UNIT 11

Hydrocarbons

Descriptive Questions

Q.1. (Ex. Q.4 (i)) Describe the importance of organic compounds in daily life. 092011001

Ans: Uses of organic compounds:

No doubt, thousands of organic compounds are synthesized naturally by animals and plants. But millions of organic compounds are being prepared in the laboratories by the 'chemists. Because these compounds are part of everything from food we eat to the various items we use in daily life to fulfil our needs.

i. **Uses as Food:** The food we eat daily such as milk, eggs, meat, vegetables, etc., 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 fibers** (cotton, silk and wool, etc.) and **synthetic fibers** (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.

Q.2. (Ex. Q.4 (ii)) Why is carbon so important as an element that the whole branch of chemistry is based on it? 092011002

Ans. All the organic compounds are known to contain carbon as an essential element. This fact has led us to define organic chemistry as the chemistry of carbon compounds. Apart from carbon, most of the organic compounds contain hydrogen and oxygen as well.

Organic compounds are famous for their large number and diverse behavior. Several million organic compounds are known to exist naturally or have been synthesized in the laboratory. Organic molecules are usually large and more complex in nature. They include life molecules like proteins, enzymes carbon hydrates, lipids, vitamins and nucleic acid, pharmaceuticals and synthetic fibres, etc.

The number of compounds formed by the element carbon is far more than the total number of compounds formed by all the rest elements put together. This is due to come unique properties of carbon.

The element carbon is present at the center of the periodic table and it is energetically not possible for it to gain or lose electrons to form ionic bond. Therefore, it forms four

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covalent bonds. Because of their small size, these covalent bonds are short and strong enabling carbon to give strong and stable bond with itself and with hydrogen, oxygen and nitrogen. The self-liking property of carbon is called **catenation** and due to this it forms long, straight and branched chains and rings.

All these facts suggest that due to diversity of carbon compounds, carbon as an element is very important and a separate branch of chemistry shared be based upon it.

Q.3. (Ex. Q.4 (iii)) A carbon-carbon single bond (C-C) does not behave as a functional group but a carbon carbon double bond (C = C) or alkene does. Explain. 092011003

Ans. "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".

Example:

-OH (Hydroxyl group) is the functional group of alcohols which give characteristic properties of alcohols.

Reasons:

i. Reactivity

C-C Single Bond: A single bond is relatively stable and non-reactive under normal conditions. It doesn't introduce significant chemical properties to a molecule.

C=C Double Bond: The double bond is weaker and more reactive than a single bond. This reactivity makes the double bond a site for various chemical reactions, such as addition reactions (e.g., hydrogenation, halogenation).

ii. Influence on Molecular Properties

C-C Single Bond: It doesn't significantly affect the physical or chemical properties of a molecule.

C=C Double Bond: It affects the molecule's shape and its electronic properties, which influence how the molecule interacts in chemical reactions.

iii. Role in Functional Group Definition

A functional group is defined as an atom or group of atoms within a molecule that determines its chemical reactivity. The double bond fits this criteria, because it:

1. Dictates how a molecule reacts.
2. Is a key site for chemical reactions.

In contrast, a single bond only connects atoms without imparting giving chemical properties.

iv. Functional Group Classification

The carbon-carbon double bond is the defining feature of alkenes, a class of organic compounds with distinct reactivity and properties. Single bonds, being inert, do not define a specific class of compounds based on reactivity.

Q.4. (Ex. Q.4 (iv)) Explain IUPAC system of nomenclature for alkanes. 092011004

Ans. As a result of the great complexity and large number of organic compounds, it is not possible to name each and every compound individually. The International Union of Pure & Applied Chemistry has devised a systematic way of naming organic compounds called **IUPAC nomenclature.**

According to IUPAC system of nomenclature, the entire name of an organic compound has three parts:

i. **Root:** It tells us the number of carbon atoms in the longest continuous chain present in the molecule. The roots up to ten carbon atoms are shown in table.

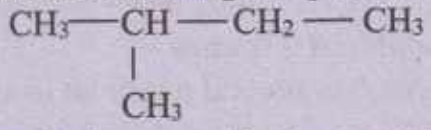
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Root	Meth-	Eth-	Prop-	But-	Pent-	Hex-	Hept-	Oct-	Non-	Dec-
No. Of Carbon atoms	1	2	3	4	5	6	7	8	9	10

ii. **Suffix:** It is added after the root and tells us about the class of organic compounds.

iii. **Prefix:** It is indicated before the root and tells us about the group or groups attached to the longest chain.

To explain the above system, let us name the following compound.

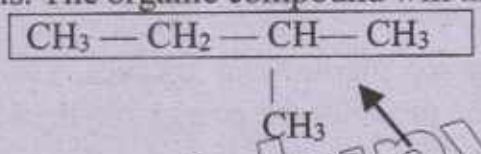


a) Identify the longest continuous chain present in the compound.

b) Identify the class of organic compounds.

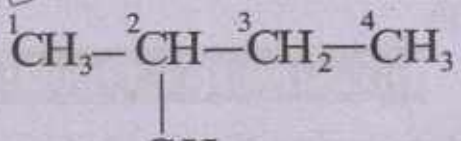
c) Identify the substitutent or substituents if present.

This organic compound contains four carbon atoms in the longest continuous chain and it belongs to the family of organic compounds called Alkane. The root is therefore But- and the suffix-ane added to this. The organic compound will thus be given the name Butane.



