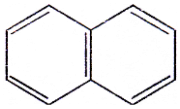
*These organic compounds contain **at least one benzene ring** in their molecule. They are also called **benzenoid compounds.***

Benzene Ring:

*A benzene ring is made up of **six carbon atoms** with **three alternating double bonds**. They are **called aromatic** because of **aroma or smell** they have.*

Examples:

Benzene

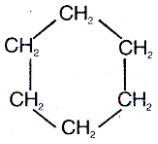


Naphthalene

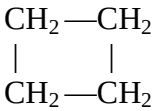
Alicyclic or Non-benzenoid Compounds:

*"**Carbocyclic compounds** which **do not have benzene ring** in their molecules are called **alicyclic or non- benzenoid compounds**".*

Examples:



Cyclo-hexane



(Cyclobutane)

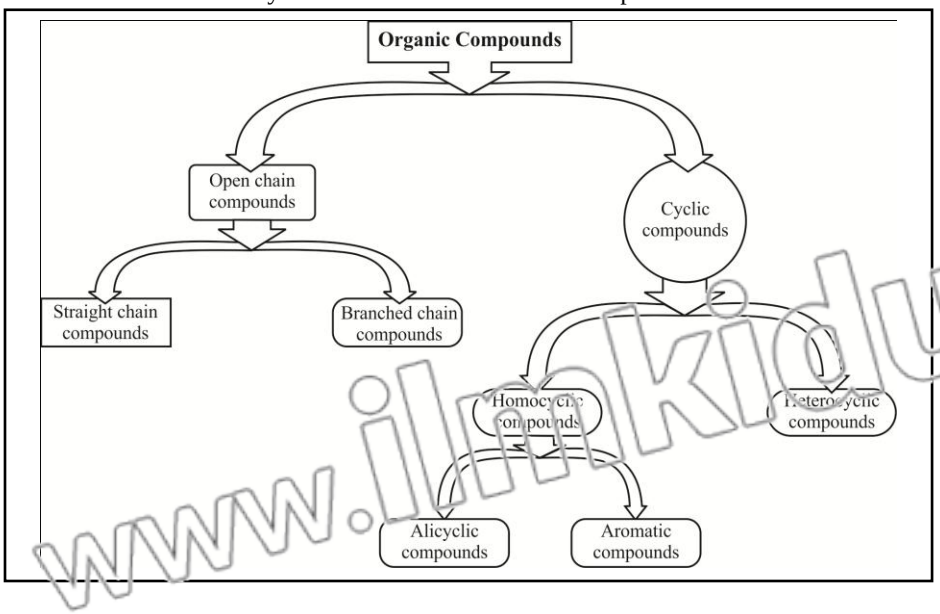
b. Heterocyclic Compounds:

*"**Cyclic compounds** that contain **one or more atoms other than** that of **carbon atoms** in their rings are called heterocyclic compounds".*

Examples:

Pyridine

Thiophene



11.1.1 CLASSIFICATION OF ORGANIC COMPOUNDS SHORT QUESTIONS

Q.1 What are aromatic compounds? ***(Knowledge Base)*** **(MTN 2016 G-I, 17)**

Ans: *Answer given on Page # 117*

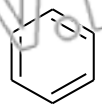
Q.2 What is Benzene Ring? ***(Knowledge Base)***

Ans:

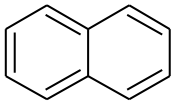
Benzene Ring

"A benzene ring is made up of ***six carbon atoms*** *with* ***three alternating double bonds.***

Examples:



Benzene



Naphthalene

Q.3 Define open chain or acyclic compounds. ***(Knowledge Base)*** **(SWL 2017)**

Ans: *Answer given on Page # 116*

Q.4 What are alicyclic or non benzenoid compounds? ***(Knowledge Base)***

Ans: *Answer given on Page # 117*

Q.5 Define heterocyclic compounds. Give two examples. ***(Knowledge Base)***

(DGK 2017, FSD 2016 G-I BWP 2016 G-I)

Ans:

HETEROCYCLIC COMPOUNDS

Definition:

"The ***cyclic compounds*** *that contain* ***one or more atoms other than*** *that of* ***carbon atoms*** *in their rings are called heterocyclic compounds".*

Examples:

Pyridine

Thiophene

Q.6 Write names of any two closed chain or cyclic chain hydrocarbons. ***(Knowledge Base)***

(SWL 2014, GRW 2014)

Ans:

CYCLIC HYDROCARBONS

Following are the names of two closed chain or cyclic chain hydrocarbons:

(i) Benzene

(ii) Naphthalene

Q.7 Write down two properties of naphthalene. ***(Knowledge Base)*** **(BWP 2016 G-II)**

Ans:

PROPERTIES OF NAPHTHALENE

Following are the two properties of naphthalene:

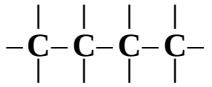
(i) It is used as laboratory reagent.

(ii) It is used in moth balls to keep insects away from clothes.

11.1.1 CLASSIFICATION OF ORGANIC COMPOUNDS
MULTIPLE CHOICE QUESTIONS

1. A benzene ring is made of carbon atoms: ***(K.B)***

(A) 4 (B) 2
(C) 6 (D) 3

2.  **is a:** ***(K.B)***

(A) Straight Chain (B) Closed Chain
(C) Branched Chain (D) Cyclic Chain

3. Aromatic compounds are also called: ***(K.B)***

(A) Benzenoid (B) Carbonoids
(C) Acyclic (D) Heterocyclic

4. Homocyclic compounds are of types: ***(K.B)***

(A) 4 (B) 3
(C) 2 (D) 1

11.1.2 DIVERSITY AND MAGNITUDE OF ORGANIC COMPOUNDS
LONG QUESTION

Q.1 Explain the diversity and magnitude of organic compounds.
(Knowledge + Understanding Base) **(Ex-Q.8)**

OR

Why organic compounds are numerous? **(Ex-Q.8)**

Ans: **DIVERSITY AND MAGNITUDE OF ORGANIC COMPOUNDS**

There are a total of 118 elements known today. The number of organic compounds (carbon compounds) is more than ten million. This number is far more than the number of compounds of all the remaining elements taken together.

Reason for Large Number of Organic Compounds:

Following are the reasons for large number of organic compounds:

- Catenation
- Isomerism
- Strength of covalent bonds of carbon
- Multiple bonding

(i) Catenation: **(BWP 2017, DGK 2017)**

"*The **ability of carbon atoms** to link with other carbon atoms to form **long chains** and **large rings** is called catenation.*"

Explanation:

Main reason for the existence of a large number of organic compounds is that carbon atoms can link with one another by means of covalent bonds to form long chains or rings of carbon atoms. The chains can be straight or branched. The **ability** of **carbon atoms** to **link** with **other carbon atoms** to form **long chains** and **large rings** is called catenation.

Conditions: **(DGK 2017)**

Two basic conditions for an element to exhibit catenation are,

(a) Valency:

Element should have valency **two** or **greater than two**.

(b) Bonds:

Bonds made by an element with its own atoms should be stronger than the bonds made by the element with other atoms especially oxygen.

Example:

$H_3C—CH_2—CH_2—CH_3$

n-butane

Carbon Shows Catenation Whereas Silicon does not:

Both silicon and carbon have similar electronic configurations but carbon shows catenation whereas silicon does not.

Reasons:

- It is mainly due to the reason that **C–C bonds** are much stronger **(355 kJ mol^{-1})** than **Si–Si (200 kJ mol^{-1})** bonds.
- On the other hand, **Si–O** bonds are much stronger **(452 kJ mol^{-1})** than **C–O** bonds **(351kJ mol^{-1})** Hence, silicon occurs in the form of silica and silicates in nature.

(ii) Isomerism:

*"The compounds having the **same molecular formula** but different arrangement of atoms in their molecules or **different structural formulae** are called isomers and this **phenomenon** is called **isomerism**".*

Examples:

Molecular formula **C_5H_{12}** can be used to draw the structures of isomers of pentane, represented by **three different structures**. Thus, **C_5H_{12} has three isomers.**

$CH_3—CH_2—CH_2—CH_2—CH_3$

n-pentane

$CH_3—CH_2—CH(CH_3)—CH_3$

(Iso-pentane)

$C(CH_3)_4$

(Neo-pentane)

Note:

Number of **isomers increases with the increase in number of carbon atoms** in the given molecular formula.

(iii)Strength of Covalent Bonds of Carbon:

Due to its **very small size**, carbon can form very **strong covalent bonds** with other carbon atoms, hydrogen, oxygen, nitrogen and halogens. This enables it to form a large number of compounds.

(iv)Multiple Bonding:

In order to satisfy its **tetravalency**, carbon can make **multiple bonds (i.e., double and triple bonds)**. This further adds to the possible number of structures.

Example:

- Two carbon atoms in ethane are linked by a single covalent bond, by a double covalent bond in ethylene and a triple covalent bond in acetylene.

11.1.2 DIVERSITY AND MAGNITUDE OF ORGANIC COMPOUNDS

SHORT QUESTIONS

Q.1 Why does silicon occur in the form of silica and silicates? *(Knowledge Base)*(GRW 2015)

Ans:

OCCURRENCE OF SILICON

Silicon occurs in form of silica and silicates because **Si – Si bonds** are much weaker **(200kJ/mol)** whereas **Si–O bonds** are much stronger **(452kJ/mol)** that is why silicon prefers to make compound with oxygen.

Q.2 Define isomerism. Give an example. ***(Knowledge Base)*** **(GRW 2014, SWL 2017, FSD 2017)**

Ans:

ISOMERISM

"The compounds having the same molecular formula but different arrangement of atoms in their molecules or different structural formulae are called isomers and this phenomenon is called isomerism".

Examples:

CH_3 — CH_2—CH_2—CH_2—CH_3
n-pentane

CH_3—CH_2—CH—CH_3
|
CH_3
(Iso-pentane)

11.1.2 DIVERSITY AND MAGNITUDE OF ORGANIC COMPOUNDS
MULTIPLE CHOICE QUESTIONS

1. How many carbon atoms are present in heptane? ***(K.B)***
(A) 5 (B) 6
(C) 8 (D) 7

2. C-C bond is stronger than: ***(K.B)***
(A) Si-Si (B) C-O
(C) Both (A) and (B) (D) None of these

3. Number of isomers increases with increase in number of atoms of: ***(K.B)***
(A) Hydrogen (B) Nitrogen
(C) Carbon (D) Oxygen

4. Energy of C-C bonds is: ***(K.B)***
(A) 355 kJ/mol (B) 351 kJ/mol
(C) 452 kJ/mol (D) 200 kJ/mol

5. Energy of Si-Si bonds is: ***(K.B)***
(A) 452 kJ/mol (B) 355 kJ/mol
(C) 200 kJ/mol (D) 351 kJ/mol

6. Energy of C-O bonds is: ***(K.B)***
(A) 452 kJ/mol (B) 355 kJ/mol
(C) 200 kJ/mol (D) 351 kJ/mol

11.1.3 GENERAL CHARACTERISTICS OF ORGANIC COMPOUNDS
LONG QUESTION

Q.1 What are the general characteristics of organic compounds? ***(Knowledge Base)*** **(Ex-Q.13)**
(GRW 2016, BWP 2016 G-I, MTN 2016 G-II, 17, DGK 2016 G-II)

Ans:

GENERAL CHARACTERISTICS OF ORGANIC COMPOUNDS

Organic compounds have the following general charcteristics:

(i) Origin:

Naturally occurring **organic compounds** are obtained from **plants and animals**. On the other hand, **inorganic compounds** are obtained from **minerals and rocks**.

(ii) Composition:

Carbon is an essential constituent of all organic compounds. They are made up of few elements such as carbon, hydrogen, nitrogen, oxygen, halogen, sulphur, etc. On the other hand, inorganic compounds are made up of almost all the elements of the Periodic Table known so far.

(iii)Covalent Linkage:

Organic compounds contain **covalent bonds** that may be **polar** or **non-polar**, while the inorganic compounds mostly contain ionic bonds.

(iv)Solubility:

Organic compounds having **non-polar linkages** are generally soluble in **organic solvents** like alcohol, ether, benzene, carbon disulphide etc. On the other hand, the inorganic compounds with **ionic bonds** are soluble in **polar solvents like water**.

(v) Electrical Conductivity:

Due to the **presence of covalent bonds**, organic compounds are **poor conductor** of electricity, whereas inorganic compounds being **ionic** in nature, are **good conductors** of electricity in **molten state** are in **aqueous solution**.

(vi)Melting and Boiling Points:

Generally **organic compounds** have **low melting and boiling points** and are **volatile** in nature. **Inorganic compounds**, on the other hand, have comparatively **high melting and boiling points.**

(vii) Stability:

Since organic compounds have low melting and boiling points, they are less stable than inorganic compounds.

(viii) Combustibility:

Organic compounds with **high percentage of carbon** are generally combustible. On the other hand, **inorganic compounds** are mostly **non-combustible.**

(ix)Isomerism:

A main characteristic of organic compounds which differentiates them from inorganic substances is their tendency to exhibit the phenomenon of isomerism. Isomerism is rare in inorganic substances.

(x) Rate of reaction:

Due to the presence of covalent linkages, the reactions of organic compounds are molecular in nature. They are often **slow** and require specific **conditions such as temperature, pressure or catalyst.**

11.1.3 GENERAL CHARACTERISTICS OF ORGANIC COMPOUNDS

SHORT QUESTIONS

Q.1 What is origin of organic compounds? ***(Knowledge Base)***

Ans: **ORIGIN OF ORGANIC COMPOUNDS**

Organic compounds are obtained from plants and animals. On the other hand, inorganic

compounds are obtained from minerals and rocks.

