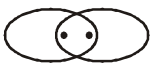
Chapter 6

Carbon and its Compounds

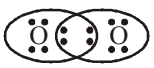
- Carbon has a unique place in our life. Each living cell, food, wood, paper, petrochemicals, cooking gas, perfumes etc. are all made of carbon. Carbon is an essential component of all living matters as proteins, carbohydrates and fats.
- **Bonding in Carbon :** A carbon atom has a total of six electrons carbon atom has four valence electrons. It could gain four electrons to form C^{4-} anion or lose four electrons to form C^{4+} cation. Both these conditions require large amount of energy. Thus it has a very little tendency to form ionic compounds. To overcome this problem carbon undergoes bonding by sharing its valence electron with other carbon atoms or with atoms of other elements. This allows it to be covalently bonded to one, two, three or four carbon atoms or atoms of other elements or groups of atoms (molecule).
- **Formation of covalent bond :** Covalent bond formation involves **sharing of electrons** between bonding atoms which may be either same or different. The bonding atoms contribute equal number of electrons (e.g. one electron each or 2 electrons each etc).
- **Covalency :** The number of electrons contributed by an atom for sharing is known as its covalency. Depending upon the number of electrons shared by each atom in bond formation, covalent bond may be single, double or triple. A **single bond** is represented by a single line (–), a **double bond** by double line (=) and a **triple bond** by a triple line (≡).

  Example :

  • $H_2 \longrightarrow H(1) = 1$

   ; H – H

  • $O_2 \longrightarrow O(8) = 2,6$

   ; O = O

  • $N_2 \longrightarrow N(7) = 2,5$

   ; N ≡ N

- **Characteristics of covalent compounds :**

(i) These compounds are molecular in nature (i.e. they exist as single molecules) e.g. H_2, Cl_2, NH_3, CH_4, SO_2 etc.

(ii) These are insoluble in water and soluble in benzene, kerosene and petrol etc.

(iii) These compounds are poor conductor of electricity.

(iv) It is a weak bond due to weak intermolecular forces. Covalent compounds have low melting and boiling points.

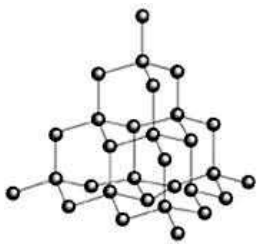
- **Allotropy in Carbon :** The property due to which an element exists in two or more forms, which differ in their physical and some of the chemical properties is known as **"Allotropy"** and the various forms are called **"Allotropes"**.

(i) Allotropes are formed due to the difference either in the number of atoms in the molecules or arrangement of atoms in the molecules.

(ii) Carbon exists in two allotropic form (1) crystalline (2) amorphous. The crystalline forms are diamond and graphite whereas the amorphous forms are coal, charcoal, lamp black etc.

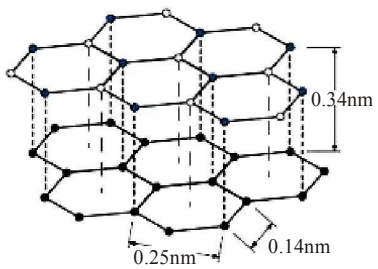
(iii) Both diamond and graphite are formed by carbon atom, the difference lies in the manner in which the carbon atom are bonded to one another.

(iv) In diamond each carbon atom is bonded to four other carbon atoms tetrahedrally by covalent bond. Thus it has a three dimensional network structure.



The structure of diamond

(v) Graphite has a two dimensional sheet structure in which each carbon atom is linked to three carbon atoms in a hexagonal planar structure, one of these bonds is a double bond and thus the valency of carbon is satisfied.



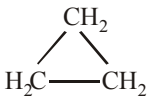
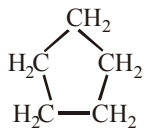
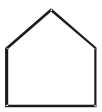
The structure of graphite

(vi) Diamonds is the hardest substance known while graphite is smooth and slippery.

(vii) Graphite is a very good conductor of electricity whereas diamond is a bad conductor of electricity.

(viii) **Fullerenes** form another class of carbon allotropes. The first one to be identified was C-60, which has carbon atoms arranged in the shape of a football. Since this looked like the geodesic dome designed by the US architect Buckminister Fuller, the molecule was names fullerenes.

- Carbon atom is unique amongst all the elements that are found in nature. It can form long chain molecules. The ability of carbon to form a long chain is called catenation. Carbon forms strong bond because of its small size which enables the nucleus to held on to the shared pairs of electrons strongly. The chains are formed because carbon atoms form tetravalent bonds with other carbon atoms. This structure can be repeated endlessly without disturbing the stability of the bonds and the compounds formed. The chains can form branches, and sub-branches. The carbon atoms also form rings.
- Catenation is also present in silicon (Si) with atomic number (Z) equal to 14. Its valence shell electronic configuration (2, 8, 4) is similar to carbon. However, only seven to eight atoms of the element can be linked by covalent bonds. It is because of smaller bond dissociation energy of Si—Si bond (200 kJ mol^{-1}) as compared to that of C—C bond. Therefore, the bonds in the silicon atoms are not as strong as in carbon atoms.
- In saturated compounds the valencies of all the carbon atoms are satisfied by single bonds between them. These compounds are very less reactive. e.g. C_2H_6, C_3H_8 etc.
- While in the unsaturated compounds, the valencies of all the carbon atoms are not satisfied by single bonds, thus in order to satisfy their valencies, they form double or triple bond between the carbon atoms. They are more reactive than the saturated carbon compounds. e.g. C_2H_2, C_2H_4, C_3H_6 etc.
- **Straight chain compounds :** The compounds which contain straight chain of carbon atoms are called straight chain compounds. e.g. normal butane (C_4H_{10}), normal pentane (C_5H_{12}) etc.
- **Branched chain compounds :** Those compounds which are branched are called branched chain compounds. E.g. iso-butane (C_4H_{10}), isopentane (C_5H_{12}), neopentane (C_5H_{12}) etc.
- **Closed chain compounds or Ring compounds : Cyclic compounds** are called closed chain or ring compounds. E.g. cyclohexane (C_6H_{12}), cyclopentane (C_5H_{10}), cyclobutane (C_4H_8), cyclopropane (C_3H_6) etc.

Molecular Formula	Condensed formula, Structural formula	Bond line notation, Representation	Common Name
C_3H_6			Cyclopropane
C_5H_{10}			Cyclopentane

- All those compounds which contain just carbon and hydrogen are called hydrocarbons. Among these the saturated hydrocarbons are called alkanes and the unsaturated hydrocarbons containing double bonds are called alkenes, while the unsaturated hydrocarbons containing triple bonds are called alkynes.
- The atom or group of atoms which determine the properties of a compound is known as functional group. e.g. –OH (alcohol), –CHO (aldehyde), > C = C < (alkene), – C ≡ C – (alkyne) etc.
- A series of compounds in which the same functional group substitutes hydrogen in a carbon chain is called a homologous series. e.g. CH_3Cl and C_2H_5Cl differ by a $–CH_2$ unit, similarly C_2H_5OH and C_3H_7OH also differ by a $–CH_2$ unit.

Characteristics of homologous series :

(i) They can be represented by the same general formula e.g. Alkanes (C_nH_{2n+2}), Alkenes (C_nH_{2n}), Alkynes (C_nH_{2n-2}) etc.

(ii) All the members of a homologous series contain the same functional group. e.g. alcohols contain –OH group; aldehydes contain –CHO group etc.

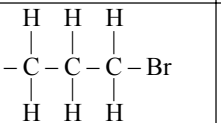
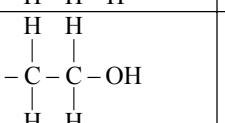
(iii) All the members of a homologous series can be prepared by same general methods of preparations.