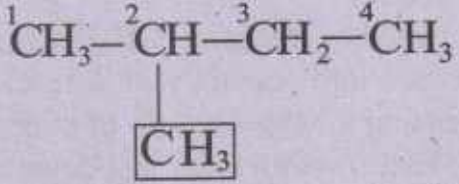
Longest continuous chain

The name of the only branch methyl-will be added to this name as prefix. So the name will become:



Branch

To specify where the branch occurs, the longest continuous chain is numbered starting from the end closest to the branch. This number is then attached to this prefix. The name of the above compound will then be:



2-Methylbutane or iso-Pentane

If compound has no branches, its name will contain only root and suffix.

Q.5. (Ex. Q.4 (v)) How combustion reaction of alkanes is useful for us? 092011005

Ans. Combustion: Alkanes burn in oxygen or air to form CO_2 and H_2O with the evolution of large amount of heat.

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$$CH_{4(g)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(g)} + \text{heat}$$

$$2CH_3 - CH_{3(g)} + 7O_{2(g)} \longrightarrow 4CO_{2(g)} + 6H_2O_{(g)} + \text{heat}$$

Types of Combustion

i. Complete Combustion: Occurs in the presence of sufficient oxygen, producing carbon dioxide and water as products. This releases a large amount of energy.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + \text{heat}$$

ii. Incomplete Combustion. Occurs when oxygen supply is limited, leading to the formation of carbon monoxide (CO) and carbon black along with water. This releases less energy and can be harmful.

$$3CH_4 + 4O_2 \longrightarrow 2CO + 6H_2O + C$$

Importance of Combustion of Alkanes

The combustion of alkanes has several practical uses and benefits in our daily lives.

i. Energy Production

- Alkanes, especially methane, propane, and butane, are used as fuels in homes and industries.
  e.g. Methane (natural gas) is used in cooking.
- Propane is used in gas cylinders in stoves.
- Large-scale combustion of alkanes in power plants generates electricity.

ii. Transportation

Gasoline and diesel, which are mixtures of alkanes, are used fuels in cars, trucks and aeroplanes. Their combustion provides the energy required to power engines.

iii. Industrial applications:

Alkanes are used as fuels in various industries, such as steel manufacturing and chemical production. For instance:

Combustion of alkanes provides the heat needed for melting metals.

It drives machinery in factories.

Investigative Questions

Q.1. (Ex. Q.5 (i)) When natural gas valve is kept open in the kitchen, the gas spreads through the whole kitchen. This may cause an explosion. What is the reason of this explosion and how can you avoid it? 092011006

Ans. Natural gas is widely used in kitchens for cooking because it is a clean and efficient source of energy. However, if the gas valve is left open without being ignited, it can spread throughout the kitchen. This situation is highly dangerous and can lead to an explosion.

Why Does an Explosion Occur?

Natural gas, primarily composed of methane (CH_4), is highly flammable. This means it can easily catch fire when it comes into contact with a spark or flame. Methane reacts rapidly with oxygen in the air, releasing a large amount of energy in the form of heat and light. A small spark, flame, or even heat from an electrical device (like a switch, bulb, or appliance) can ignite the gas-air mixture, causing a sudden and violent combustion an explosion.

Consequences of a Gas Explosion

The force of the explosion can destroy walls, windows, and appliances in the kitchen.

The explosion can start a fire, spreading further damage.

The sudden explosion can cause severe injuries or even fatalities.

How Can You Avoid a Gas Explosion?

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To prevent such accidents, follow these safety measures:

i. Always ensure the gas valve is turned off when not in use. Double-check the valve after cooking to confirm it is closed.

ii. Keep your kitchen well-ventilated. If you suspect a gas leak, open all doors and windows to allow the gas to disperse quickly. Leave the area and call gas technician to address the issue.

iii. Inspect your gas appliances, pipes, and valves regularly for leaks or damage. Replace worn-out or damaged components immediately.

iv. Install a gas leak detector in your kitchen. These devices can sense the presence of gas and alert you before it becomes dangerous.

v. Teach everyone in the household about gas safety, including how to identify a gas smell and what to do in an emergency. .

Q.2. (Ex. Q.5 (ii)) "Neem" is a common tree grown throughout our country. Comment on the medical benefits of this tree. 092011007

Ans: Medicinal Benefits of the Neem Tree

Neem is a well-known tree that is commonly grown throughout many parts of the world, including our country. It is often referred to as the "Village Pharmacy" because almost every part of this tree e.g. leaves, bark, seeds, and oil has medicinal properties. Neem is widely used in traditional medicine and plays an important role in promoting health and treating various health problems.

Medicinal Benefits of Neem

i. Neem is highly effective in killing bacteria and viruses. Its extracts are used to treat skin infections, wounds, and acne. Neem oil is applied to cuts and scratches to prevent infection and promote healing.

ii. Neem paste or neem water helps reduce pimples and other skin conditions. It is a common ingredient in soaps, creams, and face washes because of its cleansing and purifying effects.

iii. Neem twigs are traditionally used as toothbrushes. Chewing on these twigs helps clean teeth, prevent cavities, and maintain oral hygiene. Neem also fights gum infections and strengthens teeth.

iv. Consuming neem leaves or neem-based medicines helps purify the blood. This improves overall health and reduces the risk of infections.

v. Neem has compounds that help lower blood sugar levels. Drinking neem tea or consuming neem extracts is beneficial for managing diabetes.

vi. Regular use of neem strengthens the immune system, helping the body fight off diseases.

vii. Neem oil is a natural insect repellent. It is used to protect crops from pests and to keep mosquitoes and other insects away from humans.

viii. Neem helps treat stomach problems like ulcers, constipation and intestinal worms. It also promotes a healthy digestive system.

ix. Neem reduces swelling and pain in condition like joint problems.

x. Neem oil or neem shampoo helps control dandruff, lice and other scalp infections. It promotes healthy hair growth and keeps the scalp nourished.