Q.2 What do you know about solubility of organic compounds? ***(Knowledge Base)***

Ans:

SOLUBILITY OF ORGANIC COMPOUNDS

Organic compounds having non-polar linkages are generally soluble in organic solvents like alcohol, ether, benzene, carbon disulphide etc. On the other hand, the inorganic compounds with ionic bonds are soluble in polar solvents like water.

11.1.3 GENERAL CHARACTERISTICS OF ORGANIC COMPOUNDS

MULTIPLE CHOICE QUESTIONS

1. Organic compounds have: ***(K.B)***
(A) Low% of carbon (B) High% of carbon
(C) Both A and B (D) None of these

2. Organic compounds are obtained from: ***(K.B)***
(A) Plants and animals (B) Minerals
(C) Air (D) Sun

3. Organic compounds are soluble in: ***(K.B)***
(A) Organic solvent (B) Polar solvent
(C) Inorganic solvent (D) Both A and B

4. The ability of carbon atoms to form chain is called: ***(K.B)*** **(LHR 2014)**
(A) Isomerism (B) Catenation
(C) Resonance (D) Condensation

5. Rates of reactions of organic compounds are usually: ***(K.B)***
(A) Slow (B) Fast
(C) Moderate (D) Very fast

11.1 TEST YOURSELF

i. Why and how carbon completes its octet? ***(Knowledge Base)***

Ans:

COMPLETION OF OCTET

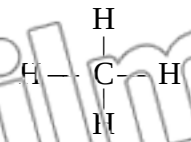
Reason:

Carbon completes its octet in order to become stable.

Method:

Carbon atom satisfies its tetravalancy by making single bond and also multiple bonds (double or triple bond). These multiple bonds are formed itself between carbon atoms or sometimes by simple sharing (covalent bond) with hydrogen atoms.

Examples:



CH_4 Methane
$H_2C = CH_2$ Ethene
$HC \equiv CH$ Ethyne

ii. Point out the properties of carbon which are responsible for formation of long chains of carbon atom compounds? ***(Understanding Base)***

Ans: **REASONS FOR CATENATION**

The properties of carbon which are the responsible for long chain of carbon compounds are as follows:

- Carbon has the valency more than two.
- Bonds formed between carbon carbon (C–C) atoms is stronger (355kJmol^{-1}) than the bond formed between carbon and other elements e.g. C – O (351kJmol^{-1})

iii. Why the melting and boiling points of organic compounds are low? ***(Understanding Base)***

Ans: **MELTING AND BOILING POINTS**

The melting and boiling points of organic compounds are generally low because:

- These are non-polar
- Intermolecular forces between the organic molecules are weak.

iv. Why the organic compounds are poor conductors of electricity? ***(Understanding Base)*** **(GRW 2015)**

Ans: **CONDUCTIVITY OF ORGANIC COMPOUNDS**

The organic compounds are poor conductors of electricity because:

- They consist of molecules having covalent bonds between atoms rather than ions.
- They do not have free electrons for electric conduction.
- The covalent bonds is between non-metals which itself are poor conductor of heat and electricity.

v. What are the reasons for the formation of millions of organic compounds? ***(Knowledge Base)***

Ans: **MILLIONS OF ORGANIC COMPOUNDS**

The reasons for formation of millions of organic compounds are:

- Catenation
- Isomerism
- Strength of covalent bond between carbon atoms
- Multiple bonding

11.2 SOURCES OF ORGANIC COMPOUNDS

11.2.1 COAL

LONG QUESTIONS

Q.1 Describe important sources of organic compounds. ***(Knowledge Base)***

Ans: **SOURCES OF ORGANIC COMPOUNDS**

Organic compounds are naturally prepared by animals and plants.

(A) Animals:

Animals synthesize two main groups of organic compounds.

(i) Proteins: e.g meat, mutton, chicken, eggs etc.

(ii) Fats/Oils. Fats are present in milk, butter, cheese etc.

(B) Plants:

Plants synthesize four main groups of organic compounds. More over dead plants burried under Earth's crust are converted through biochemical processes to coal, petroleum and natural gas. These materials are the main sources of organic compounds. We can get thousands of organic compounds by the destructive distillation of coal and fractional distillation of petroleum.

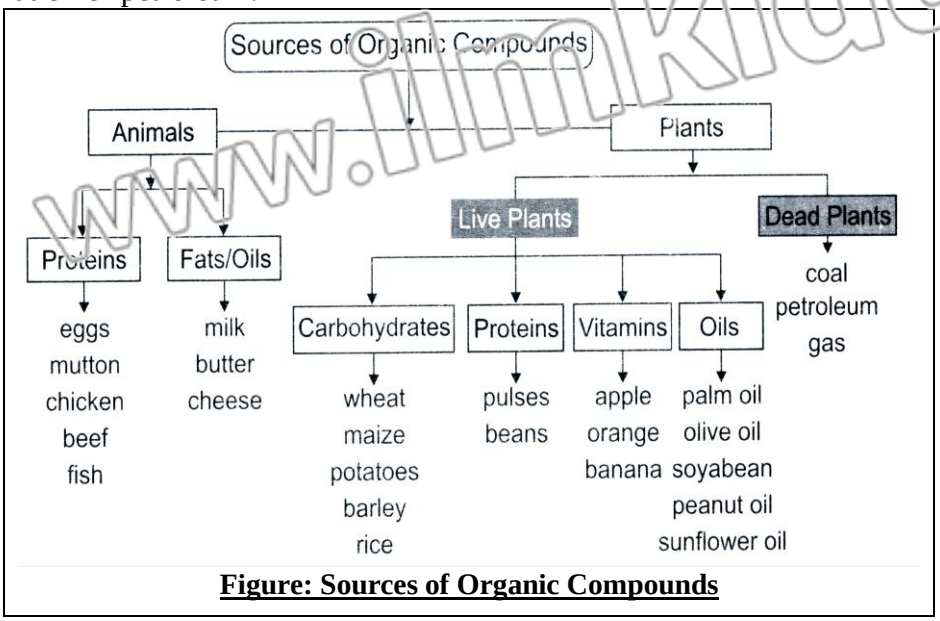


Figure: Sources of Organic Compounds

Q.2 How coal is formed? What are different types of coal?
(Knowledge Base+Understanding Base) **(Ex-Q.1) (LHR 2014)**

OR

Write down composition and uses of different types of coal.
(Knowledge Base+Understanding Base) **(Ex-Q.2)**

Ans:

FORMATION OF COAL

Definition:

*"Coal is **blackish, complex mixture** of compounds of **carbon, hydrogen and oxygen.** It also consists of **small amounts** of **nitrogen and sulphur** compounds".*

Formation of Coal:

Coal was formed by the decomposition of dead plants burried under the Earth's crust millions of years ago.

Carbonization:

"The conversion of wood into coal is called carbonization".

It is a very slow bio-chemical process. It takes place in the absence of air under high pressure and high temperature over a long period of time (about 500 millions of years).

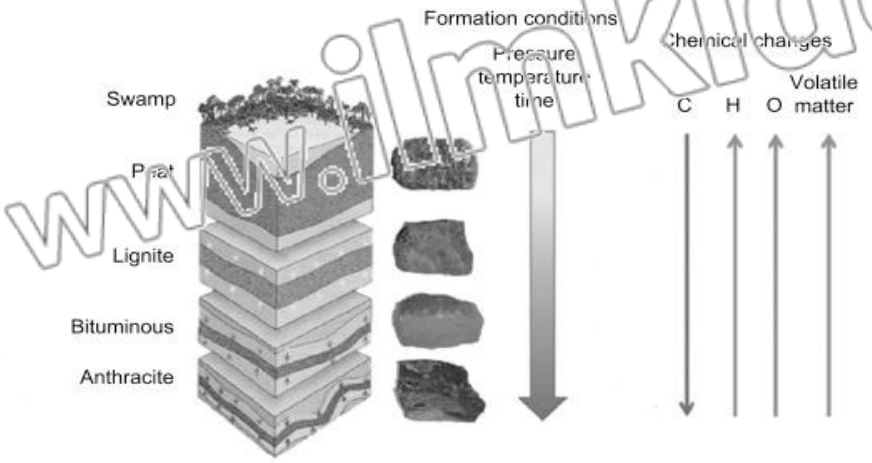
$$\underset{\text{about 500 millions years ago}}{\textit{Dead plants}} \longrightarrow \textit{Burried under Earth's crust} \xrightarrow[\text{Presence of high temp.\& press.}]{\text{Absence of air}} \textit{Coal}$$

Types of Coal: **(Ex-Q.2)**

Wood contains about **40% carbon**, so depending upon the **extent of carbonization** process, **four types of coal** are found.

Basis of Difference in Types of Coal:

These types differ with respect to carbon content, volatile matter and moisture.



Different Types of Coal: **(DGK 2016 G-I)**

Composition and uses of different types of coal are as follows:

Type of Coal	Carbon Content	Uses
Peat	**60%**	It is inferior quality coal used in kiln.
Lignite	**70%**	It is soft coal used in thermal power stations.
Bituminous	**80%**	It is common variety of coal used as household coal.
Anthracite	**90%**	It is superior quality hard coal that is used in industry.

Q.3 Which products can be obtained by the destructive distillation of coal? ***(Knowledge Base+Understanding Base)*** **(Ex-Q.3&4)**

OR

What is destructive distillation of coal? ***(Knowledge Base+Understanding Base)*** **(Ex-Q.2)**

OR

Name the different types of products obtained by the destructive distillation of coal. ***(Knowledge Base+Understanding Base)*** **(Ex-Q.2)**

Ans: **DESTRUCTIVE DISTILLATION OF COAL**

*"The **strong heating** of coal in the **absence of air** is called destructive distillation".*

Composition of Coal:

Coal contains elements like:

- Carbon
- Hydrogen
- Oxygen
- Nitrogen
- Sulphur

So, destructive distillation of coal provides large number of organic compounds along with a few inorganic compounds.

Products of Destructive Distillation of Coal:

(i) Coal Gas:

*"Coal gas is mixture of **hydrogen, methane and carbon monoxide**, produces heat when burnt in air".*

Uses:

- It is mainly used as a **fuel** in industry.
- It is also used to provide an inert or **reducing atmosphere** in various **metallurgical processes**.

(ii) Ammoniacal Liquor:

*"Ammoniacal liquor is a solution of **ammonia gas in water**".*

Uses:

- It is used to prepare **nitrogenous fertilizers**. For example, when it is treated with sulphuric acid, it produces **ammonium sulphate**, fertilizer.

(iii) Coal Tar:

"*Coal tar is a thick **black liquid**. It is a mixture of more than **200 different organic compounds, mostly aromatic**".* They are separated by **fractional distillation** of Coal Tar. Some of the important aromatic compounds are benzene, phenol, toluene, aniline, etc.

Uses:

These compounds are used to synthesize:

- Drugs
- Dyes
- Explosives
- Paints
- Varnishes
- Plastic
- Synthetic fibre
- Pesticides

Pitch:

"*The black **residue** of the **coal tar** is called pitch".*

Use:

- It is **used** for surfacing of **roads** and **roofs**.

(iv) Coke: **(BWP 2017)**

"*When **coal** is subjected to **destructive distillation**, it loses all its volatile components and leaves behind a solid residue called coke. Coke is **98% carbon**".*

Uses:

- It is mainly used as a **reducing agent** in the extraction of metals especially iron.
- It is also used as **fuel**.

11.2 SOURCES OF ORGANIC COMPOUNDS

11.2.1 COAL

SHORT QUESTIONS

Q.1 Write down names of different types of coal. ***(Knowledge Base)*** **(BWP 2017)**

Ans: **TYPES OF COAL**

Following are the names of different types of coal:

- Peat 60% C
- Lignite 70% C
- Bituminous 80% C
- Anthracite 90% C

Q.2 Write carbon content and use of peat and lignite. ***(Knowledge Base)***

Ans: **PEAT AND LIGNITE**

Following are the carbon content and uses of peat and lignite:

Type of Coal	Carbon Contents	Uses
Peat	60%	It is inferior quality coal used in kiln.
Lignite	70%	It is soft coal used in thermal power stations.

Q.3 Write any four sources of organic compounds. ***(Knowledge Base)***

Ans: **SOURCES OF ORGANIC COMPOUNDS**

Following are the four sources of organic compounds:

- Plants
- Animals
- Petroleum
- Natural gas

Q.4 Define pitch give its uses. ***(Knowledge Base)***

Ans: *Answer given on Page # 127*

Q.5 How scientists are trying to mine coal in the future? ***(Application Base)***

(Interesting Information Pg. # 69) (BWP 2016 G-II)

Ans: **MINING OF COAL IN FUTURE**

Scientists are working one ways to convert coal into gas underground so that it will not have to be mined. This will allow us to use small seams of coal or seams that are dangerous to mine because of weaknesses in the surrounding rocks.

