

PRACTICE PAPER 01 (2026-27)
CHAPTER 04: CARBON AND ITS COMPOUNDS
(STEP-BY-STEP SOLUTIONS)

SUBJECT: SCIENCE

MAX. MARKS : 40

CLASS : X

DURATION : 1½ hrs

General Instructions:

- (i) All questions are compulsory.
- (ii) This question paper contains **20** questions divided into five Sections A, B, C, D and E.
- (iii) **Section A** comprises 10 MCQs and Assertion-Reason questions of **1 mark** each. **Section B** comprises 4 Very Short Answer questions of **2 marks** each. **Section C** comprises 3 Short Answer questions of **3 marks** each. **Section D** comprises 1 Long Answer question of **5 marks**. **Section E** comprises 2 Case Study Based questions of **4 marks** each.
- (iv) There is no overall choice. Internal choice is provided in Section E.
- (v) Use of calculators is not permitted.

SECTION - A

Questions 1 to 10 carry 1 mark each.

1. The total number of covalent bonds present in a molecule of butane (C_4H_{10}) is

- (a) 10
- (b) 12
- (c) 13
- (d) 14

Solution:

Ans: (c) 13

- Four carbon atoms in a chain have 3 C-C bonds. Each of the 10 hydrogen atoms forms one C-H bond.
- Total = 3 + 10 = **13** single covalent bonds.

2. Which of the following hydrocarbons is unsaturated?

- (a) C_3H_8
- (b) C_2H_6
- (c) C_3H_6
- (d) C_4H_{10}

Solution:

Ans: (c) C_3H_6

- Saturated (alkane) formulae fit C_nH_{2n+2} : C_3H_8 , C_2H_6 , C_4H_{10} . C_3H_6 fits C_nH_{2n} (propene, $CH_3-CH=CH_2$) and has a double bond.

3. The next higher homologue of ethanol (C_2H_5OH) is

- (a) CH_3OH
- (b) C_3H_7OH
- (c) C_2H_4OH
- (d) C_3H_6OH

Solution:

Ans: (b) C_3H_7OH

- Successive members of a homologous series differ by a $-CH_2-$ unit: $C_2H_5OH + CH_2 = C_3H_7OH$ (propanol). CH_3OH is the lower homologue.

4. The functional group present in propanone is

- (a) $-OH$
- (b) $-CHO$
- (c) $>C=O$ (ketone)
- (d) $-COOH$

Solution:

Ans: (c) $>C=O$ (ketone)

- The suffix 'one' indicates a ketone: $CH_3-CO-CH_3$.

5. Vegetable oils are converted into vanaspati ghee by heating with hydrogen in the presence of nickel. This reaction is an example of

- (a) substitution reaction (b) addition reaction
(c) oxidation reaction (d) saponification

Solution:

Ans: (b) addition reaction

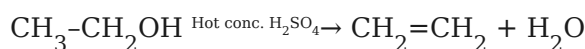
- Unsaturated vegetable oils **add** hydrogen across their double bonds in the presence of a nickel catalyst (hydrogenation).

6. When ethanol is heated at 443 K with excess concentrated sulphuric acid, the product formed is

- (a) ethane (b) ethene
(c) ethanoic acid (d) ethyl ethanoate

Solution:

Ans: (b) ethene



- Conc. H_2SO_4 acts as a dehydrating agent, removing water from ethanol.

7. When soap is shaken with hard water,

- (a) a lot of foam is formed
(b) a white curdy precipitate (scum) is formed
(c) the soap turns blue
(d) no change is observed

Solution:

Ans: (b) a white curdy precipitate (scum) is formed

- Soap reacts with the calcium and magnesium salts in hard water to form an insoluble scum, so little foam forms.

8. The number of structural isomers possible for butane is

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

Solution:

Ans: (b) 2

- A straight chain (n-butane) and a branched chain (isobutane) – same formula C_4H_{10} , different structures.

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 (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.

9. **Assertion (A):** Carbon forms covalent bonds rather than C^{4+} or C^{4-} ions.

