

CHAPTER

4

CARBON COMPOUNDS

Syllabus

Covalent bonding in carbon compounds, versatile nature of carbon, homologous series. Nomenclature of carbon compounds containing functional groups (halogens, alcohols, ketones, aldehydes, alkanes and alkynes), difference between saturated and unsaturated hydrocarbons, chemical properties of carbon compounds (combustion, oxidation, addition and substitution reaction). Ethanol and ethanoic acid (only properties and uses), soaps and detergents.



STAND ALONE MCQs

(1 mark each)

Q. 1. Which of the following is not observed in a homologous series? Give reason for your choice.

[SQP 2020]

- (A) Change in chemical properties
 (B) Difference in $-\text{CH}_2$ and 14u molecular mass
 (C) Gradation in physical properties
 (D) Same functional group

Ans. Option (A) is correct.

Explanation: Change in chemical properties due to presence of same functional group.

Q. 2. Ethane, with the molecular formula C_2H_6 has

- (A) 6 covalent bonds (B) 7 covalent bonds
 (C) 8 covalent bonds (D) 9 covalent bonds

U

Ans. Option (B) is correct.

Explanation: Ethane has 7 covalent bonds. One bond is between two carbon atoms and rest of the six are between hydrogen atoms.

Q. 3. 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

- (A) helium (B) neon
 (C) argon (D) krypton

U

Ans. Option (B) is correct.

Explanation: The nearest inert gas from carbon is Neon. An element try to attain the electronic configuration of its nearest noble gas while attaining a fully-filled outermost shell.

Q. 4. The correct electron dot structure of a water molecule is

- (A) $\text{H} \cdot \ddot{\text{O}} \cdot \text{H}$ (B) $\text{H} : \ddot{\text{O}} \cdot \text{H}$
 (C) $\text{H} : \ddot{\text{O}} : \text{H}$ (D) $\text{H} : \text{O} : \text{H}$

C

Ans. Option (C) is correct.

Explanation: Oxygen has a complete after octet, while each atom of hydrogen has two electrons in outermost shell.

Q. 5. Which among the following are unsaturated hydrocarbons?

- (i) $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3$
 (ii) $\text{H}_3\text{C}-\text{C}\equiv\text{C}-\text{CH}_3$
 (iii) $\text{H}_3\text{C}-\text{CH}=\text{CH}_2$

- (iv) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{H}_3\text{C}-\text{C}=\text{CH}_2 \\ | \\ \text{CH}_3 \end{array}$

A

- (A) (i) and (iii) (B) (ii) and (iii)
 (C) (ii) and (iv) (D) (iii) and (iv)

Ans. Option (C) is correct.

Explanation: Unsaturated hydrocarbons have multiple covalent bonds (double or triple bond) like alkene and alkyne.

- Q. 6. Oils on treating with hydrogen in the presence of palladium or nickel catalyst form fats. This is an example of
- (A) Addition reaction
 (B) Substitution reaction
 (C) Displacement reaction
 (D) Oxidation reaction

Ans. Option (A) is correct.

Explanation: Hydrogenation reaction means addition of hydrogen to double bonds of unsaturated compounds found in oil in the presence of catalysts such as palladium or nickel to give saturated hydrocarbons.

- Q. 7. In which of the following compounds, —OH is the functional group?
- (A) Butanone (B) Butanol
 (C) Butanoic acid (D) Butanal

Ans. Option (B) is correct.

Explanation: Compounds with —OH functional group are ended with suffix —ol.

- Q. 8. Identify the unsaturated compounds from the following
- (i) Propane (ii) Propene
 (iii) Propyne (iv) Chloropropane
- (A) (i) and (ii) (B) (ii) and (iv)
 (C) (iii) and (iv) (D) (ii) and (iii)

Ans. Option (D) is correct.

Explanation: Suffixes 'ene' and 'yne' show that these are unsaturated compounds of carbon.

- Q. 9. When sodium hydrogen carbonate is added to ethanoic acid a gas evolves. Consider the following statements about the gas evolved.
- (a) It turns lime water milky.
 (b) It is evolved with a brisk effervescence.
 (c) It has a smell of burning sulphur.
 (d) It is also a by-product of respiration.

The correct statements are :

- (A) (a) and (b) only (B) (b) and (d) only
 (C) (a), (c) and (d) (D) (a), (b) and (d)

[CBSE Delhi Set-III, 2020] U

Ans. Option (D) is correct.

Explanation: (a), (b) and (d). The gas evolved is carbon dioxide with brisk effervescence. It turns lime water milky. It is also a by-product of respiration.

- Q. 10. While studying the saponification reaction, what do you observe when you mix an equal amount of colourless vegetable oil and 20% aqueous solution of NaOH in a beaker?
- (A) The colour of the mixture has become dark brown
 (B) A brisk effervescence is taking place in the beaker

- (C) The outer surface of the beaker has become hot
 (D) The outer surface of the beaker has become cold [CBSE Board, All India Region, 2017]

Ans. Option (C) is correct.

Explanation: The beaker becomes hot because it is an exothermic reaction.

- Q. 11. When you add a few drops of acetic acid to a test-tube containing sodium bicarbonate powder, which one of the following is your observation ?
- (A) No reaction takes place.
 (B) A colourless gas with pungent smell is released with brisk effervescence.
 (C) A brown coloured gas is released with brisk effervescence.
 (D) Formation of bubbles of a colourless and odourless gas. [AE] [SA-II, OD. Set-I, 2017]

Ans. Option (D) is correct.