(iv) They have similar chemical properties.

(v) They show gradation in physical properties like m.p. and b.p. (generally these increase with increase in molecular weight)

Homologous series	General formula	Example	Functional group
Straight Chain Alkanes	C_nH_{2n+2} (n more than or equal to 1)	CH_4, n = 1	
Alkyl	C_nH_{2n+1} (n more than or equal to 1)	CH_3, n = 1	
Alkenes and Cyclic Alkanes	C_nH_{2n} (n more than or equal to 2)	C_2H_4, n = 2	C = C
Alkynes	C_nH_{2n-2} (n more than or equal to 2)	C_2H_2, n = 2	C ≡ C
Alcohols	$C_nH_{2n+1}OH$ (n more than or equal to 1)	CH_4O, n = 1	– OH
Carboxylic acids	$C_nH_{2n}O_2$ (n more than or equal to 1)	CH_2O_2, n = 1	– COOH
Carbohydrates	$C_n(H_2O)_n$ (n more than or equal to 1)	$C_6H_{12}O_6$ n=6	–CHO, OH

- **Nomenclature**
  Chemists developed a set of rules, for naming organic compounds based on their structures which is known as IUPAC rules, where IUPAC stands for the "International Union of Pure and Applied Chemistry".
  The IUPAC name of an organic compounds consists of three parts.
  Prefix – word root – Suffix
  Word Root : A word root indicates the nature of basic carbon skeleton. e.g. a compound containing four carbon atom have the name butane.
- In case a functional group is present, it is indicated in the name of the compound with either as a prefix or as a suffix.
- While adding the suffix to the word root the terminal 'e' of carbon chain is removed e.g. a three carbon chain with an alcohol group would be named as
  Propane – 'e' = Propan + ol $\rightarrow$ Propanol.
- If the carbon chain is unsaturated then the final 'ane' in the name of the carbon chain is substituted by 'ene' or 'yne' respectively for double and triple bonds.

Functional group	Prefix/Suffix	Functional group	Example	IUPAC Name
1. Halogen	Chloro, bromo, Iodo	–Cl, – Br, – I		–Bromopropane
2.Alcohol	–ol	–OH		–ethanol
3. Aldehyde	–al	–CHO	$CH_3CH_2CH_2CHO$	–Butanal
4. Ketone	–one	–CO	CH_3COCH_3	–Propanone
5. Carboxylic acid	–oic acid	–COOH	CH_3CH_2COOH	–Propanoic acid
6. Amine	Amino	$-NH_2$	$CH_3CH_2NH_2$	–Amino ethane
7. Ester	oate –	–COOR	CH_3COOCH_3	–Methyl ethanoate
8. Double bond	ene		$CH_3 - CH = CH_2$	–Propene
9. Triple bond	yne		$CH_3 - CH_2 - C \equiv CH$	–Butyne

- **Chemical Properties of Carbon Compounds :**

(i) Combustion reaction : Carbon undergo combustion reaction and produce carbon dioxide with the evolution of heat and light. Most carbon compounds release a large amount of heat and light on burning.

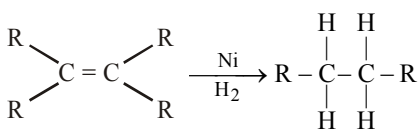
$$C + O_2 \longrightarrow CO_2 + \text{heat and light}$$

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

$$CH_3CH_2OH + O_2 \longrightarrow CO_2 + H_2O + \text{heat and light}$$

- Saturated hydrocarbons generally give a clean flame while unsaturated carbon compounds give a yellow flame with lots of black smoke. Yellow flame signifies incomplete combustion of fuel.
- All **combustion reactions** are basically **oxidation reactions** carried in the presence of air or oxygen. It is not necessary that reactants may burn during combustion.
- Combustion of ethyne (C_2H_2) with oxygen is used in **gas welding**.
- If the combustion of an organic compound (particularly of hydrocarbons) is properly controlled it may give useful organic compound.

(ii) Addition reaction : Generally alkanes do not undergoes addition reaction. Alkanes are found to be least reactive. unsaturated hydrocarbons alkenes and alkynes are more reactive. Among alkene and alkynes, the alkenes are more reactive. Unsaturated hydrocarbons undergo addition reaction in presence of catalysts e.g.



- This reaction is commonly used in the **hydrogenation of vegetable oils**.
  Other examples of addition reactions are :

$$CH_2 = CH_2 \xrightarrow{Br_2 / CCl_4} \underset{Br}{\overset{|}{CH_2}} - \underset{Br}{\overset{|}{CH_2}}$$

$$CH_2 = CH_2 + HCl \longrightarrow CH_3 - CH_2Cl$$

(iii) Substitution reaction : Saturated hydrocarbons give substitution reaction e.g. methane in presence of sunlight undergo chlorination.

$$CH_4 + Cl_2 \xrightarrow{h\upsilon} CH_3Cl + HCl$$

$$CH_3Cl + Cl_2 \xrightarrow{h\upsilon} CH_2Cl_2 + HCl$$

$$CH_2Cl_2 + Cl_2 \xrightarrow{h\upsilon} CHCl_3 + HCl$$

$$CHCl_3 + Cl_2 \xrightarrow{h\upsilon} \underset{\text{Carbon tetrachloride}}{CCl_4} + HCl$$

Substitution reactions by Br_2 and I_2 can also be carried out in similar manner.

- **Some Important Carbon Compounds**

Alcohols : Compounds containing –OH group attached to a carbon atom are known as alcohols. The general formula for alcohol is R – OH, where R is an alkyl group and –OH is a functional group.

Example : Ethanol (C_2H_5OH) : commonly known as alcohol.

Properties of Ethanol :

Physical properties :

(i) Ethanol is a colourless liquid at room temperature. Its b.p. is 351K. It is neutral to litmus.

(ii) Ethanol is commonly called alcohol and it is an active ingredient of all alcoholic drinks.

(iii) Ethanol is a hypnotic (sleep producer).

Chemical properties :

(i) Combustion : Ethanol is highly inflammable liquid and catches fire easily, burns with a blue flame.

$$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O + \text{heat} + \text{light}$$

(ii) Reaction with sodium : Due to its weakly acidic nature, ethanol reacts with sodium to librate H_2 gas.

$$2C_2H_5OH + 2Na \longrightarrow \underset{\text{Sodium ethoxide}}{2C_2H_5ONa} + H_2\uparrow$$

(iii)Reaction with ethanoic acid :

$$C_2H_5OH + CH_3COOH \xrightarrow{\text{conc. } H_2SO_4} CH_3COOC_2H_5 + H_2O$$

Ester

This process is known as **esterification.** In this conc. H_2SO_4 acts as dehydrating agent.

On treating with an alkali solution, this ester is converted back to the constituent alcohol and form sodium salt of the acid.

$$CH_3COOC_2H_5 + NaOH \longrightarrow CH_3COONa + C_2H_5OH$$

This process is known as **saponification**.

(iv) $C_2H_5OH \xrightarrow[443K]{\text{Conc. } H_2SO_4} C_2H_4 + H_2O$

Harmful Effects of Drinking Alcohol :

(i) If the alcohol used for drinking purposes contains some methyl alcohol (CH_3OH) as impurity then it may cause serious poisoning and loss of eye sight.

(ii) It is habit forming and damages liver if taken regularly in large quantities.

(iii) Under the influence of alcohol, a person loses the sense of discrimination.

(iv) If taken in large quantities it may prove to be fatal.

