4. Carbon and its Compounds - Board Exam Questions

2 Mark Questions

1) *Carbon forms millions of compounds whereas silicon, which is just below it in the Periodic Table, forms a few compounds. Explain the reason for the difference in their ability to form compounds.*

Carbon atoms are small, so they form strong and stable C–C bonds. So carbon links with itself in long chains (catenation) and forms millions of compounds.

Silicon atoms are bigger, so Si–Si bonds are weak. Silicon cannot form long chains, so it forms only a few compounds.

2) *The melting and boiling points of carbon compounds are generally low and they are largely non-conductors of electricity. State two conclusions based on these two properties.*

• Low melting and boiling points: the forces between their molecules are weak.

• They do not conduct electricity: their bonding does not form any ions.

3) *(a) Select from the following the members of same homologous series: (1) $CH_3–CH_2–CHO$ (propanal) (2) $CH_3–CO–CH_3$ (propanone) (3) $CH_3–CH_2–COOH$ (propanoic acid) (4) $CH_3–CH_2–CH_2–CHO$ (butanal) (b) What happens to (i) the melting point, and (ii) the solubility of compounds as the molecular mass of the compounds in a homologous series increases?*

(a) (1) and (4). Both are aldehydes.

(b) (i) The melting point increases.

(ii) The solubility changes step by step (gradually) as the molecular mass increases.

4) *Distinguish between a saturated and an unsaturated hydrocarbon by flame test. List the products of combustion reaction of a saturated hydrocarbon.*

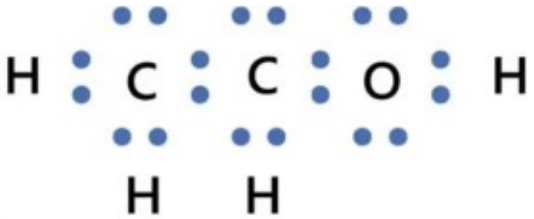
Saturated hydrocarbon	Unsaturated hydrocarbon
Burns with a clean blue flame.	Burns with a yellow flame and lots of black smoke.

Products of burning a saturated hydrocarbon: carbon dioxide and water.

3 Mark Questions

1) *An organic compound "X" with formula C_2H_6O is used to blend with petrol in order to reduce the dependence on fossil fuels and lower down the harmful emissions from the cars. It is also used as a solvent in medicines such as tincture iodine, cough syrups and many tonics. (i) Draw the electron dot structure of "X". (ii) Write the name and formula of the next homologue of "X". (iii) Write the reaction of "X" with acetic acid to form a sweet smelling substance.*

(i) X is ethanol.



(ii) Propanol, C_3H_7OH

(iii) With an acid catalyst, ethanol and acetic acid form a sweet-smelling ester (ethyl ethanoate):

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

2) *Ramya performs an experiment in the following two steps: Step 1: Heats ethanol with conc. H_2SO_4 at 170°C to get product A. Step 2: Passes hydrogen gas over product A, using Ni as a catalyst and gets product B. (i) Name the products A and B. (ii) Write the reactions involved in both the steps.*

(i) A: ethene B: ethane

(ii) Step 1: CH_3CH_2OH —(hot conc. H_2SO_4)→ $CH_2=CH_2 + H_2O$

Step 2: $CH_2=CH_2 + H_2$ —(Ni)→ $CH_3–CH_3$

3) *Why is the conversion of ethanol to ethanoic acid an oxidation reaction? Name the oxidising agent used in this conversion. Write chemical equation for this oxidation reaction. How is this reaction different from the reaction in which ethanol burns in the presence of oxygen?*

It is oxidation because oxygen is added to ethanol to make ethanoic acid.

Oxidising agent: alkaline potassium permanganate (it loses its purple colour as it reacts).

CH_3CH_2OH —(alkaline $KMnO_4$ + heat)→ CH_3COOH

Here ethanol is only oxidised to an acid. When ethanol burns, it is a combustion reaction, giving carbon dioxide, water, heat and light.

4 Mark Questions (Case Study)

1) *The combining capacity of various elements depends on the number of valence electrons. Also the reactivity of elements is explained as their tendency to attain a completely filled outer shell, that is, to attain a noble gas configuration. This may be either through gain of electrons or loss of electrons or sharing of electrons.*

(a) An element A has atomic number 16, how will it attain its nearest noble gas configuration? (1)

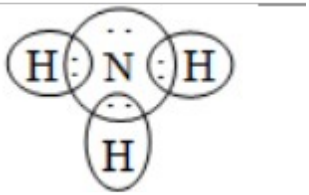
A is 2, 8, 6. It will gain or share 2 electrons.

(b) Write the number of (i) single and (ii) double covalent bonds in a molecule of butene (C_4H_8). (1)

(i) 10 single bonds (ii) 1 double bond

(c) (A) Explain the formation of a molecule of ammonia (NH_3), using electron dot structure. (Atomic number of nitrogen is 7) (2)

Nitrogen (2, 5) shares one pair of electrons with each of the three hydrogen atoms. It keeps one pair of its own (lone pair).



OR (c) (B) Why does carbon share its valence electrons with other atoms of carbon or with atoms of other elements?

Carbon has 4 outer electrons. It cannot gain 4 electrons: six protons cannot hold ten electrons (C^{4-}). It cannot lose 4 electrons: that n eeds too much energy (C^{4+}).

So carbon shares its electrons to complete its octet.

2) *Carbon is a versatile element that forms the basis of all living organisms and many of the things we use. A large variety of compounds is formed because of its tetravalency. Compounds of carbon are formed with oxygen, hydrogen, nitrogen, sulphur, chlorine and many other elements.*
(a) What are hydrocarbons? (1)

Compounds made of only carbon and hydrogen.

(b) List two properties by virtue of which carbon can form a large number of compounds. (1)

Tetravalency and catenation.

