SCIENCE
WORKSHEET_010425
CHAPTER 04 CARBON AND ITS COMPOUND
(ANSWERS)

SUBJECT: SCIENCE **MAX. MARKS : 40**

CLASS : X **DURATION : 1½ hrs**

General Instructions:

(i). **All** questions are compulsory.
(ii). This question paper contains 2**0** questions divided into five Sections A, B, C, D and E.
(iii). **Section A** comprises of **10 MCQs** of **1 mark** each. **Section B** comprises of 4 questions of **2 marks** each. **Section C** comprises of 3 questions of **3 marks** each. **Section D** comprises of 1 question of **5 marks** each and **Section E** comprises of 2 Case Study Based Questions of **4 marks** each.
(iv). There is no overall choice.
(v). Use of Calculators is not permitted

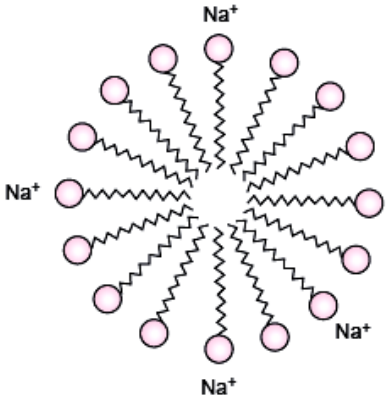
SECTION – A

Questions 1 to 10 carry 1 mark each.

1. 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. (c) sodium ethoxide and hydrogen
Ethanol (C_2H_5OH) reacts with sodium to form sodium ethoxide (C_2H_5ONa) along with the liberation of hydrogen gas.
$2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H^2$

2. A student conducts an activity where he burns methane in the presence of oxygen. What is likely to form?
(a) Water (b) Carbon dioxide
(c) Carbon dioxide and water (d) Carbon dioxide and oxygen
Ans. (c) Carbon dioxide and water
Methane (CH_4) burns in the presence of enough oxygen to produce carbon dioxide (CO_2) and water (H_2O). It creates a lot of heat as it burns, which makes it an excellent fuel source.
$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l) + Heat$

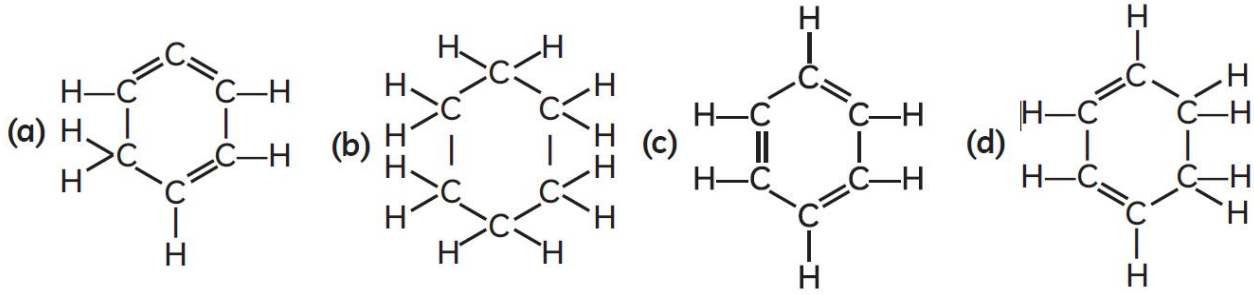
3. A student studies that soap solution results in micelle formation which helps to remove dirt. It has a unique orientation which helps in keeping the dirt out of the water as shown in the image.



The student was curious to know more about the cleansing action of the soap. What helps the dirt to rinse away?
(a) Suspension of the dirt in the micelles.
(b) A collection of water molecules in the centre of the micelle.
(c) Attraction between the ionic end and the dirt to remove it.
(d) Mixing of the soap molecules along with the dirt to make it heavier.