Denaturation of Ethanol : Ethanol is the only alcohol recommended for drinking. The drinks containing ethanol are known as alcoholic **beverages**. Since it is the major source of income to the government, it is subjected to very heavy excise duty. As a result, alcoholic drinks are extremely expensive. But ethyl alcohol is also needed for furniture polishing and as a solvent for many substances. This means that ethyl alcohol or ethanol has a great industrial importance. This has to be cheap and is subjected to very small excise duty. Now there is a big problem. It is difficult to diffrentiate between ethyl alcohol to be sold as beverage and to be sold commercially. The problem has been solved by denaturation of alcohol.

Ethanoic Acid (Acetic Acid) CH_3COOH: Ethanoic acid, commercially known as acetic acid belongs to a group of acids called carboxylic acid. 5-8% solution of acetic acid in water is vinegar and is widely used as preservative in pickles.

Properties of acetic acid :

Physical properties :

(i) It is a colourless liquid that has a sour taste and has a vinegar like smell.

(ii) It is miscible with water in all proportions.

(iii) On cooling it freezes to form ice-like flakes. They appear like a glacier. Due to this property pure ethanoic acid is called **glacial acetic acid**.

Chemical properties :

(i) Reaction with a base : It is weaker acid than mineral acids such as HCl, HNO_3, H_2SO_4 etc.

$$2CH_3COOH + 2NaOH \longrightarrow 2CH_3COONa + H_2O$$

(ii) Reaction with carbonates and bicarbonates :

$$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + CO_2 + H_2O$$

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$$

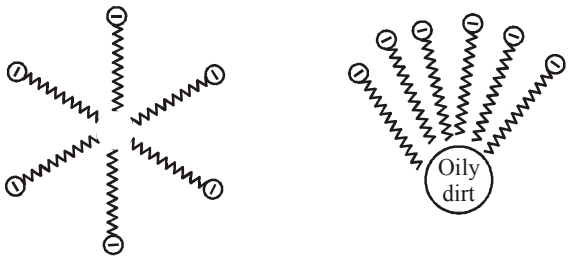
(iii)Reaction with alcohol : (Esterification)

$$CH_3COOH + C_2H_5OH \longrightarrow \underset{\text{Ethyl ethanoate (ester)}}{CH_3COOC_2H_5} + H_2O$$

- Both ethanol and ethanoic acid are organic liquids but are completely miscible with water. Actually, their molecules are attracted towards H_2O molecules by attractive force known as **hydrogen bonding**. Energy released in attraction helps in their dissolution in water.
- **Soaps** : Soaps are sodium or potassium salts of long chain acid carboxylic acids.
- **Detergent :** They are ammonium or sulphurate salts of long chain carboxylic acids.

Cleansing action of soap and detergent : Both of them follow the same principle. They contain two parts, a large hydrocarbon which is a hydrophobic (water repelling) and a negative charged head, which is hydrophillic (water attracting). In solution water molecules being polar in nature, surround the ions & not the organic part of the molecule. When a soap or detergent is dissolved in water the molecule gather together as clusters, called **micelles.** The tails stick inwards & the head outwards. The hydrocarbon tail attaches itself to oily dirt. When water is agitated, the oily dirt tends to lift off from the dirty surface & dissociates into fragments. The solution now contains small globules of oil

surrounded detergent molecules. The negatively charged heads present in water prevent the small globules from coming together and form aggregates. Thus the oily dirt is removed from the object.



Micelle formed by detergent molecules in water. The hydrocarbon tail stick to oily dirt

Advantages of Detergents over Soaps :

(i) Soaps does not lather easily in hard water and is not useful in case of hard water. Detergents work well even in hard water.

(ii) Detergents are more easily soluble than soaps.

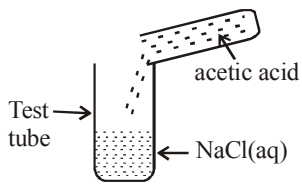
(iii) Detergents containing branched carbon chains are non-biodegradable whereas soaps are fully biodegradable.

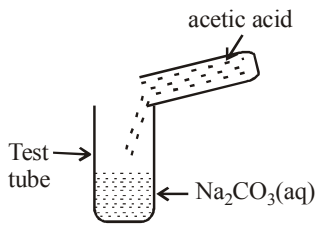
- Soaps and detergents form micelles in water only because of the presence of charge on their molecules. Micellear formation does not occur in solvent like ethyl alcohol since it is not as polar as soaps. That is why only water is used for the washing of dirty clothes.

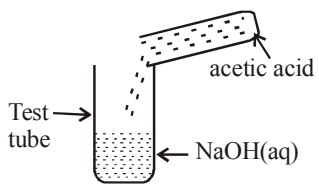
Exercise 1

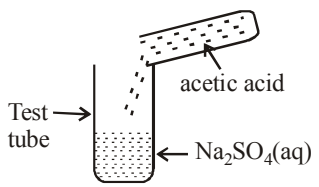
DIRECTIONS : This section contains multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which only one is correct.

1. An organic compound 'A' with molecular formula $C_2H_4O_2$ turns blue litmus to red and gives brisk effervescence with sodium hydrogen carbonate. Identify the compound
   (1) Methanoic acid (2) Ethanoic acid
   (3) Propanoic acid (4) Butanoic acid
2. In which test-tube will effervescence occur?

(1) 

(2) 

(3) 

(4) 

3. The enzyme involved in the oxidation of ethanol to form vinegar is
   (1) zymase (2) oxidase
   (3) acetobacter (4) invertase
4. Glacial acetic acid is
   (1) 100% acetic acid free of water
   (2) solidified acetic acid
   (3) gaseous acetic acid
   (4) frozen acetic acid
5. The number of isomers of an alkane with molecular weight 72 is :
   (1) 2 (2) 3
   (3) 4 (4) 5
6. When ethanoic acid reacts with ethanol a sweet smelling product is formed. The functional group of the product is
   (1) aldehyde (2) ketone
   (3) alcohol (4) ester
7. Two adjacent members of a homologous series have :
   (1) a difference of $-CH_2$ in their structure
   (2) a difference of 14 a.m.u. in molecular mass
   (3) same general methods of preparation
   (4) All the above
8. Which of the following statements is not correct?
   (1) Graphite is much less dense than diamond
   (2) Graphite is black and soft
   (3) Graphite has low melting point
   (4) Graphite feels smooth and slippery
9. Alkenes are characterized by
   (1) C – C bonds (2) C = C bonds
   (3) C ≡ C bonds (4) Cyclic structure
10. Which of the following decolourises alkaline $KMnO_4$ solution?
    (1) Ethane (2) Ethene
    (3) Methane (4) Propane
11. Which of the following contains carbonyl group?
    (1) Ketones (2) Aldehydes
    (3) Esters (4) All of these

12. A reagent used to test unsaturation in alkene is
(1) ammonical Cu_2Cl_2
(2) ammonical $AgNO_3$ solution
(3) solution of Br_2 in CCl_4
(4) conc. H_2SO_4

13. Ethyl alcohol is used
(1) as a solvent
(2) as a fuel in spirit lamps
(3) as an alcoholic beverage
(4) All the above are correct

14. A colourless liquid sample was tested with universal pH paper strip. The colour of the strip is changed to reddish pink. The sample would be
(1) tap water
(2) sodium hydroxide solution
(3) distilled water
(4) ethanoic acid solution

15. Vinegar is a solution of
(1) 50-60% acetic acid in alcohol
(2) 5-8% acetic acid in alcohol
(3) 5-8% acetic acid in water
(4) 50-60% acetic acid in water

16. Which of the following represents saponification reaction?
(1) $CH_3COONa + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$
(2) $CH_3COOH + C_2H_5OH \xrightarrow{conc.\ H_2SO_4} CH_3COOC_2H_5 + H_2O$
(3) $2C_2H_5OH + 2Na \longrightarrow 2CH_3COONa + H_2$
(4) $CH_3COOC_2H_5 + NaOH \longrightarrow CH_3COONa + C_2H_5OH$