Explanation: Acetic acid reacts with sodium bicarbonate and releases CO₂ which is colorless and odourless gas.

[AI] Q. 12. In the soap micelles

- (A) the ionic end of soap is on the surface of the cluster while the carbon chain is in the interior of the cluster.
 (B) ionic end of soap is in the interior of the cluster and the carbon chain is out of the cluster.
 (C) both ionic end and carbon chain are in the interior of the cluster.
 (D) both ionic end and carbon chain are on the exterior of the cluster. [A]

Ans. Option (A) is correct.

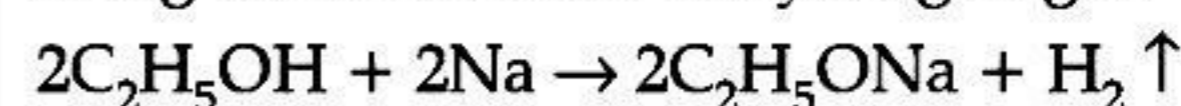
Explanation: A micelle is a spherical aggregation of soap molecules in water in which hydrocarbon ends are directed towards the centre and ionic ends are directed outwards.

Q. 13. Ethanol reacts with sodium and forms two products. These are

- (A) sodium ethanoate and hydrogen
 (B) sodium ethanoate and oxygen
 (C) sodium ethoxide and hydrogen
 (D) sodium ethoxide and oxygen

Ans. Option (C) is correct.

Explanation: Ethanol (C₂H₅OH) reacts with sodium to form sodium ethoxide (C₂H₅ONa) along with liberation of hydrogen gas.



Q. 14. Vinegar is a solution of

- (A) 50% – 60% acetic acid in alcohol
 (B) 5% – 8% acetic acid in alcohol
 (C) 5% – 8% acetic acid in water
 (D) 50% – 60% acetic acid in water [R]

Ans. Option (C) is correct.

Explanation: Vinegar is a 5%–8% aqueous solution of acetic acid.

- Q. 15. While cooking, if the bottom of the vessel is getting blackened on the outside, it means that
- (A) the food is not cooked completely.
 (B) the fuel is not burning completely.
 (C) the fuel is wet.
 (D) the fuel is burning completely

Ans. Option (B) is correct.

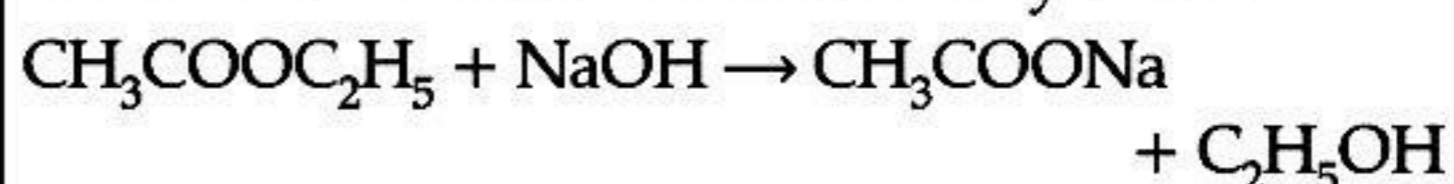
Explanation: While cooking, if the bottom of the vessel is getting blackened on the outside, then it means that the fuel is not burning completely.

- Q. 16. Which of the following represents saponification reaction?

- (A) $\text{CH}_3\text{COONa} + \text{NaOH} \xrightarrow{\text{CaO}} \text{CH}_4 + \text{Na}_2\text{CO}_3$
 (B) $\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \xrightarrow{\text{H}_2\text{SO}_4} \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$
 (C) $2\text{CH}_3\text{COO} + 2\text{Na} \longrightarrow 2\text{CH}_3\text{COONa} + \text{H}_2$
 (D) $\text{CH}_3\text{COOC}_2\text{H}_5 + 2\text{NaOH} \longrightarrow \text{CH}_3\text{COONa} + \text{C}_2\text{H}_5\text{OH}$

Ans. Option (D) is correct.

Explanation: Saponification reaction is reaction of ester with base like NaOH to form the parent alcohol and sodium salt of carboxylic acid.



ASSERTION AND REASON BASED MCQs (1 Mark each)

Directions : In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

- (A) Both A and R are true and R is the correct explanation of A.
 (B) Both A and R are true but R is NOT the correct explanation of A.
 (C) A is true but R is false.
 (D) A is false and R is true.

- AI Q. 1. Assertion (A):** In a homologous series of alcohols, the formula for the second member is $\text{C}_2\text{H}_5\text{OH}$ and the third member is $\text{C}_3\text{H}_7\text{OH}$.

Reason (R): The difference between the molecular masses of the two consecutive members of a homologous series is 14u.

Ans. Option (C) is correct.