(c) (i) Write the formula of the functional group present in (1) aldehydes, and (2) ketones. Write chemical equation for the reaction that occurs between ethanoic acid and ethanol in the presence of a catalyst. (2)
(1) Aldehyde: –CHO (2) Ketone: >C=O

$CH_3COOH + C_2H_5OH \xrightarrow{\text{(acid)}} CH_3COOC_2H_5 + H_2O$

OR (c) (ii) What are structural isomers? Write the structures of two isomers of butane (C_4H_{10}).

Compounds with the same molecular formula but different structures.

n-butane: $CH_3–CH_2–CH_2–CH_3$

isobutane (2-methylpropane): $CH_3–CH(CH_3)–CH_3$

3) *More than three million carbon compounds have been discovered in the field of chemistry. The diversity of these compounds is due to the capacity of carbon atoms for bonding with one another as well as with other atoms. Most of the carbon compounds are poor conductors of electricity and have low melting and boiling points.*

(a) Write the molecular formula of first two members of homologous series having functional group –Br. (1)

CH_3Br and C_2H_5Br

(b) Given below are the formulae of some functional groups: (i) –CHO (ii) –CO– (a C double-bonded to O, between two carbons). Write the name of these functional groups. (1)

(i) Aldehyde (ii) Ketone

(c) What would be observed on adding a 5% alkaline potassium permanganate drop by drop to some warm ethanol taken in a test tube? State the role of $KMnO_4$ in the reaction and write the chemical equation for the reaction involved. (2)

The purple colour of $KMnO_4$ disappears at first. $KMnO_4$ acts as an oxidising agent.

CH_3CH_2OH —(alkaline $KMnO_4$ + heat)→ CH_3COOH

OR (c) Write the name of the compound formed when ethanol is heated at 443 K temperature with excess of conc. H_2SO_4. What is the role of conc. H_2SO_4 in the reaction? Write the chemical equation for the reaction involved.

Ethene. Conc. H_2SO_4 acts as a dehydrating agent (it removes water).

C_2H_5OH —(conc. H_2SO_4, 443 K)→ $CH_2=CH_2 + H_2O$

4) *Alcohol forms a homologous series with general formula $C_nH_{2n+1}–OH$ and –OH group as functional group. Ethanol is commonly called alcohol*

and is used in alcoholic drinks. It is good solvent, used in medicines, cough syrups, tonics etc.

(a) Write structural formula and name of 4th member of alcohol homologous series. (1)

Butanol: $CH_3–CH_2–CH_2–CH_2–OH$

(b) What happens when ethanol is heated with alkaline $KMnO_4$? Write chemical equation involved. (1)

(refer 3rd 3 mark question)

(c) Write the chemical equation of reaction of ethanol with ethanoic acid in the presence of concentrated H_2SO_4. Write the name of this reaction. (2)

$CH_3COOH + CH_3CH_2OH \xrightarrow{\text{(acid)}} CH_3COOCH_2CH_3 + H_2O$

This is an esterification reaction.

OR (c) What happens when ethanol is heated with excess concentrated sulphuric acid at 443 K? Write chemical equation involved. What is the role of concentrated sulphuric acid in this reaction?

Ethanol loses water and forms ethene.

$C_2H_5OH \xrightarrow{\text{(conc. } H_2SO_4\text{, 443 K)}} CH_2=CH_2 + H_2O$

Conc. H_2SO_4 acts as a dehydrating agent.

5) *The table given below shows the hints given by the quiz master in a quiz.*

S.No.	Hint
(i)	Substance 'C' is used as a preservative.
(ii)	'C' has two carbon atoms; 'C' is obtained by the reaction of 'A' in presence of alkaline Potassium permanganate followed by acidification.
(iii)	Misuse of 'A' in industries is prevented by adding Methanol, Benzene, and pyridine to 'A'.
(iv)	'F' is formed on heating 'A' in presence of conc Sulphuric acid.
(v)	'F' reacts with Hydrogen gas in presence of Nickel and Palladium catalyst.

a) Give the IUPAC names of A and F (2)

A: ethanol F: ethene

b) Illustrate with the help of chemical equations the changes taking place. (A → C and A → F) (2)

A → C: (refer 3rd 3 mark question). The acidification step gives the acid: CH_3COONa —(H^+)→ CH_3COOH

A → F: (refer 2nd 3 mark question)

OR Name the chemical reactions which occur in steps 2 and 5. Identify the compounds formed in these steps if 'A' is replaced with its next homologue.

Step 2: oxidation. Step 5: addition (hydrogenation).

With propanol as 'A': propanoic acid (step 2) and propane (step 5).

6) *1. $A + H_2O$ —(Electrolysis)→ X (caustic soda) + Y↑ (anode) + Z↑ (cathode)*

2. A (molten) —(Electrolysis)→ M (cathode) + Y↑ (anode)

3. $M + CH_3COOH \rightarrow P + Z\uparrow$

4. $CH_3COOH + Q$ —(Conc. H_2SO_4)→ R

5. $R + X \rightarrow P + Q$

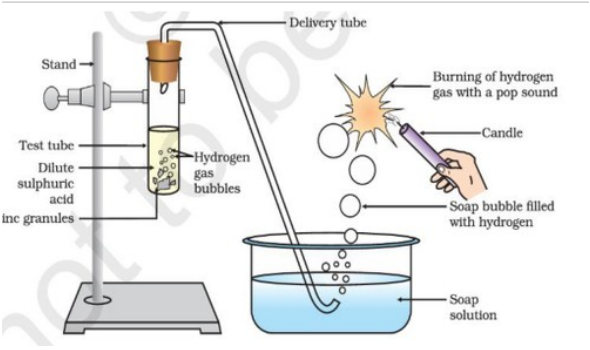
A. Derive the names of A, Y, Z, M, P & R (3)

A: sodium chloride Y: chlorine gas Z: hydrogen gas

M: sodium metal P: sodium ethanoate R: ethyl ethanoate (an ester)

B. Improvise an activity to test Z. (1)

Pass the gas through soap solution. Bring a burning candle near a soap bubble filled with the gas. It burns with a pop sound, so the gas is hydrogen.



OR C. Name the process in which compounds X, Y & Z are formed from A. Justify your response.

