Question 1:
Name the element whose one of the allotropes is buckminsterfullerene.
Solution:
Carbon

Question 2:
What are the two properties of carbon which lead to the formation of a large number of carbon compounds?
Solution:
Catenation (Self-linking of carbon atoms to form long chains) and Tetravalency.

Question 3:
State whether the following statement is true or false.
Solution:
False

Question 4:
Name the scientist who disproved the Vital force theory for the formation of organic compounds.
Solution:
Friedrich Wohler.

Question 5:
Name the element whose allotropic form is graphite.
Solution:
Carbon.

Question 6:
In addition to some propanes and ethanes, LPG cylinders contain mainly two isomers of another alkane. Name the two isomers and write their condensed structural formulae.
Solution:
n-butane and isobutane.

Question 7:
Buckminsterfullerene is a spherical molecule in which 60 carbon atoms are arranged in interlocking hexagonal and pentagonal rings of carbon atoms.
How many hexagons of carbon atoms are present in one molecule of buckminsterfullerene?
How many pentagons of carbon atoms are present in one molecule of buckminsterfullerene?
Solution:
(a) 20 hexagons
(b) 12 pentagons

Question 8:
Name the black substance of pencil. Will the current flow through the electrical circuit when we use the sharpened ends of the pencil to complete the circuit?
Solution:
Graphite
Yes, current will flow through the circuit since graphite is a good conductor of electricity.

Question 9:
How does graphite act as a lubricant?
Solution:
Graphite is used as a lubricant in the form of graphite powder or mixed with petroleum jelly or with any lubricant oil to form graphite grease.

Question 10:
Name the hardest natural substance known.
Solution:
Diamond

Question 11:
Which of the following molecules is called buckminsterfullerene?
Gas C60 C60 C60
Solution:
C60 is called buckminsterfullerene.

Question 12:
Give the name and structural formula of an alkyl group.
Solution:
Methyl

Question 13:
Write the electron-dot structures for (a) ethane, (b) ethene, and (c) ethyne.
(a) Ethane
(b) Ethene
Question 14:
Give the IUPAC name of the following compound:

Solution:
Ethane.

Question 15:
Write the structural formula of propene.

Solution:

\[
\begin{array}{c}
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\end{array}
\]

Question 16:
Write the structural formula of propyne.

Solution:

\[
\begin{array}{c}
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{C} \\
\end{array}
\]

Question 17:
Write the structural formula of butane.

Solution:

\[
\begin{array}{c}
\text{H} \\
\text{H} \\
\text{H} \\
\text{C} \\
\text{C} \\
\end{array}
\]

Question 18:
What do you call the compounds having the same molecular formula but different structural arrangements of atoms?

Solution:
Isomers.

Question 19:
Write the names of any two isomers represented by the molecular formula $C_3H_8$.

Solution:
Isopentane and neopentane.

Question 20:
Write down (i) structural formula, and (ii) electron-dot formula, of any one isomer of hexane ($C_6H_{14}$) other than n-hexane.

Solution:
(i) Isomer of hexane: 2-methylpentane

\[
\begin{array}{c}
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\end{array}
\]

(ii) Isomer of hexane: 2-methylpentane

\[
\begin{array}{c}
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{H} \\
\end{array}
\]

Question 21:
Fill in the following blanks with suitable words:
(a) The form of carbon which is known as black lead is ............
(b) The form of carbon which is used as a lubricant at high temperature is ............
(c) Compounds of carbon with hydrogen alone are called ............
(d) $C_4H_8$ is the general formula of .......... hydrocarbons.
(e) Hydrocarbons having the general formula $C_4H_2n+2$ are called .......... hydrocarbons.
(f) Ethene and ethyne are examples of .......... hydrocarbons.
(g) Ethyne has ............ carbon-hydrogen single bonds.
(h) Carbon compounds have usually ............ melting points and boiling points because they are .......... in nature.
(i) The property of carbon atoms to form long chains in compounds is called ............
(j) The general formula $C_{6}H_{12}$ for cycloalkanes is the same as that of .......... hydrocarbons.
(k) The IUPAC name of ethylene is ............
10. The IUPAC name of acetylene is ________

Solution:
(a) Graphite
(b) Graphite
(c) Hydrocarbons
(d) Alkanes
(e) Alkenes
(f) Unsaturated
(g) Two
(h) Ionic covalent.
(i) Catenation
(j) Alkenes
(k) Ethanone
(l) Ethyne

Question 22:
(a) What is the atomic number of carbon? Write its electronic configuration.
(b) What type of chemical bonds are formed by carbon? Why?
(c) Name the three allotropes of carbon.

Solution:
(a) The atomic number of carbon is 6. Its electronic configuration is 1s² 2s² 2p².
(b) Carbon forms covalent bonds because it can achieve the inert gas electron arrangement only by sharing of electrons.
(c) Diamond, graphite, and buckminsterfullerene.

Question 23:
(a) What is the general name of all the compounds made up of carbon and hydrogen?
(b) Why do carbon form compounds mainly by covalent bonding?

Solution:
(a) Hydrocarbons
(b) Carbon forms covalent bonds because it can achieve the inert gas electron arrangement only by sharing of electrons.

Question 24:
(a) What is meant by catenation? Name two elements which exhibit the property of catenation.
(b) Write the names and structural formula of all the possible isomers of hexene.

Solution:
(a) The property of self combination of carbon atoms to form long chains is called catenation. Carbon and Silicon exhibit the property of catenation.
(b) 2,3-dimethyl butane

Question 25:
(a) What is buckminsterfullerene? How is it related to diamond and graphite?
(b) Why is diamond used for making cutting tools like glass cutters but graphite is not?
(c) Why is graphite used for making dry cell electrodes but diamond is not?

Solution:
(a) Buckminsterfullerene is an allotrope of carbon containing clusters of 60-carbon atoms joined together to form spherical molecules. It burns on heating to form carbon dioxide and nothing is left behind. This shows that it is made up of carbon only like diamond and graphite.
(b) Diamond is used for making cutting tools but graphite is not because diamond is a very hard substance and graphite is a soft substance.
(c) Graphite is used for making dry cell electrodes but diamond is not because graphite is a good conductor of electricity whereas diamond is a bad conductor of electricity.

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Question 26:
(a) Give the general formula of an (i) alkane (ii) alkene (iii) alkyne.
(b) Classify the following compounds as alkanes, alkenes, and alkynes:
    - C₂H₆
    - C₂H₄
    - C₆H₁₂

Solution:
(a) (i) CnH₂n+2
    (ii) CnH₂n
    (iii) CnH₂n-2
(b) Alkanes: C₂H₆
    Alkenes: C₂H₄
    Alkynes: C₂H₂
Question 28:
Catalation is the ability of an atom to form bonds with other atoms of the same element. It is exhibited by both carbon and silicon. Compare the ability of catalation of the two elements. Give reasons.
Solution:
Carbon forms strong bonds among themselves and with other elements and this makes the carbon compounds stable whereas silicon shows catalation property due to which it forms compounds with hydrogen having chains of up to 7 or 8 silicon atoms; but due to weak bonds, these compounds are unstable.

Question 30:
(a) How can diamonds be made artificially? How do synthetic diamonds differ from natural ones?
(b) Give any two differences between the properties of diamond and graphite. What causes these differences?
Solution:
(a) Diamonds can be made artificially by subjecting pure carbon to very high pressure and temperature. The synthetic diamonds are small whereas natural diamonds are big.
(b) Diamond is hard whereas graphite is soft.
(c) Diamond is a non-conductor of electricity whereas graphite is a good conductor of electricity. The difference in the physical properties of diamond and graphite arises because of the different arrangements of carbon atoms in them.

Question 21:
(a) Why does the element carbon form a large number of carbon compounds?
(b) Write down the structures and names of two isomers of butane (C₄H₁₀).
Solution:
(a) Carbon forms a large number of carbon compounds because carbon atoms can link with one another by means of covalent bonds to form long chains of carbon atoms.
(b) Isomers of butane (C₄H₁₀):

- n-butane
- isobutane

Question 32:
(a) Give the name and structural formula of one member each of the following:
(i) Alkane (ii) Alkene (iii) Alkyne (iv) Cycloalkane
(b) Give the common name of (i) ethyne, and (ii) ethene.
(c) Write the molecular formula and structure of benzene.
Solution:

(a) (i) Ethane
   (ii) Ethene
   (iii) Ethyne
   (iv) Cyclohexane

(b) (i) Ethyne
    (ii) Ethene

(c) (i) Acetylene
    (ii) Ethene

Question 33:
(a) What is the unique property of carbon atom? How is this property helpful to us?
(b) Explain why diamond is hard while graphite is soft though both are made of carbon atoms.
Solution:
(a) The most unique property of carbon atom is its ability to combine itself to atoms to form long chains. This property of self-combination is useful to us because it results in an extremely large number of carbon compounds (organic compounds).
(b) A diamond crystal is a giant molecule of carbon atoms. Each carbon atom in the diamond crystal is linked to four other carbon atoms by strong covalent bonds. The four surrounding atoms are at the four vertices of a regular tetrahedron. This rigid structure of diamond makes it a very hard substance.
Question 24:
(a) List their structures, state the number of single bonds, double bonds and triple bonds of any in the following compounds:
(c) ethene, (d) ethene, (e) ethane, (f) benzene
(b) Write the molecular formula and structure of cyclohexane. How many covalent bonds are there in a molecule of cyclohexane?