MULTIPLE CHOICE QUESTIONS

1. Amount of carbon content in lignite is: ***(K.B)***

(A) 70% (B) 90%

(C) 80% (D) 60%

2. Vitamins are found in: ***(K.B)***

(A) Apple (B) Pulses

(C) Citrus fruits (D) Both A and C

3. Name the gas which is not found in coal gas: *(K.B)*

(A) Hydrogen (B) Nitrogen
(C) Methane (D) Carbon monoxide

4. Coal is of types: *(K.B)*

(A) 1 (B) 3
(C) 2 (D) 4

5. Dead plants produce all of these products except: *(K.B)*

(A) Coal (B) Gas
(C) Petroleum (D) Carbohydrate

6. Which one is used as reducing agent? *(K.B)*

(A) Ammonical liquor (B) Coal gas
(C) Coal tar (D) Coke

7. Which one provides inert atmosphere in metallurgical process? *(K.B)*

(A) Ammonical liqour (B) Coke
(C) Coal gas (D) Coal tar

8. Which one is soft coal? *(K.B)*

(A) Peat (B) Bituminous
(C) Lignite (D) Anthracite

9. Which type of coal is used as household coal: *(K.B)*

(A) Lignite (B) Peat
(C) Anthracite (D) Bituminous

10. Wood contains carbon about: *(K.B)* **(GRW 2014)**

(A) 10% (B) 20%
(C) 30% (D) 40%

11. Which one of the following is not a fossil fuel? *(K.B)* **(LHR 2015)**

(A) Coal (B) Natural gas
(C) Bio gas (D) Petroleum

12. The %age of carbon in anthracite is: *(K.B)* **(DKG 2016 G-II)**

(A) 90% (B) 80%
(C) 70% (D) 60%

11.2 TEST YOURSELF

i. Name the gases which are found in coal gas? *(Knowledge Base)*

Ans: **GASES FOUND IN COAL GAS**

The gases which are found in coal gas are hydrogen, methane and carbon monoxide.

ii. Is coal tar a compound? What is importance of coal tar? *(Understanding Base)*

Ans: **COAL-TAR AS A COMPOUND**

No, Coal-tar is not a compound. It is a mixture of more than 200 different organic compounds, mostly aromatic. Some of the important aromatic compounds are benzene phenol, toluene, aniline etc.

Importance:

These chemicals are used to synthesize drugs, dyes, explosives, paints, varnishes, polishes, synthetic fibre and pesticides.

iii. What is coke? For what purpose it is used? *(Understanding Base)* **(BWP 2017)**

Ans: **COKE**

Coke is **98**% **carbon**. It is left behind **residue of coal**.

Uses:

Coke is mainly used as **reducing agent** in the extraction of metals especially iron.
It is also used as **fuel**.

iv. Which is the best quality of coal? ***(Knowledge Base)*** **(SWL 2016 G-I)**

Ans:

BEST QUALITY COAL

Anthracite is considered as **superior quality** of coal containing **90% carbon content**. It is used in industry.

v. What is destructive distillation? ***(Knowledge Base)*** **(SWL 2016 G-I)**

Ans:

DESTRUCTIVE DISTILLATION

Definition:

*"The **strong heating of coal** in the **absence of air** is called destructive distillation".*

Importance:

Coal contains elements like carbon, hydrogen, oxygen nitrogen and sulphur. So destructive distillation of coal provides large number of organic compounds along with a few inorganic compounds.

11.2.2 PETROLEUM

11.2.3 NATURAL GAS

11.2.4 PLANTS

11.2.5 SYNTHESIS IN LABORATORY

LONG QUESTIONS

Q.1 Write a short note on petroleum and natural gas. ***(Knowledge Base+Understanding Base)***

Ans:

PETROLEUM

Definition:

*"Petroleum is a **dark brownish** or **greenish black** coloured **viscous liquid**. It is a complex mixture of several solid, liquid or gaseous hydrocarbons in water mixed with salts and earth particles".*

Fractional Distillation:

*"Separation of fractions or components from a mixture **depending upon** their **boiling point ranges** is called fractional distillation".*

Petroleum is a **main source** of **organic compounds**. It consists of several compounds mainly hydrocarbons. These compounds are separated by fractional distillation.

Composition of a Fraction:

Each fraction of a petroleum is not a single compound, rather each of it consists of different organic compounds.

NATURAL GAS

*"It is a **mixture** of **low molecular mass** hydrocarbons".*

Composition:

The main component about **85**% is **methane**, along with other gases: ethane, propane and butane.

Uses: **(BWP 2017)**

Nautral gas is used:

- As fuel in homes as well as in industries.
- As fuel in automobiles as compressed natural gas (CNG).
- To make carbon black and fertilizers.

Origin:

Its origin is similar to that of coal and petroleum. Therefore, it is found with their deposits.

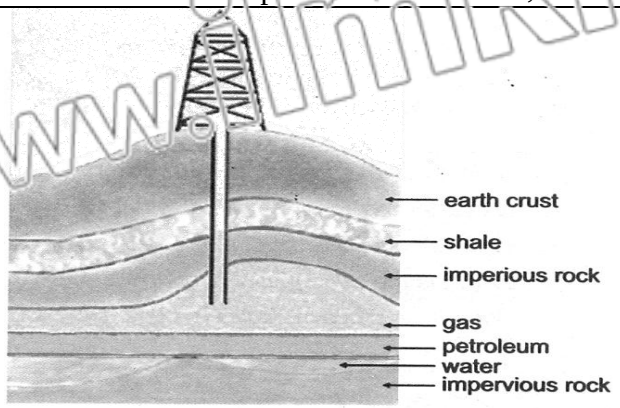


Figure: Occurrence and Drilling of Gas

Q.2 What types of compounds are synthesized by plants? ***(Knowledge Base)***

OR

Explain living plants as a source of organic compounds.

Ans: **SYNTHESIS OF COMPOUNDS BY PLANTS**

Living plants synthesize macro-molecules, like carbohydrates, proteins, oils, vitamins etc.

(i) Carbohydrates:

The basic unit of all types of carbohydrates is glucose which is synthesized by plants through photosynthesis. Glucose then further polymerizes to form sucrose, starch and cellulose.

(ii) Proteins:

Proteins are found in the pulses and beans.

Preparation:

Proteins are prepared by fixation of nitrogen by bacteria found on the roots of plants.

(iii)Oils:

Oils are found in the seeds of plants such as:

- Sunflower
- Rapeseed
- Palm
- Coconut
- Ground-nut

(iv)Vitamins:

Vitamins are found in apple and citrus fruits.

Other Substances Drived From Plants:

Besides these major food items, plants also give us substances like:

- Gums
- Rubber
- Medicines, etc.

11.2.2 PETROLEUM

11.2.3 NATURAL GAS

SHORT QUESTIONS

Q.1 What is composition of natural gas? ***(Knowledge Base)***

Ans: *Answer given on Page # 130*

Q.2 What is meant by fractional distillation? ***(Understanding Base)***

Ans: *Answer given on Page # 130*

MULTIPLE CHOICE QUESTIONS

1. Petroleum is a dark brownish _____ liquid. ***(K.B)***

(A) Viscous (B) Light

(C) Heavy (D) Transparent

2. Main component of natural gas is: ***(K.B)*** **(LHR 2016)**

(A) Methane (B) Propane

(C) Butane (D) Propyne

3. Natural gas is a mixture of _____molecular mass hydrocarbons. ***(K.B)*** **(GRW 2016)**

(A) Low (B) High

(C) Both A and B (D) Very high

4. Which one is main source of organic compounds? ***(K.B)***

(A) Petroleum (B) Natural gas

(C) Coal (D) Ammonical liquor

5. Living plants synthesize: ***(K.B)***

(A) Macromolecules (B) Micromolecules

(C) Plasmid (D) Inorganic compound

6. What percent of natural gas consists of methane (CH_4)? ***(K.B)*** **(LHR 2014)**

(A) 82% (B) 83%

(C) 84% (D) 85%

11.3 USES OF ORGANIC COMPOUNDS

LONG QUESTION

Q.1 Give some uses of organic compounds in our daily life. ***(Knowledge Base)*** **(Ex-Q.6)**
(FSD 2016 G-I, BWP 2016 G-II, SWL 2016 G-II)

Ans: **USES OF ORGANIC COMPOUNDS**

Organic compounds are part of everything, from food we eat to the various items we use

in daily life to fulfill our needs. Organic compounds are prepared naturally as well as synthetically by chemists.

(i) Uses as Food:

The food we eat daily such as milk, eggs, meat, vegetables contain carbohydrates, proteins, fats, vitamins, etc. are all organic stuff.

(ii) Uses as Clothing:

All types of clothing (we wear, we use as bed sheets etc.) are made up of natural fibres (cotton, silk and wool, etc.) and synthetic fibres (nylon, dacron and acrylic etc.) all these are organic compounds.

(iii)Uses as Houses:

Wood is cellulose (naturally synthesized organic compound). It is used for making houses and furniture of all kinds.

(iv)Uses as Fuel:

The fuels we use for automobiles and domestic purposes are coal, petroleum and natural gas. These are called fossil fuels. All of these are organic compounds.

(v) Uses as Medicines:

A large number of organic compounds (naturally synthesized by plants) are used as medicines by us. Most of the life saving medicines and drugs such as antibiotics (inhibit or kill microorganisms which cause infectious diseases) are synthesized in laboratories.

(vi)Uses as Raw Material:

Organic compounds are used to prepare a variety of materials, such as rubber, paper, ink, drugs, dyes, paints, varnishes, pesticides, etc.

11.3 USES OF ORGANIC COMPOUNDS

SHORT QUESTIONS

Q.1 Describe use of organic compounds for clothing. ***(Knowledge Base)***

Ans: **ORGANIC COMPOUNDS AS CLOTHING**

All types of clothing (we wear, we use as bed sheets etc.) are made up of natural fibres (cotton, silk and wool, etc.) and synthetic fibres (nylon, dacron and acrylic etc.) all these are organic compounds.

Q.2 Describe two uses of organic compounds. ***(Knowledge Base)*** **(GRW 2017)**

Ans: **USES OF ORGANIC COMPOUNDS**

The two uses of organic compounds are as follows:

(i) Uses as Food:

The food we eat daily such as milk, eggs, meat, vegetables contain carbohydrates, proteins, fats, vitamins, etc. are all organic stuff.

(ii) Uses as Clothing:

All types of clothing (we wear, we use as bed sheets etc.) are made up of natural fibres (cotton, silk and wool, etc.) and synthetic fibres (nylon, dacron and acrylic etc.) all these are organic compounds.

Q.3 How organic compounds can be used as fuel? ***(Knowledge Base)***

Ans: *Answer given above*

Q.4 How organic compound can be used as medicines? ***(Knowledge Base)***

Ans: *Answer given above*

11.3 TEST YOURSELF

i. Define Petroleum. ***(Knowledge Base)*** **(GRW 2015)**

Ans: **PETROLEUM**

Definition:

"Petroleum is a dark brownish or greenish black coloured viscous liquid. It is a complex mixture of several solid, liquid, or gaseous hydrocarbons mixed with water, salt and earth particles".

Importance:

- Petroleum is a main source of organic compounds.
- It consists of several compounds mainly hydrocarbons.

ii. What types of compounds are synthesized by plants? ***(Knowledge Base)***

Ans: **COMPOUNDS SYNTHESIZED BY PLANTS**

Living plants synthesize macromolecules.

Examples:

Following are the important the compounds sysnthesized by plants:

- Carbohydrates
- Proteins
- Oils
- Vitamins

iii. What is the basic unit of carbohydrates and how it is synthesized? ***(Knowledge Base)***

Ans: **BASIC UNIT OF CARBOHYDRATES**

The basic unit of all types of carbohydrates is glucose.

Synthesis of Glucose:

Glucose is synthesized by plants through photosynthesis.

$$6CO_2 + 6H_2O \xrightarrow[\text{Sunlight}]{\text{Chlorophyl}} C_6H_{12}O_6 + 6O_2 + \text{Energy}$$

iv. CNG stands for? ***(Knowledge Base)***

Ans: **CNG STANDS FOR**

CNG stands for compressed natural gas, which is used as fuel in automobiles.

v. Our existence owe to organic compounds, comment. ***(Knowledge Base)***

Ans: **OWING OF OUR EXISTENCE**

Our existence owes to organic compounds because organic compounds are the part of everything from food we eat to the various items we use in daily life to fulfill our needs.

11.3 USES OF ORGANIC COMPOUNDS MULTIPLE CHOICE QUESTIONS

1. Which one of the following is synthetic fibre? ***(K.B)***

(A) Cotton (B) Dacron
(C) Wool (D) Silk

2. Which one of the following is not fossil fuel? ***(K.B)***

(A) Dacron (B) Petroleum
(C) Natural gas (D) Coal

3. Which one of the following is natural fibre? ***(K.B)***

(A) Nylon (B) Dacron
(C) Wool (D) Acrylic

11.4 ALKANES AND ALKYL RADICALS

LONG QUESTIONS

Q.1 Define the homologous series. Write down its properties.

(Knowledge Base+Understanding Base)

(Ex-Q.7)(LHR 2015, FSD 2016 G-II)

OR

Write down the chracteristics of homologous series. **(Ex-Q.7)**

Ans:

HOMOLOGOUS SERIES

*"The **group** of **similar compounds** in which each member differs from the adjacent member by $-CH_2-$ group and have **same functional group** is called homologous series".*

Examples:

- Alkane series
- Alkene series
- Alkyne series

Most Important Homologous Series:

Alkanes from the most important homologous series of compounds. **Alkanes are saturated hydrocarbons** or paraffins (para means little, affin means affinity). Their general formula is $\mathbf{C_nH_{2n+2}}$, where 'n' is number of carbon atoms. In case of alkanes 'n' ranges from 1 to 40. In this way, alkanes form the most important homologous series of compounds.