17. Cyclohexane, a hydrocarbon, floats on water because
(1) it is immiscible with water
(2) its density is low as compared to water
(3) it is non-polar substance
(4) it is immiscible and lighter than water

18. The functional group present in $CH_3COOC_2H_5$ is
(1) ketonic (2) aldehydic
(3) ester (4) carboxylic

19. Soaps are
(1) sodium salts of sulphuric acids containing carbon atoms 10 to 16
(2) sodium salts of fatty acids containing carbon atoms 16 to 18
(3) sodium salts of trihydroxy alcohols
(4) None of the above

20. The amount of oxygen used in combustion of 1 mol of ethene is
(1) 1 mol (2) 2 mol
(3) 2.5 mol (4) 3 mol

21. The treatment of acetic acid with lithium aluminium hydride ($LiAlH_4$) produces
(1) methanol (2) ethanol
(3) ethanal (4) methanal

22. Soaps are sodium salts of fatty acids. Which of the following fatty acid does not form soap?
(1) Butyric acid (2) Oleic acid
(3) Palmitic acid (4) Stearic acid

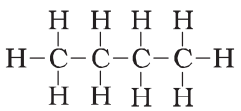
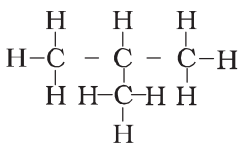
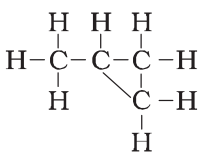
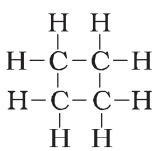
23. What is 'X' in the following reaction?
$HC \equiv CH \xrightarrow{dil.\ H_2SO_4,\ HgSO_4} 'X'$
(1) CH_3COOH (2) $CHO - CHO$
(3) CH_3CHO (4) $CH_2OH - CH_2OH$

24. By which reaction is ethene obtained from ethyne?
(1) Oxidation (2) Polymerisation
(3) Hydrogenation (4) Dehydrogenation

25. Which one of the following is the correct statement ?
Graphite can be used as lubricant because it has:
(1) a rigid structure (2) low viscosity
(3) layered structure (4) low melting point

26. The oxide of which of the following elements is used as a coolant?
(1) Silicon (2) Nitrogen
(3) Carbon (4) Phosphorus

27. Which one of the following is not an allotrope of carbon?
(1) Soot (2) Graphite
(3) Diamond (4) Carborundum

28. Which of the following are correct structural isomers of butane?
(i) 
(ii) 
(iii) 
(iv) 
(1) (i) and (iii) (2) (ii) and (iv)
(3) (i) and (ii) (4) (iii) and (iv)

29. Oils on treating with hydrogen in the presence of palladium or nickel catalyst form fats. This is an example of
(1) Addition reaction
(2) Substitution reaction
(3) Displacement reaction
(4) Oxidation reaction

30. The soap molecule has a
(1) hydrophilic head and a hydrophobic tail
(2) hydrophobic head and a hydrophilic tail
(3) hydrophobic head and a hydrophobic tail
(4) hydrophilic head and a hydrophilic tail

31. In the soap micelles
(1) the ionic end of soap is on the surface of the cluster while the carbon chain is in the interior of the cluster.
(2) ionic end of soap is in the interior of the cluster and the carbon chain is out of the cluster.
(3) both ionic end and carbon chain are in the interior of the cluster
(4) both ionic end and carbon chain are on the exterior of the cluster

32. Pentane has the molecular formula C_5H_{12}. It has
(1) 5 covalent bonds (2) 12 covalent bonds
(3) 16 covalent bonds (4) 17 covalent bonds

33. Mineral acids are stronger acids than carboxylic acids because
(i) mineral acids are completely ionised
(ii) carboxylic acids are completely ionised
(iii) mineral acids are partially ionised
(iv) carboxylic acids are partially ionised
(1) (i) and (iv) (2) (ii) and (iii)
(3) (i) and (ii) (4) (iii) and (iv)

34. Carbon forms four covalent bonds by sharing its four valence electrons with four univalent atoms, e.g. hydrogen. After the formation of four bonds, carbon attains the electronic configuration of
(1) helium (2) neon
(3) argon (4) krypton

35. Which among the following are unsaturated hydrocarbons?
(i) $H_3C-CH_2-CH_2-CH_3$
(ii) $H_3C-C\equiv C-CH_3$
(iii) $H_3C-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$
(iv) $H_3C-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH_2$
(1) (i) and (iii) (2) (ii) and (iii)
(3) (ii) and (iv) (4) (iii) and (iv)

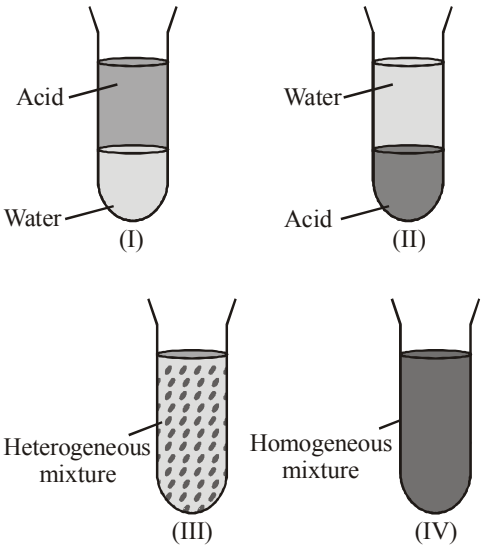
36. The heteroatoms present in
$CH_3-CH_2-O-CH_2-CH_2Cl$ are
(i) oxygen (ii) carbon
(iii) hydrogen (iv) chlorine
(1) (i) and (ii) (2) (ii) and (iii)
(3) (iii) and (iv) (4) (i) and (iv)

37. Gas welding used for welding broken pieces of iron, we normally use a mixture of :
(1) ethane and oxygen (2) ethene and oxygen
(3) ethyne and oxygen (4) ethene and air

38. Sodium hydrogen carbonate is used to distinguish :
(1) Ethanol and methanol (2) Ethanol and ethene
(3) Ethene and ethyne (4) Ethanol and ethanoic acid

39. Ethanoic acid was added to sodium bicarbonate solution and the gas evolved was tested with a burning splinter. The following four observations were reported :
(i) The gas burns with the pop sound and the flame gets extinguished.
(ii) The gas does not burn but the splinter burns with a pop sound.
(iii) The flame extinguishes and the gas does not burn.
(iv) The gas burns with a blue flame and the splinter burns brightly.
The correct observation is reported in
(1) (i) (2) (ii)
(3) (iii) (4) (iv)

40. Amount of 5 mL each of acetic acid and water are mixed together and shaken well :



The resulting mixture would appear as in
(1) I (2) II
(3) III (4) IV

41. Ethene and ethane can be distinguished from each other by :
(1) Blue litmus paper
(2) Red litmus paper
(3) Bromine water
(4) Sodium hydrogen carbonate

42. Four students observed the colour and odour of acetic acid in its reaction with sodium hydrogen carbonate. They tabulated their observations as below :

Student	Colour of acetic acid	Odour of acetic acid	Action with sodium hydrogen carbonate
I	Blue	fruity	gas evolves without bubbles
II	Colourless	smell of vinegar	effervescence
III	Light green	odourless	gas evolves without bubbles
IV	Light brown	rotten	effervescence

The correct set of observations is that of student
(1) I (2) II
(3) III (4) IV

43. According to IUPAC system, the correct name of the organic compound

$$CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_2-\overset{\displaystyle O}{\overset{\|}{C}}-OH$$ is

(1) 2- Bromobutanoic acid
(2) 2- Bromobutyric acid
(3) 3- Bromobutanoic acid
(4) 3- Bromo-2-hydroxybutan-2-one

44. Dehydration of ethyl alcohol to ethylene is carried by heating it with :
(1) conc H_2SO_4 at 200 K
(2) acidified $KMnO_4$ solution
(3) alkaline $KMnO_4$ solution
(4) conc H_2SO_4 at 443 K

45. Covalent compounds :
(1) have high melting and boiling points.
(2) are mostly soluble in water.
(3) are formed between atoms of metals and non metals
(4) are formed by the sharing of electrons in the bonding atoms.