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Q.3. Ex. Q.5 (iii) Name a few popular medicines which are, in fact, organic compounds? 092011008

Ans. Few Popular Medicines:

Several medicines we use are organic compounds, as they contain carbon-based structures essential for their biological activity.

i. Aspirin (Acetylsalicylic Acid)

It is a pain reliever, anti-inflammatory and fever reducer. Aspirin inhibits the enzyme which is involved in the production of chemicals that cause pain, inflammation and fever.

ii. Paracetamol (acetaminophen)

It is an analgesic (pain reliever) and antipyretic (fever reducer). Paracetamol acts on the brain to regulate body temperature and reduce fever. It also blocks certain chemical pathways in the brain to reduce the sensation of pain.

iii. Penicillin

It is an antibiotic. It is effective against a range of bacterial infections, including pneumonia and throat problem.

iv. Morphine

It is an opioid painkiller. It is used to manage severe pain, such as in cancer patients or after surgery. However, it can be addictive and requires careful use.

v. Insulin

It is used for hormonal treatment for diabetes. Insulin helps regulate blood sugar levels by facilitating the uptake of glucose into cells for energy or storage.

SLO based Additional Long Questions

Q.1. Describe the preparation of alkane 092011009

Ans. Generally any member of the alkane series can be prepared by the following methods.

(i) Cracking of higher Hydrocarbons

Cracking is a process in which hydrocarbons with higher molecular masses are broken up into smaller hydrocarbons which are more useful. This is done by heating the hydrocarbons at high temperature in the presence of a catalyst Fractional distillation of petroleum gives naphtha which consists of a mixture of liquid hydrocarbons. It is then heated at around 500°C in the presence of catalyst called zeolite to give hydrocarbons which have five to ten carbon atoms.

$$\text{Naphtha} \xrightarrow[\text{Zeolite}]{\text{Heat}} \text{Alkanes and alkenes containing 5 to 10 carbon atoms}$$

Mixture of hydrocarbons

(ii) Reduction of Alkenes and Alkynes:

Alkanes can be prepared by reducing alkenes and alkynes with hydrogen gas in the presence of nickel metal as a catalyst. Methane cannot be prepared by this method. The reaction is also called hydrogenation of alkenes and alkynes and is an example of addition reaction. An addition reaction occurs when hydrogen (H_2) is added to an unsaturated compound.

$$\underset{\text{Ethene}}{CH_2=CH_2} + H_2 \xrightarrow[200°C]{Ni} \underset{\text{Ethane}}{CH_3-CH_3}$$

$$\underset{\text{Ethyne}}{CH\equiv CH} + 2H_2 \xrightarrow[200°C]{Ni} \underset{\text{Ethane}}{CH_3-CH_3}$$

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(iii) Reduction of Alkyl Halides:

Alkyl halides (R-X) can be reduced to alkanes with hydrogen generated by reaction of zinc metal with hydrochloric acid.

$$R - X + 2[H] \xrightarrow{Zn/HCl} R - H + H - X$$

$$CH_3 - Cl + 2[H] \xrightarrow{Zn/HCl} CH - H + H - Cl$$

Q.2. What are substitution reactions? Explain the halogenation of alkane. 092011010



Ans. Substitution reactions:

Alkanes give substitution reactions. The reactions which involve the replacement of hydrogen of alkanes by an atom or a group of atoms like halogen are called substitution reactions.

Halogenations of alkane:

Alkanes react with halogens especially chlorine to give alkyl halides. Since these substitution reactions are carried out in the presence of sunlight, are called chemical substitution reactions.

$$\underset{\text{Methane}}{CH_4} + Cl_2 \xrightarrow{h\nu} \underset{\text{Chloromethane}}{CH_3 - Cl} + H - Cl$$

The reaction may proceed ahead and all the hydrogen atoms attached with carbon of the methane are successively replaced by chlorine atoms.

$$CH_3 - Cl + Cl_2 \xrightarrow{h\nu} \underset{\text{Dichloromethane}}{CH_2Cl_2} + HCl$$

$$CH_2Cl_2 + Cl_2 \xrightarrow{h\nu} \underset{\text{Dichloromethane or chloroform}}{CHCl_3} + HCl$$

$$CHCl_3 + Cl_2 \xrightarrow{h\nu} \underset{\text{Tetra chloromethane or carbon tetrachloride}}{CCl_4} + HCl$$

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Short Question Answers (Exercise)

Q.1 (Ex Q2 (i)) Differentiate between an organic and an inorganic compound. 092011011

Ans.

Organic Compound	Inorganic Compound
These are the compounds which contain covalently bonded carbon as an essential component.	These compounds are made up of almost all elements of periodic table except those compounds of carbon and hydrogen (hydrocarbons).
They are found in living things **i.e.,** plants and animals.	They are found in non-living things **i.e.,** rocks and minerals
For example: carbohydrates and proteins.	**For example:** NaCl and $CaCO_3$.

Q.2 (Ex Q2 (ii)) Why are organic compounds found in large number? 092011012

Ans. Organic compounds are found in large numbers due to unique properties of carbon.

i. The self-linking property of carbon called **catenation** is responsible for the existence of large number of organic compounds ranging from short to very long chains and large rings.

ii. Due to small size of carbon that can form strong bonds with the small atoms like hydrogen, oxygen and nitrogen etc.