Properties of Homologous Series:

Organic compounds are divided into groups of compounds having similar chemical properties. Each group is known as a homologous series. Organic compounds of the same homologous series have the following properties in common.

(i) General Formula:

All members of a series can be represented by a general formula.

Examples:

- General formula of Alkanes : C_nH_{2n+2}
- General formula of Alkenes : C_nH_{2n}
- General formula of Alkynes : C_nH_{2n-2}

(ii) Difference Between Successive Members:

Successive members of the series differ by one unit of $-CH_2-$ and **14** units in their **relative molecular mass**.

(iii) Chemical Properties:

They have **similar chemical properties** (because they contain the same functional group).

(iv) Physical Properties:

There is a **regular change** in their **physical properties**; the **melting** and **boiling** points **increase** gradually with the **increase** of **molecular masses**.

(v) Methods of Preparation:

They can be prepared by similar general methods.

Q.2 What is alkyl radical? How alkyl radical can be formed?

(Knowledge Base+Understanding Base)

Ans:

ALKYL RADICAL

Definition:

"The group of atoms formed by the removal of one of the hydrogen atom of an alkane is called alkyl radical".

General Formula:

Their general formula is C_nH_{2n+1}

Formation:

Alkyl radicals are **derivatives** of **alkanes**. They are **formed** by the **removal** of one of the **hydrogen atoms** of an alkane and are **represented** by a letter **'R'.**

Nomenclature:

Their name is written by replacing 'ane' of alkane with "yl".

Examples:

(i) Alkyl Radicals of Propane:

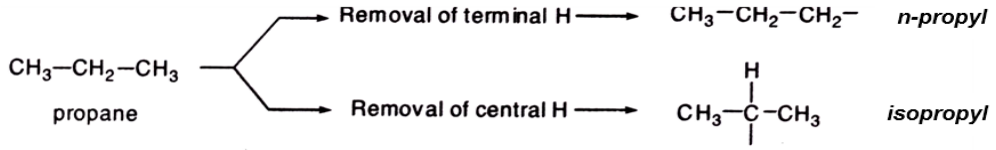
Following are two alkyl radicals of propane:

n-Propyl:

Propane has a straight chain structure. When **terminal H is removed** it is called **n-propyl.**

Iso-propyl:

When **hydrogen from central carbon** is removed it is called **isopropyl**, as explained below:



(ii) Alkyl Radicals of Butane:

Similarly, different structures of butyl radicals are explained:

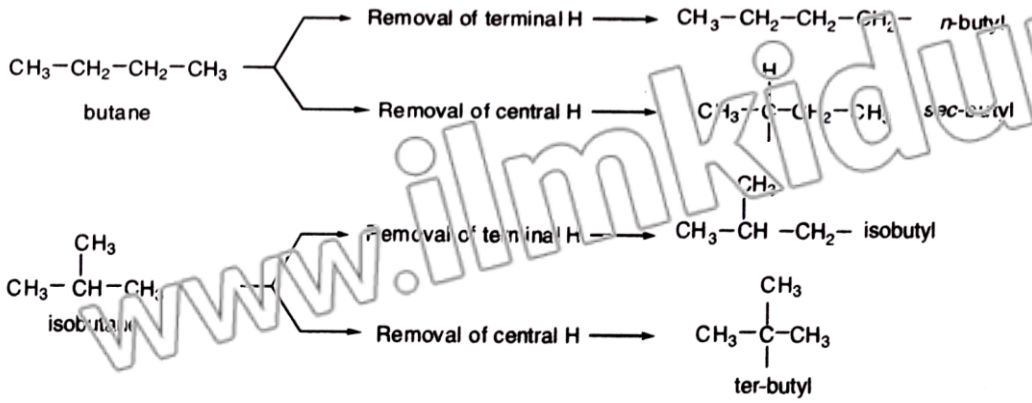


Table: Names and Molecular Formulae of Alkanes and their Alkyl Radicals

Alkane	Molecular Formula	Alkyl radical	Name
Methane	CH_4	CH_3-	Methyl
Ethane	C_2H_6	C_2H_5-	Ethyl
Propane	C_3H_8	C_3H_7-	Propyl
Butane	C_4H_{10}	C_4H_9-	Butyl
Pentane	C_5H_{12}	$C_5H_{11}-$	Pentyl
Hexane	C_6H_{14}	$C_6H_{13}-$	Hexyl
Heptane	C_7H_{16}	$C_7H_{15}-$	Heptyl
Octane	C_8H_{18}	$C_8H_{17}-$	Octyl
Nonane	C_9H_{20}	$C_9H_{19}-$	Nonyl
Decane	$C_{10}H_{22}$	$C_{10}H_{21}-$	Decyl

11.4 ALKANES AND ALKYL RADICALS

SHORT QUESTIONS

Q.1 Define homologous series. ***(Knowledge Base)*** **(SGD 2016 G-I, II, MTN 2016 G-II, SWL 2016 G-II)**

Ans: **RADICALS OF BUTANE**

Definition:

"A group of similar compounds in which each member differs from the adjacent member by $-CH_2-$ group and have same functional group is called homologous series".

Examples:

- Alkane series
- Alkene series
- Alkyne series

Q.2 Why hydrocarbons are regarded as parent organic compounds? ***(Knowledge Base)***

Ans: **PARENT ORGANIC COMPOUNDS**

Hyrocarbons are regarded as parent organic compounds because all other compounds are considered to be derived from them by substituting one or more hydrogen atoms of a hydrocarbon by one or more reactive atom or group of atoms.

MULTIPLE CHOICE QUESTIONS

1. The molecular formula of pentane is: ***(K.B)***

(A) CH_4 (B) C_3H_3

(C) C_5H_{12} (D) C_4H_{10}

2. Which of the following are derived from alkanes? ***(K.B)***

(A) Alkyl radical (B) Alkane radical

(C) Alkene radical (D) Alkyne radical

3. How many carbons are present in octane? ***(K.B)***

(A) 5 (B) 6

(C) 8 (D) 7

4. The chemical formula of butane is: ***(K.B)***

(A) C_5H_{12} (B) C_3H_8

(C) C_2H_6 (D) C_4H_{10}

5. General formula of alkyl radical is: ***(K.B)*** **(GRW 2017)**

(A) C_nH_{2n+2} (B) C_nH_6

(C) C_nH_{2n+1} (D) C_nH_8

6. Paraffins means: ***(K.B)***

(A) Little affinity (B) Very high affinity

(C) High affinity (D) None of these

7. The removal of terminal hydrogen from the straight chain of propane is called: ***(K.B)***

(A) n-propyl (B) Propane

(C) Isopropyl (D) Propene

8. Alkanes are hydrocarbons: ***(K.B)***

(A) Saturated (B) Unsatruated

(C) Cyclic (D) Very reactive

9. When one hydrogen atom is removed from alkane it gives: ***(K.B)***

(A) Ethene (B) Alkynes

(C) Alkyl radical (D) Aromatic compound

10. Each member of homologous series differs from the successive member by: ***(K.B)***

(A) CH_3 – group (B) – CH_2 – group

(C) – OH group (D) – CHO – group

11.5 FUNCTIONAL GROUPS

11.5.1 Functional Groups Containing Carbon, Hydrogen and Oxygen

11.5.2 Functional Groups Containing Carbon, Hydrogen and Nitrogen

11.5.3 Functional Groups Containing Carbon, Hydrogen and Halogen

11.5.4 Double and Triple Bond

LONG QUESTION

Q.1 Define the functional group. Explain functional groups containing carbon, hydrogen and oxygen with examples. ***(Knowledge+Understanding+Application Base)***

(Ex-Q.5)(SGD 2016 G-II)

OR

Write a detailed note on functional groups of alkenes and alkynes. How they are identified from other compounds? **(Ex-Q.5)**

Ans:

FUNCTIONAL GROUP

Definition:

*"An **atom** or **group of atoms** or presence of **double** or **triple bond** which **determines** the **characteristic properties** of an organic compound is known as functional group".*

Alkyl Radical:

"The remaining part of the organic molecule (other than functional group) mainly determines the physical properties such as melting point, boiling point, density, etc and is called alkyl part or alkyl radical".

Examples:

- – OH group is the functional group of alcohols, which gives characteristics properties of alcohols.
- – COOH group is the functional group of carboxylic acids.

FUNCTIONAL GROUPS CONTAINING CARBON, HYDROGEN AND OXYGEN

The organic compounds containing carbon, hydrogen and oxygen as functional group are alcohols, ethers, aldehydes, ketones, carboxylic acids and esters.

(i) Alcoholic Group: **(GRW 2014, SGD 2014, SWL 2016, 17) (Ex-Q.10)**

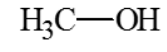
*"The **functional group –OH** is called Alcoholic group".*

The functional group of alcohols is –OH.

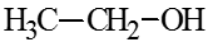
General Formula:

Their **general formula** is **ROH**, where R is any alkyl group.

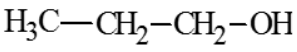
Exmaples:



Methyl Alcohol



Ethyl Alcohol



n-propyl Alcohol

(ii) Ether Linkage: **(LHR 2015)**

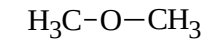
*"The functional group **C– O – C** is called ether linkage".*

The functional group of ether is C– O – C.

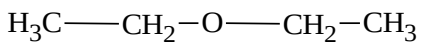
General Formula:

Their general formula is **R -O- R'**. Where R and R' are alkyl groups. R and R' may be same or different.

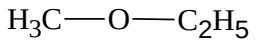
Examples:



Dimethyl ether



Diethyl ether



Ethyl methyl ether

(iii) Aldehydic Group: **(Ex-Q.11)**

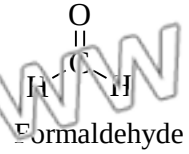
The functional group **- C - H** *is called aldehydic group".*

Aldehydes family consists of functional group **- C - H** .

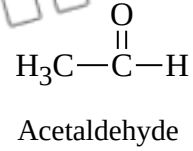
General Formula:

Their general formula is **RCHO**. Where **R** stands for **H** or some **alkyl group**.

Examples:



Formaldehyde

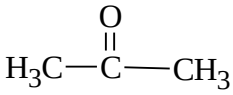


Acetaldehyde

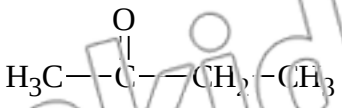
(iv) Ketonic Group: **(LHR 2015) (Ex-Q.11)**

*"The functional group **C=O** is called ketonic group".*

The compound containing **C=O** functional group are called ketones.



Dimethyl ketone



Ethyl methyl ketone

They have the general formula **R - C - R** . Where **R and R'** are alkyl groups. They may be **same or different**.

(v) Carboxyl Group: **(MTN 2016 G-II)**

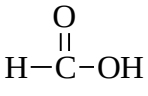
*"The functional group **–COOH** is called carboxyl group".*

The compounds containing –COOH as functional group are called carboxylic acids.

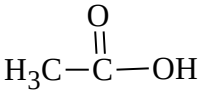
General Formula:

Their general formula is **R-COOH**. Where, **R stands for H** or some **alkyl group.**

Examples:



Formic acid



Acetic acid

(vi) Ester Linkage: **(LHR 2015)**

"The functional group **- C-O -** *is called ester linkage or ester functional group".*

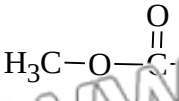
Organic compounds consisting of **- C-O -** functional group are called esters.

General Formula:

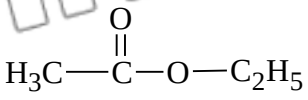
There general formula is **RCOOR'**.

Where **R and R'** are alkyl groups. They may be **same or different**, such as:

Examples:



Methyl acetate



Ethyl acetate

FUNCTIONAL GROUPS CONTAINING CARBON, HYDROGEN AND NITROGEN

(Ex-Q.9)

Amines:

*"The organic compounds containing **carbon, hydrogen and nitrogen** as functional group are called as amines".*

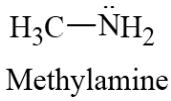
Functional Group:

Their functional group is $-\ddot{N}H_2$

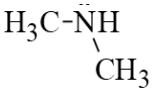
General Formula:

Their general formula is $R-\ddot{N}H_2$

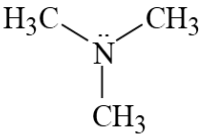
Examples:



Methylamine

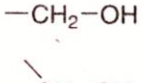
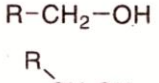
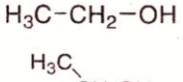
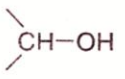
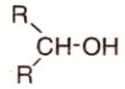
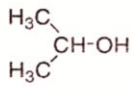
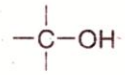
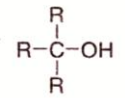
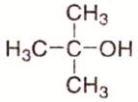
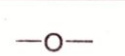
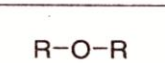
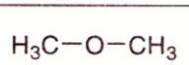
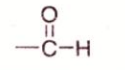
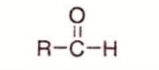
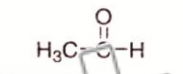
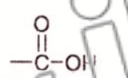
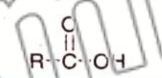
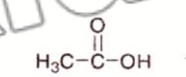
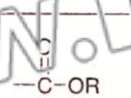
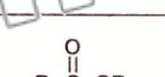
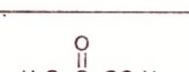


Dimethylamine



Trimethylamine

Table 11.4 Functional Groups containing carbon, hydrogen and oxygen

Class Name	Functional Group	Class Formula	Examples
Alcohols			
Primary			
Secondary			
Tertiary			
Ethers			
Aldehydes			
Ketones			
Carboxylic acids			
Esters			

FUNCTIONAL GROUP CONTAINING CARBON, HYDROGEN AND HALOGENS

*"The organic compounds having **functional group** containing **carbon**, **hydrogen** and **halogens** are called **alkyl halides".***

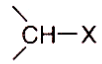
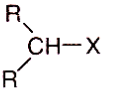
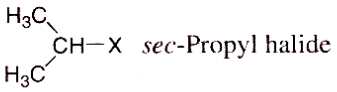
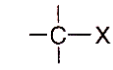
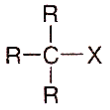
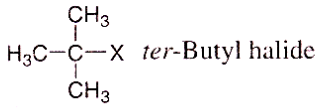
Functional Group:

Their functional group is **– X.**

General Formula:

There general formula is **R – X.** Where X = F, Cl, Br or I)

Table 11.4 Functional Groups containing carbon, hydrogen and oxygen

Class Name	Functional Group	Class Formula	Examples
Alkyl Halides			
a. Primary	$-CH_2-X$	$R-CH_2-X$	H_3C-CH_2-X Ethyl halide
b. Secondary			 *sec*-Propyl halide
c. Tertiary			 *ter*-Butyl halide

DOUBLE AND TRIPLE BOND

(i) Alkenes:

"Hydrocarbon compounds consisting of double bonds between two carbon atoms in their molecules are called alkenes".

