CBSE CLASS X

Science (086)

QUESTION PAPER

AI-generated question paper

Code: 9D95V9 **Questions: 29** **Maximum Marks: 57** **Generated: 2026-06-25 17:44**

SELECTIONS USED

Subject	Science
Lessons	4 Carbon and its Compounds
Level of understanding	Initial understanding
Question selection	Curated chapter coverage (~3 questions per section)
Model	claude-sonnet-4-6

Composition — Difficulty: 13 straightforward · 16 medium | Types: 16 Short · 9 Very short · 4 MCQ

Q1. medium · initial-understanding · § Introduction **[3]**

Carbon is found in very small amounts in the earth's crust and atmosphere, yet it is considered one of the most important elements. (i) In what two forms does carbon occur in the earth's crust? (ii) Give two reasons why carbon is considered so significant despite its limited abundance in nature.

◆ **Carbon and its Compounds**

Q2. straightforward · initial-understanding · § 4.1 BONDING IN CARBON – THE COVALENT BOND **[1]**

Carbon has an atomic number of 6. How many valence electrons does a carbon atom have, and what is its valency?

◆ **Carbon and its Compounds**

Q3. medium · initial-understanding · § 4.1 BONDING IN CARBON – THE COVALENT BOND **[3]**

Carbon has an atomic number of 6 and needs 4 more electrons to achieve a noble gas configuration. Why does carbon form covalent bonds instead of gaining or losing electrons to form ionic bonds?

◆ **Carbon and its Compounds**

Q4. medium · initial-understanding · § 4.1 BONDING IN CARBON – THE COVALENT BOND **[2]**

Carbon compounds generally have low melting and boiling points compared to ionic compounds. What does this tell us about the forces between molecules in covalent compounds?

◆ **Carbon and its Compounds**

Q5. straightforward · initial-understanding · § 4.1 BONDING IN CARBON – THE COVALENT BOND **[1]**

Most carbon compounds are poor conductors of electricity. Explain why covalent bonding results in the absence of free ions or electrons in these compounds.

◆ **Carbon and its Compounds**

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Q6. medium | initial-understanding | § 4.1 BONDING IN CARBON – THE COVALENT BOND **[1]**

Consider the following statements about covalent compounds and select the one that is correct.

(A) Covalent compounds conduct electricity because electrons are shared between atoms.
(B) Covalent compounds have high melting points because covalent bonds within molecules are strong.
(C) Covalent compounds are generally poor conductors of electricity because no ions are formed during bond formation.
(D) Covalent compounds have high boiling points because intermolecular forces are very strong.

A Covalent compounds conduct electricity because electrons are shared between atoms.
B Covalent compounds have high melting points because covalent bonds within molecules are strong.
C Covalent compounds are generally poor conductors of electricity because no ions are formed during bond formation.
D Covalent compounds have high boiling points because intermolecular forces are very strong.

◆ **Carbon and its Compounds**

Q7. medium | initial-understanding | § 4.2 VERSATILE NATURE OF CARBON **[3]**

What is catenation? Why is carbon able to form long chains and rings with other carbon atoms, while silicon shows this property to a much lesser extent?

◆ **Carbon and its Compounds**

Q8. straightforward | initial-understanding | § 4.2 VERSATILE NATURE OF CARBON **[1]**

Which of the following pairs correctly distinguishes saturated from unsaturated carbon compounds?

(A) Saturated compounds contain only carbon and hydrogen; unsaturated compounds contain other elements too.
(B) Saturated compounds have only single bonds between carbon atoms; unsaturated compounds have one or more double or triple bonds between carbon atoms.
(C) Saturated compounds are more reactive than unsaturated compounds.
(D) Saturated compounds always have a ring structure; unsaturated compounds always have a chain structure.

A Saturated compounds contain only carbon and hydrogen; unsaturated compounds contain other elements too.
B Saturated compounds have only single bonds between carbon atoms; unsaturated compounds have one or more double or triple bonds between carbon atoms.
C Saturated compounds are more reactive than unsaturated compounds.
D Saturated compounds always have a ring structure; unsaturated compounds always have a chain structure.