Q.3 (Ex Q2 (iii)) Name the products which are obtained when natural gas is oxidized under controlled conditions. 092011013

Ans. When natural gas is oxidized under controlled conditions the products depends upon the degree & oxidation and reaction condition such as temperature, pressure and catalyst etc. Excess supply of oxygen gives CO_2 , H_2O & with heat.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + Heat$$

Q.4 (Ex Q2 (iv)) How naphtha fraction is decomposed to give lower hydrocarbons? 092011014

Ans. Fractional distillation of petroleum gives naphtha which consists of a mixture of liquid hydrocarbons. It is then heated at around 500°C in the presence of catalyst called **zeolite** to give Hydrocarbons which have five to ten carbon atoms.

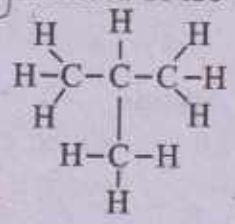
$$\text{Naphtha} \xrightarrow[\text{Zeolite}]{\text{Heat}} \text{Alkanes and alkenes containing 5 to 10 carbon atoms}$$

Mixture of hydrocarbons

Q.5 (Ex Q2 (v)) Write down the molecular formula, structured formula and the condensed structural formula for iso-butane. 092011015

Ans. The molecular formula of iso-butane is C_4H_{10}.

The structural formula of iso-butane is:



The condensed formula of iso-butane is:

$$H_3C\text{-}\underset{\displaystyle CH_3}{\underset{|}{CH}}\text{-}CH_3$$

Q.6 (Ex Q2 (vi)) How are organic compounds useful for us? 092011016

Ans. Organic compounds are useful for us in many ways such as:

i. They are major constituents of our diet as carbohydrates, proteins and fats etc.

ii. The clothes we wear are made up of natural or synthetic fibre which are organic compounds.

iii. Fossil fuels used to run transport industry contain hydrocarbons which are organic compounds.

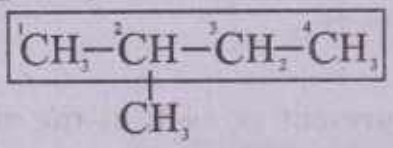
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Q.7 (Ex Q2 (vii)) **Write down the names of five such organic compounds which exist naturally.** 092011017

Ans. Five naturally occurring organic compounds are:

1. Methane 2. Glucose 3. Citric acid
4. Starch 5. Nucleic acids (DNA &RNA)

Q.8 (Ex Q2 (viii)) **Give IUPAC name to the following compound.** 092011018



Ans. The longest continuous chain contain four carbon singly bonded to each other. So, its root name will be But– and suffix will be –ane. 2–methyl butane /Iso-pentane.

Q.9 (Ex Q2 (ix)) **How do the melting and boiling points of alkanes change when we move from lower members to higher members?** 092011019

Ans. When we move from lower to higher member of alkanes their melting and boiling points increase because of increase in molecular size there is increase in the attractive forces among molecules.

Practice Question Answers (Exercise)

Q.10 What do you understand by the term structural formula of an organic compound? 092011020

Ans. Structural formula of a compound represents the exact arrangement of the different atoms of various elements present in a molecule of a substance, e.g.) Structural formula of butane is:



(n-butane)

Q.11 Name the following compounds according to IUPAC system of nomenclature. 092011021

Ans.

(i) $(CH_3)_2CH–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_2–CH_3$

The longest continuous chain has five carbons singly bonded and two methyl groups are attached at carbon number two and three. So, name: will be 2,3-dimethyl pentane.

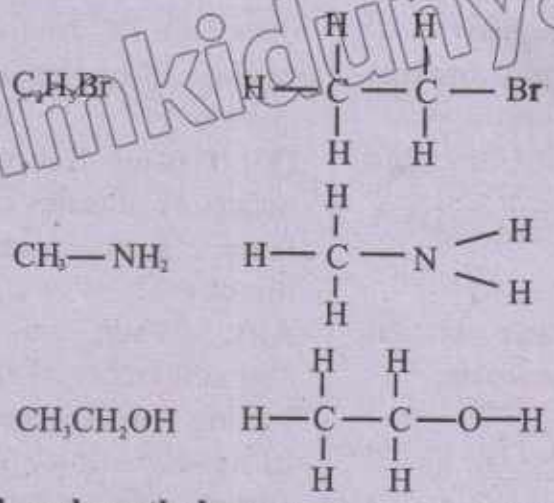
(ii) $(CH_3)_2CH–CH_2–CH_3$

The longest continuous chain has four carbons singly bonded and one methyl groups are attached at carbon number two . So, name: will be 2 -methyl butane.

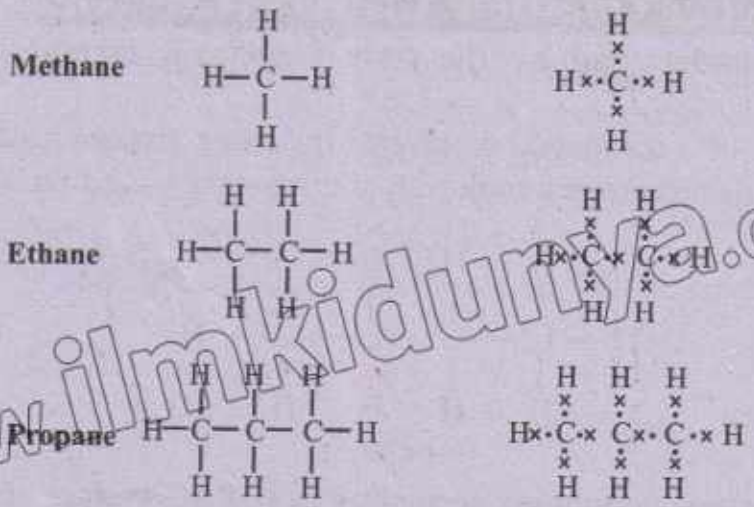
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Q.12 Draw the structural formula of the following saturated compounds. 092011022
C_2H_5Br, CH_3NH_2, CH_3CH_2OH

Ans.