Chlor-alkali process. It is named after its products: chlorine and an alkali (sodium hydroxide).

7) *'A' and 'B' are two salts used for washing purposes. Salt 'A' is used for bathing also. Four test tubes I, II, III and IV as mentioned below are taken. I. Rain water + solution of salt 'A' II. Rain water + solution of salt 'B' III. Tubewell water + solution of salt 'A' IV. Tubewell water + solution of salt 'B'. The test tubes are shaken one by one almost identically for the same time and the lengths of foam formed in each test tube is noted.*

(a) In which one of the four test tubes is the foam formed the minimum? (1)

III (tubewell water + salt A)

(b) Differentiate between salt A and salt B. (1)

Salt A is a soap. It does not form lather with hard water. Salt B is a detergent. It forms lather even with hard water.

(c) (i) What are esters? What happens when an ester reacts with an alkali (say sodium hydroxide)? Give chemical equation for the reaction. (2)

Esters are sweet-smelling compounds used in perfumes and flavours.

With an alkali, an ester changes back into an alcohol and the salt of the acid.

$CH_3COOC_2H_5 + NaOH \rightarrow C_2H_5OH + CH_3COONa$

OR (c) (ii) What is the cause of hardness of water? Sometimes it is observed that while bathing foam is formed with difficulty and an insoluble substance is formed. Name this substance and write the cause of its formation.

Hard water has calcium and magnesium salts in it.

The insoluble substance is scum. Soap reacts with the calcium and magnesium salts and forms it.

5 Mark Questions

1) *(i) Give reasons for the following: (I) Covalent compounds are poor conductor of electricity. (II) Soap does not form lather in hard water. (III) Carbon shows catenation but silicon does not.*

(ii) Write chemical equations for the following: (I) Oxidation of ethanol by acidified $K_2Cr_2O_7$. (II) Hydrogenation of ethene.

(i) (I) (refer 2nd 2 mark question)

(II) Soap reacts with the calcium and magnesium salts in hard water and forms scum, an insoluble substance.

(III) (refer 1st 2 mark question)

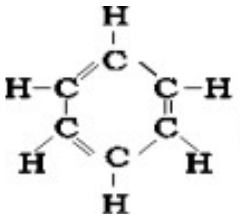
(ii) (I) CH_3CH_2OH —(acidified $K_2Cr_2O_7$ + heat)→ CH_3COOH

(II) (refer 2nd 3 mark question)

2) *(i) Write the structural formula of benzene.*

(ii) State the reason why carbon can neither form C^{4+} cation nor C^{4-} anion.

(iii) What type of bond is formed between carbon and hydrogen?
(iv) How is ethanol converted to ethanoic acid?
(v) Complete the following chemical equation: $CH_3COOC_2H_5 + NaOH \rightarrow$
(i)



(ii) C^{4+}: removing four electrons needs too much energy. C^{4-}: a nucleus wi th six protons cannot hold ten electrons.
(iii) Covalent bond
(iv) (refer 3rd 3 mark question)
(v) $CH_3COOC_2H_5 + NaOH \rightarrow C_2H_5OH + CH_3COONa$

3) *(i) Carbon cannot form C^{4+} cation and C^{4-} anion. Explain.*
(ii) Define homologous series of carbon compounds. Why are the melting and boiling points of C_4H_{10} higher than C_3H_8 or C_2H_6?
(iii) What happens when ethanol is heated with acidified potassium dichromate?
(i) C^{4+}: removing four electrons needs too much energy. C^{4-}: a nucleus wi th six protons cannot hold ten electrons.
(ii) A series of compounds in which the same functional group replaces hydrogen in a carbon chain.
C_4H_{10} has a bigger molecular mass, so its melting and boiling points are higher.
(iii) Ethanol is oxidised to ethanoic acid:
CH_3CH_2OH —(acidified $K_2Cr_2O_7$ + heat)→ CH_3COOH

4) *(i) Give reason why carbon can neither form C^{4+} cations nor C^{4-} anions bu t form covalent compounds.*
(ii) What is homologous series of carbon compound? Write the molecular

formula of any two consecutive members of homologous series of aldehydes.

(iii) Draw the structure of the molecule of cyclohexane (C_6H_{12}).

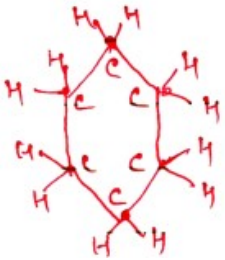
(i) C^{4+}: removing four electrons needs too much energy. C^{4-}: a nucleus with six protons cannot hold ten electrons.

So carbon shares electrons and forms covalent compounds.

(ii) A series of compounds in which the same functional group replaces hydrogen in a carbon chain.

Aldehydes: CH_3CHO and C_2H_5CHO

(iii)



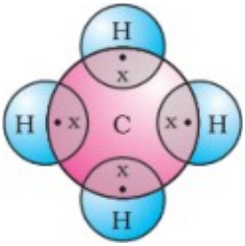
5) *(i) Name the simplest saturated hydrocarbon. Draw its electron dot structure. Which type of bonds exist in this compound?*

(ii) Name any two mixtures of the carbon compound used as a fuel in daily life, of which the above mentioned compound is an important component.

(iii) In which homologous series of carbon compounds can this compound be placed? Write the general formula of the series.

(iv) Which type of flame is produced on burning it?

(i) Methane (CH_4).



It has covalent bonds.

(ii) Biogas and CNG (compressed natural gas)

(iii) Alkanes. General formula: C_nH_{2n+2}

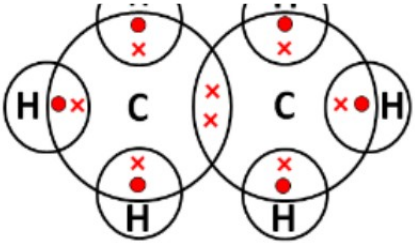
(iv) A clean (blue) flame

6) *(i) "Keerthi thinks that Substitution reaction occurs in saturated Hydrocarbons, on the contrary Krishi thinks, it occurs in unsaturated Hydrocarbons." Justify with valid reasoning whose thinking is correct.*
(ii) "Methane and Propane and their Isomers are used as fuels" Comment. Draw the electron dot structure of the immediate lower homologue of Propane. Give any two characteristics of homologues of a given homologous series.
(iii) A mixture of oxygen and ethyne is burnt for welding. Can you predict why a mixture of ethyne and air is not used?