Solution:
(a) (d) Ethene: Single bond. Triple bond: One
(b) Ethane: Single bond: Four. Double bond: One
(c) Ethane: Single bond: Nine. Double bond: Three

(b) Molecular formula of cyclohexane: \( C_6H_{12} \)

Cyclohexane
No. of covalent bonds: 18

Question 25:
(a) Write two points of difference in the structures of diamond and graphite.
(b) Explain why graphite can be used as a lubricant but diamond cannot.
(c) Explain why diamond can be used in rock drilling equipment but graphite cannot.
(d) State one use of diamond which depends on its extraordinary brilliance and one use of graphite which depends on its being black and quite soft.

Solution:
(a) Diamond:
(i) Each carbon atom is linked to four other carbon atoms.
(ii) A diamond crystal has a tetrahedral arrangement of carbon atoms.
Graphite:
(i) Each carbon atom is joined to only three other carbon atoms.
(ii) A graphite crystal has flat hexagonal rings structure.
(b) Due to its softness, powdered graphite can be used as a lubricant whereas diamond being extremely hard cannot be used as lubricant.
(c) Due to its rigid structure, diamond is the hardest known substance to man. Hence, it is used in rock drilling equipments, but graphite is soft and hence not used in rock drilling equipments.
(d) Diamonds are used for making jewellry.
Graphite is used for making pencil cores or pencil leads.

Question 26:
(a) What is diamond? Of what substance is diamond made?
(b) Describe the structure of diamond. Draw a simple diagram to show the arrangement of carbon atoms in diamond.
(c) Explain why diamond has a high melting point.
(d) State any two uses of diamond.

Solution:
(a) Diamond is a colourless transparent substance having extraordinary brilliance. It is made up of carbon.
(b) A diamond crystal has a giant molecular of carbon atoms. Each carbon atom in the diamond crystal is linked to four other carbon atoms by strong covalent bonds. The four surrounding carbon atoms are at the four vertices of a regular tetrahedron. This rigid structure of diamond makes it a very hard substance.

(c) Diamond has a high melting point because a lot of heat energy is required to break the network of strong covalent bonds in the diamond crystal.
(d) Used in rock drilling equipment. Used in making jewellry.

Question 27:
(a) What is graphite? Of what substance is graphite made?
(b) Describe the structure of graphite with the help of a labelled diagram.
(c) Why is graphite a good conductor of electricity but diamond is a non-conductor of electricity?
(d) State any two uses of graphite.

Solution:
(a) Graphite is greyish-black opaque substance. It is made up of carbon.
(b) The structure of graphite is very different from that of diamond. A graphite crystal consists of layers of carbon atoms or sheets of carbon atoms. Each carbon atom in a graphite layer is joined to three other carbon atoms by strong covalent bonds to form a plane of carbon atoms. The various layers of carbon atoms in graphite are held together by weak Van der Waals forces. Due to this sheet-like structure, graphite is a comparatively soft substance.

(c) Due to the presence of free electrons in a graphite crystal, it conducts electricity whereas a diamond crystal does not have free electrons so it does not conduct electricity.
(d) Used as a lubricant. Used in making pencil leads.
Question 30:
(a) Explain the term Isomer. Give one example of isomers.
(b) Write (i) structural formula, and (ii) skeletal dot structure, of any one isomer of n-heptane (C7H16).
(c) Write IUPAC name of the compound having the formula n-C8H18.
(d) Give the IUPAC names for the following:

(i) \(\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3\)

(ii) \(\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3\)

Solution:
(a) The organic compounds having the same molecular formula but different structures are known as isomers for e.g., n-butane and iso-butane are isomers.
(b) Name of common alkane: \(\text{methane}\)

\[
\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3
\]

(c) Butane
(d) \(\text{2-methylpropane}\)
(e) \(\text{2-methylbutane}\)
(f) Propane
(g) Propyne

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Question 30:
(a) What are hydrocarbons? Explain with examples.
(b) Explain the meaning of saturated and unsaturated hydrocarbons with two examples each.
(c) Give the names and structural formulae of one saturated cyclic hydrocarbon and one unsaturated cyclic hydrocarbon.
(d) Give one example of a hydrocarbon, other than pentane, having more than three isomers.
(e) How many isomers of the following hydrocarbons are possible?

(d) \(\text{C}_5\text{H}_{10}\)

Solution:
(a) A compound made up of hydrogen and carbon only is called a hydrocarbon (Hydro= Hydrogen + Carbon= Hydrocarbon). For example, methane (\(\text{CH}_4\)), ethane (\(\text{C}_2\text{H}_6\)), propane (\(\text{C}_3\text{H}_8\)), cyclopropane (\(\text{C}_3\text{H}_6\)), and ethylene (\(\text{C}_2\text{H}_4\)) all are hydrocarbons as they are made up of only two elements carbon and hydrogen.
(b) Saturated hydrocarbons: These are the ones in which the carbon atoms are connected by only single bonds. They are also known as alkanes. Example: Methane (\(\text{CH}_4\)) and ethane (\(\text{C}_2\text{H}_6\)).
(c) Unsaturated hydrocarbons: These are the ones in which two carbon atoms are connected by a double bond or a triple bond. Examples: Ethene (\(\text{C}_2\text{H}_4\)) and acetylene (\(\text{C}_2\text{H}_2\)).
(d) Saturated cyclic hydrocarbon: Cyclohexane, \(\text{C}_6\text{H}_{12}\)
(e) Unsaturated cyclic hydrocarbon: Benzene, \(\text{C}_6\text{H}_6\)
(f) Hexane, \(\text{C}_6\text{H}_{14}\)
(g) None (0)
(h) Two (2)
(i) Three (3)
(j) Five (5)

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Question 60:
A solid element X has four electrons in the outermost shell of its atom. An allotrope Y of this element is used as a dry lubricant in machinery and also in making pencil leads.
(a) What is element X?
(b) Name the allotrope Y.
(c) State whether allotrope Y is a good conductor or a non-conductor of electricity.
(d) Name one use of allotrope Y other than lubrication and pencil leads.
(e) Name two other allotropes of element X.

Solution:
(a) Element X: Carbon
(b) Allotrope Y: Graphite
(c) Y is a good conductor of electricity.
(d) Y is used for making graphite electrodes or carbon electrodes in dry cells.
(e) Allotropes of C: Diamond and buckminsterfullerene

Question 61:
Two organic compounds A and B have the same molecular formula \(\text{C}_7\text{H}_{12}\). Write the names and structural formulas:
(a) If A is a cyclic compound
(b) If B is an open chain compound
(c) Which compound contains single bonds as well as a double bond?
(d) Which compound contains only single bonds?

Solution:
(a) A is cyclohexane, \(\text{C}_7\text{H}_{12}\)

(b) B is hexane, \(\text{C}_7\text{H}_{12}\)

(c) A

(d) B

Question 62:
The solid element A exhibits the property of catenation. It is also present in the form of a gas B in the air which is utilized by plants in photosynthesis. An allotrope C of this element is used in glass cutters.

(a) A is cyclohexane, \(\text{C}_7\text{H}_{12}\)

(b) B is hexane, \(\text{C}_7\text{H}_{12}\)

(c) C

(d) A
What is the gas B?
Name the allotrope C.
State another use of an allotrope C (other than in glass cutters).
Name another allotrope of element A which exists as spherical molecules.
Name a yet another allotrope of element A which conducts electricity.

Solution:
(a) Element A: Carbon
(b) Gas B: Carbon dioxide
(c) Allotrope C: Diamond
(d) Used for making jewellery
(e) Buckminsterfullerene
(f) Graphite

Question 93:
An element E exists in three allotropes A, B, and C. In allotrope A, the atoms of element E are joined to form spherical molecules. In allotrope B, each atom of element E is surrounded by three other E atoms to form a sheet-like structure. In allotrope C, each atom of element E is surrounded by four other E atoms to form a rigid structure.
(a) Name the element E.
(b) What is allotrope A?
(c) What is allotrope B?
(d) What is allotrope C?
(e) Which allotrope is used in making jewellery?
(f) Which allotrope is used in making anodes of a dry cell?