Reason (R): It is very difficult for carbon to gain four electrons or to lose four electrons.

Solution:

Ans: (a)

- Gaining 4 electrons: a nucleus with 6 protons cannot hold 10 electrons. Losing 4: needs a very large amount of energy. So carbon **shares** electrons. R explains A.

10. Assertion (A): Pure ethanoic acid is called glacial acetic acid.

Reason (R): Ethanoic acid is a strong acid that is completely ionised in water.

Solution:

Ans: (c)

- (A) is true: its melting point is 290 K, so it often freezes in winter in cold climates. (R) is false: carboxylic acids are **weak** acids, not completely ionised like HCl.

SECTION - B

Questions 11 to 14 carry 2 marks each.

11. Draw the electron dot structures of (a) ethyne, C_2H_2 , and (b) chlorine, Cl_2 . State the type of bond between the two carbon atoms in ethyne. (Atomic numbers: H = 1, C = 6, Cl = 17)

Solution:

(a) C (2, 4) has 4 valence electrons. Each C shares 1 electron with H and 3 with the other C → a **triple bond** between the carbons (three shared pairs). [1]



Ethyne (C_2H_2): $H-C \equiv C-H$



Chlorine (Cl_2): $Cl-Cl$

(b) Cl (2, 8, 7) needs one electron; each Cl shares one electron → a **single bond**; each Cl keeps three lone pairs, completing its octet. [1]

[• and × show electrons from the two different atoms]

12. Carbon forms millions of compounds, many more than all other elements put together.

(a) State the two properties of carbon responsible for this.

(b) Why are the bonds formed by carbon very strong?

Solution:

(a) (i) **Catenation** – carbon can bond with other carbon atoms to form long chains, branched chains and rings. (ii) **Tetravalency** – with a valency of four, carbon can bond with four other atoms of carbon or other elements (O, H, N, S, Cl...). [$\frac{1}{2} + \frac{1}{2}$]

(b) Because of its **small size**, the carbon nucleus holds the shared pairs of electrons strongly, making the bonds strong and the compounds stable. [1]

13. The bottoms of cooking vessels in a house are getting blackened, and the gas stove gives a yellow flame.

(a) What does this indicate, and what should be done?

(b) Which type of hydrocarbons generally burn with a clean flame, and which with a yellow sooty flame?

Solution:

(a) The **air holes are blocked**, so the fuel undergoes **incomplete combustion** and forms soot (carbon); fuel is being wasted. Clean the air holes so an oxygen-rich mixture burns with a clean blue flame. [1]

(b) **Saturated** hydrocarbons generally give a clean flame; **unsaturated** compounds give a yellow flame with lots of black smoke. [$\frac{1}{2} + \frac{1}{2}$]

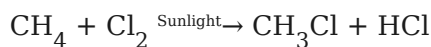
14. Methane reacts with chlorine in the presence of sunlight.

(a) Write the chemical equation for the first step of this reaction.

(b) Why is it called a substitution reaction? Why do saturated hydrocarbons undergo this reaction only under such conditions?

Solution:

(a)



[1 mark]

(b) One type of atom (a **chlorine** atom) takes the place of another (a **hydrogen** atom). [$\frac{1}{2}$]
Saturated hydrocarbons are **fairly unreactive** and inert to most reagents, so sunlight is needed. [$\frac{1}{2}$]

SECTION - C

Questions 15 to 17 carry 3 marks each.

15. About 3 mL of ethanol is warmed in a water bath and a 5% solution of alkaline potassium permanganate is added drop by drop.

(a) Why does the purple colour of KMnO_4 disappear at first but persist when excess is added?

(b) Write the equation for the reaction and name the product.

(c) What are oxidising agents? Name one other oxidising agent that can bring about this change.