Ans. (a) Suspension of the dirt in the micelles.
In micelles, one end of the molecule is towards the oil droplet while the ionic end faces outside, forming an emulsion in the water. This dissolves the dirt in water and thus, the clothes are easily washed.

4. The structural formula of benzene is:



Ans. (c)
The chemical formula of benzene is C6H6. Benzene is the simplest aromatic compound, which consists of six carbon atoms bonded in a hexagonal ring. Each carbon atom is bonded to one hydrogen atom and two carbon atoms. Benzene molecule contains alternate single and double bonds.

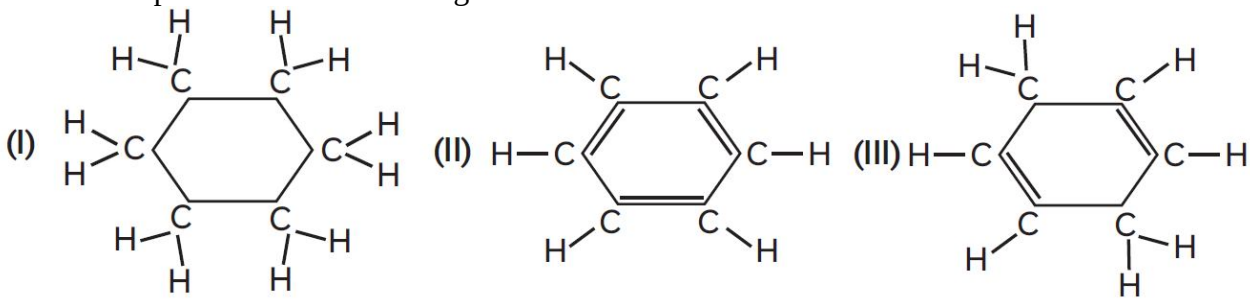
5. A student took four test tubes P, Q, R and S and filled about 8 mL of distilled water in each. After that he dissolved an equal amount of Na_2SO_4 in P, K_2SO_4 in Q, $CaSO_4$ in R and $MgSO^4$ in S. On adding an equal amount of soap solution and shaking each test tube well, a good amount of lather will be obtained in the test tubes:
(a) P and Q (b) P and R (c) P, Q and S (d) Q, R and S
Ans. (a) P and Q
Soap does not form lather in hard water as it forms an insoluble substance (scum) in hard water. The hardness in water is caused by calcium and magnesium salts and soap reacts with the calcium and magnesium salts to form scum. As test tubes R and S contain calcium and magnesium salts, no lather will be formed on adding soap solution to these test tubes. Test tubes P and Q contain sodium and potassium salts which do not react with soap. So, soap solution forms lather.

6. LPG or liquefied petroleum gas has a very wide variety of uses, mainly used for cylinders across many different markets as an efficient fuel container in the agricultural, recreation, hospitality, and industrial, construction, sailing and fishing sectors. It can serve as fuel for cooking, central heating and to water heating and is a particularly cost-effective and efficient way to heat off-grid homes. The main constituent of LPG is butane. LPG is used for cooking in many countries for economic reasons, for convenience or because it is the preferred fuel source.

Which of the following are correct structural isomers of C_4H_{10}?
Options:
(a) (I) and (III) (b) (II) and (IV) (c) (I) and (II) (d) (III) and (IV)

Ans. (c) (I) and (II)
The chemical formula of butane is C4H10. Structural formulae in other options (III) and (IV) show only 8 hydrogen atoms. (I) and (II) are isomers of butane as they have the same molecular formula but different structures. Structure (I) is n-butane and structure (II) is iso-butane.

7. Consider the structures of the three cyclic carbon compounds I, II and III given below and select the correct option from the following:



(a) I and III are isomers of hexane; II is benzene.
(b) I is an isomer of hexane; II is benzene; III is an isomer of hexene.
(c) I is a saturated cyclic hydrocarbon; II and III are unsaturated cyclic hydrocarbons.
(d) I is cyclohexane; II and III are the isomers of benzene.
Ans. (c) I is a saturated cyclic hydrocarbon; II and III are unsaturated cyclic hydrocarbons.
The main difference between saturated and unsaturated compounds is the presence of single and double or triple bonds. From the given figures, (i) is a saturated cyclic hydrocarbon because it is a cyclohexane containing all the single bonds in its structure whereas (ii) and (iii) are unsaturated cyclic hydrocarbons because they contain double bonds in their structures.