Q.13 How many methyl and methylene groups are present in each of the above compounds? 092011023



Ans. Methane has only one methyl (CH_3–) group. Ethane has two methyl (CH_3–) groups & propane has two methyl (CH_3–) and one methylene (–CH_2–) group.

Q.14 In the reduction of alkyl halides with Zn / HCℓ, alkyl halide is being reduced. Which species in this reaction is being oxidized? 092011024

Ans. During the reduction of alkyl halides using Zn/HCℓ, Hydrogen is oxidized.

$$R\text{–}X + 2[H] \xrightarrow{Zn/HC\ell} R\text{–}H + H\text{–}X$$

Q.15 During the combustion reaction of ethane, which bonds are being broken & which are being formed? 092011025

Ans.
$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O + Heat$$

C to C, C to H and O to O bonds are broken and C to O and H to O bonds are formed.

Q.16 What products other than $CH_3C\ell$ are formed methane reacts with chlorine gas? 092011026

Ans. When methane reacts with chlorine gas, a series of reactions takes place as:

$$CH_4 + C\ell_2 \xrightarrow{h\nu} CH_3C\ell + HC\ell$$
$$CH_3C\ell + C\ell_2 \xrightarrow{h\nu} CH_2C\ell_2 + HC\ell$$
$$CH_2C\ell_2 + C\ell_2 \xrightarrow{h\nu} CHC\ell_3 + HC\ell$$
$$CHC\ell_3 + C\ell_2 \xrightarrow{h\nu} CC\ell_4 + HC\ell$$

$CH_2C\ell_2$, $CHC\ell_3$ and $CC\ell_4$ are formed along with $CH_3C\ell$.

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Hydrocarbons

Q.17 What are hydrocarbons? 092011027

Ans. Hydrocarbons are organic compounds of carbon and hydrogen elements. They are alkanes, alkenes, alkynes and aromatics. **e.g**: CH_4, C_2H_6 etc.

Q.18 Why are hydrocarbons considered as parent organic compounds? 092011028

Ans. Hydrocarbons are those compounds which are made up of only carbon and hydrogen elements.

Hydrocarbons are regarded as the parent organic compounds since other organic compounds are considered to be derived from them by replacing of one or more hydrogen atoms by other atoms or group of atoms.

Q.19 What does LPG & CNG stands for? 092011029

Ans. CNG stands for compressed natural gas and LPG stands for liquified petroleum gas.

Q.20 Write categories of hydrocarbons. 092011030

Ans. Hydrocarbons are classified into structurally as:

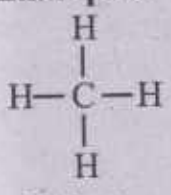
- Alkanes
- Alkenes
- Alkynes
- Aromatics

Alkanes

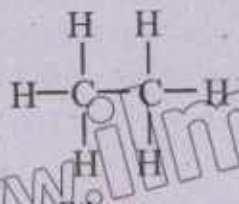
Q.21 Define alkanes and give one example. 092011031

Ans. Alkanes are saturated hydrocarbons in which all the carbon atoms are connected by only single covalent bond.

Examples:



Methane



Ethane

The general formula of alkanes is C_nH_{2n+2}

Q.22 Which property of alkanes make them distinct from other compounds? 092011032

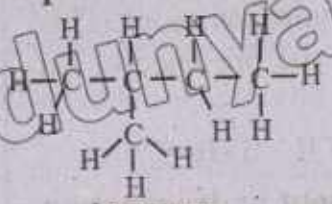
Ans. This distinguishing feature of alkanes make them district from other compounds is their lack of reactivity towards usual chemical reagents.

Q.23 Which is the simplest alkane & Give its uses? 092011033

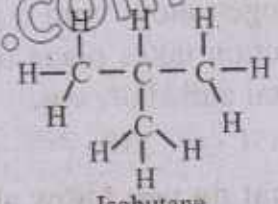
Ans. The simplest hydrocarbons are alkanes, while simplest alkane is methane having formula CH_4.

Uses: It is mainly used as a fuel but it is also used to make hydrogen gas, carbon black, carbon disulphide, chloroform, hydrocyanic acid, etc.

Q.24 Give the structural formula of Isopentane and isobutane. 092011034



Isopentane



Isobutane

Q.25 Why are the alkanes called paraffins? 092011035

Ans. Alkanes are saturated hydrocarbons. In these compounds all the bonds of carbon atoms are single that means valencies of carbon atoms are fully satisfied (saturated). Therefore they are least reactive. That is the reason alkanes are called paraffins.

Q.26 IUPAC stands for? 092011036

Ans. IUPAC stands for International Union of Pure and Applied Chemistry.

Q.27 Describe three parts of IUPAC name of organic compound. 092011037

Ans. **(i) Root:** It tells us the number of carbon atoms in the longest continuous chain present in the moleeule.

(ii) Suffix: It is added after the root and tells us about the class of organic compounds.

(iii.) Prefix: It is indicated before the root and tells us about the group or groups attached to

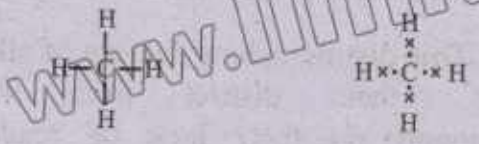
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the longest chain.