Solution:

(a) At first, KMnO_4 is used up in oxidising ethanol, so its colour disappears. Once all the ethanol is oxidised, the extra KMnO_4 remains unused and its purple colour persists. [1]

(b)



Product: **ethanoic acid** (oxygen has been added to ethanol, so it is oxidation). [1]

(c) Substances that can **add oxygen** to others are oxidising agents. Another: **acidified potassium dichromate**. [$\frac{1}{2} + \frac{1}{2}$]

16. (a) What is a homologous series? State two of its characteristics.

(b) Name the following compounds: (i) $\text{CH}_3\text{-CH}_2\text{-CHO}$ (ii) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-Br}$

(c) By how much does the molecular mass of successive members of a homologous series differ? (Atomic masses: C = 12 u, H = 1 u)

Solution:

(a) A series of carbon compounds in which the **same functional group** replaces hydrogen in a carbon chain is a homologous series. Characteristics (any two): successive members differ by $-\text{CH}_2-$; they have similar chemical properties; physical properties (melting/boiling points) change gradually with molecular mass. [1]

(b) (i) 3 carbons + aldehyde (suffix '-al') $\rightarrow$ **propanal**. (ii) 3 carbons + bromine (prefix 'bromo') $\rightarrow$ **bromopropane**. [$\frac{1}{2} + \frac{1}{2}$]

(c) Successive members differ by one CH_2 unit: $12 + 2 \times 1 = 14$ u. [1]

17. (a) Explain with the help of micelle formation how soap removes oily dirt from clothes.
 (b) Why does a soap solution appear cloudy?
 (c) Why are detergents preferred to soaps for washing clothes in hard water?

Solution:

(a) A soap molecule has an **ionic (hydrophilic) end** that interacts with water and a long **hydrocarbon (hydrophobic) tail** that interacts with oil. In water the tails cluster around the oily dirt with the ionic ends facing out, forming a **micelle**. The dirt collects at the centre, forms an emulsion and is rinsed away. [1½]

(b) Soap micelles are **large enough to scatter light**, so the solution looks cloudy. [½]

(c) The charged ends of detergents **do not form insoluble precipitates** with the calcium and magnesium ions in hard water, so they remain effective and lather well. [1]

SECTION - D

Question 18 carries 5 marks.

18. 1 mL of absolute ethanol and 1 mL of glacial acetic acid are taken in a test tube with a few drops of concentrated sulphuric acid, warmed in a water bath for five minutes and then poured into water.

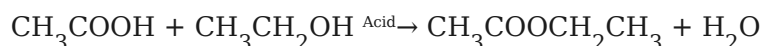
(a) Name the reaction and the type of compound formed. Write the chemical equation and give one use of the product. What is the role of conc. H_2SO_4 ?

(b) What happens when the product is treated with sodium hydroxide? Write the equation and name the reaction.

(c) You are given two unlabelled test tubes containing ethanol and ethanoic acid. How would you distinguish between them using sodium hydrogencarbonate? Write the equation.

Solution:

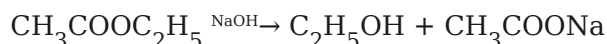
(a) **Esterification**; the product is an **ester** (ethyl ethanoate), a sweet-smelling substance.



Use: making **perfumes** and **flavouring agents**. Conc. H_2SO_4 acts as the **acid catalyst**.

[½ name + 1 equation + ½ use/role = 2 marks]

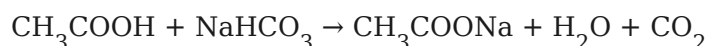
(b) The ester is converted back into the alcohol and the sodium salt of the carboxylic acid:



This is **saponification** (used in making soap). [½ + ½]

(c) Add a pinch of sodium hydrogencarbonate to each test tube.

- Ethanoic acid gives **brisk effervescence**; the gas turns lime water milky (CO_2).
- Ethanol shows **no effervescence**. [1]



[1 mark]

SECTION - E (Case Study Based Questions)

Questions 19 and 20 carry 4 marks each.