Solution:
(a) Element E: Carbon
(b) Allotrope A: Buckminsterfullerene
(c) Allotrope B: Graphite
(d) Allotrope C: Diamond
(e) C
(f) B

Question 94:
You are given the following molecular formulae of some hydrocarbons:
C\textsubscript{2}H\textsubscript{4}, C\textsubscript{2}H\textsubscript{6}, C\textsubscript{3}H\textsubscript{8}, C\textsubscript{4}H\textsubscript{10}, C\textsubscript{5}H\textsubscript{12}, C\textsubscript{6}H\textsubscript{14}, C\textsubscript{7}H\textsubscript{16}, C\textsubscript{8}H\textsubscript{18}, C\textsubscript{9}H\textsubscript{20}, C\textsubscript{10}H\textsubscript{22}
(a) Which formula represents cyclohexane as well as heptane?
(b) Which formula represents benzene?
(c) Which three formulae represent open chain unsaturated hydrocarbons having double bonds?
(d) Which two formulae represent unsaturated hydrocarbons having triple bonds?
(e) Which three formulae can represent cyclic hydrocarbons?

Solution:
(a) C\textsubscript{7}H\textsubscript{16}, C\textsubscript{8}H\textsubscript{18}, C\textsubscript{9}H\textsubscript{20}
(b) C\textsubscript{6}H\textsubscript{6}
(c) C\textsubscript{2}H\textsubscript{4}\textsubscript{2}, C\textsubscript{2}H\textsubscript{4}\textsubscript{3}, C\textsubscript{2}H\textsubscript{4}\textsubscript{4}
(d) C\textsubscript{2}H\textsubscript{2}\textsubscript{2}, C\textsubscript{2}H\textsubscript{2}\textsubscript{3}
(e) C\textsubscript{3}H\textsubscript{6}, C\textsubscript{4}H\textsubscript{6}, C\textsubscript{5}H\textsubscript{6}

Question 95:
Which of the following compounds can have a triple bond?
C\textsubscript{2}H\textsubscript{2}, C\textsubscript{2}H\textsubscript{4}, C\textsubscript{2}H\textsubscript{6}

Solution:
C\textsubscript{2}H\textsubscript{2}

Question 96:
Write the molecular and structural formula of a cyclic hydrocarbon whose molecule contains 8 atoms of carbon.

Solution:
Molecular formula: C\textsubscript{8}H\textsubscript{8}

Question 97:
What is the molecular formula and structural formula of a cyclic hydrocarbon whose one molecule contains 8 hydrogen atoms?

Solution:
Molecular formula: C\textsubscript{8}H\textsubscript{8}

Question 98:
Write the molecular formula of 13 an alkane 13 an alkenes and 13 an alkyne each having 20 carbon atoms:

Solution:
(a) C\textsubscript{20}H\textsubscript{42}
(b) C\textsubscript{20}H\textsubscript{40}, C\textsubscript{20}H\textsubscript{42}
(c) C\textsubscript{20}H\textsubscript{41}

Question 99:
Which of the following compounds can have a double bond?
C\textsubscript{2}H\textsubscript{4}, C\textsubscript{2}H\textsubscript{2}, C\textsubscript{2}H\textsubscript{2}\textsubscript{2}, C\textsubscript{2}H\textsubscript{2}\textsubscript{3}

Solution:
C\textsubscript{2}H\textsubscript{2}\textsubscript{2}, C\textsubscript{2}H\textsubscript{2}\textsubscript{3}

Question 100:
Which of the following hydrocarbons is unsaturated?
C\textsubscript{2}H\textsubscript{4}, C\textsubscript{2}H\textsubscript{2}, C\textsubscript{2}H\textsubscript{2}\textsubscript{2}, C\textsubscript{2}H\textsubscript{2}\textsubscript{3}

Solution:
C\textsubscript{2}H\textsubscript{2}\textsubscript{2}, C\textsubscript{2}H\textsubscript{2}\textsubscript{3}
Question 1:
Write the molecular formula of ethanol.
Solution:
C₂H₅OH

Question 2:
What is the next higher homologue of methanol (CH₃OH)?
Solution:
Ethanol (C₂H₅OH)

Question 3:
Identify the functional group present in the following compound and name it according to IUPAC system:
CH₂OH
Solution:
Alcohol group
Methanol

Question 4:
Give the common name and IUPAC name of the simplest aldehyde.
Solution:
Common name: Formaldehyde
IUPAC name: Methanal

Question 5:
What is the common name of methanal?
Solution:
Formaldehyde

Question 6:
Write the names of the following functional groups:
(a) \(\text{C}≡\text{C}\) (b) \(\text{C}≡\text{C}<\)
Solution:
(a) Acetylene
(b) Allenene

Question 7:
Name the simplest ketone.
Solution:
Propanone

Question 8:
What is the common name of propanone?
Solution:
Acetone

Question 9:
Write the IUPAC names of the following:
(i) CH₃COCH₃ (ii) CH₃COCH₂CH₃
Solution:
(i) Propanone
(ii) Butanone

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Question 10:
Write the name and chemical formula of the simplest organic acid.
Solution:
Formic acid: HCOOH

Question 11:
Write the IUPAC names, common names and formulae of the first two members of the homologous series of carboxylic acids.
Solution:

<table>
<thead>
<tr>
<th>IUPAC name</th>
<th>Common name</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Methanoic acid</td>
<td>Formic acid</td>
<td>HCOOH</td>
</tr>
<tr>
<td>(ii) Ethanoic acid</td>
<td>Acetic acid</td>
<td>CH₃COOH</td>
</tr>
</tbody>
</table>

Question 12:
What is the common name of (a) methanoic acid, and (b) ethanoic acid?
Solution:
(a) Formic acid
(b) Acetic acid

Question 13:
Draw the structures for the following compounds:
(a) Ethanoic acid (b) Propanoic acid
Solution:

(a) [Structure image]
(b) [Structure image]

Ethanoic acid
Propanoic acid

Question 14:
Give the common names and IUPAC names of the following compounds:
(a) HCOOH (b) CH₃COOH
Solution:
Question 15:
Give the name and structural formula of one homologue of HCOOH.
Solution:
Ethanoic acid: CH₃COOH

Question 18:
Write the formulae of (a) Methanoic acid and (b) Ethanoic acid.
Solution:
(a) Methanoic acid: HCOOH
(b) Ethanoic acid: CH₃COOH

Question 17:
Give the common name and IUPAC name of C₂H₆O.
Solution:
Common name: Ethyl alcohol
IUPAC name: Ethanol

Question 20:
Give the IUPAC name of the following compound:
C₃H₆O
Solution:
Propanol: C₃H₇OH

Question 10:
Give the name and structural formula of one member of the following:
Alcohols
Solution:
Ethanol: C₂H₅OH

Question 20:
Give the IUPAC name of the following compounds:
(a) C₃H₇OH (b) C₃H₆O
Solution:
(a) Propanol: C₃H₇OH
(b) Propanoic acid: C₃H₆O₂

Question 21:
What is the common name of methanol?
Solution:
Methyl alcohol

Question 22:
What is the difference between two consecutive homologues?
(a) In terms of molecular mass?
(b) In terms of number and kind of atoms per molecule?
Solution:
(a) Yes
(b) Two consecutive homologues differ by 1 carbon atom and 2 hydrogen atoms in their molecular formulae.

Question 23:
What type of fuel is:
(a) Burns with a flame?
(b) Burns without a flame?
Solution:
(a) Fuels which vaporise on heating, burn with a flame.
(b) Fuels which do not vaporise on heating, burn without a flame.

Question 24:
State whether the following statement is true or false:
The minimum number of carbon atoms in a carboxylic acid is two.
Solution:
False

Question 25:
Fill in the following blanks with suitable words:
(a) The next higher homologue of methanoic acid is __________
(b) The next homologue of C₂H₅OH is __________
(c) The next higher homologue of ethanoic acid is __________
(d) The functional group present in ethanoic acid is __________

(e) Organic compounds having — C — OH functional group are known as __________
Solution:
(a) Propionic acid
(b) Propanoic acid
(c) Ethanoic acid

Question 26:
(a) Give the general name of the class of compounds having the general formula CₙH₂ₙ₊₁OH.
(b) Write the molecular formulae of the first two members of the homologous series.
(c) Write the molecular formulae of the second and third members of the homologous series.
Solution:
(a) Alcohols
(b) First member: CH₃OH
(c) Second member: C₂H₅OH

Question 27:
Give the names and structural formula of the next two higher homologues of methanoic acid.
(a) Select the hydrocarbons which are members of the same homologous series. Give the name of each series.