Examples:

$H_2C = CH_2$ Ethene

$H_3C – HC = CH_2$ Propene

(ii) Alkynes:

"Hydrocarbon compounds consisting of triple bonds between two carbon atoms in their molecules are called alkynes".

Examples:

$HC \equiv CH$ Ethyne

$H_3C - C \equiv CH$ Propyne

11.5 FUNCTIONAL GROUPS SHORT QUESTIONS

Q.1 Write the general formula of aldehydic group. **(SWL 2016 G-II)**

Ans: **ALDEHYDIC GROUP**

The general formula of aldehydic group is $R - \overset{\overset{O}{\|}}{C} - H$.

Q.2 What is composition of perfume? Give functional groups present in geraniol.

(Interesting Information Pg. # 69)

Ans: **COMPOSITION OF PERFUME**

Perfumes often contain rose oil, which consists of distinct smell giving organic compound geraniol.

Functional Groups of Geraniol:

Geraniol consists of two functional groups; carbon-carbon double bond and the hydroxyl group.

Q.3 How dogs recognize the characteristic smell of human sweat?

(Interesting Information Pg. # 69)

Ans: **SMELL OF HUMAN SWEAT**

A sniffing dog can recognize the **characteristic smell** of **human sweat**. Each person's sweat contains a unique blend of **carboxylic acids.**

11.5 FUNCTIONAL GROUPS MULTIPLE CHOICE QUESTIONS

1. Functional group – OH is found in: ***(K.B)***

(A) Alcohols (B) Carboxylic acids
(C) Ethers (D) Esters

2. Perfumes contain: ***(K.B)***

(A) Sunflower oil (B) Rose oil
(C) Soya bean oil (D) Palm oil

3. Functional group C-O-C is found in: ***(K.B)***

(A) Alcohols (B) Carboxylic acids
(C) Ethers (D) Esters

4. $CH_3–O–CH_3$ is called: ***(K.B)***

(A) Dimethyl ether (B) Diethyl ether
(C) Ethyl methyl ether (D) Propyl ether

5. The characteristics of carboxylic acids are due to the presence of group: ***(K.B)***

(A) $-\overset{O}{\overset{\|}{C}}-$ (B) –COOH
(C) –OH (D) C–O–C

6. Which one contains double bond? ***(K.B)***

(A) Alkene (B) Alkyne

(C) Alkane (D) Alkyle

7. Which one contains triple bond? ***(K.B)***

(A) Alkyne (B) Alkyle

(C) Alkane (D) Alkene

8. Organic compounds containing carbon, hydrogen and halogens are called: ***(K.B)***

(A) Alkyl halides (B) Alkene

(C) Amines (D) Halides

9. Organic compounds containing $-NH_2$ are called: ***(K.B)***

(A) Thiophene (B) Alkyne

(C) Amines (D) Alkane

10. Geraniol consists of _____ functional group. ***(K.B)***

(A) 2 (B) 4

(C) 3 (D) 5

11. Organic compounds consisting of $-\overset{\overset{O}{\|}}{C}-O-$ **functional group are called** ***(K.B)***

(A) Ethers (B) Ketones

(C) Esters (D) Carboxylic acids

12. Members of a homologous series have same: ***(K.B)***

(A) Chemical properties (B) Physical properties

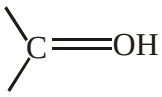
(C) Melting point (D) Density

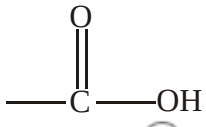
13. The functional group —COOH is found in: ***(K.B)*** **(GRW 2014)**

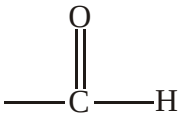
(A) Carboxylic acids (B) Aldehydes

(C) Alcohols (D) Esters

14. Which one is carboxylic group? ***(K.B)*** **(GRW 2015)**

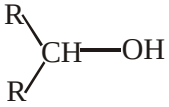
(A) 

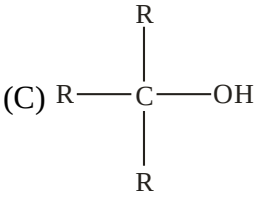
(B) 

(C) 

(D) 

15. Class formula of primary alcohols is: ***(K.B)*** **(GRW 2015)**

(A) $R-CH_2-OH$ (B) 

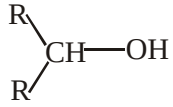
(C)  (D) R - O – R

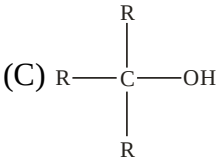
16. Which one of the following compounds is ketone? *(K.B)* **(GRW 2016)**

(A) $(CH_3)_2 CHOH$ (B) $(CH_3)_2 CO$

(C) $(CH_3)_2 NH$ (D) $(CH_3)_2 CHC\ell$

17. Formula of tertiary alcohols is. *(K.B)* **(RWP 2016 G-II)**

(A) R – CH_2 - OH (B) 

(C)  (D) R - O – R

11.6 TESTS FOR FUNCTIONAL GROUPS

LONG QUESTIONS

Q.1 Give the tests for functional groups. *(Knowlegde+Understanding+Application Base)*

Ans: **TESTS FOR FUNCTIONAL GROUPS**

a. Tests for Unsaturation: $>C=C<$ or $-C\equiv C-$

(i) Bromine Water Test:

Dissolve a **pinch** of the given **organic compound** in **2.0 cm^3 of carbon tetrachloride (CCl_4)**. Add **2 cm^3** of **bromine water** in it and shake.

Result:

Bromine will be **decolourised.**

(ii) Baeyer's Test:

Dissolve about **0.2 g** of the **organic compound** in water. Add to it **2-3 drops** of **alkaline $KMnO_4$ solution and shake.**

Result:

Pink colour will disappear.

b. Tests for Alcoholic Group –OH: **(Ex-Q.10) (SWL 2016 G-I)**

(i) Sodium Metal Test:

Take about **2-3 cm^3** of the given **organic liquid** in a **dry test tube** and add a **piece** of **sodium metal.**

Result:

Hydrogen gas will evolve.

(ii) Ester Formation Test:

Heat about **1.0 cm^3** of the **organic compound** with **1.0 cm^3** of **acetic acid** and **1-2 drops** of concentrated **sulphuric acid**.

Result:
Fruity smell will be given out.

c. Tests for Carboxylic Group –COOH:

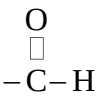
(i) Litmus Test:
Shake a **pinch** of the **given compound** with water and add a drop of **blue litmus solution**.

Result:
Litmus paper (solution) will turn red.

(ii) $NaHCO_3$ Solution Test:
Take about **2.0 cm^3 of** 5% $NaHCO_3$ solution and add a **pinch** of **given compound**.

Result:
CO_2 gas with effervescence evolves.

d. Detection of Aldehydic Group –CHO : **(Ex-Q.12)**



(i) Sodium Bisulphite Test:
Shake about **0.2 g or 0.5 cm^3** of the given compound with **1-2 cm^3** of **saturated solution** of **sodium bisulphite**.

Result:
A crystalline white precipitate will be formed.

(ii) Fehling's Solution Test:
Mix **equal volumes** of **Fehling's solution A and B** in a test tube. Add a pinch of organic compound and **boil for five minutes**.

Result:
Red precipitate will be formed.

e. Tests for Ketonic Group: **(Ex-Q.12)**

(i) Phenyl Hydrazine Test:
Shake a pinch of the given **organic compound** with about **2.0 cm^3** of **phenyl hydrazine solution.**

Result:
Orange red precipitate will be formed.

(ii) Sodium Nitroprusside Test:
Take about **2.0 cm^3 of sodium nitroprusside** solution in a test tube and add **2-3 drops of NaOH solution**. Now add a pinch of the given compound and shake.

Result:
Red colour will be formed.

(iii) Fehling's Solution Test:
No reaction

f. Tests for Primary Amino Group ($-NH_2$): **(Ex-Q.9)**

Carbyl Amine Test:
Heat about **0.2 g** of the **given compound** and add **0.5 cm^3 of chloroform** and add **2-3 cm^3**

of alcoholic KOH.

Result:

Extremely unpleasant odour will be given out.

g. Tests for Esters:

They are recognized by their fruity smell.

11.6 TESTS FOR FUNCTIONAL GROUPS

SHORT QUESTIONS

Q.1 What is carbyl amine test? *(Knowledge Base+Understanding Base)*

Ans: *Answer given on Page # 146*

Q.2 What is Baeyer's test? *(Knowledge Base+Understanding Base)*

Ans: *Answer given on Page # 145*

Q.3 How can aldehydic group be identified? *(Knowledge Base+Understanding Base)* **(Ex-Q.12)**

Ans: *Answer given on Page # 146*

Q.4 What is bromine water test? *(Knowledge Base+Understanding Base)* **(SWL 2017)**

OR

Which reaction is used to identify the unsaturation of an organic compound?

Ans: *Answer given on Page # 145*

Q.5 Pharmaceutical chemists work towards the partial and total synthesis of effective drugs. Comment. *(Understanding Base)* **(Science, Technology and Society Pg. # 73)**

Ans:

WORK OF PHARMACEUTICAL CHEMISTS

Synthesis of effective drugs to control the epidemics and fatal diseases is the need of the society. The responsibility to synthesize effective drugs is of pharmaceutical chemists. They can evaluate the efficiency and safety of these drugs. They make the drugs more and more effective by reducing their side effects and enhancing potency.

11.4 TEST YOURSELF

i. What is the functional group of an ester? *(Knowledge Base+Understanding Base)* **(LHR 2013)**

Ans:

FUNCTIONAL GROUP OF AN ESTER

Esters have $R-\overset{\overset{O}{\|}}{C}-OR'$ general formula where R and R' are the alkyl groups that may or may not be same.

Thus,

Functional group of an ester $-\overset{\overset{O}{\|}}{C}-OR$

Example: $[CH_3-\overset{\overset{O}{\|}}{C}-O-CH_3]$

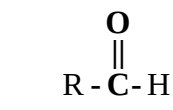
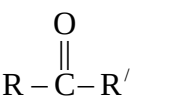
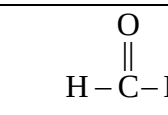
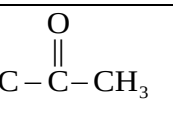
MethylAcetate

ii. What is the difference between aldehydes and ketones?

(Knowledge Base+Understanding Base)

Ans: **DIFFERENTIATION**

The differences between aldehydes and ketones are as follows:

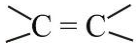
Aldehydes	Ketones
Functional Group	
• Aldehydes have functional group 	• Ketones have functional group 
General Formula	
• Their general formula is RCHO 	• Their general formula is 
Examples	
• 	• 

iii. Give the functional groups of alkenes and alkynes?

(Knowledge Base+Understanding Base)

Ans: **FUNCTIONAL GROUPS**

Folowing are the functional groups of alkenes and alkynes:

Alkenes: 

Alkynes: 

iv. How an alcohol is tested? ?*(Knowledge Base+Understanding Base)* **(SGD 2016 G-II)**

Ans: **TESTS FOR ALCOHOL**

Alcoholic group is tested by sodium metal test and ester formation test.

(i) Sodium Metal Test

Take 2 – 3 cm^3 of the given organic compound in dry test tube and add a piece of sodium metal.

Result:

Hydrogen gas will evolve.

(ii) Ester Formation Test

Take about 2–3cm^3 of given organic compound with 1.0 cm^3 of acetic acid and 1-2 drops of concentrated sulphuric acid.

Result:

Fruity smell will be given out.

v. How a ketonic group is tested? ***(Knowledge Base+Understanding Base)***

Ans: **TESTS FOR KETONIC GROUP**

Ketonic group is tested by following tests.