46. The by-product of soap is :
(1) Isoprene (2) Glycerol
(3) Butene (4) Ethylene glycol

47. When the stopper of a bottle containing a colourless liquid was removed, the bottle gave out a smell like that of vinegar. The liquid in the bottle could be :
(1) hydrochloric acid solution
(2) sodium hydroxide solution
(3) acetic acid solution
(4) saturated sodium hydrogen carbonate solution.

48. Which of the following cannot distinguish ethanol from ethanoic acid ?
(1) Blue litmus
(2) Sodium hydroxide
(3) Sodium hydrogen carbonate
(4) Sodium metal

49. Which is a general formula of alkenes ?
(1) C_nH_{2n+2} (2) C_nH_{2n}
(3) C_nH_{2n-2} (4) None of the above

50. General formula of alkyne is –
(1) C_nH_{2n+2} (2) C_nH_{2n}
(3) C_nH_{2n-2} (4) C_nH_n

51. Observe the following pairs of organic compounds :
(I) C_4H_9OH and $C_5H_{11}OH$
(II) $C_7H_{15}OH$ and $C_5H_{11}OH$
(III) $C_6H_{13}OH$ and C_3H_7OH
Which of these pair is a homologous series according to increasing order of carbon atom?
(1) (III) only (2) (II) only
(3) (I) only (4) All of these

52. Buckministerfullerene is an allotropic form of
(1) phosphorus (2) sulphur
(3) carbon (4) tin

53. We can not use graphite as a lubricant in space because
(1) there is no atmosphere in space and so graphite sublimes in space.
(2) there is no atmosphere in space and so there is no adsorbed air and water between layers of graphite.
(3) absence of external pressure transforms crystalline graphite to amorphous graphite.
(4) None of the above is correct.

54. It is advised that we should not light a candle in a closed room with people, because
(1) the carbon dioxide formed by burning candle causes breathlessness.
(2) carbon particles that are formed due to burning of candle are dangerous for respiratory tract.
(3) methane gas, which is poisonous in nature, is formed when a candle burns.
(4) carbon monoxide gas, which reduces the ability of blood to carry oxygen, is formed when a candle burns.

55. Which of the following attractive forces exists between different layers of graphite ?
(1) Gravitational forces (2) van der Waals forces
(3) Coulombic forces (4) None of these

56. Water gas is
(1) $CO + CO_2$ (2) $CO + N_2$
(3) $CO + H_2$ (4) $CO + N_2 + H_2$

57. Nature of products obtained on complete combustion of methane are
(1) acidic, basic (2) acidic, neutral
(3) basic, neutral (4) neutral, neutral

58. The IUPAC name of the following compound is :
$CH_2 = CH - CH(CH_3)_2$
(1) 1, 1dimethyl-2-propene (2) 3-methyl-1-butene
(3) 2-vinyl propane (4) 1-isopropyl ethylene

59. The IUPAC name of :
$CH_3 - C(CH_3)(OH)CH_2 - CH(CH_3)CH_3$ is –
(1) 2,4-dimethyl pentane-2-ol
(2) 2,4-dimethyl pentane-4-ol
(3) 2,2-dimethyl butane
(4) butanol-2-on

60. $CH_3CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\underset{\displaystyle CHO}{\underset{|}{CH}}-CH_2CH_3$ has the IUPAC name –
(1) 2–sec Butylbutanal
(2) 2, 3–Diethylbutanal
(3) 2–Ethyl–3–methylpentanal
(4) 3–Methyl–2–ethylpentanal

61. The IUPAC name of the compound

$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-CH_2-Cl$$ is –

(1) 1–Chloro–3–methylbutane
(2) 2–Methyl–4–chlorobutane
(3) 2–Methyl–1–chlorobutane
(4) 1–Chloropentane

62. Which is correct IUPAC name of the following compound

$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-\underset{\displaystyle CH_2-CH_3}{\underset{|}{CH}}-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3$$

(1) 3–Isopropyl–2–methylpentane
(2) 3–Ethyl–2,4–dimethylpentane
(3) 2,4–Dimethyl–3–ethylpentane
(4) 3–Isopropyl–4–methylpentane

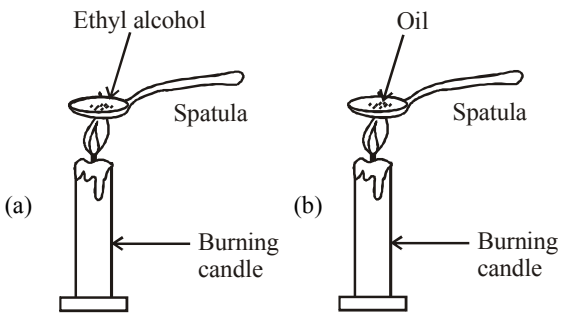
63. Ram went to chemistry lab to perform experiment, which is given as :
"He took 3 ml of ethanol in a dry test-tube and warm it gently in a water bath, then added a 5% solution of alkaline potassium permanganate drop by drop to this solution."
What did Ram not observe in his experimental test-tube :
(1) The purple colour of solution disappears upon heating.
(2) The smell of ethanol comes out
(3) The solution of the test-tube turns blue litmus to red.
(4) The smell of vinegar comes out from the test-tube.

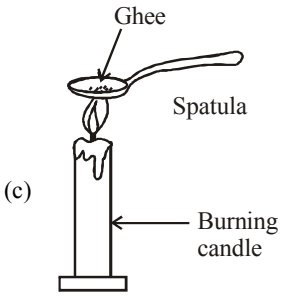
64. Observe the following table carefully

Test tube	Hard water	Soap/detergent is added	Observation (After shaking 5 minutes)
P	10 ml	Soap (5 drops)	White curd like Scum formed
Q	15 ml	Detergent (5 drops)	White curd like Scum is formed
R	8 ml	Soap (5 drops)	Lot of leather is formed
S	12 ml	Detergent (5 drops)	Lot of leather is formed

Which test-tube give correct result among these
(1) P & Q (2) Q & R
(3) P & S (4) R & S

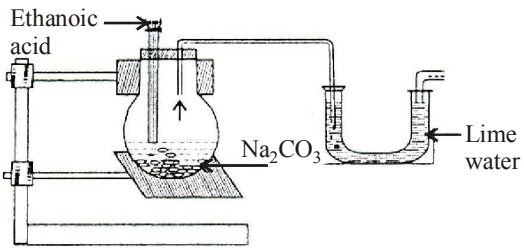
65. Observe the following experimental setup carefully.





Which set up will produce smoke ?
(1) Set up (a) (2) Set up (b)
(3) Set up (c) (4) All the set up (a), (b) & (c)

66. Observe the following experimental set up :



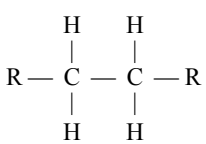
From this experimental set up which type of compound will react with lime water and what will remain in round bottom flask :
(1) CO_2 and CH_3COOH (2) H_2 and CH_3COONa
(3) CO_2 and CH_3COONa (4) H_2O and CH_3COONa

Exercise 2

Matching Based MCQ

DIRECTIONS (Qs. 1 to 6) : Match Column-I with Column-II and select the correct answer using the codes given below the columns.