C₈H₈: C₈H₁₀: C₈H₁₂: C₆H₆: C₆H₈: C₆H₆; C₅H₈: C₄H₁₀: C₄H₈: C₄H₆

Solution:

(a)

H₂C

H = C

H₂C

H₂C

H₂C

H₂C

H₂C

(b) Methane

(c) Methane: C₂H₆

(d) Methane: C₂H₄

(e) Methane: C₂H₂

(f) Methane: C₂H₂

(g) Methane: C₂H₂

Question 29:

(a) Give the molecular formula of one homologue of each of the following:

1) C₄H₁₀: C₄H₁₀: C₄H₁₂

(b) What is the difference in the molecular mass of any two adjacent hydrocarbons?

(c) By how many carbon atoms and hydrogen atoms do any two adjacent homologues differ?

Solution:

(a) C₄H₁₀: C₄H₁₀: C₄H₁₂

(b) C₄H₁₀

(c) C₄H₁₀

1 carbon atom and 2 hydrogen atoms i.e. CH₂ group.

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Question 29:

(a) Write the formula of the functional group present in carboxylic acids.

(b) Name the functional group present in CH₃–C=CH₂.

(c) Name the functional group present in the following compounds:

- CH₃COCH₃
- CH₃CH₂COH
- CH₃C(OH)₂
- CH₃CH₂C(OH)₂

Solution:

(a) The functional group present in carboxylic acids is carboxyl group.

(b) The functional group present in CH₃–C=CH₂ is Vinyl group.

(c) The functional group present in CH₃COCH₃ is Ketone.

- CH₃CH₂COH is an ester.

- CH₃C(OH)₂ is a hydroxy group.

- CH₃CH₂C(OH)₂ is an ester.

Question 30:

(a) Write the IUPAC name and common name of CH₃Cl.

(b) Draw the structure of chlorobutane.

(c) Draw the structure for bromopentane, are structural isomers possible for bromopentane?

Solution:

(a) IUPAC name: Chloromethane

(b) Common name: Methyl chloride

(c) Structure of chlorobutane:

CH₃-CH₂-CH₂-Chlorine

Yes, structural isomers are possible for bromopentane.

Question 31:

(a) Write the name and formula of an organic compound containing a ketone functional group.

(b) Write the names and formulae for the first three members of the homologous series of chloroalkanes.

(c) How would you name the following compound?

CH₃-CH₂-Br

Solution:

(a) The name of the compound containing a ketone functional group is acetone.

(b) The names and formulae for the first three members of the homologous series of chloroalkanes are:

- CH₃Cl
- CH₂Cl₂
- CHCl₃

(c) The name of the following compound is 2-bromoethane.

Question 32:

(a) Define a homologous series. Give the name and structural formula of one homologue of the following:

CH₃OH

(b) Write the molecular formula of the third member of the homologous series of carbon compounds with general formula CₓHₓOₓ.

(c) Name any two fossil fuels.

Solution:

(a) A homologous series is a group of organic compounds having similar structures and similar chemical properties in which the successive compounds differ by CH₂ group.

- CH₃OH is methanol.

(b) The molecular formula of the third member of the homologous series of carbon compounds with general formula CₓHₓOₓ is C₃H₇O.

(c) Two fossil fuels are:

- Coal
- Petroleum

Question 33:

(a) Draw the structure for the following compounds:

- Propyne (C₃H₃)
- Butynes

(b) Write the IUPAC names of the following:

- CH₃CH₂OH (Methanol)
- CH₃CH₂OH (Ethanol)
- CH₃CH₂OH (Propanol)
- CH₃CH₂OH (Butanol)

(c) Which functional group is likely to be present in an organic compound having the molecular formula CₓHₓO ? Write the formula of the organic compound.

Solution:

(a) (i) Propane

(b) Butane

(b) Methanol (Methane)

- Ethanol (Ethane)

(c) Alcohols generally have the general formula CₓH₂ₓ₊₁O.
Question 35:
(a) Name the functional group in group A with appropriate names from group B:
Group A: CH₃OH, CH₂=CH₂, CH₃NH₂
Group B: Ethanol, Methanol, Ethanal, Ethanoic acid
(b) Draw the structure of butanoic acid.
(c) What is the IUPAC name of acetic acid?

Solution:
(a) CH₃COOH: Ethanoic acid
CH₂=CH₂: Ethanal
CH₃OH: Methanol

(b) Butanoic acid

(c) Ethanoic acid.

Question 36:
(a) Which functional group do you think can be present in an organic compound having the molecular formula C₆H₁₂O₂?
(b) Write the formula of the organic compound.
(c) Give one example of each of the compounds having the following functional groups:
(i) Aldehyde group
(ii) Alcohol group
(iii) Carboxylic acid group
(iv) Halogen group
(v) Alkene group
(vi) Alkyne group.

Solution:
(a) Carboxylic acid group, COOH: C₆H₅COOH
(b) (i) Methanol: CH₃OH
(ii) Ethanol: CH₃CH₂OH
(iii) Ethanoic acid: CH₃COOH
(iv) Chloroform: CHCl₃
(v) Ethene: CH₂=CH₂
(vi) Ethyne: CH≡CH

Question 37:
(a) What is the molecular formula and structure of the alcohol which can be thought to be derived from pentane?
(b) Write names of the following functional groups:
(i) —CHO
(ii) —OH
(iii) —COOH
(iv) —O
(v) —X
(c) What makes the candle flame yellow and luminous?

Solution:
(a) C₅H₁₂O or C₅H₁₀OH
(b) (i) Aldehyde group
(ii) Alcohol group
(iii) Carboxylic acid group
(iv) Ester group
(v) Halogen group
(c) When a candle is lit, the wax melts, rises up the wick and gets converted into vapours. In a candle, there is no provision for the proper mixing of oxygen. So, the wax vapours burn in an insufficient supply of oxygen, which leads to an incomplete combustion of wax. This incomplete combustion of wax produces small sooty carbon particles. These sooty carbon particles rise in the flame, get heated and glow to give yellowish light. This makes the candle flame yellow and luminous.

Question 38:
(a) What is a homologous series? Explain with an example.
(b) State two characteristics of a homologous series.
(c) The molecular formula of an organic compound is C₄H₁₀. Name its homologous series.
(d) Select the hydrocarbons which belong to the same homologous series. Give the name of each series.

Solution:
(a) A homologous series is a group of organic compounds having similar structures and similar chemical properties in which the successive compounds differ by CH₂ group.

Question 39:
(a) What is meant by a functional group? Explain with an example.
(b) Write three common functional groups present in organic compounds. Give their symbols/formulae.
(c) Name the functional group present in the following compounds:
(i) CH₃COOH
(ii) CH₃CH₂COOH
(iii) CH₃CH₂OH

Solution:
(a) A 'atom' or a group of atoms which makes a carbon compound (or organic compound) reactive and decides its properties is called a functional group. The alcohol group, —OH, present in ethanol, C₂H₅OH, is an example of a functional group.
Question 40:
(a) What happens when carbon burns in air? Write the chemical equation of the reaction which takes place.
(b) Why are coal and petroleum called fossil fuels?
(c) Explain how coal was formed in the earth.
(d) Describe how petroleum was formed in the earth.
(e) Name a fossil fuel other than coal and petroleum.

Solution:
(a) When carbon burns in air, it forms carbon dioxide gas and releases a large amount of heat and some light.
\[ C + O_2 \rightarrow CO_2 + \text{ Heat} + \text{ Light} \]
(b) Coal and petroleum are called fossil fuels because they were formed by the decomposition of the remains of prehistoric plants and animals that lived millions of years ago.
(c) Coal was formed by the decomposition of large land plants and trees burned under the earth millions of years ago. It is believed that millions of years ago, due to earthquakes and volcanic eruptions, the forests were buried under the surface of the earth and got covered with sand, clay, and mud. Due to high temperature and high pressure inside the earth, and in the absence of air, wood was converted into coal.
(d) Petroleum oil and natural gas was formed by the decomposition of the remains of microscopic plants and animals buried under the sea and under the pressure of water. Petroleum oil is mostly located in the bottom of the sea and was never covered with sand and mud. The chemical effects of pressure, heat, and bacteria converted the remains of microscopic plants and animals into petrolum oil and natural gas, just as they converted forest trees into coal. This conversion took place in the absence of oxygen or air. The petroleum that was formed got trapped between two layers of impervious rocks (very porous rocks) forming oil and gas traps.
(e) Natural gas.

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Question 58:
An organic compound having the molecular formula C₂H₄O₂ can exist in the form of two isomers A and B having different functional groups. The isomer A is a liquid which is used as a solvent for nail polish. The isomer B is also a liquid. An aqueous solution of one of the lower homologues of B is used for preserving biological specimens in the laboratory.
(a) What is compound A?
(b) Write the electron-dot structure of A.
(c) What is compound B?
(d) Write the electron-dot structure of B.
(e) Name the lower homologue of compound B which is used in preserving biological specimens.

