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CLASS X · SCIENCE (086) · CHEMISTRY · CBSE BOARD EXAMINATION 2027

CHAPTER 4

Carbon and its Compounds

C–C–C

C_nH_{2n+2}

Chapter Practice Booklet · Questions only · Answers in the separate Answer Booklet

16 note blocks + 4 diagrams | 75 practice questions | 3 case studies | Board question index

INSIDE THIS BOOKLET

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STUDENT DETAILS

NAME _____

CLASS & SECTION _____

ROLL NO. _____

BOOKLET STARTED ON _____

CHAPTER TEST SCORE _____ / 20

1

READ THIS FIRST

Chapter Notes

The whole chapter in short-note form: every definition, activity, diagram, formula and reason. Revise from here – you should not need the textbook again.

1 Carbon and the covalent bond

Covalent bond: a bond formed by **sharing** a pair of electrons between two atoms. Each shared pair is one bond.

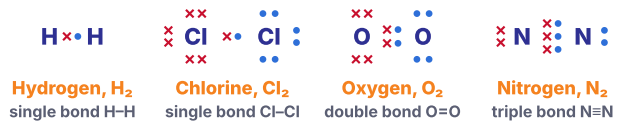
- Carbon (atomic number 6) is **2, 4**: it has 4 valence electrons and needs 4 more for an octet.
- It cannot **gain** 4 electrons – a nucleus of 6 protons cannot hold 10 electrons (C^{4-}). It cannot **lose** 4 – removing them needs too much energy (C^{4+}).
- So carbon **shares** its 4 electrons and forms **covalent bonds**. Hydrogen, oxygen, nitrogen and chlorine also share electrons this way.

Compound	Melting point (K)	Boiling point (K)
Ethanoic acid	290	391
Chloroform	209	334
Ethanol	156	351
Methane	90	111

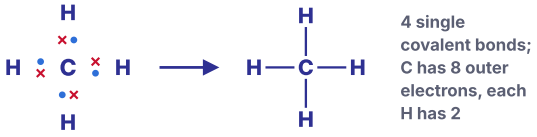
- **Covalent compounds** have **low melting and boiling points** – the forces between their molecules are weak.
- They are generally **poor conductors** of electricity – they contain **no ions**.

2 Electron dot structures

× electron of the 1st atom / of C • electron of the 2nd atom / of H



Hydrogen, H_2 – single bond H–H | Chlorine, Cl_2 – single bond Cl–Cl | Oxygen, O_2 – double bond O=O | Nitrogen, N_2 – triple bond N≡N



Methane, CH_4 – dots | Structural formula

Outer electrons shown as dots and crosses; shared pairs sit between the atoms

- **Single bond** – one shared pair (H–H, Cl–Cl, C–H). **Double bond** – two shared pairs (O=O). **Triple bond** – three shared pairs (N≡N), the strongest of the three.
- After sharing, each atom has a full outer shell: 8 electrons (2 for hydrogen).

3 Why carbon forms so many compounds

- Millions of carbon compounds are known – more than those of all other elements put together. Two properties explain this:
- **Catenation:** carbon atoms join to other carbon atoms by covalent bonds, giving **long chains, branched chains and rings**. The C–C bond is very **strong**, so these chains are **stable**. Silicon forms chains of only 7–8 atoms, and these are very reactive.
- **Tetravalency:** with valency 4, each carbon bonds to four other atoms – carbon, hydrogen, oxygen, nitrogen, sulphur, chlorine and others – so a huge variety of compounds is possible.
- Carbon is a **small** atom: its nucleus holds the shared electrons tightly, so its bonds are strong.

Carbon as an element: diamond (each C joined to 4 others in a rigid 3-D network – the hardest natural substance), graphite (each C joined to 3 others in flat layers – soft, slippery and a good conductor) and fullerene C-60 (a football-shaped cage) are all pure carbon. Forms of one element with different structures are called allotropes.

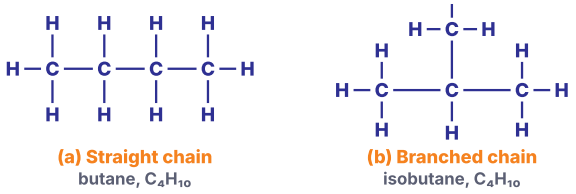
4 Saturated and unsaturated hydrocarbons

Hydrocarbons contain only carbon and hydrogen. **Saturated**: only single bonds between carbons (alkanes). **Unsaturated**: at least one double or triple bond (alkenes, alkynes) – these are more reactive.