8. A student is given equal amount of three samples of water with temporary hardness labelled as 'A', 'B' and 'C'. He keeps the three samples at different temperatures – A at room temperature, B at 50 ºC and C at 95 ºC.
Which sample will give maximum amount of lather when 10 mL of soap solution is added to each sample and shaken for equal time?
(a) A only (b) Both A and B (c) Both B and C (d) C only
Ans. (d) C only
On increasing the temperature, lather forming tendency increases.

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

9. **Assertion(A):** Carbon has a strong tendency to either lose or gain electrons to attain noble gas configuration.
Reason (R): Carbon has four electrons in its outermost shell and has the tendency to share electrons with carbon or other elements.
Ans. (d) (A) is false but (R) is true.

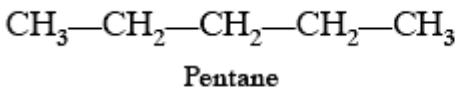
10. **Assertion (A):** Esterification is a process in which a sweet smelling substance is produced.
Reason (R): When esters react with sodium hydroxide an alcohol and sodium salt of carboxylic acid are obtained.
Ans. (b) Both (A) and (R) are true, and (R) is not the correct explanation of (A).

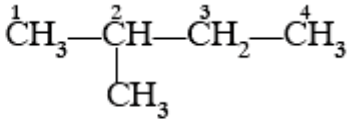
SECTION – B

Questions 11 to 14 carry 2 marks each.

11. What is meant by isomers? "We cannot have isomers of first three members of alkane series." Give reason to justify this statement. Draw the structures of two isomers of pentane, C_5H_{12}.

Ans. Isomers are those compounds which have same molecular formula and different structural formula.
In first three members of alkane series, branching is not possible, therefore, isomers are not possible.


Pentane

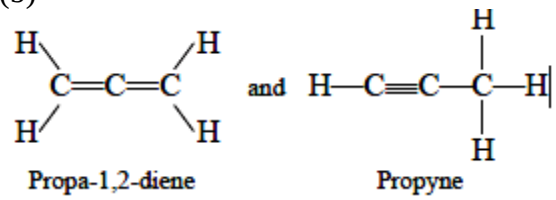

2-methylbutane

12. The table shows the electronic structures of four elements.

Element	Electronic Structure
P	2,6
Q	2,8,1
R	2,8,7
S	2,8,8

(a) Identify which element(s) will form covalent bonds with carbon.
(b) "Carbon reacts with an element in the above table to form several compounds." Give suitable reason.
Ans. (a) P and R
(b) Carbon has a valency four or tetravalency and catenation are responsible.

13. Alkanes are saturated compounds of carbon and hydrogen that can be represented by the general formula C_nH_{2n+2} where 'n' is the number of carbon atoms. An example of such a compound is ethane C_2H_6.
Maya has a compound of carbon and hydrogen whose formula is C_3H_4.
(a) What is true about the type of flame this compound will give on combustion?
(b) Draw all the possible straight chain structures of this compound.
Ans. (a) The compound being unsaturated will burn with a sooty or smoky flame
(b)


Propa-1,2-diene and Propyne

14. Manasi wrote the names of four compounds as the first members of their respective homologous series.
– Methanol – Methanal
– Methanone – Methanoic acid
(a) Which name has she written incorrectly? Justify your answer.
(b) What name should she have written instead?
Ans. (a) – Methanone is not possible
– The smallest ketone has three carbon atoms.
(b) Propanone

OR

(i) Chemical properties of ethanol is different from methyl ethanoate. Justify the statement with proper reason.
(ii) Methyl ethanoate is used in making perfumes. Justify.
Ans. (i) Ethanol reacts with sodium metal, methyl ethanoate does not. They differ in functional group,
differ in chemical properties.
(ii) It is because it has pleasant fruity smell.