◆ **Carbon and its Compounds**

Q9. medium | initial-understanding | § 4.2 VERSATILE NATURE OF CARBON **[3]**

Methanol, ethanol, propanol, and butanol belong to the same homologous series. (i) What is the structural difference between any two successive members of this series? (ii) Why do all members of this series show very similar chemical properties despite having different physical properties?

◆ **Carbon and its Compounds**

Q10. straightforward | initial-understanding | § 4.2.1 Saturated and Unsaturated Carbon Compounds **[2]**

Ethane (C_2H_6) and ethene (C_2H_4) are both compounds of carbon and hydrogen. Which one is saturated and which is unsaturated? Give a reason for your answer.

◆ **Carbon and its Compounds**

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Q11. medium | initial-understanding | § 4.2.1 Saturated and Unsaturated Carbon Compounds **[1]**

Which of the following statements correctly explains why unsaturated carbon compounds are more reactive than saturated carbon compounds?

(A) Unsaturated compounds have more hydrogen atoms, which makes them more chemically active.
(B) Unsaturated compounds contain double or triple bonds between carbon atoms, which can participate in addition reactions.
(C) Saturated compounds have only single bonds, which makes them more reactive than double bonds.
(D) Unsaturated compounds have a higher boiling point, which increases their tendency to react.

A Unsaturated compounds have more hydrogen atoms, making them lighter and easier to break apart.
B Unsaturated compounds contain double or triple bonds between carbon atoms, which can participate in addition reactions.
C Saturated compounds contain double bonds that make them rigid and resistant to reactions.
D Saturated compounds have fewer carbon atoms and therefore fewer sites available for reaction.

◆ **Carbon and its Compounds**

Q12. straightforward | initial-understanding | § 4.2.2 Chains, Branches and Rings **[1]**

Two compounds both have the molecular formula C_4H_{10} but have different structures. What are such compounds called? Draw or describe the structures of both compounds to show how they differ.

◆ **Carbon and its Compounds**

Q13. medium | initial-understanding | § 4.2.3 Will you be my Friend? **[3]**

What is a functional group in a carbon compound? How does the functional group determine the chemical properties of a carbon compound?

◆ **Carbon and its Compounds**

Q14. straightforward | initial-understanding | § 4.2.4 Homologous Series **[3]**

What is a homologous series? State two characteristics that all members of a homologous series share.

◆ **Carbon and its Compounds**

Q15. straightforward | initial-understanding | § 4.2.5 Nomenclature of Carbon Compounds **[1]**

Write the IUPAC name and structural formula of the simplest ketone that has three carbon atoms in its chain.

◆ **Carbon and its Compounds**

Q16. medium | initial-understanding | § 4.3 CHEMICAL PROPERTIES OF CARBON COMPOUNDS **[3]**

Saturated hydrocarbons burn with a clean blue flame while unsaturated hydrocarbons burn with a sooty yellow flame. (i) Why do unsaturated hydrocarbons produce a sooty flame during combustion? (ii) What does this tell us about their carbon-to-hydrogen ratio compared to saturated hydrocarbons?

◆ **Carbon and its Compounds**

Q17. straightforward | initial-understanding | § 4.3.1 Combustion **[1]**

When a saturated hydrocarbon burns in a limited supply of air, what kind of flame is produced and what deposit forms on a surface held above the flame?

◆ **Carbon and its Compounds**

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Q18. straightforward | initial-understanding | § 4.3.1 Combustion **[1]**

Which of the following correctly describes why fuels such as coal and petroleum are considered environmental pollutants when burned?

(A) They release only carbon dioxide, which is harmless.

(B) They contain nitrogen and sulphur, whose combustion produces oxides that pollute the air.

(C) They produce water vapour that causes acid rain.

(D) They burn with a clean blue flame that depletes oxygen rapidly.

A They release only carbon dioxide, which is harmless.

B They contain nitrogen and sulphur, whose combustion produces oxides that pollute the air.

C They produce water vapour that causes acid rain.

D They burn with a clean blue flame that depletes oxygen rapidly.