Series	Formula	First members
Alkane (C–C)	C_nH_{2n+2}	methane CH_4, ethane C_2H_6, propane C_3H_8, butane C_4H_{10}
Alkene (C=C)	C_nH_{2n}	ethene C_2H_4, propene C_3H_6, butene C_4H_8
Alkyne (C≡C)	C_nH_{2n-2}	ethyne C_2H_2, propyne C_3H_4, butyne C_4H_6

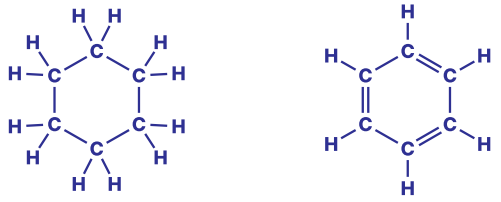
- Ethane, C_2H_6, has **7** covalent bonds: 6 C–H and 1 C–C. Ethene is $CH_2{=}CH_2$; ethyne is $HC{\equiv}CH$.
- Stem names by number of carbons: **meth** 1, **eth** 2, **prop** 3, **but** 4, **pent** 5, **hex** 6.

5 Chains, branches, rings and isomers



(a) Straight chain — butane, C_4H_{10}

(b) Branched chain — isobutane, C_4H_{10}



(c) Ring: cyclohexane — C_6H_{12}, single bonds only

(d) Ring: benzene — C_6H_6, alternate C–C and C=C

Carbon atoms can form straight chains, branched chains and rings

- **Isomers:** compounds with the **same molecular formula** but **different structures**. Butane and isobutane are both C_4H_{10} (2 isomers); pentane, C_5H_{12}, has 3 isomers.
- Methane, ethane and propane have only one possible structure each – isomers begin with 4 carbons.
- A ring of 5 carbons with single bonds is cyclopentane, C_5H_{10}. Benzene, C_6H_6, is a ring with alternate single and double bonds.

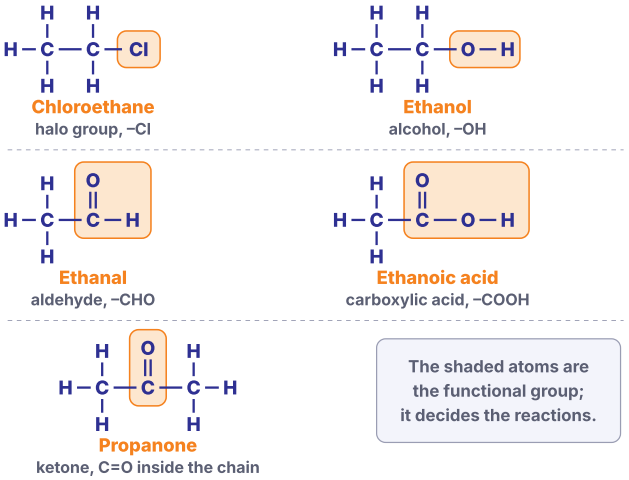
6 Homologous series

Homologous series: a family of compounds with the **same functional group** (the reactive part – see block 7), in which each member differs from the next by **$-CH_2-$** (a mass of **14 u**).

- Alcohols: CH_3OH, C_2H_5OH, C_3H_7OH, C_4H_9OH – general formula $C_nH_{2n+1}OH$.
- All members have the same general formula and **similar chemical properties** (same functional group).
- **Physical properties change gradually** with mass: melting and boiling points rise; solubility in a solvent changes step by step.

7 Functional groups

Functional group: an atom or group of atoms (other than C and H) that gives a carbon compound its typical **chemical properties**. A heteroatom (Cl, O, N…) takes the place of hydrogen in the chain.



Chloroethane — halo group, –Cl

Ethanol — alcohol, –OH

Ethanal — aldehyde, –CHO

Ethanoic acid — carboxylic acid, –COOH

Propanone — ketone, C=O inside the chain

The shaded atoms are the functional group; it decides the reactions.

The same two-carbon chain carries different functional groups

Group	Formula	Name	Example (3 C)
Halo	–Cl, –Br	prefix chloro-, bromo-	chloropropane
Alcohol	–OH	suffix -ol	propanol
Aldehyde	–CHO	suffix -al	propanal
Ketone	>C=O	suffix -one	propanone
Carboxylic acid	–COOH	suffix -oic acid	propanoic acid
Double bond	C=C	suffix -ene	propene
Triple bond	C≡C	suffix -yne	propyne

8 Naming carbon compounds

- **Step 1:** count the carbon atoms → stem (meth, eth, prop, but, pent, hex).
- **Step 2:** find the functional group → prefix (chloro-, bromo-) or suffix (-ol, -al, -one, -oic acid, -ene, -yne).
- **Step 3:** if the suffix starts with a vowel, drop the final 'e' of the alkane name: propan**e** → propan**ol**, propan**one**. For -ene and -yne, replace 'ane': propane → propene, propyne.

Formula	Name
CH_3CH_2Br	bromoethane
$HCHO$	methanal
CH_3CHO	ethanal
CH_3COCH_3	propanone
$CH_3CH_2CH_2COOH$	butanoic acid
$CH_3CH{=}CH_2$	propene

The carbon of –CHO, >C=O or –COOH is counted in the chain: propanal and propanone each have 3 carbons.