1.

	Column I	Column II
(A)	$CH_2=CH_2+Br_2\rightarrow$ CH_2Br-CH_2Br	(p) Combustion reaction
(B)	$2CH_3COOH+Na_2CO_3\rightarrow 2CH_3COONa+CO_2+H_2O$	(q) Test for carboxylic acid
(C)	$CH_2=CH_2+H_2O\xrightarrow{H_2SO_4}CH_3CH_2OH$	(r) Hydration reaction
(D)	$CH_2=CH_2+2O_2\longrightarrow CO_2+2H_2O$	(s) Addition reaction
(E)	$R_2C=CR_2\xrightarrow{Ni/H_2}$ 	(t) Hydrogenation reaction

(1) A-(s); B-(q); C-(r); D-(p); E-(t)
(2) A-(q); B-(p); C-(r); D-(s); E-(t)
(3) A-(r); B-(s); C-(q); D-(p), E -(t)
(4) A-(s); B-(r); C-(q); D-(p), E -(t)

2.

	Column I	Column II
(A)	Propane	(p) C_2H_5OH
(B)	Ethyl alcohol	(q) C_3H_8
(C)	Carboxylic acid	(r) CH_3COOH
(D)	Ethyl ethanoate	(s) $CH_3COOC_2H_5$
(E)	Butanone	(t) $CH_3CH_2COCH_3$

(1) A-(s); B-(r); C-(q); D-(t), E -(p)
(2) A-(q); B-(p); C-(r); D-(s); E-(t)
(3) A-(r); B-(s); C-(q); D-(p), E -(t)
(4) A-(s); B-(r); C-(q); D-(p), E -(t)

3.

	Column I	Column II
(A)	Aldehyde	(p) -chloro
(B)	Ketone	(q) -ol
(C)	Alcohol	(r) -one
(D)	Halogen	(s) -al
(E)	Carboxylic acid	(t) -oic acid

(1) A-(s); B-(r); C-(q); D-(t), E -(p)
(2) A-(s); B-(p); C-(r); D-(q), E -(t)
(3) A-(r); B-(s); C-(q); D-(p), E -(t)
(4) A-(s); B-(r); C-(q); D-(p), E -(t)

4.

	Column I		Column II
(A)	Covalent bond	(p)	Atomic molecule
(B)	Low m.pt. and low b.pt.	(q)	Double bond
(C)	Ethylene	(r)	High refractive index
(D)	Argon	(s)	Hydrogen molecule
(E)	Diamond	(t)	Covalent compounds

(1) A-(s); B-q; C-(r); D-(p); E-(t)
(2) A-(s); B-(t); C-(q); D-(p), E -(r)
(3) A-(r); B-(s); C-(q); D-(p), E -(t)
(4) A-(t); B-(s); C-(q); D-(p), E -(r)

5.

	Column I		Column II
(A)	Allotrope of carbon	(p)	Hydrocarbons
(B)	Good lubricant	(q)	Unsaturated hydrocarbons
(C)	Compounds of carbon and hydrogen	(r)	Fullerene
(D)	n-butane and iso-butane	(s)	Graphite
(E)	Alkynes	(t)	Isomers

(1) A-(r); B-(s); C-(p); D-(t), E -(q)
(2) A-(s); B-(t); C-(q); D-(p), E -(r)
(3) A-(r); B-(s); C-(q); D-(p), E -(t)
(4) A-(t); B-(s); C-(q); D-(p), E -(r)

6.

	Column I		Column II
(A)	Treatment of ester with NaOH	(p)	Chemical properties
(B)		(q)	2, 2 dimethyl propane
(C)	Branched chain hydrocarbon	(r)	14 amu
(D)	Functional group	(s)	Saponification
(E)	Consecutive homologues	(t)	Ketonic group

(1) A-(r); B-(s); C-(p); D-(t), E -(q)
(2) A-(s); B-(q); C-(t); D-(p), E -(r)
(3) A-(s); B-(t); C-(q); D-(p), E -(r)
(4) A-(t); B-(s); C-(q); D-(p), E -(r)

Statement Based MCQ

7. Consider the following statements with regard to diamond and graphite:
(a) Diamond and graphite are isotopes of carbon.
(b) C-C bond length in diamond is greater than that in graphite.
(c) Graphite is less reactive than diamond.
Which of these statement(s) is/are correct ?
(1) (a) and (b) (2) Only (a)
(3) Only (b) (4) Only (c)

8. Consider the following statements :
(a) Diamond is known as black lead.
(b) Diamond contains carbon.
(c) Steel is harder than diamond.
Which of the statement(s) given above is/are correct ?
(1) Only (a) (2) Only (b)
(3) (b) and (c) (4) (a), (b) and (c)

9. Which of the statements regarding carbon dioxide is /are correct?
(a) It is prepared on large scale by the action of water on lime.
(b) In the solid form it can be used as a refrigerant.
Select the correct answer using the code given below:
(1) (a) only (2) (b) only
(3) Both (a) and (b) (4) Neither (a) nor (b)

10. Consider the following statements :
Hard water does not give lather with soap because hard water contains:
(a) calcium bicarbonate
(b) magnesium bicarbonate
(c) chlorides of calcium and magnesium
(d) sulphates of calcium and magnesium
Which of these statements are correct ?
(1) (a) and (b) (2) (c) and (d)
(3) (a), (b) and (c) (4) (a), (b), (c) and (d)

11. Consider the following statements:
(a) Saturated hydrocarbons burn with a smoky flame.
(b) Carbon is a versatile compound.
Which of these statement(s) is/are correct ?
(1) (a) only (2) (b) only
(3) Both (a) and (b) (4) Neither (a) nor (b)

12. Consider the following statements:
(a) Ethanol is the first member of the homologous series of alcohol.
(b) We can distinguish between ethanol and ethanoic acid with the help of litmus test.
(c) Ethanol when oxidised with alkaline $KMnO_4$ forms ethanoic acid.
Which of these statements(s) is/are correct ?
(1) (a) and (b) (2) (a) and (c)
(3) (b) and (c) (4) All are correct

13. Consider the following statements:
(a) The simplest saturated hydrocarbon is methane.
(b) The gas evolved by the action of ethanoic acid with washing soda is carbon monoxide.
Which of these statement(s) is/are correct ?
(1) (a) only (2) (b) only
(3) Both (a) and (b) (4) Neither (a) nor (b)

14. Consider the following statements:
(a) Unsaturated hydrocarbons give addition reactions.
(b) By hydrogenation, vegetable oils can be converted into vanaspati ghee.
(c) Soaps are sodium salts of sulphonic acids.
Which of these statement(s) is/are correct ?
(1) (a) and (b) (2) (a) and (c)
(3) (b) and (c) (4) All are correct

15. Consider the following statements:
(a) Graphite is used in pencils.
(b) Pentane has three isomers.
Which of these statement(s) is/are correct ?
(1) (a) only (2) (b) only
(3) Both (a) and (b) (4) Neither (a) nor (b)

16. Consider the following statements:
(a) Esters are sweet smelling compounds.
(b) Glucose and fructose can be represented by the same molecular formula.
Which of these statement(s) is/are correct ?
(1) (a) only (2) (b) only
(3) Both (a) and (b) (4) Neither (a) nor (b)

Passage Based MCQ

DIRECTIONS (Qs. 17 to 25) : Read the passage(s) given below and answer the questions that follow.

PASSAGE - 1

Hydrocarbons are the compounds containing carbon and hydrogen. There are two types of hydrocarbons.

Saturated hydrocarbon which contains only carbon carbon single covalent bonds.