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. Ethanol (C_2H_5OH) is heated with alkaline potassium permanganate to give a compound X.

$$C_2H_5OH \xrightarrow{\text{alkaline } KMnO_4 + \text{heat}} X$$

(a) How many carbon atoms will compound X contain?

(b) Compound X is now reacted with ethanol in the presence of an acid catalyst to give a compound Y.

$X + C_2H_5OH$ acid $\rightarrow$ Y

(i) Name the type of compound formed in the above reaction with respect to the functional group it contains.

(ii) State one characteristic property of compounds of the type of compound Y.

(iii) State one use of compounds of this type.

Ans. (a) Two

$$C_2H_5OH + 2[O] \xrightarrow{\text{alkaline } KMnO_4} \underset{\text{'X'}}{CH_3COOH}$$

(b) (i) ester

$$\underset{\text{'X'}}{CH_3COOH} + C_2H_5OH \xrightarrow{\text{acid}} CH_3COOC_2H_5 + H_2O$$

(ii) Esters are pleasant fruity smelling compounds in ice creams, cold drinks etc.

(iii) – perfumes

– flavouring agents in ice creams, cold drinks, etc.) (any one)

16. How would you bring about the following conversions? Name the process and write the reaction involved.

(a) Ethanol to ethene

(b) Propanol to propanoic acid

Write the reactions.

Ans. (a) Ethanol can be converted to ethene by dehydration of ethanol in the presence of concentrated sulphuric acid at 170°C. The reaction is named as dehydration reaction.

$$\underset{\text{(Ethanol)}}{CH_3CH_2OH} \xrightarrow[160°\text{-}170°C]{\text{Conc. } H_2SO_4} \underset{\text{(Ethene)}}{CH_2{=}CH_2} + H_2O$$

(b) Propanol can be converted to propanoic acid by oxidation in the presence of alkaline potassium permanganate and heat i.e., by the oxidation of propanol using an oxidising agent such as alkaline KMnO4. It is named as oxidation reaction.

$$\underset{\text{(Propanol)}}{CH_3CH_2CH_2OH} \xrightarrow[\text{Heat}]{\text{Alk. } KMnO_4} \underset{\text{(Propanoic acid)}}{CH_3CH_2COOH}$$

OR

(a) Why does micelle formation take place when soap is added to water?

(b) Why are micelles not formed when soap is added to ethanol?

Ans. (a) It is because large number of molecular ions of soaps get aggregated and form colloidal solution. Soap has hydrophobic tail (hydrocarbon) which dissolves in hydrocarbon part and hydrophilic head part dissolves in water.

(b) Ethanol is a non-polar solvent therefore micelles are not formed because hydrocarbon part gets attracted towards ethanol and ionic end will not dissolve in alcohol.

17. A compound X is formed by the reaction of a carboxylic acid C2H4O2 and an alcohol in the presence of a few drops of H2SO4. The alcohol, on oxidation with alkaline KMnO4 followed by acidification, gives the same carboxylic acid as used in this reaction.

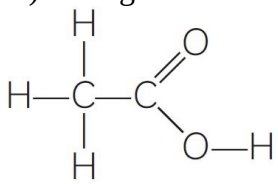
Give the names and structures of:

(a) Carboxylic acid

(b) Alcohol

(c) The compound X. Also write the reaction.