Solution:
(a) Propionic (or Acetone)
(b) Electron-dot structure of A:
\[
\begin{align*}
\text{H} & : \text{C} : \text{C} : \text{H} \\
\end{align*}
\]
(c) Propanol
(d) Electron-dot structure of B:
\[
\begin{align*}
\text{H} & : \text{C} : \text{C} : \text{OH} \\
\end{align*}
\]
(e) Methanol (or Formic acid) is used in preserving biological specimens.

Question 57:
A hard material X which is mined from the earth is used as a household fuel and also for the generation of electricity at Thermal Power Stations. A soft material Y is also used as a fuel in the form of cinders. A gaseous material Z which occurs along with petroleum is increasingly being used as a fuel in running vehicles in its compressed form.
(a) What are materials X, Y and Z?
(b) When materials X, Y and Z are burned separately.
(c) Which material burns by producing a yellow, luminous flame?
(d) Which material ultimately burns without producing a flame?
(e) Which material can burn in a gas stove by producing a blue flame?

Solution:
(a) X is coal, Y is wax; Z is natural gas
(b)(ii) Y (wax)
(c) Y (wax)
(d) Z (natural gas)

Question 58:
Three organic compounds A, B and C have the following molecular formulas:
A: C₂H₄O₂
B: C₂H₆O
C: C₂H₆O₆
(a) Which compound contains an alcohol group? Write its name and structural formula.
(b) Which compound contains a carboxyl group? Write its name and structural formula.
(c) Which molecular formula can represent an aldehyde as well as a ketone? Write the names and structural formulae of the aldehyde and ketone represented by this molecular formula.

Solution:

![Chemical structures](image)

Question 59:
A colourless organic liquid X of molecular formula C₇H₈O₂ turns blue litmus to red. Another colourless organic liquid Y of molecular formula C₅H₁₀O₂ has no action on any litmus but it is used as a nail polish remover. A yet another colourless organic liquid Z of molecular formula C₆H₁₂O₆ has also no action on litmus but it is used in tincture of iodine.

(a) Name the liquid X. To which homologous series does it belong? Give the name of another member of this homologous series.
(b) Name the liquid Y. To which homologous series does it belong? Write the name of another member of this homologous series.
(c) Can you name an organic compound having the same molecular formula as liquid Y but which belongs to a different homologous series? What is this homologous series?
(d) Name the liquid Z. To which homologous series does it belong? Write the name of another member of this homologous series.

Solution:

(a) Liquid X is ethanoic acid; it belongs to homologous series of carboxylic acids. Methanoic acid is another member of this homologous series.
(b) Liquid Y is Propanone; it belongs to homologous series of ketones. Butane is another member of this homologous series.
(c) Propanal; it belongs to homologous series of aldehydes.
(d) Liquid Z is ethanol; it belongs to homologous series of alcohols. Methanol is another member of this homologous series.

Question 60:
You are given an organic compound having the molecular formula C₆H₁₂O₆. Give the name and formula of the compound formed:
(a) when one atom of C₆H₁₂O₆ is replaced by a CH₄ atom.
(b) when one atom of C₆H₁₂O₆ is replaced by a CH₂ group.
(c) when one atom of C₆H₁₂O₆ is replaced by a CO₂H group.
(d) when two atoms joined to the middle carbon atom of C₆H₁₂O₆ are replaced by one O atom.

Solution:

(a) Chloroacetic acid, CH₃-C₂H₂-COOH
(b) Propanoic acid, CH₃-C₂H₂-COOH
(c) Butanoic acid, CH₃-C₃H₇-COOH
(d) Propionic acid, CH₃-C₃H₇-COOH

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Question 1:
Name the gas which is evolved when ethanoic acid is added to sodium carbonate. How would you prove the presence of this gas?

Solution:
Carbon dioxide (CO₂) gas is evolved in the reaction. When passed through lime water, it turns lime water milky.

Question 2:
Which of the following will give brick effervescence with sodium hydrogencarbonate and why? CH₃COOH, CH₃CHO, CH₃OH

Solution:
CH₃COOH will give brick effervescence. Being acid, it reacts with sodium hydrogencarbonate to produce carbon dioxide gas.

Question 3:
Name the functional group present in an organic compound which gives brick effervescence with NaHCO₃.

Solution:
Carboxylic acid group - COOH gives brick effervescence with NaHCO₃.

Question 4:
Name the hydrocarbon formed when ethanol is heated with conc. H₂SO₄ at 170°C. What is this reaction known as?

Solution:
Ethene is formed when ethanol is heated with conc. H₂SO₄ at 170°C. This reaction is called dehydration.

Question 5:
What does ethyne (acetylene) burn with a sooty flame? Why?

Solution:
Ethyne (acetylene) burns with a sooty flame because ethyne is an unsaturated hydrocarbon and the percentage of carbon in these hydrocarbons is comparatively higher which does not get oxidised completely in oxygen of air.

Question 6:
Name the product formed when hydrogen is added to ethene.

Solution:
Ethane is formed when hydrogen is added to ethene.

Question 7:
Explain why, ethene decolourises bromine water whereas ethane does not.

Solution:
Ethene decolourises bromine water because ethene is an alkene. All alkenes and alkanes are unsaturated compounds which decolourise bromine water. On the other hand, ethane being an alkane is a saturated compound which does not decolourise bromine water.

Question 8:
Solution: Nickel or palladium can be used as catalyst in the hydrogenation of unsaturated compounds.

Question 9: State two disadvantages of incomplete combustion.

Solution: Disadvantages of incomplete combustion:
1. It leads to the formation of soot which is nothing but unburnt carbon which pollutes the atmosphere, blackens clothing, and Actor’s clothes.
2. It leads to the formation of an extremely poisonous gas called carbon monoxide.

Question 10: What happens when (give chemical equation).
Sodium reacts with ethanol (ethyl alcohol).

Solution: When Sodium reacts with ethanol (ethyl alcohol), hydrogen gas is evolved.

\[ 2C_{2}H_{5}OH + 2Na \rightarrow 2C_{2}H_{5}ONa + H_{2} \]

Question 11: Describe one reaction of ethano.

Solution: Ethanol reacts with sodium metal to form sodium ethoxide and hydrogen gas. This reaction is used as a test for ethanol. When a small piece of sodium metal is put into an ethano, the dry test tube used to observe the reaction is produced due to evolution of hydrogen gas.

\[ 2C_{2}H_{5}OH + 2Na \rightarrow 2C_{2}H_{5}ONa + H_{2} \]

Question 12: Name one liquid carbon compound which is being used as an additive in petrol in some countries.

Solution: Ethanol is used as an additive in petrol.

Question 13: What are the raw materials required for making soap in a laboratory or at home?

Solution:
(a) Vegetable oil (like castor oil, cottonseed oil, or soybean oil)
(b) Sodium hydroxide (caustic soda)
(c) Sodium chloride (common salt)

Question 14: Would you be able to check whether water is hard by using a detergent? Why?

Solution: No, we would not be able to check the hardness of water by using a detergent because a detergent forms a layer easily even with hard water.

Question 15: Describe a test for carboxylic acids.

Solution: Litmus test. Some blue litmus solution is added to the organic compound to be tested. If the blue litmus solution turns red, it shows that the organic compound is acidic in nature and hence it is a carboxylic acid.

Question 16: Why is the conversion of ethanol into ethanoic acid an oxidation reaction?

Solution: Conversion means controlled combustion. When ethanol is heated with alcoholic potenti or copper carbonate solution or with acidified potassium dichromate solution, it gets oxidised into ethanoic acid. It is called an oxidation reaction because oxygen is added to it during this conversion.

\[ CH_{3}CH_{2}OH + \text{O} \rightarrow CH_{3}CH_{2}COOH + H_{2}O \]

Question 17: Explain why alkanes are excellent fuels.

Solution: Alkanes burn in air to produce a lot of heat due to which they are known to be excellent fuels.

Question 18: Name one chemical compound which can be used to distinguish between ethanol and ethanoic acid.

Solution: Sodium hydrogen carbonate can be used to distinguish between ethanol and ethanoic acid.

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Question 20: Complete and balance the following equations:

(1) \( CH_{4} + O_{2} \rightarrow \)
(2) \( CH_{4} + Cl_{2} \rightarrow \)

Solution:
(a) \( CH_{4} + 2O_{2} \rightarrow CO_{2} + 2H_{2}O + \text{Heat} + \text{Light} \)
(b) \( CH_{4} + 4Cl_{2} \rightarrow 4HCl + CHCl_{3} \)

Question 21: Fill in the following blanks with suitable words:
(a) The process of burning of hydrocarbons in the presence of air to give \( CO_{2}, H_{2}O, \) heat and light is known as __________.
(b) The sodium salt of a long chain fatty acids is called __________.
(c) It is better than soap for washing clothes when the water is hard.
(d) The organic acid present in vinegar is __________.