Unsaturated hydrocarbon which contains carbon carbon double bond or carbon carbon triple bond.

17. A hydrocarbon is –
    (1) a compound containing carbon, hydrogen and oxygen
    (2) is sodium hydrogen carbonate
    (3) a compound containing carbon and hydrogen only
    (4) a derivative of benzene
18. An unsaturated hydrocarbon
    (1) contains six carbon atoms
    (2) contains fewer hydrogen atoms than is needed for carbon to have its usual valency of four
    (3) contains excess of hydrogen
    (4) contains a chain of carbon atom
19. A saturated hydrocarbon contain
    (1) carbon carbon single bond only
    (2) carbon carbon double or triple bond
    (3) those hydrocarbons which contain carbon chain atleast 5 carbon long
    (4) those hydrocarbons which contain branched chains only.

PASSAGE - 2

When an element exists in two or more forms without changing its state and has different physical properties but the same chemical properties, the different forms are known as **allotropic form** or **allotropes** of that element, and the phenomenon is called **allotropy**.

Pure carbon exists in both *crystalline* and *amorphous* form.

Crystalline : Diamond, graphite.

Amorphous : Charcoal, coal, coke, carbon black.

20. An element exists in different allotropic forms because of
    (1) different arrangement of atoms
    (2) different amounts of energy associated in the formation of each allotropic form
    (3) different methods of formation
    (4) All the above are correct
21. Which of the following allotropes of carbon is used for manufacture of fullerenes?
    (1) Graphite (2) Diamond
    (3) Coke (4) Charcoal
22. Which statement best confirms that two substances are allotropes of carbon ?
    (1) They both reduce heated iron (III) oxide to iron,
    (2) They have different crystalline structures.
    (3) Equal masses of the substances require equal masses of oxygen for complete combustion.
    (4) Equal masses of the substances require equal masses of carbon dioxide, and no other product, when completely burnt in oxygen.

PASSAGE - 3

Carbon forms two oxides X and Y. The oxide Y is poisonous in nature and the oxide X is non-poisonous. X is used for artificial respiration in the form of carbogen. 'Y' if inhaled in large quantity may prove to be fatal.

23. Name the oxide 'X'
    (1) Carbon monoxide (2) Carbon dioxide
    (3) Methane (4) None of these
24. What is the approximate percentage of "X" in **carbogen** ?
    (1) 5% (2) 60%
    (3) 80% (4) 95%
25. Why "Y" causes death ?
    (1) It combines with haemoglobin to form carboxy - haemoglobin.
    (2) It causes dehydration in our body
    (3) It induces sleep.
    (4) None of the above

Assertion Reason Based MCQ

DIRECTIONS (Qs. 26 to 35) : Following questions consist of two statements, one labelled as the **'Assertion'** and the other as **'Reason'**. You are to examine these two statements carefully and select the answer to these items using the code given below.

Code :

(1) Both A and R are individually true and R is the correct explanation of A:
(2) Both A and R are individually true but R is not the correct explanation of A.
(3) A is true but R is false
(4) A is false but R is true.

26. **Assertion :** Sometime, during cooking, the bottom of the vessel becomes black from outside.
    Reason : Food is not properly cooked.
27. **Assertion :** Soaps are formed by saponification reactions.
    Reason : In a saponification reaction, an organic acid combines with an alkali like NaOH or KOH.
28. **Assertion :** Denaturation of ethyl alcohol makes it unfit for drinking purposes.
    Reason : Denaturation of ethyl alcohol is carried by methyl alcohol.
29. **Assertion :** C.N.G. (Compressed natural gas) is mainly methane compressed in the liquefied form.
    Reason : Combustion of methane is exothermic in nature.
30. **Assertion :** Chemical bonds in organic compounds are of covalent nature.
    Reason : A covalent bond is formed by the sharing of electrons in the bonding atoms.
31. **Assertion :** The large number of carbon compounds exist due to the self-linking property of carbon known as catenation.
    Reason : The strength of the carbon to carbon bonds is very high.
32. **Assertion :** Acetic acid is a very useful solvent for organic compounds.
    Reason : Solubility is governed by the principle that like dissolve like.

33. **Assertion :** Purely - covalent compounds cannot conduct electricity while purely ionic compounds can.
Reason : Purely covalent compounds have lower melting and boiling points than purely ionic compounds.

34. **Assertion :** Carbon forms the largest number of compounds.
Reason : Carbon shows valency of 4.

35. **Assertion :** Atmospheric carbon dioxide is concentrated in its lower layers.
Reason : Carbon dioxide is produced in the process of combusion close to the ground.

Correct definition Based MCQ

36. Covalency is
(1) number of electrons donated by an atom
(2) number of electrons contributed by an atom for sharing
(3) number of electrons contributed by an atom to form ionic bond
(4) total number of electrons shared between two covalently bonded atoms.

37. Homologous series is a
(1) series of compounds in which the same functional group substitutes hydrogen in a carbon chain.
(2) series of compounds in which different functional groups substitutes hydrogen in a carbon chain.
(3) series of compounds in which two members differ by – CH_2 unit.
(4) series of compounds having similar chemical properties

38. Combustion reactions are
(1) exothermic reactions occurs in presence of air or oxygen.
(2) oxidation reactions carried in presence of air or oxygen.
(3) redox reactions carried in presence of air or oxygen.
(4) photochemical reactions carried in presence of air or oxygen.

Feature based MCQ

39. On the basis of following features identify the correct option
I. This reaction is given by saturated hydrocarbons.
II. This reaction occurs in presence of sunlight.
(1) Oxidation reaction (2) Addition reaction
(3) Substitution reaction (4) Photochemical reaction

40. On the basis of following features identify the correct option
I. Drinks containing ethanol
II. These drinks are major source of income to government
(1) Alcoholic beverages (2) Soft drinks
(3) Carbonated beverages (4) Rectified spirit

41. On the basis of following features identify the correct option
I. They have $-SO_4^- Na^+$ group.
II. They easily produce lather in hard water.
(1) Soaps (2) Detergents
(3) Both (1) and (2) (4) Neither (1) nor (2)

42. On the basis of following features identify the correct option
I. These compounds are less reactive
II. Valencies of all carbon atoms are satiesfied by single bonds.
(1) Alkanes (2) Alkenes
(3) Alkynes (4) Both (1) and (2)

Hints & SOLUTIONS

Exercise 1

1. **(2)** The molecular formulae of various given acids are
methanoic acid, HCOOH i.e., CH_2O_2
ethanoic acid, CH_3COOH i.e., $C_2H_4O_2$
propanoic acid, C_2H_5COOH i.e., $C_3H_6O_2$
butanoic acid, C_3H_7COOH i.e., $C_4H_6O_2$

2. **(2)** Effervescence is due to evolution of $CO_2(g)$

$$Na_2CO_3 + 2CH_3COOH \longrightarrow 2CH_3COONa + H_2O + CO_2(g)$$

3. **(3)** **4.** **(1)**

5. **(2)** The alkane is C_5H_{12} (i.e., Pentane).

6. **(4)** **7.** **(4)** **8.** **(1)**

9. **(2)**

10. **(2)** Methane, ethane and propane are saturated hydrocarbons thus they do not decolourises alk. $KMnO_4$. Ethene ($CH_2 = CH_2$), unsaturated hydrocarbon decolourises alkaline $KMnO_4$.