9 Combustion

- Carbon and most of its compounds **burn in oxygen** to give carbon dioxide and water, releasing **heat and light** – so they are used as fuels.

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

$$CH_4 + 2\,O_2 \longrightarrow CO_2 + 2\,H_2O + \text{heat} + \text{light}$$

$$CH_3CH_2OH + 3\,O_2 \longrightarrow 2\,CO_2 + 3\,H_2O + \text{heat} + \text{light}$$

- **Saturated** hydrocarbons burn with a clean **blue flame**. **Unsaturated** ones burn with a **yellow, sooty flame** in air (incomplete burning).
- A gas stove has **air holes** so that enough air mixes with the gas and it burns completely. A blackened vessel bottom means the air holes are blocked.
- A **flame** forms only when **gases** burn. Wax and LPG vaporise and give a flame; coal and charcoal only **glow**.
- Coal and petroleum contain some nitrogen and sulphur: burning them gives their oxides, which pollute the air.
- **Welding:** ethyne is burnt in pure **oxygen** – it burns completely and gives a very high temperature. In air it burns with a sooty, cooler flame.

10 Oxidation, addition and substitution

- **Oxidation:** alcohols change to carboxylic acids when oxygen is added. **Alkaline potassium permanganate** (heated) or **acidified potassium dichromate** are **oxidising agents** – they supply the oxygen.

$$CH_3CH_2OH \xrightarrow{\text{alkaline } KMnO_4 + \text{heat}} CH_3COOH$$

- **Addition (hydrogenation):** unsaturated compounds add hydrogen in the presence of a **nickel or palladium catalyst** and become saturated. Vegetable oils are changed into **vanaspati ghee** this way.

$$CH_2{=}CH_2 + H_2 \xrightarrow{Ni} CH_3{-}CH_3$$

- Vegetable oils (unsaturated) are better for health; animal fats (saturated) such as butter and ghee are harmful in large amounts.
- **Substitution:** saturated hydrocarbons are fairly unreactive, but in **sunlight** chlorine replaces their hydrogen atoms one by one.

$$CH_4 + Cl_2 \xrightarrow{\text{sunlight}} CH_3Cl + HCl$$

11 Ethanol, C_2H_5OH

- Colourless liquid at room temperature (boils at 351 K), **soluble in water** in all proportions. Commonly called alcohol.
- **Uses:** in medicines (tincture of iodine, cough syrups, tonics); a good **solvent**; a **fuel** – made by fermenting molasses from sugarcane and mixed with petrol.
- **With sodium** it gives **hydrogen** gas and sodium ethoxide:

$$2\,Na + 2\,CH_3CH_2OH \longrightarrow 2\,CH_3CH_2ONa + H_2$$

- **Dehydration:** heated at **443 K with excess concentrated sulphuric acid** it loses water and gives **ethene**. The acid is a **dehydrating agent**.

$$CH_3CH_2OH \xrightarrow{\text{hot conc} \cdot H_2SO_4} CH_2{=}CH_2 + H_2O$$

- **Harm:** drinking alcohol slows the body and judgement; long use damages health. **Methanol** is poisonous – it can cause blindness and death. Industrial alcohol is **denatured** with methanol and a blue dye so that it cannot be drunk.

12 Ethanoic acid, CH_3COOH

- Also called **acetic acid**. A 5–8% solution in water is **vinegar**, used to preserve pickles. Pure acid melts at **290 K**, so it freezes in cold weather: **glacial acetic acid**.
- A **weak acid** – it ionises only partly, so its pH is higher than that of hydrochloric acid of the same strength.
- **Esterification** (acid + alcohol, warmed with a few drops of concentrated sulphuric acid as catalyst) gives a **sweet-smelling ester**, used in perfumes and flavours:

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

- **Saponification:** an ester with sodium hydroxide gives back the alcohol and the sodium salt of the acid. Soap is made this way.

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

- **With a base** and **with carbonates/hydrogencarbonates** (brisk fizzing; the gas turns lime water milky):

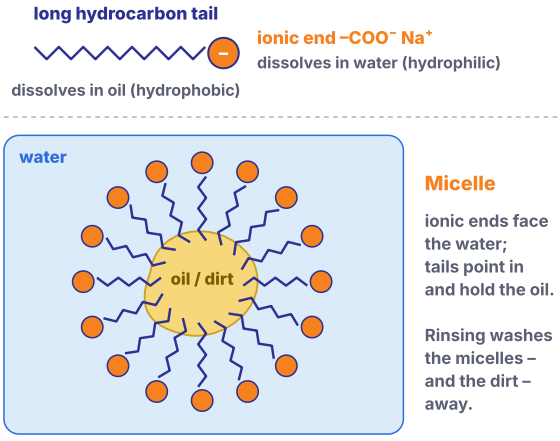
$$NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$$

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

Ethanol or ethanoic acid? Add sodium hydrogencarbonate: only the acid fizzes. The acid also turns blue litmus red and smells of vinegar.