Solution:
(a) Combustion
(b) Soap
(c) Detergent
(d) Ethanoic acid

Question 22: Which of the following hydrocarbons will give substitution reactions and why?

(a) \( CH_{2}, C_{2}H_{6}, C_{3}H_{8}, C_{4}H_{10}, C_{5}H_{12} \)
Solution:
(a) \( CH_{2}, C_{2}H_{6}, C_{3}H_{8}, C_{4}H_{10}, C_{5}H_{12} \) all are not saturated hydrocarbons (alkanes) and hence will give substitution reactions.

Solution 23:
\( C_{2}H_{4} \) and \( C_{2}H_{4} \) will give addition reactions because these are unsaturated hydrocarbons (alkene and allene) and unsaturated hydrocarbons give addition reactions.

Question 24:
(a) Write the chemical equation of the reaction which takes place during the burning of ethanol in air.
(b) Why is ethanol used as a fuel?
(i) State two uses of ethanol (other than as a fuel).

Solution:

(a) \( \text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O} + \text{Heat} \)

Since ethanol burns with a clear flame giving off a lot of heat, therefore, it is used as a fuel.

(c) Uses of ethanol:
(i) It is used in the manufacture of paints, varnishes, lacquers, medicines, perfumes, dyes, soaps, and synthetic rubber.
(ii) It is used as a solvent. Many organic compounds which are insoluble in water are soluble in ethyl alcohol.

Question 28:
(a) What happens when propionic acid is warmed with methanol in the presence of a few drops of concentrated sulfuric acid? Write the equation of the reaction involved.
(b) What change will you observe if you test soap solution with a litmus paper (red and blue)? Give reason for your observation.
(c) What is meant by denatured alcohol? What is the need to denature alcohol?

Solution:
(a) Propionic acid will react with the alcohol in the presence of concentrated sulfuric acid to form water.
\[ \text{CH}_3\text{CH}_2\text{COOH} + \text{CH}_3\text{OH} \rightarrow \text{CH}_3\text{CH}_2\text{COOCH}_3 + \text{H}_2\text{O} \]

(b) Red litmus paper turns blue in soap solution and no change occurs on blue litmus paper because soap is basic in nature.

(c) Denatured alcohol is ethanol which has been made unfit for drinking purposes by adding small amounts of poisonous substances like methanol, pyridine, copper sulphate, etc. This is done to prevent the misuse of industrial alcohol for drinking purposes or black marketing, i.e., it is supplied duty-free for industrial purposes by the government.

Question 29:
(a) How would you test for an alcohol?
(b) Give the harmful effects of drinking alcohol.
(c) Explain why methanol is much more dangerous to drink than ethanol.

Solution:
(a) Sodium metal test: Add a small piece of sodium metal to the organic liquid (to be tested), taken in a dry test tube. If bubbles of hydrogen are evolved, it indicates that the given organic liquid is an alcohol.
(b) Harmful effects of drinking alcohol:
(i) Alcohol slows down the activity of the nervous system and brain due to which the judgment of a person is impaired and his reaction becomes slow.
(ii) Heavy drinking of alcohol in particular causes to staggered movement, slurred speech and vomiting.
(c) Unlike ethanol, drinking methanol even in a small quantity can be fatal leading to permanent blindness and even death. Methanol damages the optic nerve causing permanent blindness in a person. This happens because methanol is oxidized to formaldehyde in the liver of a person. This methanal reacts rapidly with the components of the cell causing coagulation of their protoplasm. Due to this, the cells stop functioning normally.

Question 27:
How would you convert:
(a) ethanol into ethene?
(b) propene into propionic acid?

Solution:
(a) Dehydration conversion of ethanol into ethene:
\[ \text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{CH}_2=\text{CH}_2 + \text{H}_2\text{O} \]

(b) Oxidation conversion of propene into propionic acid:
\[ \text{CH}_3\text{CH}=\text{CH}_2 + \text{O}_2 \rightarrow \text{CH}_3\text{CH}_2\text{COOH} + \text{H}_2\text{O} \]

Question 28:
Give reasons for the following observations:
(a) Air holes of a gas burner have to be adjusted when the vessel is being heated at the boiling point.
(b) Use of synthetic detergents causes pollution of water.

Solution:
(a) Air holes of a gas burner have to be adjusted to ensure efficient burning of vessels show that the air holes of the gas stove are getting blocked and hence the fuel is not burning completely due to insufficient supply of oxygen.
(b) Some of the detergents synthetic are not bio-degradable, that is, they cannot be decomposed by microorganisms like bacteria and hence cause water pollution.

Question 29:
(a) What would be observed on adding a 5% alkaline potassium permanganate solution drop by drop to some warm ethanol in a test tube? Write the name of the compound formed during the chemical reaction. Also, write chemical equation of the reaction which takes place.
(b) How would you distinguish experimentally between an alcohol and a carboxylic acid on the basis of a chemical property?

Solution:
(a) On adding 5% alkaline potassium permanganate solution drop by drops to some warm ethanol, we would observe that the purple color of potassium permanganate starts disappearing, the product formed by this process: ethanoic acid can turn blue litmus red.
\[ \text{CH}_3\text{COOH} + \text{MnO}_4^- + 8\text{H}^+ \rightarrow \text{CO}_2 + 4\text{H}_2\text{O} + \text{Mn}^{2+} \]

(b) A carboxylic acid reacts with sodium hydrogen carbonate to give brisk effervescence of carbon dioxide gas but an alcohol does not react with sodium hydrogen carbonate.

Question 30:
Name the functional group of organic compounds that can be hydrogenated. With the help of a suitable example, explain the process of hydrogenation, mentioning the conditions of the reaction and any one change in physical property with the formation of the product. Name any one natural source of organic compounds that are hydrogenated.

Solution:
Alkanes can be hydrogenated.

The addition of hydrogen to an unsaturated hydrocarbon to obtain a saturated hydrocarbon is called hydrogenation.

Example: Ethane reacts with hydrogen in the presence of finely divided nickel as a catalyst to form ethene.

Liquid vegetable oils are hydrogenated into vegetable ghee (solid fat).

Question 31:
Name the gas evolved when ethanol reacts with sodium.

What type of compound is formed when a carboxylic acid reacts with an alcohol in the presence of concentrated sulfuric acid?

What will you observe when dilute ethanoic acid and dilute hydrochloric acid are put on universal indicator paper, one by one? What does it show?

Solution:
(a) Hydrogen gas is evolved when ethanol reacts with sodium.

(b) Esters are formed when a carboxylic acid reacts with an alcohol in the presence of concentrated sulfuric acid.

(c) Dilute ethanoic acid turns universal indicator paper to purple, showing that its pH is about 4 which tells us that ethanoic acid is a weak acid. On the other hand, dilute hydrochloric acid turns universal indicator paper to red, showing that its pH is about 1. This shows us that hydrochloric acid is a strong acid.

Question 32:
(a) What type of compound is CH₃COOH?
(b) What substance should be oxidised to prepare CH₃COOH?
(c) What is the physical state of CH₃COOH?
(d) State one advantage of soaps over detergents.

Solution:
(a) CH₃COOH is a carboxylic acid.
(b) Ethanol, CH₃CH₂OH should be oxidised to prepare CH₃COOH.
(c) Liquid state.
(d) Soaps are biodegradable whereas detergents are non-biodegradable.

Question 33:
(a) What happens when ethanol reacts with acetic acid in the presence of a little of concentrated sulphuric acid? Write equation of the reaction involved.
(b) What happens when ethanol is heated with concentrated sulphuric acid at 120°C? Write the equation of the reaction which takes place.

Solution:
(a) When ethanol reacts with acetic acid in the presence of a little of concentrated sulphuric acid, a sweet smelling ester called ethyl acetate is formed.
Question 34:
(a) What happens when ethanol is oxidised with alkaline potassium permanganate (or acidified potassium dichromate)? Write the equation of the reaction involved.
(b) Choose those compounds from the following which can turn blue litmus solution red:
HCN, CH₃COOH, C₂H₅OH, HCOOH, CH₃CHO. Give reasons for your choice.
Solution:
(a) When ethanol is oxidised with alkaline potassium permanganate (or acidified potassium dichromate), it gets oxidised to form ethanoic acid.
(b) C₂H₅OH and HCOOH can turn blue litmus solution red. These are organic acids.