(i) Keerthi is correct. In saturated hydrocarbons, hydrogen atoms are replaced by other atoms (substitution). Unsaturated hydrocarbons show addition reactions, where molecules are added across the double or triple bond.

(ii) Methane and propane burn in oxygen and give a lot of energy, so they are good fuels.

The lower homologue of propane is ethane:



Characteristics: Two neighbouring members differ by $–CH_2–$ (14 u). They have the same general formula.

(iii) With enough oxygen, ethyne burns completely with a clean blue flame and gives a lot of heat. In air there is not enough oxygen, so it burns incompletely with a sooty flame.

7) *(i) Define a homologous series of carbon compounds.*
(ii) Why is the melting and boiling points of C_4H_8 higher than that of C_3H_6 or C_2H_4?
(iii) Why do we NOT see any gradation in chemical properties of a homologous series compounds?
(iv) Write the name and structures of (i) aldehyde and (ii) ketone with molecular form C_3H_6O.

(i) A series of carbon compounds in which the same functional group replaces hydrogen in a carbon chain.

(ii) Melting and boiling points increase as the molecular mass increases.

(iii) Chemical properties depend on the functional group, which is the same in the whole series.

(iv) (i) Aldehyde: propanal, CH_3CH_2CHO

(ii) Ketone: propanone, CH_3COCH_3

8) *(i) What is homologous series? Which two of the following organic compounds belong to the same homologous series? C_2H_4, C_4H_{10}, C_3H_4, C_4H_8*
(ii) Write the product(s) in the following reactions: (I) $CH_3–CH_2–OH$ +

CH_3COOH →(Acid) (II) $C_2H_5OH + O_2$ →(Burning)

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

(i) A series of compounds in which the same functional group replaces hydrogen in a carbon chain.

C_2H_4 and C_4H_8 (both alkenes, C_nH_{2n}).

(ii) (I) (refer 1st 3 mark question)

(II) $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

(iii) The ionic end of soap is attracted to water, and the carbon chain is attracted to oil (dirt). So the soap molecules arrange themselves into a ball-like structure called a micelle.

9) *(a) What is meant by the term homologous series of carbon compounds? Write molecular formula of any two consecutive members of homologous series of ketones.*

(b) Write chemical equation of the reactions of ethanoic acid with (i) Sodium hydroxide and (ii) Ethanol (in the presence of an acid); giving the name of the products in each case.

(c) Draw the structure of the molecule of benzene.

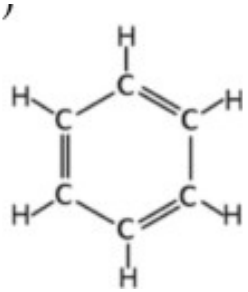
(a) A series of carbon compounds in which the same functional group replaces hydrogen in a carbon chain.

Ketones: CH_3COCH_3 and $CH_3COC_2H_5$

(b) (i) $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$. Product: sodium ethanoate.

(ii) $C_2H_5OH + CH_3COOH$ —(acid)→ $CH_3COOC_2H_5 + H_2O$. Product: ethyl ethanoate (an ester).

(c)



10) *(i) Draw the structure of the following compounds: (a) Butanoic acid (b) Chloropentane*
(ii) How are structure (i) and structure (ii) given below related to one another? Give reason to justify your answer. Structure (i): $(CH_3)_2CH–CH(CH_3)_2$ Structure (ii): $(CH_3)_3C–CH_2CH_3$. Draw one more possible structure for above case.
(iii) Differentiate between saturated and unsaturated carbon compounds on the basis of their general formula.
(i) (a) $CH_3–CH_2–CH_2–COOH$ (b) $CH_3–CH_2–CH_2–CH_2–CH_2–Cl$
(ii) They are isomers: they have the same molecular formula but different structures.
One more structure:

$$CH_3 - CH_2 - CH_2–CH_2–CH_2–CH_3$$

(iii) Saturated: C_nH_{2n+2}. Unsaturated: C_nH_{2n} (double bond) and C_nH_{2n-2} (triple bond).

11) *(i) Name the following compounds: (I) $CH_3–CO–CH_3$ (II) $CH_3–C\equiv C–H$*
(ii) Name the reaction which is commonly used in the conversion of vegetable oils to fats.
(iii) Why is the melting point of C_4H_{10} higher than C_3H_8?
(iv) What happens when a piece of sodium is dropped into ethanol?
(v) Write the products in the following reaction: $CH_3COOC_2H_5 + NaOH \rightarrow$
(i) (I) Propanone (II) Propyne
(ii) Hydrogenation

(iii) C_4H_{10} has a bigger molecular mass, and the melting point increases with molecular mass.
(iv) Sodium ethoxide (C_2H_5ONa) forms and hydrogen gas is given out.
(v) $CH_3COONa + C_2H_5OH$

12) *(i) How would you name the following: I. $CH_3–CH_2–CHO$ II. $CH_3–C≡CH$*
(ii) When ethanol reacts with ethanoic acid in the presence of conc. H_2SO_4, a substance with sweet smell is produced. Answer the following: I. State the class of compounds to which the sweet smelling compounds belong. II. Write the chemical equation for the reaction.
(iii) Why soaps do not produce foam with hard water?
(i) I. Propanal II. Propyne
(ii) I. Esters
II. (refer 1st 3 mark question)
(iii) Soap reacts with the calcium and magnesium salts in hard water and forms scum (an insoluble substance), so it does not foam.