◆ **Carbon and its Compounds**

Q19. medium | initial-understanding | § 4.3.1 Combustion **[3]**

A student burns two different hydrocarbons in air and observes that one produces a clean blue flame while the other produces a sooty, yellow flame. (i) Which type of hydrocarbon — saturated or unsaturated — is more likely to produce each kind of flame? Give a reason for your answer. (ii) Under what condition could even the hydrocarbon that normally burns cleanly begin to produce a sooty flame?

◆ **Carbon and its Compounds**

Q20. medium | initial-understanding | § 4.3.2 Oxidation **[3]**

Ethanol is converted to ethanoic acid using alkaline potassium permanganate. (i) What type of chemical reaction is this? Give one reason to justify your answer. (ii) What is the role of alkaline potassium permanganate in this reaction?

◆ **Carbon and its Compounds**

Q21. straightforward | initial-understanding | § 4.3.3 Addition Reaction **[1]**

What type of compound is formed when hydrogen is added to an unsaturated hydrocarbon? Name one catalyst used for this reaction.

◆ **Carbon and its Compounds**

Q22. straightforward | initial-understanding | § 4.3.4 Substitution Reaction **[1]**

Methane reacts with chlorine in the presence of sunlight to form chloromethane (CH_3Cl) and HCl. What type of reaction is this? Give a reason for your answer.

◆ **Carbon and its Compounds**

Q23. medium | initial-understanding | § 4.4 SOME IMPORTANT CARBON COMPOUNDS – ETHANOL AND ETHANOIC ACID **[3]**

Ethanol reacts with sodium metal to release hydrogen gas. Based on this observation, what can you say about the O–H bond in ethanol? How is this reaction similar to or different from the reaction of water with sodium?

◆ **Carbon and its Compounds**

Q24. straightforward | initial-understanding | § 4.4.1 Properties of Ethanol **[1]**

When ethanol reacts with sodium metal, what are the two products formed?

◆ **Carbon and its Compounds**

Q25. medium | initial-understanding | § 4.4.1 Properties of Ethanol **[2]**

What is the role of concentrated sulphuric acid when ethanol is heated with it at a high temperature? Name the organic product formed and give the name of this type of reaction.

◆ **Carbon and its Compounds**

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Q26. medium | initial-understanding | § 4.4.2 Properties of Ethanoic Acid **[2]**

Both ethanoic acid and hydrochloric acid are acids, yet they differ in strength. Explain why ethanoic acid is classified as a weak acid while hydrochloric acid is a strong acid.

◆ **Carbon and its Compounds**

Q27. medium | initial-understanding | § 4.4.2 Properties of Ethanoic Acid **[3]**

When ethanoic acid reacts with ethanol in the presence of a few drops of concentrated sulphuric acid, a new compound is formed. (i) Name this type of reaction and identify the product formed. (ii) What happens when this product is treated with sodium hydroxide solution?

◆ **Carbon and its Compounds**

Q28. medium | initial-understanding | § 4.5 SOAPS AND DETERGENTS **[3]**

What is a micelle? Describe how the structure of a micelle helps soap to clean oily dirt from clothes.

◆ **Carbon and its Compounds**

Q29. straightforward | initial-understanding | § 4.5 SOAPS AND DETERGENTS **[1]**

Why does soap fail to produce a good lather and instead form a white curdy precipitate when used with hard water?

◆ **Carbon and its Compounds**

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CBSE CLASS X

Science (086)

ANSWER KEY

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Code: 9D95V9	Questions: 29	Maximum Marks: 57	Generated: 2026-06-25 17:44

Q1. medium · initial-understanding · § Introduction **[3]**

Carbon is found in very small amounts in the earth's crust and atmosphere, yet it is considered one of the most important elements. (i) In what two forms does carbon occur in the earth's crust? (ii) Give two reasons why carbon is considered so significant despite its limited abundance in nature.

◆ Carbon and its Compounds

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Model Answer

(i) Carbon occurs in the earth's crust in two forms:

- As minerals such as **carbonates and hydrogencarbonates**
- As **coal and petroleum**

(The atmosphere contains carbon as carbon dioxide — 0.03%.)