13 Soaps and the cleaning action

Soap: the sodium or potassium salt of a **long-chain carboxylic acid**. One end is **ionic** (dissolves in water); the long **hydrocarbon tail** dissolves in oil.



A soap molecule and a micelle with oil trapped inside

- In water the tails keep away from water and gather together; the ionic ends face the water. These clusters are **micelles**.
- Oily dirt dissolves in the tails at the centre of the micelle. The micelles stay spread in water (an **emulsion**), so rinsing carries the dirt away. Scrubbing or beating the clothes helps to pull the dirt off.
- Micelles do not settle: their ionic surfaces repel each other. They are large enough to **scatter light**, so soap solution looks cloudy.
- In ethanol the tail dissolves too, so **no micelles** form there.

14 Hard water and scum

- **Hard water** contains **calcium and magnesium** salts (hydrogencarbonates, chlorides and sulphates). Rainwater and distilled water are soft.
- Soap reacts with these salts to form an insoluble white precipitate called **scum**, so a lot of soap is wasted before any lather forms.
- **Test:** shake 10 mL each of distilled water and hard water with equal drops of soap solution. Distilled water gives plenty of foam; hard water gives little foam and scum.

15 Detergents

- **Detergents** are usually sodium salts of **sulphonic acids** or ammonium salts with chloride or bromide ions, with a long hydrocarbon chain. Their charged ends do **not** form insoluble compounds with calcium and magnesium, so they work well in hard water.
- Used in shampoos and washing powders. A detergent lathers in both hard and soft water, so it cannot be used to test hardness.

16 Soap or detergent?

Soap	Detergent
Na/K salt of a long-chain carboxylic acid	Na salt of a sulphonic acid (or an ammonium salt)
Made from vegetable oils or animal fats + NaOH/KOH	Made from petroleum products
Ionic end $–COO^-$	Ionic end $–SO_3^-$ (or $–N^+$)
Forms scum in hard water	Works in hard and soft water

Explain why – quick answers

Common 1- and 2-mark reasons

Carbon forms covalent bonds – it can neither gain nor lose 4 electrons easily, so it shares them.

Covalent compounds melt easily – the forces between their molecules are weak.

Covalent compounds do not conduct – they have no ions.

Carbon forms millions of compounds – catenation and tetravalency.

Carbon chains are stable – the small carbon atom forms strong C–C bonds.

Unsaturated hydrocarbons give a sooty flame – they burn incompletely in air.

A vessel blackens on the stove – the air holes are blocked and the fuel burns incompletely.

Welders burn ethyne in oxygen – complete burning gives a very high temperature.

Vegetable oils are healthier than ghee – they are unsaturated; animal fats are saturated.

Glacial acetic acid freezes in winter – it melts at 290 K (about 17 °C).

Soap does not lather in hard water – calcium and magnesium ions form insoluble scum.

Detergents work in hard water – their calcium and magnesium compounds are soluble.

Exam snapshot

What the board asks, and how to prepare

SYLLABUS 2026–27

- Covalent bonding in carbon compounds; versatile nature of carbon; homologous series; naming of compounds with functional groups (halogens, alcohol, ketone, aldehyde, alkanes and alkynes); saturated and unsaturated hydrocarbons; combustion, oxidation, addition and substitution reactions; ethanol and ethanoic acid (properties and uses); soaps and detergents.

BOARD WEIGHTAGE

25 / 80

Chemistry = 25 marks (Section B). Chapters 1–4 share these marks. This chapter got 7 marks in the 2026 paper (two 1-mark questions and the 5-mark long answer) and 7 in the 2026–27 sample paper (two MCQs, a 2-mark and a 3-mark question). Every board paper checked (2025 and 2026) had a 5-mark question from this chapter.

MOST ASKED IN BOARD AND SAMPLE PAPERS, 2025–2027 (5 PAPERS CHECKED)

How often	Question type	Marks	Papers
★★☆	Covalent bonding, electron dot structures, properties of covalent compounds	1–3	2 of 5
★★★	Catenation, tetravalency, saturated and unsaturated hydrocarbons, isomers, homologous series	1–5	5 of 5
★☆☆	Functional groups and naming	1	1 of 5
★★★	Combustion, oxidation, addition (hydrogenation) and substitution	1–5	5 of 5
★★★	Ethanol and ethanoic acid: dehydration, esterification, reactions of the acid	3–5	4 of 5
★★★	Soaps, micelles, hard water and detergents	1–5	4 of 5

MISTAKES THAT COST MARKS

- Mixing up the formulas: alkane C_nH_{2n+2}, alkene C_nH_{2n}, alkyne C_nH_{2n-2}.
- Forgetting the C–C bond when counting bonds – ethane has **7** covalent bonds, not 6.
- Writing 'propaneol' – drop the 'e' before a vowel: **propanol**. Count the carbon of –CHO or –COOH in the chain.
- Calling $KMnO_4$ a catalyst – it is an **oxidising agent**. Hot conc. H_2SO_4 is a **dehydrating agent** at 443 K.
- Mixing up **esterification** (acid + alcohol → ester) and **saponification** (ester + NaOH → salt + alcohol).
- Saying the soap tail faces the water – the **ionic end** faces water; the tail holds the oil.