13) *(i) Draw two isomeric structures of Butene (C_4H_8).*
(ii) Name the following compounds: (I) $CH_3–CH_2–CH_2–Cl$ (II) $CH_3–CH_2–CO–CH_3$
(iii) Write the chemical equations for the following reactions. Mention one essential condition each for these reactions to take place. (I) Ethanol undergoes complete oxidation (II) Propene undergoes hydrogenation (III) Ethanoic acid reacts with ethanol
(i) $CH_2=CH–CH_2–CH_3$ (but-1-ene) and $CH_3–CH=CH–CH_3$ (but-2-ene)
(ii) (I) Chloropropane (II) Butanone
(iii) (I) (refer 3rd 3 mark question)
(II) $CH_3CH=CH_2 + H_2 \xrightarrow{(Ni)} CH_3CH_2CH_3$
(III) (refer 1st 3 mark question)

14) *(i) Differentiate between saturated and unsaturated hydrocarbons by giving one example each, with a structural formula.*
(ii) Write the method of converting an unsaturated hydrocarbon into

a saturated hydrocarbon. Name the industry where this reaction is commonly used.
(iii) Write the name and structure of a hydrocarbon having double bond and four carbon atoms in its one molecule.
(i)

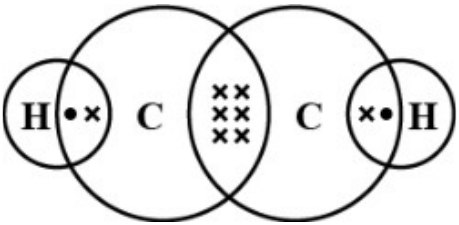
Saturated hydrocarbons	Unsaturated hydrocarbons
All the carbon atoms are joined by single bonds.	At least one double or triple bond between carbon atoms.
Example: propane, $CH_3CH_2CH_3$	Example: propene, $CH_2=CH–CH_3$

(ii) Add hydrogen in the presence of a nickel or palladium catalyst (hydrogenation).
It is used to make vegetable ghee from vegetable oil.
(iii) Butene: $CH_2=CH–CH_2–CH_3$

15) *A carbon compound 'P' of molecular formula C_2H_6O is found to be neutral when tested with red and blue litmus. A gas that burns with a pop sound is produced when sodium metal reacts with compound 'P'.*
(i) Identify the compound 'P'.
(ii) The carbon compound 'P' is heated with conc. H_2SO_4 at 443 K to produce compound 'Q'. (I) Write the chemical equation for the reaction. (II) What is the role of conc. H_2SO_4 in this reaction?
(iii) What is likely to be observed on heating compound 'P' with ethanoic acid with an acid as a catalyst? Write the chemical equation for the reaction.
(i) P: ethanol
(ii) (I) CH_3CH_2OH —(hot conc. H_2SO_4)→ $CH_2=CH_2 + H_2O$
(II) It is a dehydrating agent (it removes water).
(iii) (refer 1st 3 mark question)

16) *(i) Name a commercially important carbon compound having functional group –OH and write its molecular formula.*
(ii) Write chemical equation to show its reaction with (1) Sodium metal (2) Excess conc. sulphuric acid (3) Ethanoic acid in the presence of an acid catalyst (4) Acidified potassium dichromate. Also write the name of the product formed in each case.
(i) Ethanol, C_2H_5OH
(ii) (1) $2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa$ (sodium ethoxide) + H_2
(2) C_2H_5OH —(excess conc. H_2SO_4, 443 K)→ $CH_2=CH_2$ (ethene) + H_2O
(3) (refer 1st 3 mark question). The product is an ester, ethyl ethanoate.
(4) C_2H_5OH —(acidified $K_2Cr_2O_7$)→ CH_3COOH (ethanoic acid)

17) *(a) Write the molecular formula of ethyne and draw its electron dot structure.*
(b) Write chemical equation to show the reaction of ethanol with (i) Sodium metal (ii) Ethanoic acid (in the presence of an acid) (iii) Acidified potassium dichromate. Write the name of the product formed in each case.
(a) C_2H_2



(b) (i) $2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$. Product: sodium ethoxide.
(ii) (refer 1st 3 mark question). Product: ethyl ethanoate (an ester).
(iii) C_2H_5OH —(acidified $K_2Cr_2O_7$, heat)→ CH_3COOH. Product: ethanoic acid.

18) *(i) A carbon compound X is a good solvent. On reaction with sodium, X forms two products Y and Z. Z is used to convert vegetable oil into vegetable ghee. Identify and name X, Y and Z. Also write the equation of*

reaction of X with sodium to justify your answer.
(ii) Write chemical equation to show what happens when ethanol: (I) burns in oxygen/air. (II) is heated at 443 K in excess conc. H_2SO_4. (III) reacts with acidified potassium dichromate.
(i) X: ethanol Y: sodium ethoxide Z: hydrogen

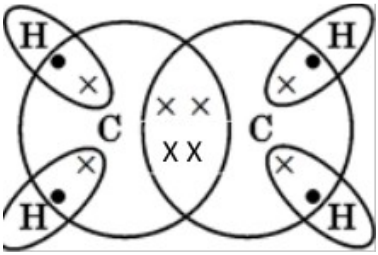
$CH_3CH_2OH + Na \rightarrow CH_3CH_2ONa + ½H_2$

(ii) (I) $2C_2H_5OH + 6O_2 \rightarrow 4CO_2 + 6H_2O$ + heat + light
(II) C_2H_5OH —(conc. H_2SO_4, 443 K)→ $C_2H_4 + H_2O$
(III) C_2H_5OH —(acidified $K_2Cr_2O_7$)→ CH_3COOH

19) *(i) Write the name and structure of an organic compound 'X' having two carbon atoms in its molecule and its name is suffixed with '–ol'.*
(ii) What happens when 'X' is heated with excess concentrated sulphuric acid at 443 K? Write chemical equation for the reaction stating the conditions for the reaction. Also state the role played by concentrated sulphuric acid in the reaction.
(iii) Name and draw the electron dot structure of hydrocarbon produced in the above reaction.
(i) Ethanol, CH_3CH_2OH
(ii) Ethene is formed.