Question 35:
(a) Explain the process of preparation of soap in laboratory.
(b) Why is common salt (sodium chloride) added during the preparation of soap?
(c) Why is soap not suitable for washing clothes when the water is hard?
Solution:
(a) Soap can be prepared in the laboratory as follows:
1. Take about 30 ml of castor oil (labeled as soya bean oil) in a beaker.
2. Add 30 ml of 20% sodium hydroxide solution to it.
3. Heat the mixture with constant stirring till a paste of soap is formed.
4. Then add 5 to 10 grams of common salt (sodium chloride).
5. Stir the mixture well and allow it to cool. On cooling the solution, solid soap separates out.
6. When the soap sets, it can be cut into pieces called soapbar.
(b) Common salt is added to the mixture to make the soap come out of solution. Though most of the soap separates out on its own but some of it remains in solution. Common salt is added to precipitate out all the soap from the aqueous solution.
(c) When soap is used for washing clothes with hard water, a large amount of soap in water is reacting with the calcium and magnesium ions of hard water to form an insoluble precipitate called scum, before it can be used for the real purpose of washing.

Question 36:
(a) What happens when methane is exposed to light in air? Write the chemical equation of the reaction involved.
(b) What happens when ethanoic acid reacts with sodium carbonate? Write the chemical equation of the reaction involved.
Solution:
(a) Methane is a hydrocarbon. When exposed to light in air, methane can undergo a reaction with oxygen to form water and carbon dioxide.
CH₄ + O₂ → H₂O + CO₂
(b) Ethanoic acid reacts with sodium carbonate to form carbonic acid and sodium ethanoate.
2CH₃COOH + Na₂CO₃ → 2CH₃COONa + H₂O + CO₂

Question 37:
(a) Describe, giving an example, a chemical reaction which is characteristic of saturated hydrocarbons (or alkanes).
(b) What is an oxidising agent? Name two oxidising agents which can oxidise ethanol to ethanoic acid.
(c) Describe one reaction of a carboxylic acid.
Solution:
(a) A characteristic chemical property of a saturated hydrocarbon (alkane) is its ability to burn in the presence of oxygen, releasing heat and light energy.
CH₃CH₂CH₃ + 9O₂ → 6CO₂ + 6H₂O
(b) An oxidising agent is one which facilitates or enhances the formation of a compound containing oxygen. Examples of oxidising agents are:
- Oxygen (O₂)
- Permanganate ion (MnO₄⁻)
(c) A reaction of a carboxylic acid is the reaction with a base to form a salt and water.
CH₃COOH + NaOH → CH₃COONa + H₂O

Question 38:
(a) Write names and formulae of hydrocarbons containing a single and a double bond (one example for each). Give one characteristic chemical property of each.
(b) What is a detergent? Name one detergent.
(c) Why have detergents replaced soap as a washing agent?
Solution:
(a) Single bond: Methane, CH₄. They are quite unreactive hence they undergo substitution reaction with chlorine in the presence of sunlight.
Double bond: Ethylene, C₂H₄. They undergo addition reaction in the presence of a catalyst like nickel or platinum.
(b) A detergent is the sodium salt of long chain benzene sulphonic acid which has cleaning properties in water. Ex: Sodium n-dodecyl benzene sulphonate.
(c) Detergents are better cleaning agents than soaps because they do not form insoluble calcium and magnesium salts with hard water, and hence can be used for washing even with hard water.

Question 39:
(a) How does ethanoic acid react with sodium hydrogen carbonate? Write the equation of the reaction which takes place.
(b) Why is carbon and its compounds used as fuels for most applications?
(c) Which of the two is better for washing clothes when the water is hard: soap or detergent? Give one reason for your answer.
Solution:
(a) Ethanoic acid reacts with sodium hydrogen carbonate to evolve a brisk effervescence of carbon dioxide gas.
CH₃COOH + NaHCO₃ → CH₃COONa + CO₂ + H₂O
(b) Carbon and its compounds are used as fuels for most applications because they are inexpensive and produce heat energy.
(c) Detergent is better for washing clothes with hard water. They are better cleaning agents than soaps because they do not form insoluble calcium and magnesium salts with hard water, and hence can be used for washing even with hard water.

Question 40:
(a) What is meant by a substitution reaction? Give an example with an equation of the substitution reaction of an alkane.
(b) How is soap made? Write a word equation involved in soap making.
Solution:
(a) The reaction of which one of the hydrocarbon atoms of an alkane is replaced by some other atom(s) (like chlorine) is called a substitution reaction.
CH₄ + Cl₂ → CH₃Cl + HCl
(b) Soap is made by heating a fat or vegetable oil with concentrated sodium hydroxide solution.
Fats or oils → Soap + Glycerol

Question 41:
(a) How is ethanoic acid obtained from ethylene? Write down the chemical equation of the reaction involved.
(b) How would you distinguish between ethanol and ethanoic acid by chemical test?
(c) Explain the formation of scum when hard water is tricked with soap.
Solution:
(a) Ethanoic acid is obtained from ethylene by the means of oxidation reaction. When ethylene is heated with alkaline potassium permanganate solution, it gets oxidised to ethanoic acid as in the oxidation reaction.
(b) In an alkaline solution, ethanoic acid turns blue litmus paper red, but ethanol is neutral.
(c) When hard water is tricked with soap, the calcium and magnesium ions of hard water react with the sodium and potassium ions of the soap to form hard water precipitates.
organic compound is found in nature and hence it is a corrosive acid. It has no effect on any tissue or solid.

When soap is used for washing clothes with hard water, a large amount of soap in water reacts with the calcium and magnesium ions of hard water to form hard-water scale or calcium carbonate. This makes the cleaning of clothes difficult.

Question 4.5
(a) What happens when ethanoic acid reacts with sodium hydroxide? Give the equation of the reaction which takes place.
(b) What happens when vegetable oils are hydrogenated? Name the catalyst used.
(c) What is the advantage of detergents over soaps for washing clothes? Also state one disadvantage.

Solution
(a) Ethanoic acid reacts with sodium hydroxide in the presence of sunlight to form sodium ethanoate and carbon dioxide. This reaction is called neutralisation reaction.

\[ \text{CH}_3\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O} \]

(b) The above reaction is a neutralisation reaction as it is a reaction between an acid and a base to form a salt and water. Application: Vegetable oils are hydrogenated to form solid fat. Animal fats like palm oil or vegetable oil can be used as the catalyst.

(c) Advantages: Detergents can be used even with hard water and have stronger cleaning action.

Disadvantages: Detergents are not biodegradable and hence cause water pollution.

Question 4.6
(a) What is meant by an addition reaction? Give an example with an equation of an addition reaction of an alkene.
(b) What is added to groundnut oil when it is to be converted to vanaspati ghee?
(c) Which of the two is better for our health: butter or vegetable oil? Why?

Solution
(a) The reaction in which an unsaturated hydrocarbon combines with another substance to give a single product is called an addition reaction. Example: Ethene reacts with hydrogen when heated in the presence of nickel catalyst to form ethane.

\[ \text{CH}_2=\text{CH}_2 + \text{H}_2 \rightarrow \text{CH}_3\text{CH}_3 \]

(b) Hydrogen is added to the unsaturated double bond of oleic oil to get vanaspati ghee.

(c) Vegetable oil is better because it has unsaturated fatty acids which are good for our health.

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Question 4.8
(a) When ethanoic acid reacts with sodium hydroxide, then a salt X is formed and a gas Y is evolved. Name the salt X and gas Y. Describe an activity with the help of a labelled diagram of the apparatus used to prove that the evolved gas is the one which you have named. Also write the chemical equation of the reaction involved.
(b) Give any two uses of ethanoic acid.

Solution
(a) Salt X is sodium acetate. \( \text{CH}_3\text{COONa} \). Gas Y is carbon dioxide, \( \text{CO}_2 \).

Activity: Take a boiling tube and put about 0.5 g of sodium carbonate in it. Add 2 ml of dilute ethanoic acid to the boiling tube through a stopcock. We will observe that brisk effervescence of carbon dioxide gas is produced. Let us pass this gas through lime water taken in a test tube. We will find that lime water turns milky. So, this experiment proves that when ethanoic acid reacts with sodium carbonate, then carbon dioxide gas is evolved.

\[ \text{CH}_3\text{COONa} + \text{H}_2\text{CO}_3 \rightarrow \text{CH}_3\text{COOH} + \text{CO}_2 + \text{H}_2\text{O} \]

(b) Dilute ethanoic acid (in the form of vinegar) is used as a food preservative in the preparation of pickles and sauces.

(c) It is used in the manufacture of acetone and esters used in perfumes.

Activity:
(d) Take 1 ml of pure ethanol (absolute alcohol) in a test tube and add 1 ml of glacial ethanoic acid to it. Then add 2 or 3 drops of concentrated sulphuric acid to the mixture.