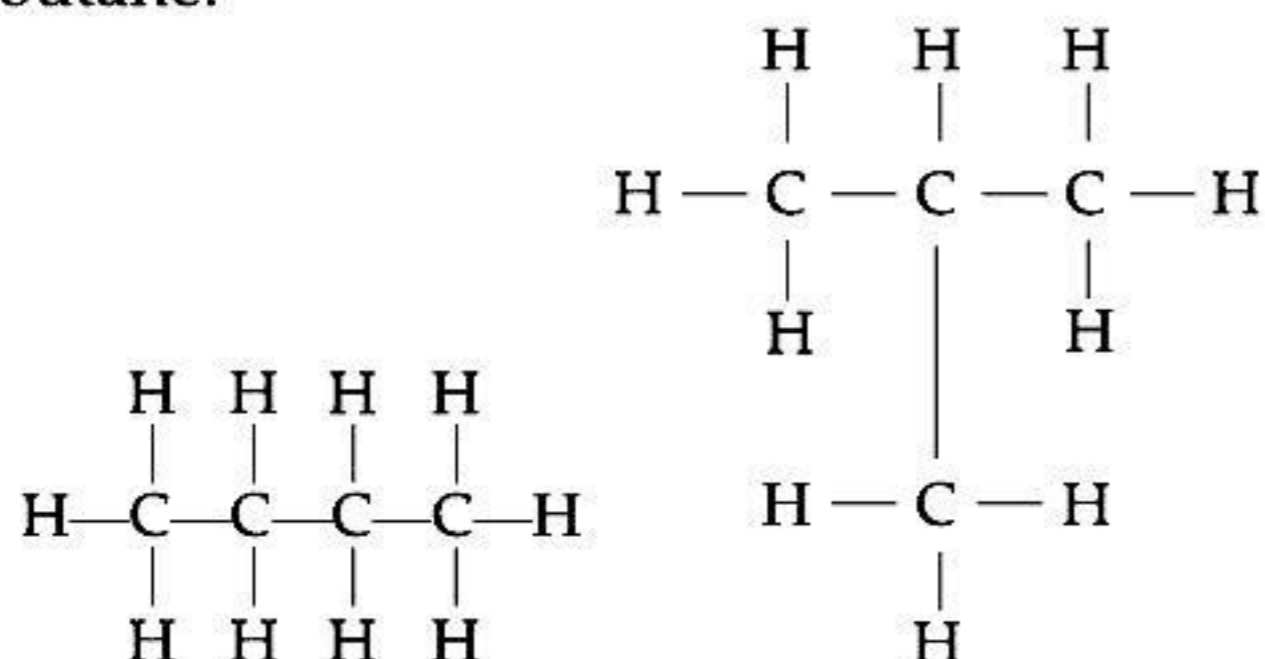
Explanation: In homologous series of alcohols, the formula for the second member is $\text{C}_2\text{H}_5\text{OH}$ and the third member is $\text{C}_3\text{H}_7\text{OH}$. The difference between the molecular masses of the two consecutive members of a homologous series is 14u.

- Q. 2. **Assertion (A):** Following are the members of a homologous series : CH_3OH , $\text{CH}_3\text{CH}_2\text{OH}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

Reason (R): A series of compounds with same functional group but differing by $-\text{CH}_2-$ unit is called a homologous series. [Delhi Set-II, 2020]

Ans. Option (A) is correct.

- Q. 3. **Assertion (A):** Following are the structural isomers of butane.



Reason (R): Structural isomers have the same molecular formula but they differ in their structures.

[Board SQP, 2020]

Ans. Option (A) is correct.

Explanation: Isomers are defined as those compounds that possess same molecular formula but different structural arrangement. Butane has the molecular formulae C_4H_{10} . Therefore, the structural isomers of butane will be n-butane and iso-butane.

- Q. 4. **Assertion (A):** Third member of alkane is propane (C_3H_8)

Reason (R): It is obtained from general formula $\text{C}_n\text{H}_{2n+2}$

Ans. Option (A) is correct.

Explanation: C_3H_8 can be obtained from general formula, $\text{C}_n\text{H}_{2n+2}$.

- Q. 5. **Assertion (A):** Iso-butane is the isomer of C_4H_{10} .

Reason (R): Iso-butane has four C and ten-H atom.

Ans. Option (B) is correct.

Explanation: $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{CH}-\text{CH}_3 \end{array}$ is the structural isomer of butane.

- AI Q. 6. Assertion (A):** CH_3Cl is obtained from CH_4 by the action of Cl_2 in the presence of sunlight.

Reason (R): It is obtained by addition reaction.

Ans. Option (C) is correct.

Explanation: CH_3Cl is obtained from CH_4 by substitution reaction by the action of Cl_2 in the presence of sunlight.

- Q. 7. **Assertion (A):** Most of the carbon compounds are good conductors of electricity.

Reason (R): They do not dissociate to form ions and remain as molecules.

Ans. Option (D) is correct.

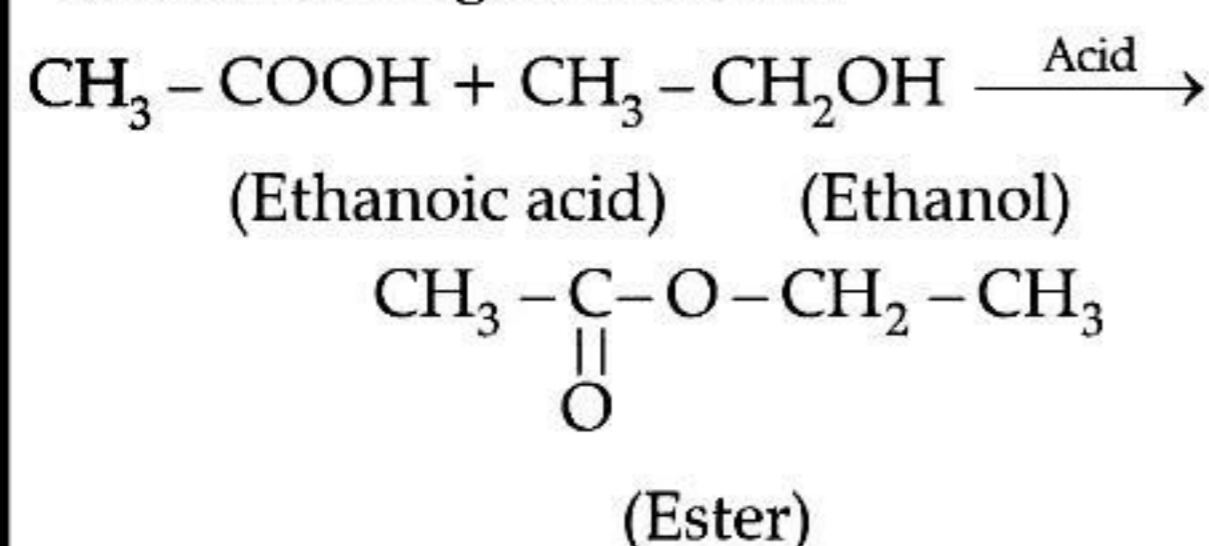
Explanation: Carbon compounds are mainly poor conductors of electricity.