(i) Phenyl Hydrazine Test:

Shake a pinch of the given organic compound with 2.0 cm^3 of phenyl hydrazine solution.

Result:

Orange red precipitate will be formed.

(ii) Sodium Nitroprusside Test:

Take about 2.0 cm^3 of sodium nitroprusside solution in test tube and add 2-3 drops of NaOH solution. Now add a pinch of organic compound and shake it.

Result:

Red colour will be formed.

(iii) Fehling's Solution Test:

No reaction

11.6 TESTS FOR FUNCTIONAL GROUPS

MULTIPLE CHOICE QUESTIONS

1. Baeyer's test results in disappearance of colour: ***(K.B)***

(A) Pink (B) Red

(C) Orange red (D) White

2. Esters are recognized by their: ***(K.B)***

(A) Fruity smell (B) Fruity taste

(C) Fruity colour (D) Unpleasant smell

3. Fehling's solution test gives colour precipitate of: ***(U.B+K.B)***

(A) Red colour (B) White colour

(C) Black colour (D) Orange red colour

4. Extremely unpleasant smell will be given out for test: ***(K.B)***

(A) Carbyl amine (B) Fehling solution

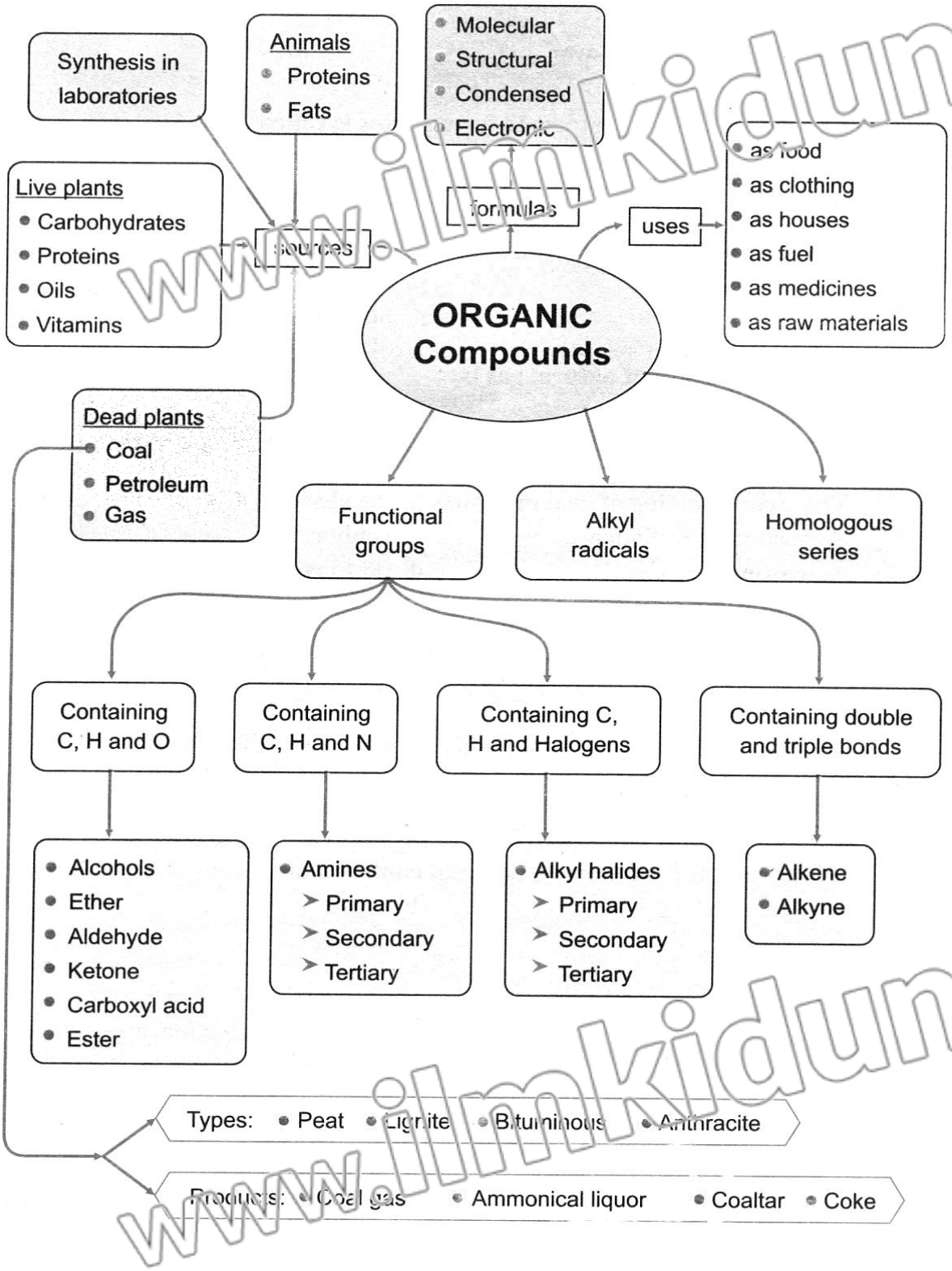
(C) Sodium sulphite (D) Litmus

5. Phenylhydrazine reacts with ketones and forms: ***(A.B)***

(A) Orange red ppt (B) Brown ppt.

(C) White ppt. (D) Red ppt.

CONCEPT DIAGRAM



ANSWER KEY
MULTIPLE CHOICE QUESTIONS
INTRODUCTION

1	D
2	A
3	A
4	A
5	B

11.1 ORGANIC COMPOUNDS

1	C	6	C
2	D	7	C
3	B	8	C
4	A	9	A
5	D		

11.1.1 CLASSIFICATION OF ORGANIC COMPOUNDS

1	C
2	A
3	A
4	C

11.1.2 DIVERSITY AND MAGNITUDE OF ORGANIC COMPOUNDS

1	D
2	C
3	C
4	A
5	C
6	D

11.1.3 GENERAL CHARACTERISTICS OF ORGANIC COMPOUNDS

1	B
2	A
3	A
4	B
5	A

11.2 SOURCES OF ORGANIC COMPOUNDS

1	A	6	B	11	C
2	D	7	C	12	A
3	B	8	A		
4	D	9	D		
5	D	10	D		

11.2.2 PETROLEUM To 11.2.5 SYNTHESIS IN LABORATORY

1	A	6	D
2	A		
3	A		
4	A		
5	A		

11.3 USES OF ORGANIC COMPOUNDS

1	B
2	A
3	C

11.4 ALKANES AND ALKYL RADICALS

1	C	6	A
2	A	7	A
3	C	8	A
4	D	9	C
5	C	10	B

11.5 FUNCTIONAL GROUPS

1	A	6	A	11	C	16	B
2	B	7	A	12	A	17	C
3	C	8	A	13	A		
4	A	9	C	14	B		
5	B	10	A	15	A		

11.6 TESTS FOR FUNCTIONAL GROUPS

1	A
2	A
3	A
4	A
5	A

EXERCISE SOLUTION
MULTIPLE CHOICE QUESTIONS

1. The ability of carbon atoms to form chains is called: *(K.B)*
(GRW 2013, LHR 2014, SGD 2014, FSD 2016 G-II, SWL 2017 G-I)
(a) Isomerism (b) Catenation
(c) Resonance (d) Condensation

2. Coal having 90% carbon contents is called: *(K.B)* **(DGK 2017, MTN 2017, SGD 2017)**
(a) Peat (b) Lignite
(c) Anthracite (d) Bituminous

3. Main component of natural gas is: *(K.B)* **(GRW 2013, LHR 2015, RWP 2017, MTN 2016 G-I, II)**
(a) Methane (b) Propane
(c) Butane (d) Propene

4. The strong heating of coal in retorts in the absence of air is called: *(K.B)*
(a) Fractional distillation (b) Sublimation
(c) Roasting (d) Destructive distillation

5. Pitch is black residue of: *(K.B)* **(SGD 2016 G-I, SWL 2016 G-II, BWP 2016 G-II)**
(a) Coke (b) Coal tar
(c) Coal (d) Coal gas

6. Natural gas is 85% methane. It is used to make the following except: *(K.B)*
(a) Carbon black (b) Coke
(c) Coal tar (d) Coal gas

7. Which one of the following does not contain starch? *(K.B)*
(a) Sugar cane (b) Maize
(c) Barley (d) Potatoes

8. Petroleum is refined by: *(K.B)*
(a) Destructive distillation (b) Fractional distillation
(c) Simple distillation (d) Dry distillation

9. In laboratory urea was prepared by: *(K.B)* **(SGD 2016 G-II, MTN 2016, G-II)**
(a) Wohler (b) Rutherford
(c) Berzellius (d) Dalton

10. General formula of alkyl radical is: *(K.B)* **(SGD 2017, BWP 2016 G-I)**
(a) C_nH_{2n+2} (b) C_nH_{2n-2}
(c) C_nH_{2n+1} (d) C_nH_{2n}

11. Identify which one of the following compounds is a ketone? *(K.B)*
(a) $(CH_3)_2CHOH$ (b) $(CH_3)_2CO$
(c) $(CH_3)_2NH$ (d) $(CH_3)_2CHCl$

12. The functional group -COOH is found in: *(K.B)* **(GRW 2014)**
(a) Carboxylic acid (b) Aldehydes
(c) Alcohols (d) Esters

13. Which one of the following statements is not true about fossil fuels? *(K.B)*

(a) They all contain carbon (b) They are renewable

(c) They produce pollutants when burnt (d) They cause acid rain

14. Which one of the following is the hardest coal? *(K.B)* **(DGK 2017, SWL 2016 G-I)**

(a) Peat (b) Lignite

(c) Bituminous (d) Anthracite

15. In which of the following groups, oxygen is attached on both sides with carbon atoms?*(U.B)*

(a) Ketone (b) Ether

(c) Aldehyde (d) Ester

16. Carbonization process is the conversion of: *(K.B)*

(a) Coal into coal gas (b) Coal into wood

(c) Wood into coal (d) Wood into coal tar

17. Coal gas is a mixture of: *(K.B)* **(FSD 2016 G-I)**

(a) CO and CH_4 (b) CO, CH_4, CO_2

(c) CO, CH_4, H_2 (d) CO, H_2 and CO_2

18. Which one of the following is a synthetic fibre? *(K.B)*

(a) Cotton (b) Wool

(c) Nylon (d) Silk

19. Which one of the following is not a fossil fuel? *(K.B)*

(a) Coal (b) Natural gas

(c) Biogas (d) Petroleum

20. Which one of the following does not contain protein? *(K.B)*

(a) Pulses (b) Potatoes

(c) Beans (d) Eggs

21. Conversion of dead plants into coal by the action of bacteria and heat is called: *(K.B)* **(DGK 2016 G-I)**

(a) Carbonization (b) Catenation

(c) Hydrogenation (d) Cracking

22. Which one of the following compounds is an aldehyde? *(K.B)*

(a) $CH_3 - CH_2 - OH$ (b) $CH_3 - COOH$

(c) CH_3CHO (d) CH_3COCH_3

23. Formula of acetaldehyde is:

(a) $CH_3 - CH_2OH$ (b) $CH_3 - \overset{O}{\overset{\|}{C}} - OH$

(c) $CH_3 - \overset{O}{\overset{\|}{C}} - H$ (d) $H - \overset{O}{\overset{\|}{C}} - H$

ANSWER KEY

1	b	6	a	11	b	16	c	21	a
2	c	7	a	12	a	17	c	22	c
3	a	8	b	13	b	18	c	23	c
4	d	9	a	14	d	19	c		
5	b	10	c	15	b	20	b		

EXERCISE SHORT QUESTIONS

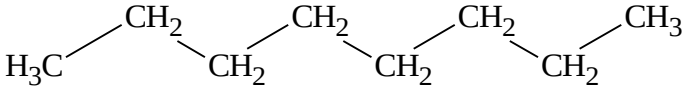
1. What is meant by the term catenation? Give an example of a compound which displays catenation. *(Knowledge Base)* **(GRW 2014, SWL 2016 G-I, DGK 2016 G-II)**

Ans: **CATENATION**

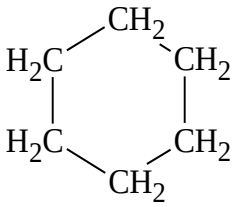
Definition:

"*The ability of carbon atoms to link with other carbon atoms to form long chains and large rings is called catenation".*

Examples:



n-octane



cyclohexane

2. How coal is formed? *(Knowledge+Understanding Base)*

Ans: **FORMATION OF COAL**

Coal is formed by the decomposition of dead plants burried under the Earth's crust millions of years ago. It is very show bio-chemical process. Coal is formed by carbonization of wood. It takes place in the absence of air under high pressure and high temperature over a long period of time (about 500 millions of years).

Wood $\xrightarrow[\text{Biochemical}]{\text{Bactarial}}$ **Peat** $\xrightarrow[\text{Press}]{\text{High temperature}}$ **Lignite** $\xrightarrow{\text{Pressure}}$ **Bituminous** $\xrightarrow{\text{Pressure}}$ **Anthracite**

40% C **60% C** **70% C** **80% C** **90% C**

3. What is importance of natural gas? *(Knowledge Base)* **(BWP 2016 G-I)**

Ans: **IMPORTANCE OF NATURAL GAS**

Natural gas is used:

- As fuel in homes as well as in industries.
- As fuel in automobiles as compressed natural gas (CNG).
- To make carbon black and fertilizer.