(e) Warm the test-tube containing above reaction mixture in hot water bath (a beaker containing hot water) for about 5 minutes.

(f) Pour the contents of the test-tube in about 50 ml of water taken in another beaker and smell it.

(g) A sweet smell is obtained indicating the formation of an ester.

Reactions:

Use of esters:

(e) Esters are used in making artificial flavourings and essences. These are used in cold drinks, ice-creams, sweets and perfumes.

(f) Esters are used as solvents for oils, fats, gums, resins, cellulose, paints, varnishes, etc.
Question 4B:
(a) Name the reaction which is usually used in the conversion of vegetable oils to fats. Explain the reaction involved in detail. Write a chemical equation to illustrate your answer.
(b) What is saponification? Write the chemical equation of the reaction involved in this process. Name all the substances which take part in this process and also those which are formed.
(c) Why does micelle formation take place when soap is added to water? Will a micelle be formed in other solvents like ethanol also?

Solution:
(a) Hydrogenation of oils: Vegetable oils are unsaturated and having double bonds between some of their carbon atoms and can undergo addition reactions if heated with hydrogen gas under pressure in the presence of a catalyst, usually nickel. The reaction is represented as follows:

\[ R-C=CH \quad \overset{\text{H}_2}{\longrightarrow} \quad R-C\text{CH}_3 \]

(b) Saponification: This is the chemical reaction of oils and fats with alkalis to form soap and glycerol. The reaction is represented as follows:

\[ \text{Fatty acid} + \text{NaOH} \rightarrow \text{Soap} + \text{Glycerol} + \text{Water} \]

(c) A soap molecule is made up of long chains of hydrocarbon units and alcoholic units. When soap is added to water, the hydrophobic parts of the molecule will align along the surface of water and the hydrophilic ends will remain out of water. This leads to the formation of micelles. In a soap molecule, the hydrophobic part of the molecule is kept away from the water to form micelles. In a soap molecule, the hydrophilic part of the molecule is kept away from the water to form micelles.

Question 4B:
(a) What is a soap? Name one soap.
(b) Describe the structure of a soap molecule with the help of a diagram.
(c) Explain the cleansing action of soap. Draw diagrams to illustrate your answer.

Solution:
(a) A soap is the sodium salt of a long-chain fatty acid. For example, sodium stearate, CH₃(CH₂)₁₇COONa.

(b) A soap molecule has two parts: the long-chain organic part and the ionic part containing the COO⁻ group. It has to be remembered that this is not an ion; it is the ionic compound.

(c) The cleaning action of soap is explained with the help of the image below:

Inside water, these molecules have a unique orientation that keeps the hydrophobic portion inside the water. This is achieved by forming clusters of molecules in which the hydrophobic tails are in the interior of the cluster and the ionic ends are on the surface of the cluster. This formation is called a micelle. When a dirty cloth is put in water containing dissolved soap, then soap in the form of a micelle is able to clean. The hydrophobic ends of the soap attach to the oily dirt particles and entrap them at the centre of the micelle. The ionic ends in the micelles remain attached to water. When the dirty cloth is agitated in soap solution, the oily dirt particles entrapped by soap micelles get dispersed in water and the cloth gets cleaned.

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Question 68:
A neutral organic compound X of molecular formula C₆H₁₂O₂ on oxidation with acidified potassium dichromate gives an acidic compound Y. Compound X reacts with Y on warming in the presence of cone. H₂SO₄ to give a sweet smelling substance Z. What are X, Y and Z?

Solution:
X is ethanol.
Y is ethanoic acid.
Z is ethyl ethanoate.
Ethanol reacts with ethanoic acid to form ethyl ethanoate ester.

Question 67:
Consider the following organic compounds:
H₂C=CH₂CH₂OH, CH₃COOH, CH₃CH₂OH, C₂H₅Cl
Choose two compounds which can react in the presence of cone. H₂SO₄ to form an ester. Give the name and formula of the ester formed.

Solution:
CH₃COOH and CH₃CH₂OH react in the presence of conc. H₂SO₄ to form an ester. Ethyl ethanoate, C₂H₅CO₂CH₃ is formed in the reaction.

Question 66:
A neutral organic compound is warmed with some ethanoic acid and a little of cone. H₂SO₄. Vapours having sweet smell if finely smell are evolved. What type of functional group is present in this organic compound? The structural formula of an ester is:

Solution:
Acid group - OH. Acids react with alcohols to form sweet smelling esters.

Question 89:
The structural formula of an ester is:

Write the formula of the acid and the alcohol from which it is formed.

Solution:

Acid Ethanoic acid
CH₃COOH
Alcohol Ethanol
CH₃CH₂OH

Question 70:
Consider the following organic compounds:
Oxirane, cyclic oxirane, ethylene oxide, calcium, C₂H₅, C₂H₅OH, CH₃OH. Out of these, name:

...
(a) Which compound is most likely to be sweet-smelling?
(b) Which compound on treatment with concentrated HNO₃ forms an allene?
(c) Which compound on repeated chlorination forms chloroform?
(d) Which compound when added to alcohol to denature it?
(e) Which compound is a constituent of vinegar?
(f) Which compound is used to sterilize wounds and syringes?

Solution
(a) CH₃COOH: Ethanoic acid
(b) CH₃CH₂OH: Alcohol forms ethene, C₂H₄
(c) CH₄: Methane
(d) CH₃OH: Methanol
(e) CH₃COOH: Acetic acid
(f) CH₃CH₂OH: Ethanol

Question 71:
An organic acid X is a liquid which often freezes during winter time in cold countries, having the molecular formula C₃H₆O₂.
On warming it with methanol in the presence of a few drops of concentrated sulphuric acid, a compound Y with a sweet smell is formed.
(a) Identify X and Y. Also write their formulas showing the functional group present in them.
(b) Write a chemical equation for the reaction involved.

Solution
(a) X is ethanoic acid
CH₃-COOH
(b) Y is methyl ethanoate, CH₃-C-O-C₂H₅

Question 72:
An organic compound A having the molecular formula C₄H₉O₂ is a liquid at room temperature. The organic liquid A reacts with sodium metal to evolve a gas which burns causing a little explosion. When the organic liquid A is heated with concentrated sulphuric acid at 170°C, it forms a compound B which dissolves in bromine water. The compound B exists on one molecule of hydrogen in the presence of Ni as catalyst to form compound C which gives substitution reactions with chlorine.
(a) What is compound A?
(b) What is compound B?
(c) What type of reaction occurs when A is converted into B?
(d) What is compound C?
(e) What type of reaction takes place when B is converted into C?

Solution
(a) A is propanol, CH₃-CH₂-OH
(b) B is propanoic acid, CH₃-COOH
(c) Dehydration reaction.
(d) C is propanone, CH₃-C(=O)-CH₃
(e) Addition reaction

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Question 73:
An organic compound A (molecular formula C₆H₁₂O₆) reacts with Na metal to form a compound B and evolves a gas which burns with a pop sound. Compound A on treatment with an alcohol C, in the presence of a little of concentrated sulphuric acid forms a sweet-smelling compound D (molecular formula C₇H₁₁O₈). Compound D on treatment with NaOH solution gives back B and C. Identify A, B, C and D.

Solution
A is ethanoic acid, CH₃COOH
B is sodium ethanolate, C₂H₅ONa
C is methanol, CH₃OH
D is ethanolic etherate, C₂H₅OCH₂COONa

Question 74:
Which of the following hydrocarbons can decolourise bromine water and which cannot? Why?
C₂H₆, C₂H₄, C₅H₆

Solution
C₂H₂ and C₅H₆ can decolourise bromine water since these are unsaturated hydrocarbons.
C₂H₆ cannot decolourise bromine water since it is a saturated hydrocarbon.

Question 75:
A four carbon atoms containing neutral organic compound X reacts with sodium metal to evolve a gas which burns with a pop sound. Another four carbon atoms containing carbon compound reacts with sodium hydrogen carbonate to evolve a gas which burns lime water milky. When compounds X and Y are heated together in the presence of a little of concentrated sulphuric acid, a new compound Z is formed.
(a) What is compound X? Also write its formula.
(b) What is compound Y? Also write its formula.
(c) What is compound Z? Also write its formula.
(d) What type of smell is given by compound Z?
(e) What is the general name of compounds like Z?
(f) What is the general name of the reaction which takes place between X and Y to form Z?

Solution
(a) X is butanol, C₄H₉OH
(b) Y is butanoic acid, CH₃CH₂COOH
(c) Z is butyl butanoate, C₄H₉CO₂C₂H₅
(d) Sweet smell is given by the compound Z.
(e) Esters
(f) Esterification reaction.