Q. 8. Assertion (A): Esterification is a process in which a sweet smelling substance is produced.

Reason (R): When esters react with sodium hydroxide an alcohol and sodium salt of carboxylic acid are obtained. [CBSE, 2020]

Ans. Option (B) is correct.

Explanation: Esterification is a reaction in which alcohol like ethanol reacts with carboxylic acids to form esters and water in the presence of sulphuric acid. Esters are generally sweet smelling substances.

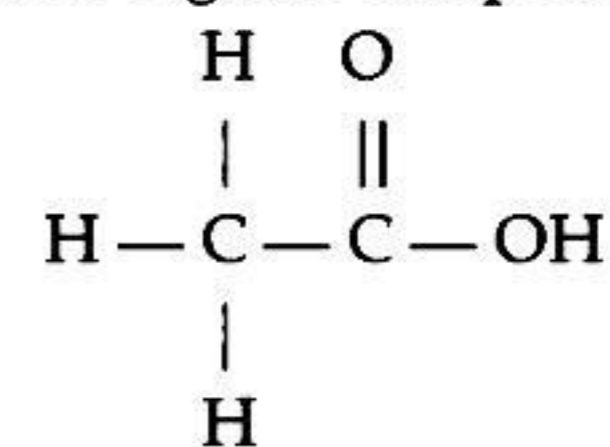


Q. 9. Assertion (A): Acetic acid has six single bond and one double bond.

Reason (R): It is unsaturated organic compound.

Ans. Option (A) is correct.

Explanation: Acetic acid has structure which has six single bond and only one double bond. It is an unsaturated organic compound.



Q. 10. Assertion (A): In esterification, carboxylic acid and alcohol reacts in the presence of acid to give ester.

Reason (R): Esterification is the reverse of saponification.

Ans. Option (A) is correct.

Explanation: In esterification, RCOOH, - H is replaced by - R' of R'OH in the presence of acid to form RCOOR'.

Q. 11. Assertion (A): Soap has good cleansing action.

Reason (R): Soap has short chain of hydrocarbon which acts as hydrophobic and long ionic part which acts as hydrophilic.

Ans. Option (C) is correct.

Explanation: Soap has long chain of hydrocarbon and short chain of ionic part.



Attempt any 4 sub-parts from each question. Each sub-part carries 1 mark.

I. Read the passage and answer any four questions from Q.1. to Q.5.

A homologous series is a series of organic compounds which belong to the same family (*i.e.* possess same functional group) and show similar chemical properties. The members of this series are called homologous and differ from each other by the number of CH₂ units in the main carbon chain.

Q. 1. The chemical properties of which of the following compounds is similar to the butane ?

- (A) Butyne (B) Propene
(C) Propyne (D) Pentane

Ans. Option (D) is correct.

Explanation: Methane, ethane, propane, butane, pentane etc. are all part of the alkane homologous series and have similar chemical properties.

Q. 2. The difference between two consecutive members in a homologous series in alkanes in terms of molecular mass and number of atoms of elements is:

- (A) 14 a.m.u and CH₂ respectively
(B) 12 a.m.u and CH₃ respectively
(C) 14 a.m.u and CH respectively
(D) 12 a.m.u and CH₃ respectively

Ans. Option (A) is correct.

Explanation: Homologous series is a series of compounds in which the members present have the same functional group and similar chemical properties and any two successive members in a particular series differ in their molecular formula by a -CH₂ unit.

Q. 3. The name and structure of a saturated compound in which 6 carbon atoms are arranged in a ring is :

- (A) Hexane (B) Cyclohexane
(C) Pentane (D) cyclopentane

Ans. Option (B) is correct.

Explanation: The series like methanol, ethanol, propanol and so on is also a homologous series. The functional group attached to these compounds is alcohol.

Q. 4. Which of the following is not the property of a homologous series ?

- (A) They show similar chemical properties.
(B) They differ by 14 units by mass.
(C) They all contain double bond
(D) They can be represented by a general formula.

Ans. Option (C) is correct.

Explanation: The characteristics of a homologous series are :

- They have same general formula.
- Successive compounds differ by -CH₂ unit.

- Successive compounds have molecular mass difference of 14u.
- Molecular mass increases down the series. Therefore members of homologous series show gradation in physical properties such as melting point and boiling points.
- Members of homologous series show similar chemical properties.

Q. 5. Which of the following represent the name and formula of the 2nd member of homologous series having general formula $C_n H_{2n+2}$?