11. **(4)**

12. **(3)** Alkenes give addition reaction with Br_2 / CCl_4 as a result brown colour of bromine gets discharged.

$$CH_2 = CH_2 \xrightarrow{Br_2/CCl_4} \underset{Br}{\overset{}{CH_2}} - \underset{Br}{\overset{}{CH_2}}$$

13. **(4)** **14.** **(4)** **15.** **(3)**

16. **(4)** Alkaline hydrolysis of esters is called saponification

17. **(4)** **18.** **(3)** **19.** **(2)**

20. **(4)**

$$\begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix} + 3O_2 \longrightarrow 2CO_2 + 2H_2O$$

21. **(2)** **22.** **(1)** **23.** **(3)**

24. **(3)** $HC \equiv CH \xrightarrow{Ni/H_2} CH_2 = CH_2$

25. **(3)** Graphite can be used as lubricant because it has layer structure different layers slide over each other.

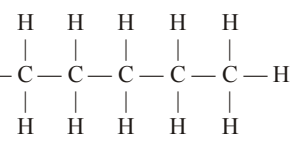
26. **(3)**

27. **(4)** Carborundum is SiC (silicon carbide).

28. **(3)** **29.** **(1)** **30.** **(1)**

31. **(1)**

32. **(3)**



pentane

33. **(1)** **34.** **(2)** **35.** **(3)**

36. **(4)**

37. **(3)** A mixture of ethyne and oxygen is used for gas welding. The reaction is highly exothermic in nature.
$C_2H_2(g) + 5/2\ O_2(g) \rightarrow 2CO_2(g) + H_2O(l)$ + heat and light
Ethyne

38. **(4)** Sodium hydrogen carbonate distinguishes ethanol from ethanoic acid. The acid gives brisk effervescence of carbon dioxide gas with sodium hydrogen carbonate while ethyl alcohol does not.

$CH_3COOH(aq) + NaHCO_3(aq) \rightarrow$

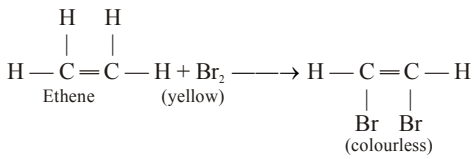
$CH_3COONa(aq) + H_2O(aq) + CO_2(g)$

$C_2H_5OH\ (aq) + NaHCO_3(aq) \longrightarrow$ No reaction

39. **(3)** In this case carbon dioxide (CO_2) gas is evolved, which is neither combustible nor a supporter of combustion. Therefore, the gas does not burn and the flame gets extinguished.

40. **(4)** Acetic acid and water are completely miscible with each other in all proportions due to hydrogen bonding. Therefore a clear solution will be formed.

41. **(3)** Bromine water will discharge the colour of ethene when the vapours of the gas are passed through it.

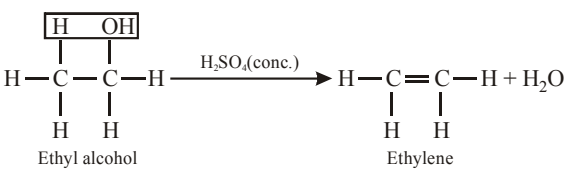


Ethane will not react with bromine water and the colour will not be discharged.

42. **(2)** This student (II) has made the correct observation. Acetic acid is colourless with vinegar smell. It gives brisk effervescence of carbon dioxide on reacting with sodium hydrogen carbonate.

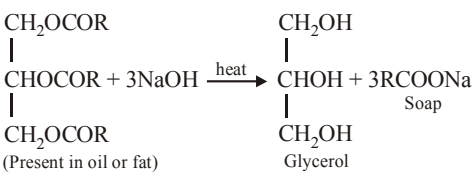
43. **(3)**

44. **(4)** Conc. H_2SO_4 brings about the dehydration of ethyl alcohol to ethylene at 443 K.



45. **(4)** Covalent compounds are formed by the sharing of one or more electrons in the combining atoms. They mostly belong to non-metals.

46. **(2)** Soaps are formed by the saponification of triesters of glycerol (oils or fats) with alkalies like NaOH or KOH upon heating. Glycerol is formed as by product.



47. **(3)** Acetic acid solution has the smell of vinegar.

48. **(4)** Sodium metal will react with both the acid and alcohol evolving hydrogen gas

$2CH_3COOH + 2Na \longrightarrow 2CH_3COONa + H_2$

$2C_2H_5OH + 2Na \longrightarrow 2C_2H_5ONa + H_2$

It cannot be used for distinction between acid and alcohol.

49. **(2)** **50.** **(3)** **51.** **(3)**

52. **(3)** **53.** **(1)** **54.** **(4)**

55. **(2)**

56. **(3)** Water gas is a mixture of CO and H_2.

57. **(2)** On complete combustion of methane, we get CO_2 (acidic) and H_2O (neutral).

58. **(2)** **59.** **(1)** **60.** **(3)**

61. **(1)** **62.** **(2)**

63. **(4)** $C_2H_5OH \xrightarrow{\text{alk. } KMnO_4} CH_3COOH$

64. **(3)** Hard water does not give lather with soap it forms white scum. Detergent can form lather even in hard water

65. **(2)** Unsaturated hydrocarbons (oil) burns with smoke.

66. **(3)** $2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$

Exercise 2

1. **(1)** **2.** **(2)** **3.** **(4)**

4. **(2)** **5.** **(1)** **6.** **(3)**

7. **(3)** Diamond and graphite are allotropes of carbon. Diamond being the densest is almost inert. The C–C bond length in graphite is shorter (142pm) than that of diamond (154 pm).

8. **(2)** Diamond is purest and hardest substance of carbon. Graphite is known as black lead.

9. **(3)** Solid CO_2 is used as a refrigerant under the commercial name tricol.

10. **(2)** Since hard water contains soluble chloride and sulphate salts of calcium and magnesium which forms insoluble curdy precipitate.

$2C_{17}H_{35}COONa + CaCl_2 \longrightarrow (C_{17}H_{35}COO)_2Ca + 2NaCl$

soluble sodium stearate (soap); calcium chloride (in hard water); insoluble calcium stearate

$2C_{17}H_{35}COONa + MgSO_4 \longrightarrow (C_{17}H_{35}COO)_2Mg + Na_2SO_4$

soluble sodium stearate; magnesium sulphate (in hard water); insoluble magnesium stearate (soap)

11. **(2)** **12.** **(3)**

13. **(1)** The gas evolved is carbondioxide

14. **(1)** **15.** **(3)**

16. **(3)** Esters have fruity smell. Glucose and fructose can be represented by same molecular formula $C_6H_{12}O_6$.

17. **(3)** **18.** **(2)** **19.** **(1)**

20. **(4)**

21. **(1)** The fullerenes can be synthesized by evaporation of graphite using laser radiation and subsequent condensation of carbon vapour.

22. **(4)**

23. **(2)** It is carbon dioxide.

24. **(1)** Carbogen contains 5-10% CO_2 and rest oxygen.

25. **(1)**

26. **(3)** The bottom of the vessel becomes black when the fuel is not burning completely and unburnt carbon particles escape as smoke. They blacken the vessel from outside.

27. **(3)** In a saponification reaction, an organic ester (triglyceride in nature) combines with NaOH or KOH to form soap and glycerol.

28. **(1)**

29. **(2)** Combustion of methane (CH_4) is complete with no unburnt carbon particles. Therefore, C.N.G. does not cause any pollution problem.

30. **(1)** **31.** **(1)** **32.** **(1)**

33. **(2)** Purely covalent compounds do not have free electrons or ions like ionic compounds to assist in conduction of electricity. The molecules in covalent compounds are held together by weak vander waal's forces of attraction while ions in ionic compounds are held by strong electrostatic force of attraction.

34. **(2)** The property of catenation is responsible for a very large number of compounds of carbon. Carbon has only two energy shells K, L i.e. 2, 4, so shows maximum valency of + 4.

35. **(1)** **36.** **(2)** **37.** **(1)**

38. **(2)** **39.** **(3)** **40.** **(1)**

41. **(2)** **42.** **(1)**