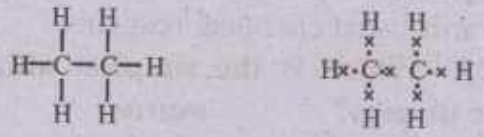
Q.28 Write dot and cross structure of methane, ethane and propane. 092011038

Ans. Dot and Cross structures of Alkanes

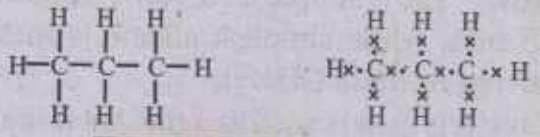
Methane



Ethane



Propane



Preparation

Q.29 How are alkyl halides reduced? 092011039

Ans. Reduction means addition of nascent hydrogen. In fact, it is a replacement of a halogen atom with a hydrogen atom. This reaction takes place in the presence of Zn metal and HCl. **e.g.**

$$CH_3-Cl+2[H]\xrightarrow{Zn/HCl}CH_3-H+H-Cl$$

What do you know about hydrogenation of alkenes? 092011040

Ans. Hydrogenation means addition of molecular hydrogen to an unsaturated hydrocarbon in presence of a catalyst (Ni, Pt) to form saturated compound e.g.

$$\underset{\text{Ethene}}{CH_2=CH_2} + H_2 \xrightarrow[200^\circ C]{Ni} \underset{\text{Ethane}}{CH_3-CH_3}$$

Q.30 What is the importance of cracking of petroleum? 092011041

Ans. Cracking of petroleum helps balance the availability of petroleum fractions with the demand for them. When cracking transforms bigger hydrocarbons break up into smaller hydrocarbons. In this way, the fuel supply is increased, that helps to balance demand of supply.

Q.31 How is margarine produced? 092011042

Ans. Margarine is produced by adding molecular hydrogen to vegetable oil at 200°C in the presence of catalyst (Ni).

$$\text{vegetable oil} + H_2 \xrightarrow[200^\circ C]{Ni} \text{Margarine}$$

Greater the amount of hydrogen is added, the more solid the margarine becomes.

Important Reactions

Q.32 Why does the burning of alkanes require sufficient supply of oxygen? 092011043

Ans. Complete combustion takes place in excess of air or oxygen to produce CO_2,H_2O & large amount of heat.

$$CH_4+2O_2 \longrightarrow CO_2+2H_2O+Heat$$

Q.33 Why are the alkanes used as fuel? /How hydrocarbons act as a fuel? / How does combustion of methane take place? Describe the combustion process with equation. 092011044

Ans. Alkanes burn in the presence of excess of air or oxygen to produce a lot of heat, carbon dioxide and water. This reaction takes place in automobile combustion engines, domestic heaters and cooking appliances. It is highly exothermic reaction and because of it alkanes are used as fuel. e.g.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + heat$$

Q.34 What are addition reactions? Explain with an example. 092011045

Ans: Those reactions in which products are formed by the addition of a substance like H_2, $C\ell_2$, etc to an unsaturated hydrocarbon.

Example: Addition of hydrogen to an unsaturated hydrocarbon in the presence of catalyst (Ni, Pt) at 250 – 300°C.

$$\underset{\text{Ethene}}{CH_2=CH_2} + H_2 \xrightarrow[200^\circ C]{Ni} \underset{\text{Ethane}}{CH_3-CH_3}$$

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Q.36 What is substitution reaction? 092011047

Ans. Reaction which involves the replacement of hydrogen of alkanes by an atom or group of atoms like halogen are called substitution reaction.

e.g. $CH_4 + Cl_2 \xrightarrow[\text{Sunlight}]{\text{Room temp.}} CH_3Cl + HCl$

Q.37 Why alkane not give addition reaction? 092011048

Ans. It is because in alkanes, valency of carbon is fully satisfied by forming single bond. Alkanes are saturated compounds that's why they do not give addition reaction.

Q.38 Give roots of first five carbon atoms. 092011049

Ans. Carbon 1 = Meth-
Carbon 2 = Eth-
Carbon 3 = prop-
Carbon 4 = But-
Carbon 5 = pent -

Q.39 How alkanes are prepared? 092011050

Ans. Alkanes are prepared by:
1. Cracking of higher Hydrocarbons
2. Reduction of alkenes and alkynes

Q.40 How alkynes are reduced? 092011051

Ans. Alkynes are reduced with nascent hydrogen in presence of catalyst Ni at temperature of 200° C

Q.41 Why alkanes are considered non-polar? 092011052

Ans. Alkanes contain carbon and hydrogen. The electronegativity values of carbon (2.6) and hydrogen (2.1) do not differ appreciably and the bonding electrons between C-H and C-C are almost equally shared. This make alkane non-polar.

Constructed Response Questions

Q.1 (Ex. Q.3 (i)) Why do alkanes show little reactivity towards the other reagents? 092011053

Ans. The unreactivity of alkanes may be explained on the basis of the strength of single bond which is difficult to break. A significant amount of energy is required to break these bond for a reaction to occur.

Q.2 (Ex. Q.3 (ii)) Why does a mixture of natural gas and air explode? 092011054

Ans. Natural gas primarily contain methane which is very flammable. (gives combustion reaction readily when ignited) that is why mixture of natural gas and air explode and a large amount of heat is released along with CO_2 and water vapours:

$$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)} + \text{Heat}$$

Q.3 (Ex. Q.3 (iii)) How do you compare the melting and boiling points of inorganic and organic compounds? 092011055

Ans. Organic compounds are molecular in nature and have weak intermolecular forces, having covalent bond so generally organic compounds have low melting and boiling points. On the other hand inorganic compounds mostly contain ionic bonds and have strong attractive forces. So inorganic compounds have comparatively high melting and boiling points.