- (A) Methane CH_4 (B) Ethane C_2H_6
(C) Ethene C_2H_4 (D) Ethyne C_2H_2

Ans. Option (B) is correct.

Explanation: Methane, ethane, propane, butane, etc. are all part of the alkane homologous series. The general formula of this series is $C_n H_{2n+2}$.

II. Read the given passage and answer any of the four questions from Q.1. to Q.5.

Carbon has the unique property to form bonds with other atoms of carbon.

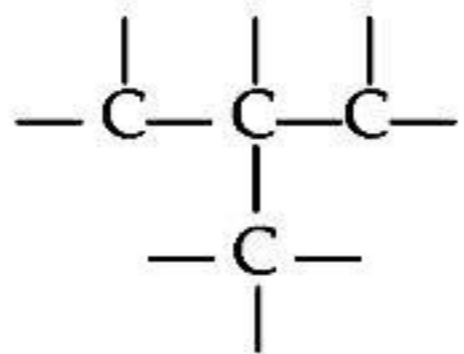


Fig.A

Q. 1. Name the characteristic property of carbon as depicted in the fig. A

- (A) Catenation (B) Polymerisation
(C) Isomerisation (D) None of the above.

Ans. Option (A) is correct.

Explanation: Carbon forms bond with other atoms of carbon. This property of carbon is known as catenation.

Q. 2. Carbon forms large number of compounds due to :

- (A) Catenation only
(B) Tetravalency only
(C) Both catenation and tetravalency
(D) None of the above

Ans. Option (C) is correct.

Explanation: Carbon forms large number of compounds due to the following :

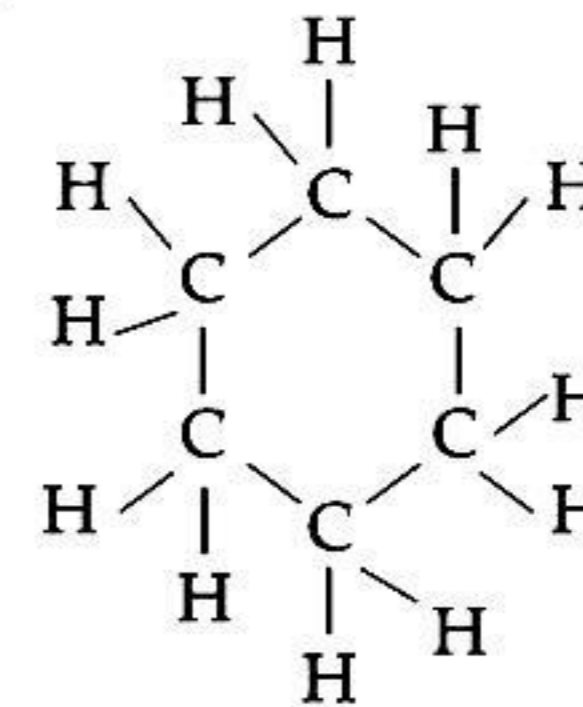
- (i) **Catenation:** Carbon forms bond with other atoms of carbon.
(ii) **Tetravalency:** Carbon share four electrons with other atoms.

Q. 3. Write the name and structure of a saturated compound in which 6 carbon atoms are arranged in a ring.

- (A) Hexane (B) Cyclohexane
(C) Pentane (D) cyclopentane

Ans. Option (B) is correct.

Explanation: Cyclohexane is the carbon compounds in which carbon atoms are arranged in the form of a ring. It is a cyclic carbon compounds. Its structure is :



Q. 4. Give the number of single bonds present in the above mentioned compound.

- (A) 16 (B) 14
(C) 6 (D) 18

Ans. Option (D) is correct.

Explanation: The chemical bond formed by the sharing of electrons between the atoms is known as a covalent bond. The total no. of single bonds in cyclohexane (C_6H_{12}) is 18.

Q. 5. Carbon is :

- (A) Divalent (B) Monovalent
(C) tetravalent (D) Trivalent

Ans. Option (C) is correct.

Explanation: Carbon has valency of four. It is capable of bonding with four other atoms of carbon or atoms of some other monovalent element. Carbon can form bond with Oxygen, Hydrogen, Nitrogen, Sulphur, Chlorine and many other elements giving rise to compounds with specific properties.

III. Read the passage and answer any four questions Q.1. to Q.5.

An organic compound A of molecular formula C_2H_4 on reduction gives another compound B of molecular formula C_2H_6 . B on reaction with chlorine in the presence of sunlight gives C of molecular formula C_2H_5Cl .

Q. 1. The compounds A, B and C are:

- (A) A : ethene B : ethane C : chloroethane
(B) A : ethane B : ethyne C : chloromethane
(C) A : ethyne B : ethane C : chloroethane
(D) A : ethene B : ethyne C : chloroethane

Ans. Option (A) is correct.

Explanation: The compound is A : $CH_2 = CH_2$ (Ethene), B is CH_3-CH_3 (Ethane) and C is CH_3-CH_2-Cl (Chloroethane)

Q. 2. Unsaturated hydrocarbons undergo _____ reaction.

- (A) Substitution (B) Halogenation
(C) Addition (D) All of the above

Ans. Option (C) is correct.

Explanation: Unsaturated hydrocarbons undergo addition reactions. In unsaturated hydrocarbon, hydrogen added in the presence of catalyst palladium or nickel.