(ii) Carbon is significant despite its limited abundance because:

1. **Catenation** — Carbon can form bonds with other carbon atoms, producing long chains, branched chains, and rings. This gives rise to millions of stable compounds.
2. **Tetravalency** — Carbon has a valency of four, allowing it to bond with many other elements (H, O, N, S, Cl), forming compounds with diverse and specific properties that are essential to all living organisms.

Source: Introduction and Section 4.2, Chapter 4 — Carbon and its Compounds

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Explanation

- Part (i) is directly from the introduction: "0.02% carbon in the form of minerals (like carbonates, hydrogencarbonates, coal and petroleum)." List exactly these — don't guess.
- Part (ii) expects the **two keywords**: **catenation** and **tetravalency**. Examiners look for these terms by name plus a brief explanation of each. Simply saying "forms many compounds" without naming the property will lose marks.
- Don't spend words on carbon dioxide for part (i) — the question asks about the **crust**, not the atmosphere. Mentioning it briefly as a bonus is fine but not required.

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Q2. straightforward | initial-understanding | § 4.1 BONDING IN CARBON – THE COVALENT BOND **[1]**

Carbon has an atomic number of 6. How many valence electrons does a carbon atom have, and what is its valency?

◆ Carbon and its Compounds

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Model Answer

Carbon (atomic number 6) has **4 valence electrons** (electronic configuration: 2, 4) and its **valency is 4** (tetravalent).

Explanation

Electronic configuration of carbon is 2, 4 — so 4 electrons are in the outermost shell. Valency equals the number of electrons needed to complete the octet or electrons available for sharing; here carbon shares all 4, giving valency = 4. The source passage directly states "carbon has a valency of four." Examiners expect both values stated clearly in one line.

Q3. medium | initial-understanding | § 4.1 BONDING IN CARBON – THE COVALENT BOND **[3]**

Carbon has an atomic number of 6 and needs 4 more electrons to achieve a noble gas configuration. Why does carbon form covalent bonds instead of gaining or losing electrons to form ionic bonds?

◆ Carbon and its Compounds

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Model Answer

Carbon (atomic number 6) has 4 valence electrons and needs 4 more to achieve noble gas configuration. Forming ionic bonds is not feasible for carbon because:

1. **Gaining 4 electrons** would form C^{4-}, but the nucleus with only 6 protons cannot hold 10 electrons stably.
2. **Losing 4 electrons** would form C^{4+}, but this requires an extremely large amount of energy to remove four electrons, leaving just 2 electrons with 6 protons.

Therefore, carbon overcomes this problem by **sharing** its 4 valence electrons with other atoms, forming **covalent bonds**. This allows both atoms to achieve noble gas configuration without gaining or losing electrons.

Source: Chapter 4, Section 4.1 – Bonding in Carbon: The Covalent Bond

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Explanation

Examiners look for **two specific reasons** (one for each ionic option) clearly stated — this is where most marks lie. Simply saying "carbon shares electrons" without explaining *why* ionic bonding is impossible will lose marks. Always use the terms C^{4-} and C^{4+} with their reasoning. The conclusion about covalent bond formation ties it together for the third mark.

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Q4. medium | initial-understanding | § 4.1 BONDING IN CARBON – THE COVALENT BOND **[2]**

Carbon compounds generally have low melting and boiling points compared to ionic compounds. What does this tell us about the forces between molecules in covalent compounds?

◆ Carbon and its Compounds

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Model Answer

The low melting and boiling points of carbon (covalent) compounds tell us that the **intermolecular forces of attraction between the molecules are weak**. Although the covalent bonds within each molecule are strong, the forces holding separate molecules together are not very strong, so less energy (heat) is needed to overcome them and change the state.

Source: Chapter 4, Section 4.1 – Bonding in Carbon

Explanation

- The key distinction examiners look for: **strong intramolecular (within molecule) covalent bonds** vs. **weak intermolecular forces** — students often confuse the two.
- Quote or paraphrase the textbook line: *"Covalently bonded molecules have strong bonds within the molecule, but intermolecular forces are weak."*
- For 2 marks: one mark for stating intermolecular forces are weak; one mark for linking this to low melting/boiling points or contrasting with ionic compounds.