Q.4 (Ex. Q.3 (iv)) Reactions of alkanes with chlorine takes place in the presence of sunlight. / What is the role of sunlight in the reaction. 092011056

Ans. Reactions of alkanes with chlorine follow free radical mechanism. Sunlight fall on Cl_2 molecule and generates a chlorine free radical which attack on alkane molecule to form alkyl halide. That is why sunlight is quite necessary for reaction of chlorine with alkane molecule.

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Q.5 (Ex. Q.3 (v)) **How do you compare the boiling point n–butane with that of iso-butane?** 092011057

Ans. Straight chain structured compounds have strong intermolecular forces than branched chain compounds and hence higher boiling point. n-butane has straight chain of four carbon atoms. While iso-butane has straight chain three carbon atoms with one carbon as a branch. So, n-butane has higher boiling point than iso-butane.

Q.6 (Ex. Q.3 (vi)) **Why are organic compounds not generally soluble in water?** 092011058

Ans. Organic compounds are mostly non-polar in nature. According to general principle of solubility "like dissolve like" non-polar compounds are soluble in non-polar solvents while polar compounds are soluble in polar solvent. As water is a polar solvent, so generally organic compounds are not soluble in water.

Multiple Choice Questions (Exercise)

Tick (✓) the correct answer.

1. Which other atom is almost always present along with carbon atom in all organic compounds? 092011059
(a) Oxygen (b) Nitrogen
(c) Hydrogen (d) Halogen

2. Which other metal can be used to reduce alkyl halides? 092011060
(a) Aℓ (b) Mg
(c) Ni (d) Co

3. If naphtha undergoes a combustion reaction what products do you expect to form? 092011061
(a) Alkanes
(b) Alkenes
(c) CO_2 and H_2O
(d) Both alkanes and alkenes

4. Why does a mixture of zinc and hydrochloric acid acts as a reducing agent? 092011062
(a) Because zinc acts as a reducing agent.
(b) Because atomic hydrogen is produced with Zn/HCℓ which acts as a reducing agent.
(c) Because molecular hydrogen is produced with Zn. HCℓ which act as a reducing agent.
(d) Because chloride ions are produced with Zn/HCℓ which act as a reducing agent.

5. Which alkane will evolve the most amount of heat when it is burnt with oxygen? 092011063
(a) Ethane (b) Propane
(c) Butane (d) iso-Butane

6. Indicate the most reactive hydrocarbon? 092011064
(a) $CH_3–CH_3$ (b) $CH_2=CH_2$
(c) $CH\equiv CH$ (d) CH_4

7. Which hydrocarbon is responsible for explosions in coal mines? 092011065
(a) Butane (b) Pentane
(c) Methane (d) Ethene

8. Which product will be formed when ethyl bromide (C_2H_5Br) is treated with Zn/HCI: 092011066
(a) CH_4 (b) $CH_3–CH_3$
(c) $CH_3–CH_2–CH_2–CH_3$
(d) $CH_3–CH_2–CH_3$

9. Which of the following is not a process of halogenation of alkanes? 092011067
(a) Cracking (b) Chlorination
(c) Bromination (d) Iodination

10. How many moles of oxygen will be required to completely burn propane? 092011068
(a) 4 moles (b) 5 moles
(c) 3 moles (d) 6 moles

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SOLO Based Additional MCQs

Introduction

11. **The ability of carbon atoms to form chains is called:** 092011069
(a) Isomerism (b) Catenation
(c) Resonance (d) Condensation

12. **The branch of chemistry which deals with the study of hydrocarbons and their derivatives is known as:** 092011070
(a) Organic chemistry
(b) Inorganic chemistry
(c) Biochemistry
(d) Nuclear chemistry

13. **The most essential element for organic compound is:** 092011071
(a) Carbon (b) Hydrogen
(c) Nitrogen (d) Oxygen

14. **Which carbon compounds are not considered organic compound?** 092011072
(a) Carbonates (b) Cyanides
(c) Carbides (d) All of these

15. **Carbon is present in periodic table:** 092011073
(a) Left side (b) Right side
(c) Middle (d) None of these

16. **Examples of organic compounds are:** 092011074
(a) C_2H_6 (b) CH_3Cl
(c) CH_3OH (d) All of these

17. **The valency of carbon is:** 092011075
(a) 1 (b) 2
(c) 3 (d) 4

18. **The formula which represents the actual number of atoms in one molecule of an organic compound is called:** 092011076
(a) Molecular formula
(b) Structural formula
(c) Condensed formula
(d) Dot and cross formula

Hydrocarbons

19. **Simplest family of organic compounds is:** 092011077
(a) Carbohydrates (b) Proteins
(c) Oils (d) Hydrocarbons

20. **Which of the following is considered as parent organic compound?** 092011078
(a) Alkanes (b) Alkenes
(c) Alkynes (d) Aromatics

Alkanes

21. **Which one of these hydrocarbon molecules would have no effect on an aqueous solution of bromine?** 092011079
(a) CH_4 (b) $C_{10}H_{10}$
(c) C_2H_4 (d) C_2H_2

22. **If an organic compound has 4 carbon atoms. All singly bonded, it will have the following characteristics except one:** 092011080
(a) It will be saturated hydrocarbon
(b) It will have 8 hydrogen atoms
(c) Its name will be n-butane
(d) It will be least reactive