19. Alkanes form a homologous series. The table below shows some members of this series with their boiling points:

Alkane	Molecular formula	Boiling point (K)	State at room temperature (≈ 298 K)
Methane	CH_4	111	Gas
Ethane	C_2H_6	184	Gas
Propane	C_3H_8	231	Gas
Butane	C_4H_{10}	273	Gas
Pentane	C_5H_{12}	309	Liquid

- (a) What trend do you observe in boiling point as we go down the series? Give a reason. **(1)**
(b) Predict the physical state of hexane (C_6H_{14}) at room temperature. Justify your answer. **(1)**
(c) Butane exists in two forms with the same formula. Draw their structural formulae and name the phenomenon. **(2)**

OR

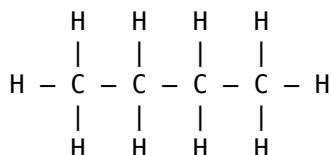
- (c) Write the general formula of alkanes. Ethane has 7 covalent bonds; how many covalent bonds does pentane have? Show your working. **(2)**

Solution:

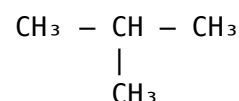
(a) Boiling point **increases** steadily ($111\text{ K} \rightarrow 309\text{ K}$). Physical properties of a homologous series change gradually with **increasing molecular mass**. [1]

(b) Hexane is the next member after pentane, so its boiling point will be **higher than 309 K**, i.e. above room temperature ($\approx 298\text{ K}$). It will be a **liquid**. [1]

(c) Structural formulae of the two forms of C_4H_{10} :



n-Butane (straight chain)



Isobutane (branched chain)

Phenomenon: **structural isomerism** - same molecular formula, different structures. [1 + 1]

OR

(c) General formula: $\text{C}_n\text{H}_{2n+2}$. [$\frac{1}{2}$]

Pentane C_5H_{12} : C-C bonds = $5 - 1 = 4$; C-H bonds = 12.

Total covalent bonds = $4 + 12 = 16$. (Check with ethane: $1 + 6 = 7$.) [$\frac{1}{2}$]

20. Read the passage and answer the questions that follow.

Sugarcane juice is used to prepare molasses, which is fermented to give ethanol. Some countries add ethanol to petrol because it is a cleaner fuel. Ethanol is also a good solvent used in medicines such as tincture iodine and cough syrups. To prevent misuse of industrial ethanol, poisonous substances and a blue dye are added to it. In the laboratory, a teacher dropped a small piece of sodium into absolute ethanol and the students observed bubbles of a gas.

(a) Name the gas evolved when sodium reacts with ethanol and write the balanced equation.

(1)

(b) What is denatured alcohol? Why is a blue dye added to it? (1)

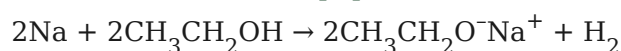
(c) Write the balanced equation for the complete combustion of ethanol. Why is ethanol considered a cleaner fuel? (2)

OR

(c) Why is the methanol added to industrial alcohol extremely dangerous if consumed? (2)

Solution:

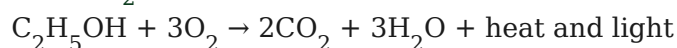
(a) **Hydrogen** gas is evolved (it burns with a pop sound); sodium ethoxide also forms.



[$\frac{1}{2} + \frac{1}{2}$]

(b) Industrial ethanol made **unfit for drinking** by adding poisonous substances like methanol. The blue dye lets it be **identified easily**. [$\frac{1}{2} + \frac{1}{2}$]

(c) Skeletal: $\text{C}_2\text{H}_5\text{OH} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$. Balance C: 2CO_2 ; H (6): $3\text{H}_2\text{O}$; O on RHS = $4 + 3 = 7$, LHS has 1 in ethanol $\rightarrow 3\text{O}_2$.



[1 mark]

It is cleaner because in sufficient air it gives **only carbon dioxide and water**, unlike coal and petroleum which also release oxides of sulphur and nitrogen. [1]

OR

(c) Even very small quantities of methanol can cause **death**. In the liver it is oxidised to **methanal**, which reacts rapidly with cell components and **coagulates the protoplasm**. [1]

Methanol also affects the **optic nerve**, causing **blindness**. [1]

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