Q5. straightforward | initial-understanding | § 4.1 BONDING IN CARBON – THE COVALENT BOND **[1]**

Most carbon compounds are poor conductors of electricity. Explain why covalent bonding results in the absence of free ions or electrons in these compounds.

◆ Carbon and its Compounds

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Model Answer

In covalent bonding, electrons are **shared** between atoms rather than transferred. Since no charged particles (ions) or free electrons are produced, carbon compounds cannot conduct electricity.

Source: Chapter 4, Section 4.1 – Bonding in Carbon

Explanation

The key phrase from the textbook is: *"Since the electrons are shared between atoms and no charged particles are formed, such covalent compounds are generally poor conductors of electricity."* For 1 mark, you only need to state that sharing (not transfer) of electrons means no free ions/electrons are available to carry charge.

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Q6. medium | initial-understanding | § 4.1 BONDING IN CARBON – THE COVALENT BOND **[1]**

Consider the following statements about covalent compounds and select the one that is correct.

(A) Covalent compounds conduct electricity because electrons are shared between atoms.
(B) Covalent compounds have high melting points because covalent bonds within molecules are strong.
(C) Covalent compounds are generally poor conductors of electricity because no ions are formed during bond formation.
(D) Covalent compounds have high boiling points because intermolecular forces are very strong.

A Covalent compounds conduct electricity because electrons are shared between atoms.
B Covalent compounds have high melting points because covalent bonds within molecules are strong.
C Covalent compounds are generally poor conductors of electricity because no ions are formed during bond formation.
D Covalent compounds have high boiling points because intermolecular forces are very strong.

◆ Carbon and its Compounds

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Model Answer

(C) Covalent compounds are generally poor conductors of electricity because no ions are formed during bond formation.

Explanation

The passage explicitly states: "Since the electrons are shared between atoms and no charged particles are formed, such covalent compounds are generally poor conductors of electricity." Options A, B, and D are incorrect because: covalent compounds do NOT conduct electricity; they have **low** (not high) melting/boiling points; and intermolecular forces are **weak** (not very strong).

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Q7. medium | initial-understanding | § 4.2 VERSATILE NATURE OF CARBON **[3]**

What is catenation? Why is carbon able to form long chains and rings with other carbon atoms, while silicon shows this property to a much lesser extent?

◆ Carbon and its Compounds

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Model Answer

Catenation is the unique ability of carbon atoms to bond with other carbon atoms to form long chains, branched chains, or rings.

Carbon can form long chains and rings because the **carbon–carbon bond is very strong and stable**, allowing large molecules to exist without breaking down. Also, carbon's **small atomic size** enables its nucleus to hold the shared electron pairs firmly, making its bonds strong.

Silicon, although it can also show catenation, forms compounds with chains of only up to seven or eight atoms. These silicon–hydrogen compounds are very **reactive and unstable** because silicon has a larger atomic size, so its bonds are much weaker and less stable than carbon–carbon bonds.

Source: Chapter 4, Section 4.2 Versatile Nature of Carbon

Explanation

- **1 mark**: Definition of catenation.
- **1 mark**: Reason carbon shows catenation extensively — strong C–C bond + small atomic size.
- **1 mark**: Why silicon shows it less — larger atom → weaker bonds → reactive/unstable compounds (chains only up to 7–8 atoms).

Examiners expect you to **contrast** carbon and silicon directly. Mentioning "small size of carbon" is important — many students forget this point. Avoid writing lengthy explanations; these three points, written concisely, earn full marks.

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Q8. straightforward | initial-understanding | § 4.2 VERSATILE NATURE OF CARBON **[1]**

Which of the following pairs correctly distinguishes saturated from unsaturated carbon compounds?

(A) Saturated compounds contain only carbon and hydrogen; unsaturated compounds contain other elements too.
(B) Saturated compounds have only single bonds between carbon atoms; unsaturated compounds have one or more double or triple bonds between carbon atoms.
(C) Saturated compounds are more reactive than unsaturated compounds.
(D) Saturated compounds always have a ring structure; unsaturated compounds always have a chain structure.