23. **What is the molecular formula for the eight alkane member, octane, which is found in petrol?** 092011081
(a) C_8H_8 (b) C_8H_{16}
(c) C_8H_{18} (d) C_8H_{2o}

24. **Which one of the following is a substitution reaction?** 092011082
(a) Halogenation of alkynes
(b) Halogenation of alkenes
(c) Halogenation of alkanes
(d) Bromination of alkenes

25. **Which is the simplest alkane?** 092011083
(a) CH_4 (b) C_3H_8
(c) C_2H_2 (d) C_2H_4

26. **Condensed formula of ethane is:** 092011084
(a) C_3H_8 (b) C_2H_6
(c) H_3CCH_3 (d) None of these

27. **Molecular formula of butane is:** 092011085

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(a) C_4H_{10} (b) C_5H_5
(c) C_4H_8 (d) C_4H_6

28. The formula of pentane is: 092011086
(a) C_5H_{12} (b) C_5H_{10}
(c) C_5H_8 (d) C_5H_{14}

29. The general formula of saturated hydrocarbons is: 092011087
(a) CnH_{2n+1} (b) CnH_{2n-2}
(c) CnH_{2n} (d) CnH_{2n+2}

30. Saturated hydrocarbons are also called: 092011088
(a) Olefins (b) Paraffins
(c) Alkene (d) Alkyne

31. Alkane molecules are: 092011089
(a) polar (b) non-polar
(c) both a and b (d) none of these

32. Which one of these is a saturated hydrocarbon? 092011090
(a) C_2H_4 (b) C_3H_6
(c) C_4H_8 (d) C_5H_{12}

33. The longest continuous carbon chain in IUPAC nomenclature tells: 092011091
(a) Root (b) Suffix
(c) Prefix (d) None of these

34. The group /groups attached to longest continuous carbon chain determines _____ name. 092011092
(a) Root (b) Suffix
(c) Prefix (d) None of these

35. The root prop- corresponds to _____ no. of carbon atoms: 092011093
(a) 1 (b) 2
(c) 3 (d) 4

Preparation

36. The reduction of alkyl halides takes place in the presence of: 092011094
(a) Zn/HCℓ (b) Na/HCℓ
(c) Mg/HCℓ (d) Cu/HCℓ

37. Hydrogenation of alkenes and alkynes takes place at room temperature in the presence of: 092011095
(a) Ni (c) Pd
(b) Pt (d) both a and b

38. Alkenes are produced in large amounts by cracking of: 092011096
(a) Natural gas
(b) Petroleum
(c) Benzene
(d) Xylol

39. Higher molecular mass hydrocarbons are broken up into smaller in a process called: 092011097
(a) Refining
(b) Cracking
(c) Distillation
(d) Condensation

40. During the process of cracking, naphtha is heated up to: 092011098
(a) 300°C (b) 400°C
(c) 500°C (d) 600°C

41. The catalyst used for cracking of naphtha is: 092011099
(a) Common salt
(b) washing soda
(c) Zeolite
(d) Ni

42. The breakdown of naphtha produce: 092011100
(a) Alkane (b) Alkenes
(c) Both a and b (d) Aromatics

43. Alkenes are produced in large amounts by cracking of: 092011101
(a) Natural gas
(b) Petroleum
(c) Benzene
(d) Xylol

44. Which of the following will react with one mole of H_2 to form saturated hydrocarbon? 092011102
(a) Alkanes (b) Alkene
(c) Alkyne (d) Benzene

Important Reactions

45. Halogenation of methane produces following valuable chemical compounds used as solvent except: 092011103

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(a) Carbon tetrachloride
(b) Chloroform
(c) Carbon black
(d) Chloromethane

46. Substitution reaction is the characteristics of: 092011104

(a) alkanes (b) alkenes
(c) alkynes (d) none of these

47. Halogenation of alkanes in the presence of diffused sunlight takes: 092011105

(a) Suddenly, only in one step
(b) Slowly in one step
(c) In a series of four step
(d) Fastly in two steps

48. Alkanes give reaction only: 092011106

(a) Addition
(b) Decomposition
(c) Substitution
(d) Displacement

49. Alkanes do not react in: 092011107

(a) Diffused sunlight
(b) Bright sunlight
(c) Dark
(d) None of these

50. Main component of natural gas is: 092011108

(a) Methane (b) Propane
(c) Butane (d) Propene

51. What percent of natural gas consists of methane (CH_4)? 092011109

(a) 82% (b) 83%
(c) 84% (d) 85%

52. Alkanes are least reactive compounds because they are: 092011110

(a) Saturated hydrocarbons
(b) Unsaturated hydrocarbons
(c) Both (a) and (b)
(d) None of the above

53. Which one is the formula of chloromethane? 092011111

(a) $CH_2C\ell_2$ (b) CO_2
(c) $CHC\ell_3$ (d) $CH_3C\ell$

54. No. of moles of oxygen required to completely burn ethane is: 092011112

(a) 4 (b) 5
(c) 6 (d) 7

Answer Key

1	c	2	b	3	c	4	b	5	c
6	b	7	c	8	b	9	a	10	b
11	b	12	a	13	a	14	d	15	c
16	c	17	d	18	a	19	d	20	a
21	a	22	b	23	c	24	c	25	a
26	c	27	a	28	a	29	d	30	b
31	b	32	d	33	a	34	c	35	c
36	a	37	d	38	a	39	b	40	c
41	c	42	c	43	b	44	b	45	c
46	a	47	c	48	c	49	c	50	a
51	d	52	a	53	d	54	d		

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