Q. 3. Which of these statements is correct regarding addition reaction ?

- (A) Addition of hydrogen does not require catalyst.
 (B) Multiple bonds (double and triple bonds) must be present between carbon atoms in the chain of hydrocarbon.
 (C) Multiple bonds are not required for the reaction to take place.
 (D) None of the above.

Ans. Option (B) is correct.

Explanation: Essential conditions required for the addition reaction to occur:

- (i) Multiple bonds (double and triple bonds) must be present between carbon atoms in the chain of hydrocarbon.
 (ii) Addition of hydrogen should be carried out in the presence of catalyst such as nickel or platinum.

Q. 4. The general formula for alkene is :

- (A) $C_n H_{2n}$ (B) $C_n H_{2n+2}$
 (C) $C_n H_{2n-2}$ (D) $C_n H_{2n+1}$

Ans. Option (A) is correct.

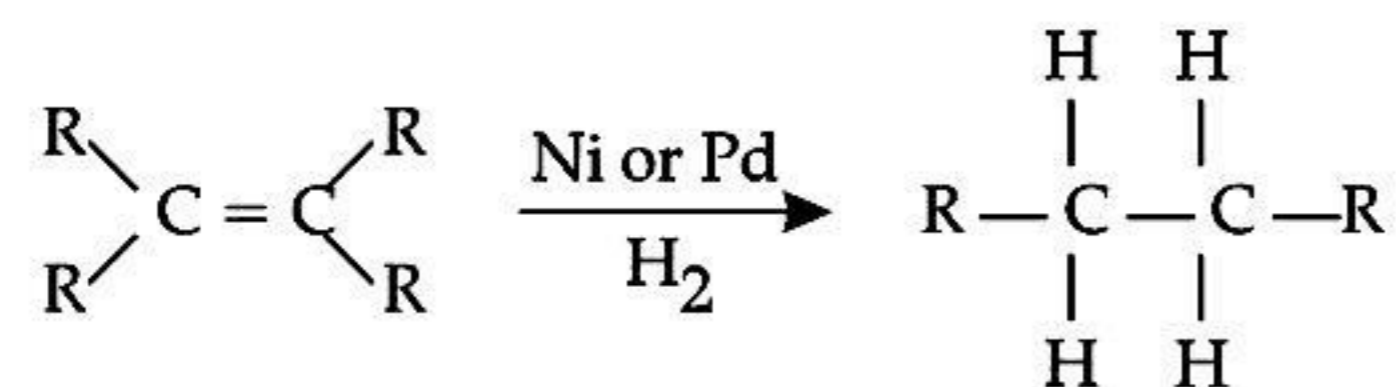
Explanation: The General formula for alkenes are $C_n H_{2n}$, where n = number of carbon atoms.
 C_2H_4 , C_3H_6 , C_4H_8 .

Q. 5. Choose the correct condition for conversion of ethene to ethane:

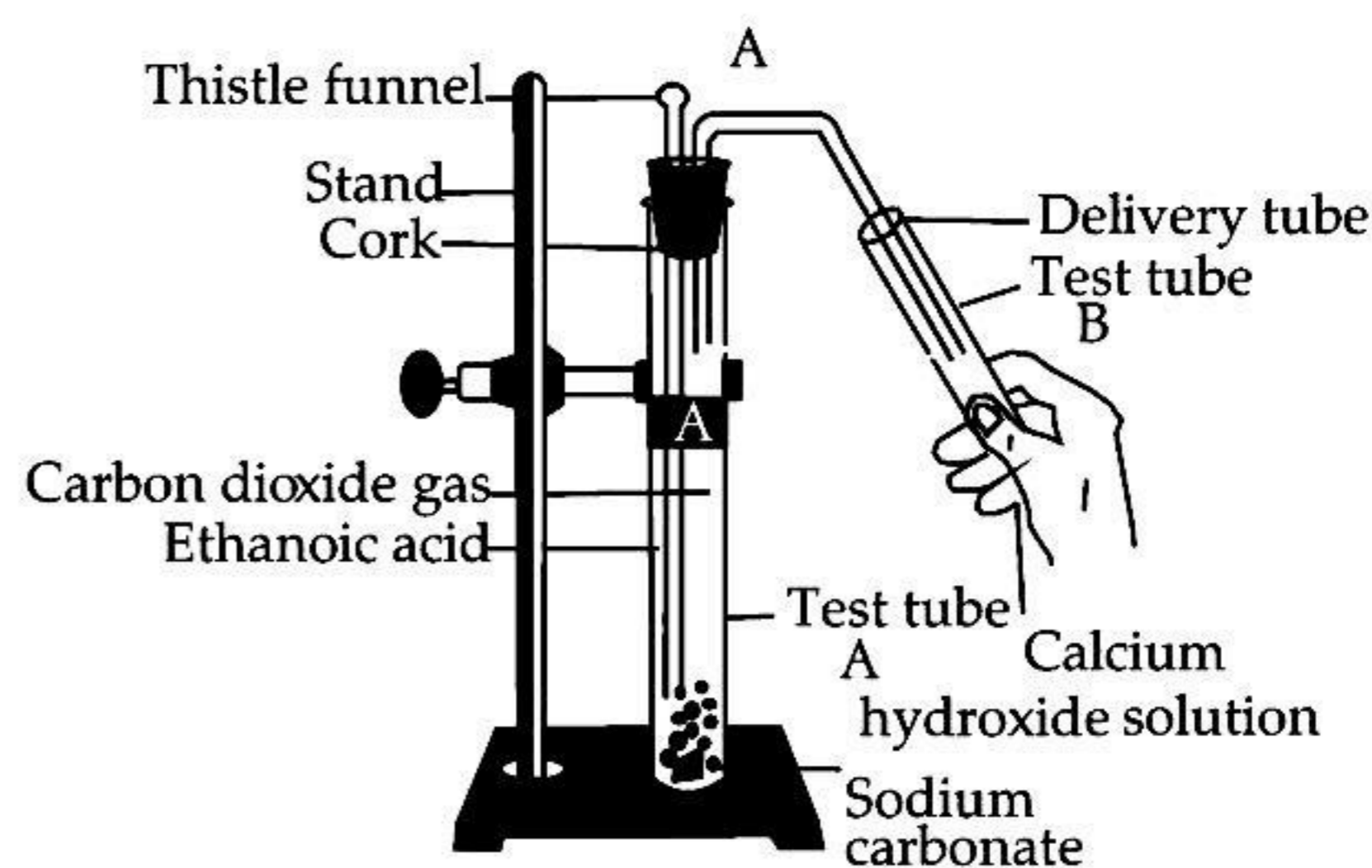
- (A) Dehydrogenation at $450^\circ C$
 (B) Hydrogenation in presence of catalyst like nickel or platinum
 (C) Photolytic decomposition
 (D) All of the above