4. Justify that organic compounds are used as food. *(Knowledge Base)*

(GRW 2014, MTN 2017, DGK 2016 G-I)

Ans: **ORGANIC COMPOUNDS AS FOOD**

Organic compounds are used as food because the food we eat daily such as milk, eggs, meat,

vegetables etc. contains carbohydrates, proteins, fats, vitamins etc. are all organic stuff.

5. How alkyl radicals are formed? Explain with examples. ***(Knowledge Base)***

(FSD 2016 G-I)

Ans:

FORMATION OF ALKYL RADICALS

Alkyl radicals are the derivatives of alkanes. They are formed by the removal of one hydrogen atom of an alkane and are represented by a letter "R".

Example:

Alkyl Radicals of Propane:

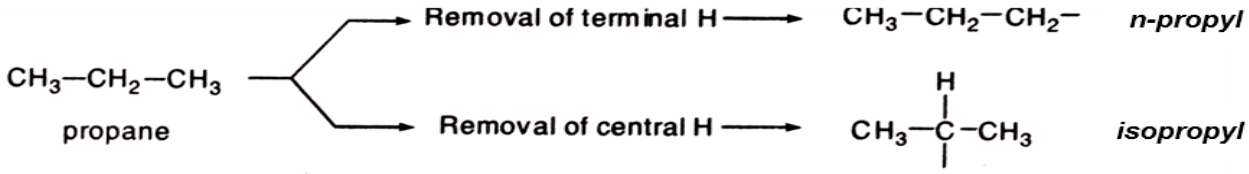
Following are two alkyl radicals of propane:

n-Propyl:

Propane has a **straight chain** structure. When **terminal H** is **removed** it is called **n-propyl.**

Iso-propyl:

When **hydrogen** from central carbon is **removed** it is called **isopropyl**, as explained below:



6. What is the difference between n-propyl and isopropyl?

(Knowledge+Understanding Base) **(LHR 2015, FSD 2016G-II, MTN 2016 G-II)**

Ans:

DIFFERENTIATION

The differences between n-propyl and isopropyl are as follows:

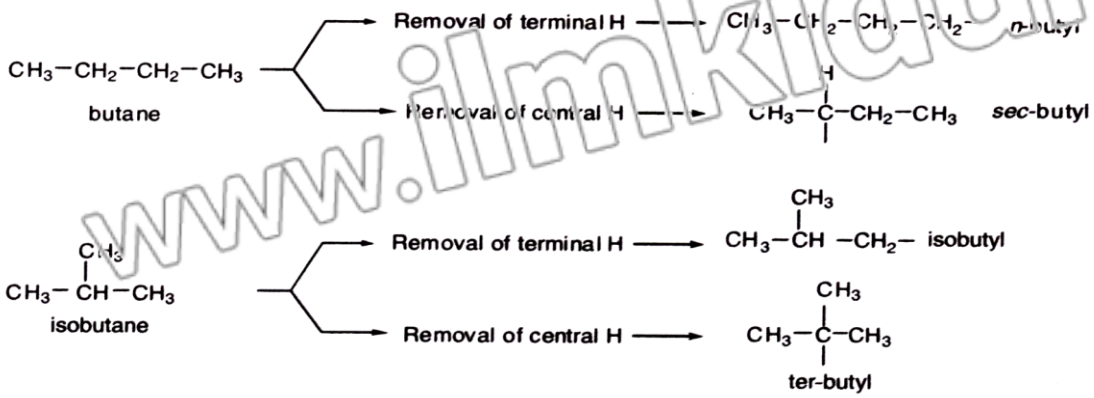
n-Propyl	Isopropyl
Definition	
When **terminal hydrogen** is **removed** from the structure of n-propane, n propyl is obtained. n-propyl is the radical of propane.	When **central hydrogen** is **removed** from the structure of n-propane, it is called isopropyl. Isopropyl is also the radical of propane.
Formation	
$CH_3 - CH_2 - CH_3 \rightarrow$ Removal of terminal "H" ↓ $CH_3 - CH_2 - CH_2 -$ n-propyl	$CH_3 - CH_2 - CH_3 \rightarrow$ Removal of Central "H" ↓ $CH_3 - \underset{\text{Iso–propyl}}{\overset{\overset{H}{\vert}}{C}} - CH_3$

7. Explain different radicals of butane. *(Knowledge Base)* **(RWP 2017, SGD 2016 G-II)**

Ans: **RADICALS OF BUTANE**

Butane has two isomers, n-butane and isobutane.

Different radicals of butane which are possible, are as follows.



8. Define functional group with an example. *(Knowledge Base)*

(LHR 2014, 15, GRW 2013M, SGD 2016 G-II, DGK 2016 G-II)

Ans: **FUNCTIONAL GROUP**

Definition:

*"An **atom** or **group of atoms** or presence of **double or triple bond** which determines the **characteristic properties** of an **organic compound** is known as the **functional group**".*

Examples:

- **Alcoholic functional group: (–OH)** present in alcohols
- **Carboxylic functional group: (–COOH)** present in carboxylic acids

9. What is an ester group? Write down the formula of ethyl acetate. *(Knowledge Base)*

(LHR 2013, FSD 2016 G-II)

Ans: **ESTER GROUP**

Definition:

"The functional group $-\overset{\overset{O}{\|}}{C}-O-$ *is called ester group"*

General Formula:

General formula of esters is $R-\overset{\overset{O}{\|}}{C}-O-R'$.

Where R and R′ are alkyl groups. They may be same or different.

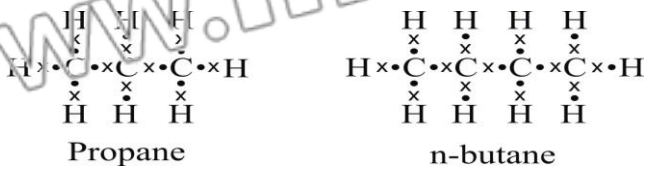
Formula of Ethyl Acetate:

Formula of ethyl acetate is $CH_3COOCH_2CH_3$.

10. Write down the dot and cross formulae of propane and n-butane? *(Knowledge Base)*

Ans: **DOT AND CROSS FORMULAE**

The dot and cross formulae of propane and n-butane are as follows:.



11. Define structural formula. Draw the structural formulae of n-butane and isobutane. ***(Knowledge Base)*** **(BWP 2017, MTN 2017, SWL 2016 G-I)**

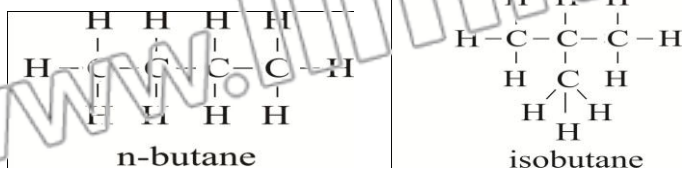
Ans: **STRUCTURAL FORMULA**

Definition:

"Structural formula of a compound represents the ***exact arrangement*** *of* ***different atoms*** *of* ***various elements*** *present in a molecule of a substance".*

Structural formulae:

Structural formulae of n-butane and isobutane are as follows:



12. Write down classification of coal. ***(Knowledge Base)***

Ans: **CLASSIFICATION OF COAL**

Following are the different classes of coal:

Type of Coal	Carbon Contents	Uses
Peat	**60%**	It is inferior quality coal used in kiln.
Lignite	**70%**	It is soft coal used in thermal power stations.
Bituminous	**80%**	It is common variety of coal used as household coal.
Anthracite	**90%**	It is superior quality hard coal that is used in industry.

13. What are heterocyclic compounds? Give two examples. ***(Knowledge Base)***

(DGK 2017, FSD 2016 G-I, BWP 2016 G-I)

Ans: **HETEROCYCLIC COMPOUNDS**

Definition:

"The ***cyclic compounds*** *that contain* ***one*** *or* ***more atoms other than*** *that of* ***carbon*** *atoms in their rings are called heterocyclic compounds"*

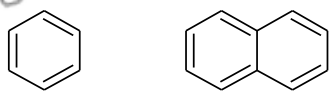
Examples:

14. Why benzene and other homologous compounds of benzene are called aromatic compounds? ***(Knowledge Base)*** **(DGK 2016 G-II)**

Ans: **AROMATIC COMPOUNDS**

These compounds are called aromatic because of **aroma or smell** that these compounds have. These compounds are also called benzenoid compounds.

Examples:



EXERCISE LONG QUESTIONS

Q.1 How is coal formed? What are the different types of coal?
Ans: See LQ.2 (Topic 11.2)
Q.2 Write down the composition and uses of different types of coal.
Ans: See LQ. 2 (Topic 11.2)
Q.3 What is destructive distillation of coal?
Ans: See LQ.3 (Topic 11.2)
Q.4 Name the different types of the products obtained by the destructive distillation of coal.
Ans: See LQ.3 (topic 11.2)
Q.5 Write a detailed note on functional groups of alkenes and alkynes. How they are identified from other compounds? ***(Knoowlegde+Understanding Base)***
Ans:

FUNCTIONAL GROUPS

Alkenes:

"Hydrocarbon compounds consisting of ***double bonds*** *between* ***two carbon atoms*** *in their molecules are called alkenes".*

Examples:

- **$H_2C = CH_2$ Ethene**
- **$H_3C – HC = CH_2$ Propene**

Alkynes:

"Hydrocarbon compounds consisting of ***triple bonds*** *between* ***two carbon atoms*** *in their molecules are called alkynes".*

Examples:

- $HC \equiv CH$ **Ethyne**
- $H_3C — C \equiv CH$ **Propyne**

IDENTIFICATION OF ALKENES AND ALKYNES

Alkenes and alkynes are identified form other organic compoudns by the following tests:

(i) Bromine Water Test:

Dissolve a pinch of the given organic compound in 2.0 cm^3 of carbon tetrachloride (CCl_4). Add 2 cm^3 of bromine water in it and shake.

Result:

Bromine will be decolourised.

(ii) Baeyer's Test:

Dissolve about 0.2 g of the organic compound in water. Add to it 2-3 drops of alkaline $KMnO_4$ solution and shake.

Result:

Pink colour will disappear.

Q.6 Give some uses of organic compounds in our daily life.
Ans: See LQ.1 (Topic 11.3)
Q.7 Write down the characteristics of homologous series.
Ans: See LQ.1 (Topic 11.4)
Q.8 Why organic compounds are numerous?
Ans: See LQ.1 (Topic 11.1.2)
Q.9 What are amines? Explain the different types of amines giving an example of each

type. How primary amino group is identified?

Ans:

AMINES:

"The organic compounds containing carbon, hydrogen and nitrogen as functional group are called as amines".

Functional Group:

Their functional group is $-\ddot{N}H_2$

General Formula:

Their general formula is $R-\ddot{N}H_2$

TYPES OF AMINES

Following are the types of amines:

Primary Amines:

"The amines in which one carbon atom is attached directly to the nitrogen atom of amino $(-\ddot{N}H_2)$ *group are called primary amines."*

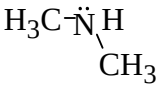
Example: $CH_3-\ddot{N}H_2$

Methyl Amine

Secondary Amines:

"The amines in which ***two carbon atoms*** *are attached directly to the nitrogen atom of amino* $(-\ddot{N}H_2)$ *group are called secondary amines."*

Example:

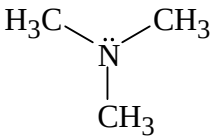


Dimethylamine

Tertiary amines:

"The amines in which ***three carbon atoms*** *are attached directly to the nitrogen atom of amino* $(-\ddot{N}H_2)$ *group are called tertiary amines."*

Example:



Trimethylamine

IDENTIFICATION OF PRIMARY AMINO GROUP

Carbyl Amine Test is used for the identification of primary amino group. Heat about 0.2 g of the given compound and add 0.5 cm^3 of chloroform and add 2-3 cm^3 of alcoholic KOH.

Result:

Extremely unpleasant odour will be given out.

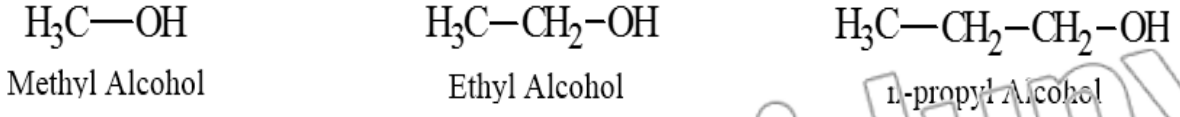
Q.10 Describe the functional group of an alcohol. How alcoholic groups are identified?

Ans: **(GRW 2014, SGD 2014, SWL 2016, 17)(Ex.Q.10)**

ALCOHOLIC GROUP

"The functional group of ***alcohols is –OH****".*

Their **general formula is ROH**, where R is any alkyl group.



Identification of Alcoholic Group –OH: **(Ex-Q 10) (SWL 2016 G-I)**

(i) Sodium Metal Test:

Take about 2-3 cm^3 of the given organic liquid in a dry test tube and add a piece of sodium metal.

Result:

Hydrogen gas will evolve.

(ii) Ester Formation Test:

Heat about 1.0 cm^3 of the organic compound with 1.0 cm^3 of acetic acid and 1-2 drops of concentrated sulphuric acid.

Result:

Fruity smell will be given out.

Q.11 Differentiate between aldehydic and ketonic functional groups. How both are identified from each other?