A Saturated compounds contain only carbon and hydrogen; unsaturated compounds contain other elements too.
B Saturated compounds have only single bonds between carbon atoms; unsaturated compounds have one or more double or triple bonds between carbon atoms.
C Saturated compounds are more reactive than unsaturated compounds.
D Saturated compounds always have a ring structure; unsaturated compounds always have a chain structure.

◆ Carbon and its Compounds

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Model Answer

(B) Saturated compounds have only single bonds between carbon atoms; unsaturated compounds have one or more double or triple bonds between carbon atoms.

Explanation

The textbook (section 4.2) explicitly states: "Compounds of carbon linked by only single bonds between carbon atoms are called saturated compounds. Compounds having double or triple bonds are called unsaturated compounds." Options A, C, and D are factually incorrect — both types can contain other elements; unsaturated compounds are actually *more* reactive; and both types can have ring or chain structures (e.g., cyclohexane is saturated and cyclic; benzene is unsaturated and cyclic).

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Q9. medium | initial-understanding | § 4.2 VERSATILE NATURE OF CARBON **[3]**

Methanol, ethanol, propanol, and butanol belong to the same homologous series. (i) What is the structural difference between any two successive members of this series? (ii) Why do all members of this series show very similar chemical properties despite having different physical properties?

◆ **Carbon and its Compounds**

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Model Answer

(i) Structural difference between successive members:

Any two successive members of this homologous series differ by one **–CH₂– unit** (i.e., one carbon atom and two hydrogen atoms), with a difference of **14 u** in molecular mass. For example, methanol (CH_3OH) and ethanol (C_2H_5OH) differ by $–CH_2–$.

(ii) Similar chemical properties:

All members of this series contain the same functional group **–OH (hydroxyl group)**. Since chemical properties are determined solely by the functional group, all members show very similar chemical properties. The difference in physical properties (like boiling point and solubility) is due to the gradual increase in molecular mass along the series.

Source: Chapter 4, Section 4.2.4 – Homologous Series

Explanation

- **(i)** The examiner expects the key phrase "$–CH_2–$ unit" and the mass difference of 14 u, with an example for full marks.
- **(ii)** The core idea is: **functional group → chemical properties; molecular mass → physical properties**. Both parts must be addressed. The textbook explicitly states "the chemical properties, which are determined solely by the functional group, remain similar in a homologous series."
- Avoid writing long paragraphs; crisp, pointed sentences score better in board exams.

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Q10. straightforward | initial-understanding | § 4.2.1 Saturated and Unsaturated Carbon Compounds **[2]**

Ethane (C_2H_6) and ethene (C_2H_4) are both compounds of carbon and hydrogen. Which one is saturated and which is unsaturated? Give a reason for your answer.

◆ **Carbon and its Compounds**

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Model Answer

Ethane (C_2H_6) is saturated and **ethene (C_2H_4) is unsaturated.**

In ethane, all valencies of carbon atoms are satisfied by **single bonds** only, so it is saturated. In ethene, the two carbon atoms are joined by a **double bond** (C=C), leaving no free valency — such compounds with double or triple bonds are called unsaturated.

Source: Carbon and its Compounds, Section 4.2.1

Explanation

- Examiners expect you to **name** which is saturated/unsaturated (1 mark) and **give the reason** based on bond type (1 mark).
- Key terms to use: *single bond* → saturated; *double/triple bond* → unsaturated.
- Avoid vague reasons like "fewer hydrogen atoms" — always refer to the **type of bond** between carbon atoms, as the textbook defines it.

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Q11. medium | initial-understanding | § 4.2.1 Saturated and Unsaturated Carbon Compounds **[1]**

Which of the following statements correctly explains why unsaturated carbon compounds are more reactive than saturated carbon compounds?

(A) Unsaturated compounds have more hydrogen atoms, which makes them more chemically active.
(B) Unsaturated compounds contain double or triple bonds between carbon atoms, which can participate in addition reactions.
(C) Saturated compounds have only single bonds, which makes them more reactive than double bonds.
(D) Unsaturated compounds have a higher boiling point, which increases their tendency to react.

A Unsaturated compounds have more hydrogen atoms, making them lighter and easier to break apart.
B Unsaturated compounds contain double or triple bonds between carbon atoms, which can participate in addition reactions.
C Saturated compounds contain double bonds that make them rigid and resistant to reactions.
D Saturated compounds have fewer carbon atoms and therefore fewer sites available for reaction.