HOW TO USE THIS BOOKLET

1. **Day 1:** Read the notes and the key tables; then Part A (NCERT).
2. **Day 2:** Part B (Exemplar) and Part C (board pattern). Do every MUST DO question first.
3. **Day 3:** Part D (case studies) and the real board questions listed in Part E.
4. **Chemistry chapter test – 20 marks: Sat 16 Jan for Rose and Lily, Tue 12 Jan for Marigold.**
5. Check every answer in the **Answer Booklet**. Write each mistake on the My Mistakes page (Part F).

PART A · NCERT PRACTICE

A NCERT Practice

The ideas of every NCERT activity, in-text question and exercise, asked in new words. Finish every question.

Bonding in carbon

A1. Why does carbon form neither C^{4+} nor C^{4-} ions? How does it reach a stable configuration? [3] MUST DO

A2. Draw the electron dot structures of (i) fluorine, F_2 (ii) hydrogen sulphide, H_2S (iii) carbon dioxide, CO_2. [3] MUST DO

A3. Explain the bonding in chloromethane, CH_3Cl, with its electron dot structure. [3]

A4. Why do covalent compounds have low melting and boiling points? Why are they poor conductors of electricity? [2] MUST DO

A5. The number of covalent bonds in a molecule of ethane, C_2H_6, is: [1]

(a) 6 (b) 7 (c) 8 (d) 9

Versatile nature of carbon

A6. Name the two properties of carbon that let it form a very large number of compounds. Explain each. MUST DO [3]

A7. What are isomers? Write the structures of all the isomers of pentane, C_5H_{12}. MUST DO [3]

A8. Write the molecular formula of cyclopentane. How many covalent bonds does a molecule have? [2]

A9. What is a homologous series? Give three of its features, with the alcohols as an example. MUST DO [3]

A10. Which of these hydrocarbons take part in addition reactions: C_2H_6, C_3H_8, C_3H_6, C_2H_2, CH_4? Why? MUST DO [2]

Functional groups and naming

A11. Write the condensed formulas of (i) ethanoic acid (ii) 1-bromopentane (iii) butanone (iv) hexanal. Can bromopentane have structural isomers? [3]

A12. Name these compounds: MUST DO [2]

(i) CH_3-CH_2-Br (ii) $HCHO$

(iii) $H-C\equiv C-H$ (iv) CH_3COCH_3

A13. What is a functional group? Name the functional group in (i) propanal (ii) propanol (iii) propanone (iv) propanoic acid. [3]

Chemical properties

A14. Why are carbon and its compounds used as fuels for most purposes? [2]

A15. While cooking, the bottom of a vessel turns black. What does this show, and what should be done? MUST DO [2]

A16. Why is the change of ethanol into ethanoic acid called an oxidation reaction? Name two substances used for it. MUST DO [2]

A17. What is hydrogenation? Give its use in industry. Why are vegetable oils advised over animal fats? MUST DO [3]

A18. Ethyne mixed with oxygen is burnt for welding. Why is a mixture of ethyne and air not used? [2]

Ethanol and ethanoic acid

A19. How would you tell ethanol from ethanoic acid using (i) a physical property (ii) a chemical test? Write the equation. MUST DO [3]

A20. What is an ester? Describe how you would make one in the laboratory, with the equation. MUST DO [3]

A21. Write equations for: (i) sodium with ethanol (ii) ethanol heated with excess conc. sulphuric acid at 443 K. What is the role of the acid in (ii)? [3]

Soaps and detergents

A22. Explain how soap removes oily dirt from a cloth. MUST DO [3]

A23. Why does a micelle form when soap is added to water? Will micelles form in ethanol? [2]

A24. Explain the formation of scum when soap is used with hard water. Why do detergents not form scum? MUST DO [2]

A25. What is seen when soap solution is tested with red and blue litmus? Can a detergent be used to check whether water is hard? [2]

B

PART B · EXEMPLAR PRACTICE

Exemplar Practice

Exemplar-style questions, one step harder. Write a balanced equation wherever a reaction is asked.