Ans. (a) Carboxylic acid is ethanoic acid: Carboxylic acid with molecular formula $C_2H_4O_2$ is acetic acid or ethanoic acid (CH_3COOH) having the structure as:



(b) Alcohol is ethanol: The given alcohol forms acetic acid on oxidation with alkaline $KMnO_4$, followed by acidification. Therefore, it must be ethanol with structure $CH_3—CH_2—OH$.

$$CH_3CH_2OH \xrightarrow[\text{Acidification}]{\text{Alkaline } KMnO_4} CH_3COOH$$

(c) X is ethyl ethanoate: The reaction of ethanoic acid with ethanol in the presence of a few drops of conc. H_2SO_4 is an esterification reaction that forms an ester, ethyl ethanoate ($CH_3COOC_2H_5$).

$$\underset{\text{(Ethanoic acid)}}{CH_3—COOH} + \underset{\text{(Ethanol)}}{C_2H_5OH} \xrightarrow{H_2SO_4} \underset{\text{(Ethyl ethanoate)}}{CH_3—COOC_2H_5} + H_2O$$

OR

Srishti heated ethanol with a compound P in presence of a few drops of concentrated sulphuric acid and observed a sweet smelling compound B is formed. When Q is treated with sodium hydroxide it gives back Ethanol and a compound R.

(a) Identify P and R.

(b) Give one use each of compounds P and Q.

(c) Write the chemical reactions involved and name the reactions.

Ans. (a) P – Ethanoic acid/ Or any other carboxylic acid , R- Sodium salt of ethanoic acid/ any other carboxylic acid/ sodium ethanoate.

(b) Use of P- dil. solution used as vinegar in cooking/ preservative in pickles.

Use of Q – making perfumes, flavoring agent.

(c)

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

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

SECTION – D

Questions 18 carry 5 marks.

18. A compound C (molecular formula, $C_2H_4O_2$) reacts with Na-metal to form a compound R and evolves a gas which burns with a pop sound. Compound C on treatment with an alcohol A in presence of an acid forms a sweet smelling compound S (molecular formula $C_3H_6O_2$). On addition of NaOH to C, it also gives R and water. S on treatment with NaOH solution gives back R and A. Identify C, R, A, S and write down the reactions involved.

Ans. C — Ethanoic acid

R — Sodium salt of ethanoic acid (sodium acetate) and gas evolved is hydrogen

A — Methanol

S — Ester (Methyl acetate)

(*i*) $\underset{\text{(C)}}{2CH_3COOH} + 2Na \longrightarrow \underset{\text{(R)}}{2CH_3COONa} + H_2$

(*ii*) $\underset{\text{(C)}}{CH_3COOH} + \underset{\text{(A)}}{CH_3OH} \xrightarrow{\text{conc. } H_2SO_4} \underset{\text{(S)}}{CH_3COOCH_3} + H_2O$

(*iii*) $\underset{\text{(C)}}{CH_3COOH} + NaOH \xrightarrow{\text{conc. } H_2SO_4} \underset{\text{(R)}}{CH_3COONa} + H_2O$

(*iv*) $\underset{\text{(S)}}{CH_3COOCH_3} + NaOH \longrightarrow \underset{\text{(R)}}{CH_3COONa} + \underset{\text{(A)}}{CH_3OH}$

OR

(a) What is homologous series of carbon compounds? Write general formula of alkynes. Name and draw the electron dot structure of first homologue of this series.
(b) State the meaning of the functional group in an organic compound. Write the formula of functional group present in alcohols and carboxylic acids.
Ans. (a) The series of organic compounds having same functional group, similar chemical properties, gradation in physical properties are called homologous series.
General formula of alkynes C_nH_{2n-2}

H—C≡C—H, Ethyne, 

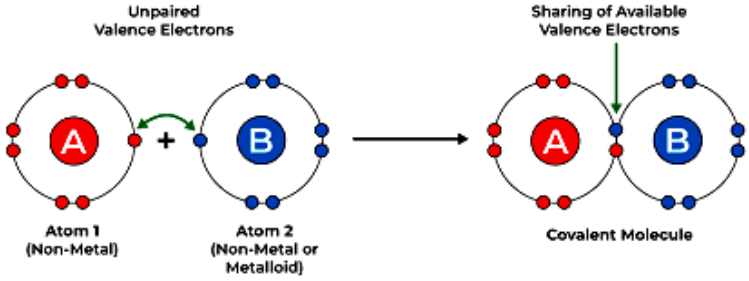
(b) Functional group is an atom or group of atoms or reactive part of compound which determines chemical properties of organic compounds e.g., —OH is present in alcohols, —COOH is functional group in carboxylic acids.

SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Read the given passage and answer the questions based on passage and related studied concepts.

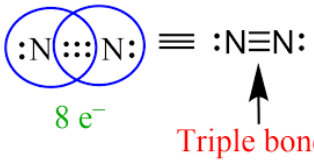
Covalent bonds are formed by sharing electrons. Not just carbon, but many other elements form molecules by sharing electrons in this manner. The shared electrons belong to outer shells of both the atoms and lead to both atoms attaining the noble gas configuration. Hydrogen is simplest molecule formed in this manner. Single bond is formed between two hydrogen atoms by sharing one electron each. Double bond is formed by sharing two electrons each. Triple bond is formed by sharing three electrons each. Ammonia, water, methane also have covalent bonds.



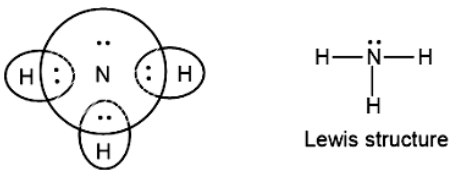
Covalently bonded molecules are seen to have strong bonds within the molecule but intermolecular forces are small.
(a) Hydrogen molecule acquires stable electronic configuration of which noble gas after forming covalent bonds?
(b) Draw the electron dot diagram of nitrogen.
(c) Draw the electron dot diagram of ammonia. Does it conduct electricity? Give reason.

OR

(c) Draw electron dot diagram of water molecule. Which has higher boiling point-H_2O or NaCl? Give reason.
Ans. (a) Helium
(b)



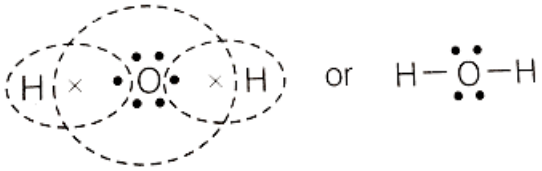
(c)



It does not conduct electricity because no charged particles are formed as electrons are shared

OR

(c)



NaCl has higher boiling point than H_2O because Na^+ and Cl^- have strong forces of attraction as compared to intermolecular forces of attraction between water molecules.

20. Read the given passage and answer the questions based on passage and related studied concepts.

Observe the table of boiling points of alcohols and carboxylic acids. Study this table and answer the questions related to studied concepts.

Compound	Boiling point
1. Methanol	64°C
2. Ethanol	78°C
3. Propanol	97°C
4. Butanol	117°C
5. Methanoic acid	101°C
6. Ethanoic acid	118°C
7. Propanoic acid	141°C
8. Butanoic acid	164°C

(a) Why do acids have higher boiling points than alcohol?

(b) Why does ethanol have higher boiling point than CH_3OH?

(c) (i) What is vinegar?

(ii) What is glacial acetic acid?

OR

(c) (i) Which acid is present in Rancid butter?

(ii) What happens when 5% alkaline $KMnO_4$ is added to butanol?

Ans: (a) It is because acids have stronger forces of attraction than alcohols.

(b) C_2H_5OH has higher molar mass, more van der Waals' forces of attraction than CH_3OH.

(c) (i) 5 to 8% solution of acetic acid in water is called vinegar.

(ii) Pure acetic acid is called glacial acetic acid.

OR

(i) Butanoic acid (Butyric acid).

(ii) $CH_3CH_2CH_2CH_2OH \xrightarrow[KMnO_4]{Alkaline} CH_3CH_2CH_2COOH$

Butanoic acid is formed.