◆ Carbon and its Compounds

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Model Answer

(B) Unsaturated compounds contain double or triple bonds between carbon atoms, which can participate in addition reactions, making them more reactive than saturated compounds with only single bonds.

Explanation

The textbook (section 4.2) defines unsaturated compounds as those having double or triple bonds, and section 4.3.3 explains that these bonds allow addition reactions (e.g., hydrogenation). Examiners expect students to link **double/triple bonds → addition reactions → greater reactivity**. Options A, C, and D are factually incorrect as per the source.

Q12. straightforward | initial-understanding | § 4.2.2 Chains, Branches and Rings **[1]**

Two compounds both have the molecular formula C_4H_{10} but have different structures. What are such compounds called? Draw or describe the structures of both compounds to show how they differ.

◆ Carbon and its Compounds

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Model Answer

Such compounds are called **structural isomers**. Butane has a straight chain (C–C–C–C) and isobutane has a branched chain (central C bonded to three other C atoms); both share formula C_4H_{10}.

Explanation

The question is worth only 1 mark, so name the term and briefly distinguish the two structures. Examiner looks for: (1) the term *structural isomers* and (2) a clear indication that one structure is straight-chain and the other is branched. No detailed diagram is needed for 1 mark — a brief description suffices.

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Q13. medium | initial-understanding | § 4.2.3 Will you be my Friend? **[3]**

What is a functional group in a carbon compound? How does the functional group determine the chemical properties of a carbon compound?

◆ Carbon and its Compounds

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Model Answer

Functional Group: An atom or group of atoms (containing heteroatoms like O, N, Cl) present in a carbon compound that confers specific chemical properties to it is called a functional group. Examples: –OH (alcohol), –COOH (carboxylic acid), –CHO (aldehyde).

How it determines chemical properties: The functional group bestows characteristic properties to the carbon compound regardless of the length or nature of the carbon chain. For example, all alcohols show similar reactions due to the –OH group, and all carboxylic acids show acidic properties due to the –COOH group.

Source: Chapter 4, Section 4.2.3

Explanation

- **1 mark** for defining functional group (mention heteroatom + specific properties + example).
- **2 marks** for explaining how it determines properties: key phrase is "regardless of the length and nature of the carbon chain" — examiners look for this. Give one or two examples of functional groups and their characteristic properties.
- Do **not** write lengthy descriptions of every functional group; two examples suffice.

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Q14. straightforward | initial-understanding | § 4.2.4 Homologous Series **[3]**

What is a homologous series? State two characteristics that all members of a homologous series share.

◆ Carbon and its Compounds

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Model Answer

A **homologous series** is a series of carbon compounds in which the same functional group substitutes for hydrogen in a carbon chain, with each successive member differing by a $-CH_2-$ unit (molecular mass difference of 14 u).

Two characteristics shared by all members:

1. **Similar chemical properties** — Since chemical properties are determined solely by the functional group, all members show similar chemical reactions (e.g., all alcohols like CH_3OH, C_2H_5OH show similar reactions).
1. **Gradation in physical properties** — As molecular mass increases, physical properties such as melting point, boiling point, and solubility show a regular gradation.

Source: Chapter 4, Section 4.2.4 — Homologous Series

Explanation

- The definition (1 mark) must include two key ideas: **same functional group** and **successive members differ by $-CH_2-$**.
- For the two characteristics (1 mark each), examiners expect: **similar chemical properties** and **gradation in physical properties**. Giving an example (like the alcohols) strengthens the answer but is not compulsory.
- Avoid writing that physical properties are the same — they are *similar in trend/gradation*, not identical.

Q15. straightforward | initial-understanding | § 4.2.5 Nomenclature of Carbon Compounds **[1]**

Write the IUPAC name and structural formula of the simplest ketone that has three carbon atoms in its chain.