Multiple choice

1 mark each

B1. Which of these is NOT an alkane? [1]

(a) C_2H_6 (b) C_3H_8 (c) C_4H_8 (d) C_5H_{12}

B2. The first member of the alkyne series is: [1]

(a) ethene (b) ethyne (c) propyne (d) methane

B3. Successive members of a homologous series differ in molecular mass by: [1]

(a) 12 u (b) 14 u (c) 16 u (d) 28 u

B4. Which pair are isomers? [1]

(a) ethanol and ethanal (b) butane and isobutane
(c) methane and ethane (d) propane and propene

B5. The functional group in propanal is: [1]

(a) –OH (b) –CHO
(c) –COOH (d) >C=O within the chain

B6. Vinegar is about: [1]

(a) 5–8% ethanoic acid in water (b) 5–8% ethanol in water
(c) 50% ethanoic acid in water (d) pure ethanoic acid

B7. Pure ethanoic acid is called glacial acetic acid because it: [1]

(a) is made from glaciers (b) freezes in cold weather
(c) is a gas at room temperature (d) is very strong

B8. When ethanol is heated with excess hot conc. sulphuric acid, the acid acts as: [1]

(a) an oxidising agent (b) a dehydrating agent
(c) a reducing agent (d) a hydrogenating agent

B9. Which of these burns in air with a yellow, sooty flame? [1]

(a) methane (b) ethane (c) ethyne (d) propane

B10. Detergents are usually: [1]

(a) sodium salts of long-chain carboxylic acids (b) sodium salts of sulphonic acids
(c) calcium salts of fatty acids (d) esters of ethanol

Short answer

2–3 marks

B11. A compound X, $C_2H_4O_2$, turns blue litmus red and fizzes with sodium carbonate. Identify X and write its reaction with sodium carbonate. What forms when X is warmed with ethanol and a little conc. sulphuric acid? [3] MUST DO

B12. Write the general formula of the alkenes. Name the third member and write its structure. [2]

B13. Two compounds have the same formula C_3H_6O. One is an aldehyde and the other a ketone. Name and write both. What is this called? [3] MUST DO

B14. Saturated hydrocarbons burn with a blue flame but unsaturated ones give a sooty flame in air. Explain. Why are the air holes of a gas burner kept open? [2]

B15. Give reasons: (a) ethanol is used in medicines like cough syrups and tincture of iodine; (b) industrial alcohol is mixed with methanol and a blue dye. [2]

B16. Write the balanced equation for burning ethanol in air. Why is ethanol called a cleaner fuel? [2]

C

PART C · BOARD PATTERN

Board Pattern Practice

Question types from the 2025 and 2026 board papers and the CBSE sample papers. ★★★ = asked in 3 or more of the 5 papers checked · ★★ = 2 papers · ★ = 1 paper.

ASSERTION–REASON: HOW TO ANSWER

(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, but R is true.

Covalent bonding

★★☆ 2 of 5 papers · 1–3 marks

C1. The number of electrons shared in a triple bond is: [1]

(a) 2 (b) 3 (c) 6 (d) 8

C2. ASSERTION–REASON [1]

Assertion (A): Covalent compounds are generally poor conductors of electricity.
Reason (R): Covalent compounds contain no ions.

C3. The total number of lone pairs of electrons in a molecule of carbon dioxide is: [1]

(a) 2 (b) 4 (c) 6 (d) 0

C4. An element X has atomic number 6. (a) Write its electronic configuration and valency. (b) What type of bond does it form with chlorine? Give the formula. (c) Will this compound conduct electricity? Why? [3] MUST DO

Catenation, isomers and homologous series

★★★ 5 of 5 papers · 1–5 marks

C5. A hydrocarbon with three carbon atoms and one triple bond is: [1]

(a) C_3H_8 (b) C_3H_6 (c) C_3H_4 (d) C_3H_5

C6. The next higher homologue of C_2H_5OH is: [1]

(a) CH_3OH (b) C_3H_7OH (c) C_2H_5CHO (d) C_4H_9OH

C7. ASSERTION–REASON [1]

Assertion (A): Silicon forms far fewer compounds than carbon.

Reason (R): Silicon chains are short and their compounds are very reactive, unlike the strong, stable C–C chains.

C8. How many structural isomers does butane, C_4H_{10}, have? [1]

(a) 1 (b) 2 (c) 3 (d) 4

C9. Write the formula of the third member of the alkanes and the second member of the alkynes. Which of the two is saturated? [2]

C10. Draw the structures of the two isomers of butane and name them. Why do they have different properties? [3]

C11. Carbon and silicon both have valency 4. Why does carbon form so many more compounds? [2]

MUST DO

Functional groups and naming

★☆☆ 1 of 5 papers · 1 marks

C12. The group –CHO is present in: [1]

(a) propanone (b) propanal (c) propanol (d) propanoic acid

C13. The name of $CH_3-CH_2-CH_2-OH$ is: [1]

(a) propanal (b) propanol (c) propanone (d) ethanol

C14. Which of these is a ketone? [1]