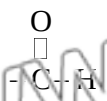
Ans: **DIFFERENTIATION**

The differences between aldehydes and ketones are as follows:

Aldehydes	Ketones
Functional Group	
• The aldehydic $-\overset{\overset{O}{\|}}{C}-H$ functional group is present in aldehydes.	• The ketonic $-\overset{\overset{O}{\|}}{C}-$ functional group is present in ketones
Examples	
• $H-\overset{\overset{O}{\|}}{C}-H$	• $H_3C-\overset{\overset{O}{\|}}{C}-CH_3$

IDENTIFICATION

Tests for Aldehydic Group: **(Ex-Q.12)**



(i) Sodium Bisulphite Test:

Shake about 0.2 g or 0.5 cm^3 of the given compound with 1-2 cm^3 of saturated solution of sodium bisulphite.

Result:

A crystalline white precipitate will be formed.

(ii) Fehling's Solution Test:

Mix equal volumes of Fehling's solution A and B in a test tube. Add a pinch of organic compound and boil for five minutes.

Result:

Red precipitate will be formed.

Tests for Ketonic Group: **(Ex-Q.12)**

(i) Phenyl Hydrazine Test:

Shake a pinch of the given organic compound with about 2.0 cm^3 of phenyl hydrazine solution.

Result:

Orange red precipitate will be formed.

(ii) Sodium Nitroprusside Test:

Take about 2.0 cm^3 of sodium nitroprusside solution in a test tube and add 2-3 drops of NaOH solution. Now add a pinch of the given compound and shake.

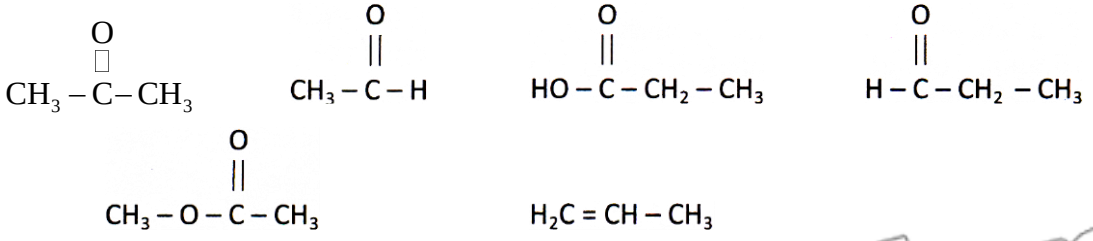
Result:

Red colour will be formed.

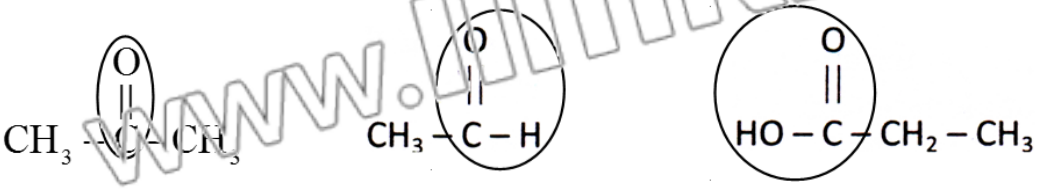
(iii) Fehling's Solution Test:

No reaction

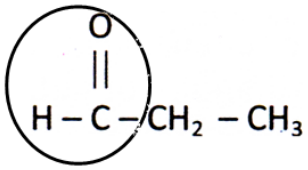
Q.12 Encircle the functional groups in the following compounds. Also give the names of the functional groups?



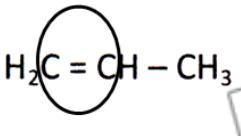
Ans:



(i)Ketonic group (ii) Aldehydic group (iii) Carboxylic group



(iv) Aldehydic group



(v) Double bond

(vi) Ester group

Q.13 What are general properties of organic compounds?

Ans: See Q.NO.1 for the topic 11.1.3

Q.14 Write a detailed note on classification of organic compounds.

Ans: See Q.NO.1 for the topic 11.1.1

ADDITIONAL CONCEPTUAL QUESTIONS

Q.1 Differentiate between Carbonization and Destructive distillation.

Ans:

DIFFERENTIATION

The differences between Carbonization and Destructive distillation are as follows:

Carbonization	Destructive Distillation
Definition: The conversion of wood into coal is called carbonization. **Products:** • Peat • Lignite • Bituminous • Anthracite	**Definition:** The strong heating of coal in the absence of air is called destructive distillation. **Products:** • Coal gas • Coal tar • Coke • Ammonical liquor

Q.2 Why silicon does not show catenation whereas carbon does?

Ans:

Carbon Shows Catenation Whereas Silicon does not

Both silicon and carbon have similar electronic configurations but carbon shows catenation whereas silicon does not.

Reasons:

- It is mainly due to the reason that C-C bonds are much stronger (355 kJ mol^{-1}) than Si-Si (200kJ mol^{-1}) bonds.
- On the other hand, Si-O bonds are much stronger (452 kJ mol^{-1}) than C-O bonds (351 kJ mol^{-1}) Hence, silicon occurs in the form of silica and silicates in nature.

Q.3 Differentiate between Alkene and Alkynes.

Ans: **DIFFERENTIATION**

Alkenes	Alkynes
Definition: "Hydrocarbon compounds, consisting of double bonds between two carbon atoms in their molecules are called alkenes."	**Definition:** "Hydrocarbon compounds consisting of triple bonds between two carbon atoms in their molecules are called alkynes."
Example: • $H_2C = CH_2$ Ethene $H_3C - HC = CH_2$ Propene	**Example:** $HC \equiv CH$ Ethyne $H_3C - C \equiv CH$ Propyne

Q.4 Differentiate between open chain and closed chain compounds.

Ans: **DIFFERENTIATION**

Open Chain Compounds	Closed Chain Compounds
Definition: Open chain or Aliphatic compounds are those in which end carbon atoms are not joined with each other in this way they form a long chain of carbon atoms. **Types:** • Straight chain • Branched chain **Example:** • $CH_3 - CH_2 - CH_2 - CH_3$ n-butane	**Definition:** Closed chain or cyclic compunds are those in which carbon atoms at the end of the chain are not free. They are linked to form a ring. **Types:** • Homocylic • Heterocyclic **Example:** • $CH_2 - CH_2$ | | $CH_2 - CH_2$ Cyclo Butane

Q.5 Differentiate between pitch and coke.

Ans: **DIFFERENTIATION**

Pitch	Coke
Definition: It is the black residue of coal tar. **Uses:** • It is used for surfacing of roads and roofs.	**Definition:** It is the left behind residue of coal. **Uses:** • It is mainly used as reducing agent in the extraction of metals especially iron.

Q.7 Differentiate ether and esters.

Ans:

DIFFERENTIATION

Ethers	Esters
Definition: • Its functional group is – O – • Its general formula is $R-O-R'$ **Example:** • $CH_3-O-C_2H_5$ Ethyl Methyl Ether	**Definition:** • Its functional group is $-\overset{\overset{O}{\|}}{C}-OR$ • Its general formula is $R-\overset{\overset{O}{\|}}{C}-OR'$ **Example:** • $CH_3-\overset{\overset{O}{\|}}{C}-OC_2H_5$ Ethyl Acetate

Q.8 Write down formulas of sec-propyl Alcohol and Tertiary Butyl chloride.

Ans:

Sec propyl Alcohol	Tertiary Butyl chloride
$CH_3-\underset{\underset{CH_3}{\|}}{CH}-OH$	$CH_3-\underset{\underset{CH_3}{\|}}{\overset{\overset{CH_3}{\|}}{C}}-Cl$

TERMS TO KNOW

Terms	Definitions
Vital Force Theory	According to this theory organic compounds could not be prepared in laboratories because they were supposed to be synthesized under the influence of a mysterious force called Vital Force, inherent only in living things.
Molecular Formula	The formula which represents the actual number of atoms in one molecule of the organic compound is called the molecular formula.
Structural Formula	Structural formula of a compound represents the exact arrangement of the different atoms of various elements present in a molecule of a substance.
Condensed Formula	The formula that indicates the group of atoms joined together to each carbon atom in a straight chain or a branched chain is called the condensed formula.
Dot and Cross Formula	The formula which shows the sharing of electrons between various atoms in one molecule of the organic compound is called dot and cross formula or electronic formula".
Organic Compounds	Organic compounds are hydrocarbons (compounds of carbon and hydrogen) and their derivatives, in which covalently bonded carbon is an essential constituent".
Organic Chemistry	The branch of chemistry which deals with the study of hydrocarbons and their derivatives is known as organic chemistry.
Open Chain Compounds	Open chain compounds are those in which the end carbon atoms are not joined with each other in this way they form a long chain of carbon atoms.
Straight Chain Compounds	Straight chain compounds are those in which carbon atoms link with each other through a single, double or triple bond forming a straight chain.
Branched Chain Compounds	Branched chain compounds are those in which there is a branch along straight chain.
Closed Chain or Cyclic Compounds	Closed chain or cyclic compounds are those in which the carbon atoms at the end of chain are not free. They are linked to form a ring.
Homocyclic or Carbocyclic Compounds	Homocyclic or carbocyclic compounds contain rings which are made up of only one kind of atoms, i.e., carbon atoms are called homocyclic compounds.
Benzene Ring	A benzene ring is made up of six carbon atoms with three alternating double bonds. They are called aromatic because of aroma or smell they have.
Aromatic Compounds	These organic compounds contain at least one benzene ring in their molecule are called aromatic compounds. They are also called benzenoid compounds.
Heterocyclic Compounds	The cyclic compounds that contain one or more atoms other than that of carbon atoms in their rings are called heterocyclic compounds.
Catenation	The ability of carbon atoms to link with other carbon atoms to form long chains and large rings is called catenation.
Isomerism	The compounds having the same molecular formula but different arrangement of atoms in their molecules or different structural formulae are called isomers and this phenomenon is called isomerism.

Destructive Distillation	The strong heating of coal in the absence of air is called destructive distillation.
Coal Gas	Coal gas is mixture of hydrogen, methane and carbon monoxide, produces heat when burnt in air.
Ammonical Liquor	Ammonical liquor is a solution of ammonia gas in water
Coal Tar	Coal tar is a thick black liquid. It is a mixture of more than 200 different organic compounds, mostly aromatic. They are separated by fractional distillation of Coal Tar. Some of the important aromatic compounds are benzene, phenol, toluene, aniline, etc.
Pitch	The black residue of the coal tar is called pitch.
Coke	When coal is subjected to destructive distillation, it loses all its volatile components and leaves behind a solid residue called coke. Coke is 98% carbon.
Petroleum	Petroleum is a dark brownish or greenish black coloured viscous liquid. It is a complex mixture of several solid, liquid or gaseous hydrocarbons in water mixed with salts and earth particles.
Fractional Distillation	Separation of fractions or components from a mixture depending upon their boiling point ranges is called fractional distillation.
Natural Gas	It is a mixture of low molecular mass hydrocarbons.
Homologous Series	The group of similar compounds in which each member differs from the adjacent member by $-CH_2-$ group and have same functional group is called homologous series.
Alkyl Radical	The group of atoms formed by the removal of one of the hydrogen atom of an alkane is called alkyl radical or alkyl group.
Functional Group	An atom or group of atoms or presence of double or triple bond which determines the characteristic properties of an organic compound is known as functional group.
Amines	The organic compounds containing carbon, hydrogen and nitrogen as functional group are called as amines.
Alkyl Halides	The organic compounds having functional group containing carbon, hydrogen and halogens are called alkyl halides.
Alkenes	Hydrocarbon compounds consisting of double bonds between two carbon atoms in their molecules are called alkenes.
Alkynes	Hydrocarbon compounds consisting of triple bonds between two carbon atoms in their molecules are called alkynes.
Esters	Organic compounds consisting of' functional group $-\overset{\overset{O}{\|}}{C}-O-$ are called esters.
Aldehydes	Aldehydes have functional group $-\overset{\overset{O}{\|}}{C}-H$.
n-Propyl	When terminal hydrogen is removed from the structure of propane, n propyl is obtained.

CUT HERE

SELF TEST

Time: 35 Minutes **Marks: 25**

Q.1 Four possible answers (A), (B), (C) and (D) to each question are given, mark the correct answer. (5×1=5)

1. Vital Force Theory was further negated by:

(A) Kolbe, 1845 (B) Farat 1545

(C) Divan, 1435 (D) Derek, 348

2. Octane has molecular formula:

(A) C_8H_{19} (B) C_8H_{18}

(C) C_8H_{23} (D) C_8H_{16}

3. Energy of C-O bonds is:

(A) 452 kJ/mol (B) 355 kJ/mol

(C) 200 kJ/mol (D) 351 kJ/mol

4. The percentage of machine in natural gas is:

(A) 87 (B) 85

(C) 89 (D) 90

5. –CHO is functional group of:

(A) Aldehydes (B) Ketones

(C) Ethers (D) Esters

6. Perfumes often contain:

(A) Rose oil (B) Olive oil

(C) Kerosene oil (D) None of these

Q.2 Give short answers to the following questions. (5×2=10)

(i) Differentiate between open chain and closed chain compounds.

(ii) Which factors influence catenation?

(iii) What is pitch?

(iv) Explain ammonical liquor?

(v) How organic compounds are used for fuel?

Q.3 Answer the following questions in detail. (5+4=9)

(i) Explain briefly types of formulae of organic compounds **(5)**

(ii) Explain the tests for the following functional groups. **(4)**

(i) Aldehydic group (ii) Carboxylic group

NOTE: Parents or guardians can conduct this test in their supervision in order to check the skill of students.