Ans. Option (B) is correct.

Explanation: Hydrogenation of ethene forms ethane in the presence of metal catalyst like Nickel at high temperature. This reaction is called hydrogenation reaction.



IV. Study the given experimental set-up and answer any four questions from Q.1. to Q.5.



Q. 1. Name the gas released in test tube B: R

- (A) CO (B) CO_2
 (C) H_2 (D) Cl_2

Ans. Option (B) is correct.

Explanation: The gas evolved in test tube B is carbon dioxide.

Q. 2. Name the salt produced in the above activity: C

- (A) Sodium chloride (B) Ethyl acetate
 (C) Sodium acetate (D) Acetic acid

Ans. Option (C) is correct.

Explanation: Reaction of ethanoic acid with sodium carbonate forms the salt ethyl acetate.

Q. 3. What happens when ethanol is used instead of ethanoic acid ? AE

- (A) Same products are formed
 (B) No reaction
 (C) A different salt is produced
 (D) None of the above

Ans. Option (B) is correct.

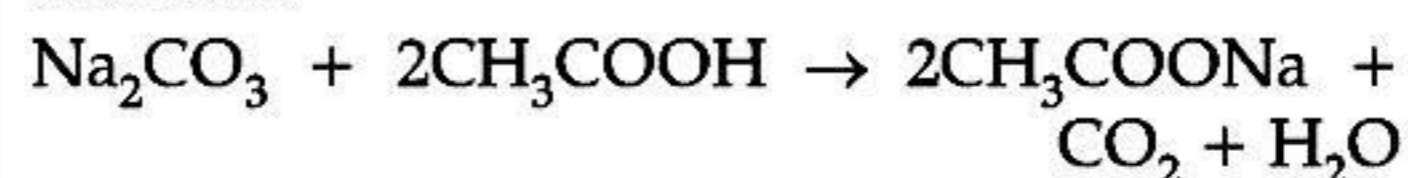
Explanation: When ethanol is used instead of ethanoic acid to react with Na_2CO_3 then it show no reaction with alcohol,

Q. 4. Choose the correct reaction which justifies the above activity: U

- (A) $2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$
 (B) $Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$
 (C) $2CH_3CHO + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O$
 (D) $2CH_3COOH + Na_2CO_3 \rightarrow H_2O + CO_2$

Ans. Option (A) is correct.

Explanation: The reaction that take place in test tube A is:



Q. 5. Which gas turns lime water milky ? C

- (A) CO (B) CO_2
 (C) H_2 (D) O_2

Ans. Option (B) is correct.

Explanation: Calcium hydroxide solution in test tube B will react with carbon dioxide gas and turns milky due to the formation of insoluble calcium carbonate ($CaCO_3$).

V. Read the below passage and answer any four question from Q.1. to Q.5.

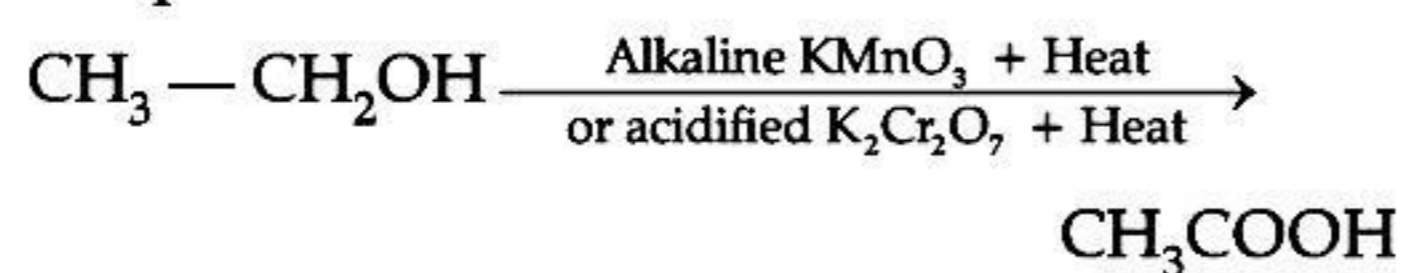
An organic compound A is a constituent of many medicines and is used as antifreeze. Its molecular formula is C_2H_6O . Upon the reaction with alk. $KMnO_4$, the compound A is oxidized to another compound B with formula $C_2H_4O_2$.