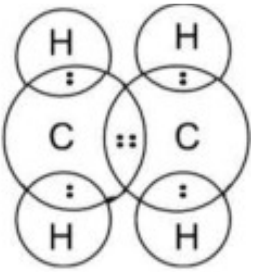
C_2H_5OH —(excess conc. H_2SO_4, 443 K)→ $CH_2=CH_2 + H_2O$

Conc. H_2SO_4 acts as a dehydrating agent.
(iii) Ethene:



20) *(i) Name the compound formed when ethanol is heated at 443 K in the presence of conc. H_2SO_4 and draw its electron dot structure. State the role*

of conc. H_2SO_4 in this reaction.
(ii) What is hydrogenation? Explain it with the help of a chemical equation. State the role of this reaction in industry.
(i) Ethene (C_2H_4):



Conc. H_2SO_4 acts as a dehydrating agent.
(ii) Hydrogenation: unsaturated hydrocarbons add hydrogen in the presence of a catalyst (nickel or palladium) and become saturated.
$R_2C{=}CR_2$ —(H_2, Ni/Pd catalyst)→ $R_2CH{-}CHR_2$
In industry, it is used to change vegetable oils into fats (vegetable ghee).

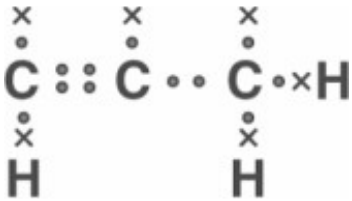
21) *A saturated organic compound 'A' belongs to the homologous series of alcohols. On heating 'A' with concentrated sulphuric acid at 443 K, it forms an unsaturated compound 'B' with molecular mass 28 u. The compound 'B' on addition of one mole of hydrogen in the presence of Nickel, changes to a saturated hydrocarbon 'C'.*
(i) Identify A, B and C.
(ii) Write the chemical equations showing the conversion of A into B.
(iii) What happens when compound C undergoes combustion?
(iv) State one industrial application of hydrogenation reaction.
(v) Name the products formed when compound A reacts with sodium.
(i) A: ethanol (CH_3CH_2OH) B: ethene ($CH_2{=}CH_2$) C: ethane ($CH_3{-}CH_3$)
(ii) (refer 2nd 3 mark question)
(iii) It gives carbon dioxide and water, and a lot of heat is released.
(iv) Changing vegetable oil into fat (vegetable ghee).

(v) Sodium ethoxide and hydrogen

22) *A carbon compound 'A' on heating with excess conc. H_2SO_4 forms a compound 'B', which on addition of one mole of hydrogen gas in the presence of nickel catalyst forms a compound 'C'. 'C' on combustion in air forms 2 moles of carbon dioxide and 3 moles of water. Identify 'A', 'B' and 'C' and write their structures. Give chemical equations of the reactions involved. Also state the role of concentrated sulphuric acid in the formation of 'B' from 'A'.*

A: ethanol, CH_3CH_2OH B: ethene, $CH_2=CH_2$ C: ethane, $CH_3–CH_3$
A to B and B to C: (refer 2nd 3 mark question)
Conc. H_2SO_4 is a dehydrating agent.
Burning C: $C_2H_6 + 7/2\ O_2 \rightarrow 2CO_2 + 3H_2O$

23) *A hydrocarbon with the formula C_{xHy} undergoes complete combustion as shown in the following equation: $2C_{xHy} + 9O_2 \rightarrow 6CO_2 + 6H_2O$.*
(a) What are the values of 'x' and 'y'?
(b) Give the chemical (IUPAC) name of the hydrocarbon.
(c) Draw its electron dot structure.
(d) Name the alcohol which on heating with conc. H_2SO_4 will produce the above hydrocarbon C_{xHy}.
(e) Write a balanced chemical equation for the reaction of C_{xHy} with hydrogen gas in presence of Nickel.
(a) x = 3, y = 6 (2 molecules give 6 CO_2 and 6 H_2O, so each has 3 C and 6 H).
(b) Propene
(c)



(d) Propanol

(e) $CH_2=CH–CH_3 + H_2 \xrightarrow{(Ni)} CH_3–CH_2–CH_3$

24) *(i) What happens when a small piece of sodium is dropped in ethanol? Write the equation for this reaction.*
(ii) Why is glacial acetic acid called so?
(iii) What happens when ethanol is heated at 443 K in the presence of conc. H_2SO_4? Write the role of conc. H_2SO_4 in this case.
(iv) Write an equation showing saponification.
(i) Hydrogen gas is given out and sodium ethoxide forms.

$$2CH_3CH_2OH + 2Na \rightarrow 2CH_3CH_2ONa + H_2$$

(ii) Pure ethanoic acid melts at 290 K (a low temperature), so it freezes like ice (glacier) in cold winters.
(iii) Ethene forms: $CH_3CH_2OH \xrightarrow{(\text{hot conc. } H_2SO_4)} CH_2=CH_2 + H_2O$
Conc. H_2SO_4 is a dehydrating agent.
(iv) $CH_3COOCH_2CH_3 \xrightarrow{(NaOH)} CH_3COO^-Na^+ + CH_3CH_2OH$

25) *Carry out the following conversions, stating the condition(s) for each: (i) Ethanol → Ethene (ii) Ethene → Ethane (iii) Ethane → Chloroethane (iv) Ethanol → Ethanoic acid (v) Ethanoic acid → Ethyl ethanoate*
(i) and (ii) (refer 2nd 3 mark question)
(iii) $C_2H_6 + Cl_2 \xrightarrow{(sunlight)} C_2H_5Cl + HCl$
(iv) (refer 3rd 3 mark question)
(v) (refer 1st 3 mark question)

26) *(a) What is the role of concentrated Sulphuric acid when it is heated with Ethanol at 443 K. Give the reaction involved.*
(b) Reshu by mistake forgot to label the two test tubes containing Ethanol and Ethanoic acid. Suggest an experiment to identify the substances correctly? Illustrate the reactions with the help of chemical equations
(a) It acts as a dehydrating agent.

$$C_2H_5OH \xrightarrow{(\text{conc. } H_2SO_4,\ 443\ K)} C_2H_4 + H_2O$$

(b) Add sodium carbonate to both. Ethanol does not react. Ethanoic acid gives brisk bubbles of carbon dioxide.