(a) CH_3CHO (b) CH_3COCH_3 (c) CH_3COOH (d) CH_3CH_2OH

C15. Name each compound and its functional group: MUST DO [2]

(i) CH_3COOH (ii) CH_3CH_2Cl

(iii) $CH_3CH_2CH_2CHO$ (iv) $CH_3CH=CH_2$

C16. State the steps used to name a carbon compound with a functional group. Name $CH_3CH_2CH_2COOH$ and $CH_3CH_2CH_2CH_2OH$. [3]

Combustion, oxidation, addition and substitution

★★★ 5 of 5 papers · 1–5 marks

C17. Vegetable oil is changed into vanaspati ghee by: [1]

(a) oxidation (b) hydrogenation (c) substitution (d) esterification

C18. $CH_4 + Cl_2 \longrightarrow CH_3Cl + HCl$ in sunlight is an example of: [1]

(a) addition (b) substitution (c) oxidation (d) combustion

C19. ASSERTION–REASON [1]

Assertion (A): Natural gas burns in a stove with a clean blue flame.

Reason (R): Methane is a saturated hydrocarbon and burns completely in enough air.

C20. ASSERTION–REASON [1]

Assertion (A): Ethanol is changed into ethanoic acid by heating with alkaline potassium permanganate.

Reason (R): Alkaline potassium permanganate removes oxygen from ethanol.

C21. Write equations for (a) the complete combustion of methane (b) the addition of hydrogen to ethene. Name the catalyst used in (b). MUST DO [3]

C22. Alkaline potassium permanganate is added drop by drop to warm ethanol. At first its purple colour disappears; later the colour stays. Explain, with the reaction. MUST DO [3]

C23. Why do coal and charcoal only glow when burnt, while LPG and wax burn with a flame? [2]

Ethanol and ethanoic acid

★★★ 4 of 5 papers · 3–5 marks

C24. When sodium is added to ethanol, the gas given off is: [1]

(a) oxygen (b) hydrogen (c) carbon dioxide (d) carbon monoxide

C25. The ester formed from ethanoic acid and ethanol is: [1]

(a) methyl ethanoate (b) ethyl ethanoate

(c) ethyl methanoate (d) propyl ethanoate

C26. ASSERTION–REASON [1]

Assertion (A): Ethanoic acid is a weak acid.

Reason (R): Ethanoic acid ionises only partly in water.

C27. Write the reaction of ethyl ethanoate with sodium hydroxide. What is this reaction called, and how is it linked to making soap? MUST DO [2]

Soaps and detergents

★★★ 4 of 5 papers · 1–5 marks

C28. In a micelle, the soap molecules are arranged so that: [1]

(a) the ionic ends point inward (b) the tails point toward the oil at the centre

(c) the tails point out into the water (d) the molecules lie flat

C29. Water is hard because it contains salts of: [1]

(a) sodium and potassium (b) calcium and magnesium

(c) iron and copper (d) ammonium

C30. Distinguish between soaps and detergents (three points). MUST DO [3]

C31. A student shakes soap solution with distilled water in one tube and with hard water in another. What does she see? Explain. [2]

Long answer

5 marks

C32. A compound A, C_2H_6O, is used in cough syrups. Heated with excess conc. sulphuric acid at 443 K it gives B. B adds hydrogen in the presence of nickel to give C. (a) Identify A, B and C. (b) Write the two equations. (c) Write the equation for burning C in air. MUST DO [5]

C33. (a) What is a soap? Explain its cleaning action with a labelled diagram of a micelle. (b) Why is soap not suitable for washing in hard water? MUST DO [5]

C34. (a) Write the reactions of ethanoic acid with (i) sodium hydroxide (ii) sodium hydrogencarbonate (iii) ethanol. (b) How would you show that the gas in (ii) is carbon dioxide? [5]

PART D · SECTION B CASE STYLE

D Case-Based Questions

Each case carries 4 marks (1 + 1 + 2), as in the case-based questions of the board paper.

D1. Case Study · The Kitchen Burner [4]

Meera noticed that the flame of the gas stove at home had turned yellow and the bottoms of the pans were turning black. A mechanic cleaned the small holes near the burner, and the flame became blue again. He explained that cooking gas is mainly butane, a hydrocarbon with four carbon atoms, and that welders at his workshop burn ethyne with pure oxygen.

(i) Why did the flame turn yellow before the holes were cleaned? [1]

(ii) Write the molecular formula of butane. Is it saturated or unsaturated? [1]

(iii) Write the balanced equation for the complete combustion of butane. [2]

OR

(iii) Why do welders burn ethyne with oxygen and not with air? [2]

D2. Case Study · A Sweet Smell in the Lab [4]

In the laboratory, Arjun took 1 mL of ethanol and 1 mL of glacial ethanoic acid in a test tube, added a few drops of concentrated sulphuric acid and warmed it in a water bath. When he poured the mixture into a beaker of water, a sweet, fruity smell spread through the room. His teacher said that such compounds are used in perfumes and that the same family of reactions, run backwards with an alkali, is used to make soap.