Q. 1. Identify the compounds A and B.

- (A) Ethanol, ethanoic acid
- (B) Ethanoic acid, Ethanol
- (C) Ethane, ethanoic acid
- (D) Ethanol, acetic acid

Ans. Option (A) is correct.

Explanation: The compound A is ethanol and compound B is ethanoic acid.



Q. 2. What is the role of alk. $KMnO_4$.

- (A) It is a reducing agent
- (B) It is an oxidising agent
- (C) It is a catalyst
- (D) It helps in precipitation.

Ans. Option (B) is correct.

Explanation: Alk. $KMnO_4$ is used as oxidizing agent. It can give oxygen to other substances.

Q. 3. Choose the correct compound which can be used instead of alk. $KMnO_4$:

- (A) Acidified potassium dichromate
- (B) Manganese dioxide
- (C) Platinum
- (D) Palladium with hydrogen

Ans. Option (A) is correct.

Explanation: Acidified potassium dichromate can be used instead of alk. $KMnO_4$. alk. $KMnO_4$ / acidified $K_2Cr_2O_7$ add oxygen to ethanol hence they are called oxidising agent.

Q. 4. Which of the following statement is true ?

- (A) Ethanol is more lethal than methanol.
- (B) Methanol is more lethal than ethanol
- (C) Both ethanol and methanol are equally poisonous.
- (D) Methanol when taken only cause little drowsiness.

Ans. Option (B) is correct.

Explanation: Methanol is more lethal than ethanol because it is oxidized to methanal in the liver. Methanal reacts rapidly with the components of cells and causes the protoplasm to get coagulated (In the same way, as an egg gets coagulated on boiling). Methanol also affects the optic nerve causing blindness.

Q. 5. Which of the following statement is true for ethanol ?

- (A) It does not affect litmus paper.
- (B) It turns red litmus blue
- (C) It turns blue litmus red.

(D) It is basic in nature.

Ans. Option (A) is correct.

Explanation: Ethanol (A) is a neutral substance, so it does not affect litmus paper.

VI. Read the given passage and answer any four questions from Q.1. to Q.5.

A sample of water which gives lather with soap with difficulty is known as hard water, while a sample of water which gives lather with soap easily is known as soft water.

Hardness of water is due to the presence of bicarbonates, sulphates and chlorides of calcium and magnesium. Hardness of water is of two types, temporary and permanent hardness. When hardness of water is due to the presence of bicarbonates of magnesium and calcium, it is called temporary hardness. When hardness of water is due to the presence of sulphates and chlorides of magnesium and calcium, it is called permanent hardness.

The amount of hardness causing substances in a certain volume of water measures the extent of hardness or degree of hardness. Hardness of water is always calculated in terms of calcium carbonate although it is never responsible for causing hardness of water because of its insoluble nature. The reason for choosing calcium carbonate as the standard for calculating hardness of water is the ease in calculation as its molecular weight is exactly 100. Degree of hardness is usually expressed as parts per million (ppm).

Q. 1. A student requires hard water for an experiment in his laboratory which is not available in the neighbouring area. In the laboratory there are some salts, which when dissolved in distilled water can convert it into hard water. Select from the following groups of salts, a group, and each salt of which when dissolved in distilled water will make it hard.

- (A) Sodium chloride, Potassium chloride
- (B) Sodium sulphate, Potassium sulphate
- (C) Sodium sulphate, Calcium sulphate
- (D) Calcium sulphate, Calcium chloride

Ans. Option (D) is correct.

Explanation: Salts like Calcium sulphate and Calcium chloride makes the water hard.

Q. 2. Hardness of water is due to :

- (A) carbonates and sulphides of calcium only
- (B) sulphates and chlorides of magnesium only
- (C) bicarbonates of magnesium and calcium.
- (D) bicarbonates, sulphates and chlorides of calcium and magnesium

Ans. Option (D) is correct.

Explanation: Hardness of water is due to bicarbonates, sulphates and chlorides of calcium and magnesium.

Q. 3. Why do soaps not form lather (foam) with hard water?

- (A) Ca^{2+} and Mg^{2+} present in hard water form insoluble substance with soap.
- (B) Ca^{2+} and Mg^{2+} present in hard water form soluble substance with soap
- (C) HCO_3^- present in hard water form insoluble substance with soap
- (D) SO_4^{2-} present in hard water form soluble substance with soap

Ans. Option (A) is correct.

Explanation: The magnesium and calcium salt present in hard water reacts with soap molecule to form insoluble product called scum. This scum creates difficulty in cleansing action.

Q. 4. Hardness of water is calculated in terms of :

- (A) Calcium oxide
- (B) Calcium hydroxide
- (C) Calcium carbonate
- (D) Calcium bicarbonate.

Ans. Option (C) is correct.

Explanation: Hardness of water is always calculated in terms of calcium carbonate although it is never responsible for causing hardness of water because of its insoluble nature.

Q. 5. Which of these statements is not correct ?

- (A) Hard water does not form lather with soap
- (B) Hard water forms lather with soap
- (C) Permanent hardness can't be removed by boiling
- (D) Water obtained from rains is soft water

Ans. Option (B) is correct.

Explanation: Soaps do not form lather when the water is hard. When soap is added to hard water, calcium and magnesium salts present in water displace sodium or potassium ions from the soap molecules forming an insoluble substance called scum.