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

27) *a) Rehmat classified the reaction between Methane and Chlorine in presence of sunlight as a substitution reaction. Support Rehmat's view with suitable justification and illustrate the reaction with the help of a balanced chemical equation.*
b) Chlorine gas was prepared using electrolysis of brine solution. Write the chemical equation to represent the change. Identify the other products formed in the process and give one application of each.

a) Rehmat is correct. A hydrogen atom of methane is replaced (substituted) by a chlorine atom.

$CH_4 + Cl_2 \text{ —(sunlight)→ } CH_3Cl + HCl$

b) $2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$

Other products: sodium hydroxide, used to remove grease from metals; hydrogen, used as a fuel.

28) *(i) A compound 'X' having two carbon atoms in its molecule turns blue litmus red and 5 – 8% solution of 'X' in water is widely used as a preservative. Identify the compound 'X' and write its structure.*
(ii) Compare its pH nature with a mineral acid.
(iii) 'X' on reacting with alcohols produces sweet smelling compounds, used in making perfumes. Name the reaction and write its chemical equation.
(iv) When sodium carbonate is added to 'X', a colourless gas is produced which turns lime water milky. Write the chemical equation for the reaction giving the name of the salt produced.

(i) X: ethanoic acid, CH_3COOH

(ii) Its pH is higher than that of a mineral acid (it is a weaker acid).

(iii) Esterification reaction.

$CH_3COOH + CH_3CH_2OH \text{ —(acid)→ } CH_3COOCH_2CH_3 + H_2O$

(iv) $2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + CO_2 + H_2O$. Salt: sodium acetate (sodium ethanoate).

29) *A carbon compound 'A' is widely used as a preservative in pickles and has a molecular formula $C_2H_4O_2$. This compound reacts with ethanol to form a sweet smelling compound 'B'.*
(i) Identify the compound 'A' and write its structure.
(ii) Write the chemical equation for the reaction of 'A' with ethanol to form compound 'B'. State the role of presence of an acid in the reaction.
(iii) How can we get compound 'A' back from 'B'?
(iv) How can 'A' be obtained from ethanol?
(v) Name the gas produced when compound 'A' reacts with washing soda.
(i) A: ethanoic acid, CH_3COOH
(ii) $CH_3COOH + C_2H_5OH \xrightarrow{(acid)} CH_3COOC_2H_5 + H_2O$. The acid acts as a catalyst.
(iii) Add dilute NaOH to B and heat (saponification). This gives the sodium salt of A; adding a strong acid gives A back.
(iv) (refer 3rd 3 mark question)
(v) Carbon dioxide

30) *(i) A compound 'A' with a molecular formula of $C_2H_4O_2$ reacts with a base to give salt and water. Identify 'A', state its nature and the name of the functional group it possesses. Write chemical equation for the reaction involved.*
(ii) When the above stated compound 'A' reacts with another compound 'B' having molecular formula C_2H_6O in the presence of an acid, a sweet smelling compound 'C' is formed. (1) Identify 'B' and 'C'. (2) State the role of acid in this reaction. (3) Write chemical equation for the reaction involved.
(i) A: ethanoic acid (CH_3COOH). It is acidic. Functional group: carboxylic acid (–COOH).

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

(ii) (1) B: ethanol C: ethyl ethanoate (an ester)
(2) The acid acts as a catalyst.
(3) $CH_3COOH + C_2H_5OH \xrightarrow{(acid)} CH_3COOC_2H_5 + H_2O$

31) *Name an alcohol and a carboxylic acid having two carbon atoms in their structures. Draw their structures and state how this alcohol can be converted into a carboxylic acid. What happens when these two compounds react in the presence of an acid? Write chemical equations for the reactions involved in the two cases mentioned above.*

Alcohol: ethanol (CH_3CH_2OH). Acid: ethanoic acid (CH_3COOH).
Alcohol to acid: (refer 3rd 3 mark question)
The two react to form an ester: (refer 1st 3 mark question)

32) *A neutral organic compound 'X' (Molecular formula C_2H_6O) on reacting with acidified $K_2Cr_2O_7$ gives an organic compound 'Y' which is acidic in nature. 'X' reacts with 'Y' on warming in the presence of conc. H_2SO_4 to give a sweet smelling compound 'Z'.*
(i) Identify 'X', 'Y' and 'Z'.
(ii) Write the chemical equations for the reactions in the conversion of (1) 'X' to 'Y' and (2) 'X' to 'Z'.
(iii) State the role of (1) acidified $K_2Cr_2O_7$ in the conversion of 'X' to 'Y' and (2) conc. H_2SO_4 in the reaction of 'X' and 'Y'.
(iv) Name the reaction which occurs when 'Z' reacts with an alkali.
(i) X: ethanol Y: ethanoic acid Z: ethyl ethanoate
(ii) (1) $C_2H_5OH \xrightarrow{\text{(acidified } K_2Cr_2O_7)} CH_3COOH$
(2) (refer 1st 3 mark question)
(iii) (1) Oxidising agent (2) Dehydrating agent
(iv) Saponification

33) *Mohan heated ethanol with a compound 'X' in the presence of a few drops of conc. H_2SO_4 and observed a sweet smelling compound 'Y' is formed. When 'Y' is treated with sodium hydroxide it gives back ethanol and a compound 'Z'.*
(i) Identify 'X', 'Y' and 'Z'.
(ii) Write the role of conc. H_2SO_4 in the reaction.
(iii) Write the chemical equations involved and name the reactions.

(i) X: ethanoic acid (CH_3COOH) Y: ethyl ethanoate ($CH_3COOC_2H_5$) Z: sodium ethanoate (CH_3COONa)

(ii) It acts as a catalyst.