(i) Name the sweet-smelling compound formed. [1]

(ii) What is the role of the concentrated sulphuric acid? [1]

(iii) Write the equation for the reaction. Name the reverse reaction with sodium hydroxide. [2]

OR

(iii) How would you show which of the two starting liquids is the acid? Write the equation. [2]

D3. Case Study · Washing Day [4]

In a village, clothes washed with soap in well water came out with a white, sticky deposit and needed a lot of soap. When the same clothes were washed with a detergent powder in the well water, they came out clean with plenty of lather. Rainwater collected on the roof, however, lathered well even with soap.

(i) Which ions make the well water hard? [1]

(ii) Name the white deposit formed with soap. [1]

(iii) Why did the detergent work in the well water while soap did not? [2]

OR

(iii) Why does soap solution look cloudy, and why do the micelles not settle down? [2]

PART E · REAL BOARD QUESTIONS

E Board PYQ Index

Real questions from recent Science board papers and CBSE sample papers, by type. Open the official paper and solve the listed questions.

Frequency	Question type	Marks	Where asked (year: paper code, question number)	Practise here
★★☆	**Covalent bonding, electron dot structures, properties of covalent compounds**	1–3	**2026:** 31/1/1 Q24 (A–R: covalent bonding), Q29 (why covalent compounds conduct poorly) · **SQP 2026–27:** Q26 (electron dot structure)	A1–A5, C1–C4
★★★	**Catenation, tetravalency, saturated and unsaturated hydrocarbons, isomers, homologous series**	1–5	**2026:** 31/1/1 Q29 (catenation: carbon vs silicon) · **2025:** OD Set 1 Q4 (which is not an alkane) · **2025:** Delhi Set 1 Q4 (compound with one C–C bond and a triple bond) · **SQP 2024–25:** Q34 (isomers, homologous series) · **SQP 2026–27:** Q21 (isomers), Q25 (carbon vs silicon compounds), Q26 (homologue of ethanol)	A6–A10, B1–B4, B12, C5–C11
★☆☆	**Functional groups and naming**	1	**2026:** 31/1/1 Q20 (aldehyde group)	A11–A13, B5, B13, C12–C16
★★★	**Combustion, oxidation, addition (hydrogenation) and substitution**	1–5	**2026:** 31/1/1 Q29 (oxidation of ethanol; hydrogenation) · **2025:** OD Set 1 Q17 (A–R: fuels), Q27(b) (burning natural gas) · **2025:** Delhi Set 1 Q34 (hydrogenation, combustion) · **SQP 2024–25:** Q34 (substitution; ethyne for welding) · **SQP 2026–27:** Q26 OR (hydrogenation)	A14–A18, B9, B14, B16, C17–C23, C32, D1
★★★	**Ethanol and ethanoic acid: dehydration, esterification, reactions of the acid**	3–5	**2026:** 31/1/1 Q29 OR (esterification: X, Y, Z) · **2025:** OD Set 1 Q34 (ethanol, ethanoic acid, esterification) · **2025:** Delhi Set 1 Q34 (dehydration; OR acetic acid) · **SQP 2026–27:** Q26 (ester; OR dehydration)	A19–A21, B6–B8, B11, B15, C24–C27, C34, D2
★★★	**Soaps, micelles, hard water and detergents**	1–5	**2026:** 31/1/1 Q29 (soap in hard water) · **2025:** OD Set 1 Q34 OR (micelle, hard water) · **SQP 2024–25:** Q34 OR (micelle, saponification) · **SQP 2026–27:** Q19 (soap vs detergent in hard water)	A22–A25, B10, C28–C31, C33, D3

PAPERS CHECKED (5)

- 2026 board paper 31/1/1 (Set 1) – first paper with separate Biology, Chemistry and Physics sections
- 2025 board paper, Outside Delhi Set 1
- 2025 board paper, Delhi Set 1
- CBSE Sample Question Paper 2024–25
- CBSE Sample Question Paper 2026–27 (the pattern for your exam)

★★★ = asked in 3 or more of the 5 papers checked · ★★ = 2 papers · ★ = 1 paper. Codes: OD = Outside Delhi. Each paper was read question by question; questions from the 2026–27 Sample Paper after Q20 were checked from a summary of the paper. Download the official papers from cbse.gov.in → Previous Year Question Papers and cbseacademic.nic.in → Sample Question Papers, and solve the exact questions listed.

PART F · YOUR RECORD

F My Mistakes

Write down each mistake from this chapter, including the chapter test.

Every wrong answer is a free lesson. Write it here, find the rule you missed, and redo the question after three days. Bring this page to class before the chapter test.

Date	Part & Q No.	What went wrong	Correct rule or method	Redone ✓