(iii) $CH_3COOH + CH_3CH_2OH \xrightarrow{(acid)} CH_3COOCH_2CH_3 + H_2O$ (esterification)

$CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$ (saponification)

34) *Shristi heated Ethanol with a compound A in presence of a few drops of concentrated sulphuric acid and observed a sweet smelling compound B is formed. When B is treated with sodium hydroxide it gives back Ethanol and a compound C.*

(a) Identify A and C

(b) Give one use each of compounds A and B.

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

(a) A: ethanoic acid C: sodium ethanoate

(b) A: its dilute solution (vinegar) is used in cooking. B: used in making perfumes.

(c) $CH_3COOH + C_2H_5OH \xrightarrow{(conc.\ H_2SO_4)} CH_3COOC_2H_5 + H_2O$ (esterification)

$CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$ (saponification)

35) *An acid 'X' and an alcohol 'Y' react with each other in the presence of an acid catalyst to form a sweet smelling substance 'Z'. Identify 'X', 'Y' and 'Z'. Write the chemical equation for the reaction involved and name it. The substance 'Z' on treatment with sodium hydroxide produces back the alcohol 'Y' and sodium ethanoate. Write the chemical equation for the reaction involved and name it, giving justification for the name.*

X: ethanoic acid Y: ethanol Z: ethyl ethanoate

$CH_3COOH + C_2H_5OH \xrightarrow{(acid\ catalyst)} CH_3COOC_2H_5 + H_2O$ (esterification)

$CH_3COOC_2H_5 \xrightarrow{(NaOH)} C_2H_5OH + CH_3COONa$ (saponification)

It is called saponification because this kind of reaction is used to make soap.

36) *Raina while doing certain reactions observed that heating of substance 'X' with vinegar like smell with a substance 'Y' (which is used as an industrial solvent) in presence of conc. Sulphuric acid on a water bath gives a sweet-smelling liquid 'Z' having molecular formula $C_4H_8O_2$. When heated with caustic soda (NaOH), 'Z' gives back the sodium salt of and the compound 'Y'. Identify 'X', 'Y', and 'Z'. Illustrate the changes with the help of suitable chemical equations.*

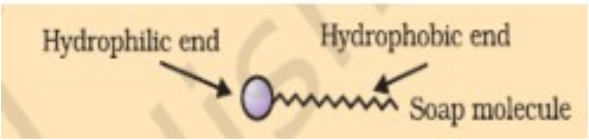
X: ethanoic acid Y: ethanol Z: ethyl ethanoate

$CH_3COOH + CH_3CH_2OH \xrightarrow{(acid)} CH_3COOCH_2CH_3 + H_2O$

$CH_3COOC_2H_5 \xrightarrow{(NaOH)} C_2H_5OH + CH_3COONa$

37) *What are soaps? Write the structure of a soap molecule. Explain the cleansing action of a soap. Why are soaps not considered suitable for washing clothes in a region where water is hard? How is this problem overcomed?*

Soaps are sodium or potassium salts of long-chain carboxylic acids.



A soap molecule has a water-hating (hydrophobic) carbon chain and a water-loving (hydrophilic) ionic end.

Most dirt is oily and does not dissolve in water. The ionic end of soap stays in the water, and the carbon chain sticks to the oil. The molecules form balls called micelles, with the oil trapped inside. The micelles pull the dirt out into the water, and it is washed away.

Hard water has calcium and magnesium salts. They react with soap and form scum, so there is no foam and the soap is wasted.

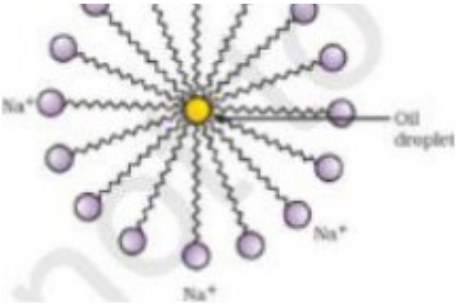
The problem is solved by using detergents.

38) *(i) 'A' & 'B' are sodium salts of long-chain carboxylic acid and long chain Sulphonic acid respectively. Which one of A or B will you prefer as a cleansing agent while using underground water (hand pump water)? Give the reason for your answer.*
(ii) Elaborate on the process of cleansing action. Illustrate micelle with the help of labelled diagram.
(iii) Write the chemical equation of the preparation of soap from an ester CH_3COOCH_3. What is the name of this process?

(i) B (the detergent). The calcium and magnesium salts in underground water form insoluble scum with carboxylic acid salts (soap). Their salts with sulphonic acids dissolve in water, so a detergent still works.

(ii) A soap molecule has two ends: one dissolves in water (hydrophilic), the other dissolves in oil (hydrophobic).

The ionic end stays in the water and the carbon chain goes into the oil drop. So the molecules form micelles, with the oil inside and the ionic ends facing outside. The micelles carry the dirt into the water.



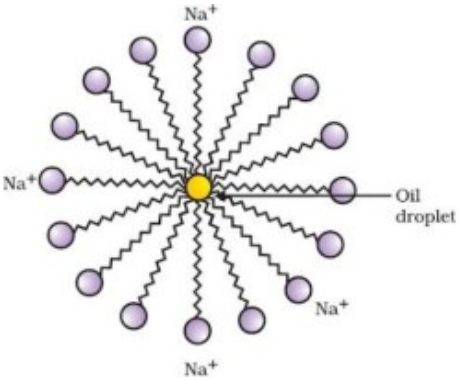
(iii) $CH_3(CH_2)_{16}COOR + NaOH \rightarrow CH_3(CH_2)_{16}COONa + ROH$

The process is saponification.

39) *(i) With the help of diagram, show the formation of micelles, when soap is applied on oily dirt.*
(ii) Take two test tubes X and Y with 10 mL of hard water in each. In test

tube 'X', add few drops of soap solution and in test tube 'Y' add a few drops of detergent solution. Shake both the test tubes for the same period. (1) In which test tube the formation of foam will be more? Why? (2) In which test tube is a curdy solid formed? Why?

(i)



(ii) (1) Test tube Y. Detergents work well even in hard water.

(2) Test tube X. Soap reacts with the calcium and magnesium salts in hard water and forms insoluble scum.