◆ Carbon and its Compounds

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Model Answer

IUPAC name: Propanone

Structural formula: $CH_3—C(=O)—CH_3$

Explanation

The simplest ketone has the carbonyl group (C=O) flanked by carbon atoms, requiring a minimum of 3 carbons. The suffix for ketone is **-one**, and dropping the final 'e' from propane gives **propanone**. Examiners expect both the name and structural formula.

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Q16. medium | initial-understanding | § 4.3 CHEMICAL PROPERTIES OF CARBON COMPOUNDS **[3]**

Saturated hydrocarbons burn with a clean blue flame while unsaturated hydrocarbons burn with a sooty yellow flame. (i) Why do unsaturated hydrocarbons produce a sooty flame during combustion? (ii) What does this tell us about their carbon-to-hydrogen ratio compared to saturated hydrocarbons?

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Model Answer

(i) Unsaturated hydrocarbons have a higher proportion of carbon relative to hydrogen. During combustion, the available oxygen is insufficient to burn all the carbon completely. This results in incomplete combustion, releasing unburnt carbon particles as soot, producing a yellow, smoky flame.

(ii) This shows that unsaturated hydrocarbons have a **higher carbon-to-hydrogen ratio** compared to saturated hydrocarbons. The higher carbon content means more carbon remains unburnt, whereas saturated hydrocarbons, having relatively more hydrogen, burn completely with a clean blue flame.

Source: Chapter 4, Section 4.3.1 Combustion

Explanation

- Examiners expect you to link "sooty flame" directly to **incomplete combustion** and **higher C:H ratio** — these are the two scoring points.
- Part (i) is worth ~2 marks: mention high carbon proportion → insufficient oxygen → incomplete combustion → unburnt carbon = soot.
- Part (ii) is worth ~1 mark: a direct comparative statement about the C:H ratio is enough.
- Never just say "they have double/triple bonds" without connecting it to *why* that causes soot — the examiner wants the combustion logic.

Q17. straightforward | initial-understanding | § 4.3.1 Combustion **[1]**

When a saturated hydrocarbon burns in a limited supply of air, what kind of flame is produced and what deposit forms on a surface held above the flame?

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Model Answer

When a saturated hydrocarbon burns in a limited supply of air, incomplete combustion occurs, producing a **yellow, sooty flame**, and a **black sooty (carbon) deposit** forms on the surface held above it.

Explanation

The key phrase is "limited supply of air" — this causes incomplete combustion even of saturated hydrocarbons (which normally give a clean blue flame). Examiners expect both parts: type of flame (yellow/sooty) and the deposit (soot/carbon). Source: Chapter 4, Section 4.3.1 (Combustion).

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Q18. straightforward | initial-understanding | § 4.3.1 Combustion **[1]**

Which of the following correctly describes why fuels such as coal and petroleum are considered environmental pollutants when burned?

(A) They release only carbon dioxide, which is harmless.

(B) They contain nitrogen and sulphur, whose combustion produces oxides that pollute the air.

(C) They produce water vapour that causes acid rain.

(D) They burn with a clean blue flame that depletes oxygen rapidly.

A They release only carbon dioxide, which is harmless.
B They contain nitrogen and sulphur, whose combustion produces oxides that pollute the air.
C They produce water vapour that causes acid rain.
D They burn with a clean blue flame that depletes oxygen rapidly.

◆ Carbon and its Compounds

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Model Answer

(B) They contain nitrogen and sulphur, whose combustion produces oxides that pollute the air.

Explanation

The textbook explicitly states: *"Fuels such as coal and petroleum have some amount of nitrogen and sulphur in them. Their combustion results in the formation of oxides of sulphur and nitrogen which are major pollutants in the environment."* Options A, C, and D are factually incorrect as per the source. This is a direct recall question — memorise the exact reason.

Source: Chapter 4, Section 4.3.1 (Combustion)

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Q19. medium | initial-understanding | § 4.3.1 Combustion **[3]**

A student burns two different hydrocarbons in air and observes that one produces a clean blue flame while the other produces a sooty, yellow flame. (i) Which type of hydrocarbon — saturated or unsaturated — is more likely to produce each kind of flame? Give a reason for your answer. (ii) Under what condition could even the hydrocarbon that normally burns cleanly begin to produce a sooty flame?

◆ Carbon and its Compounds

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Model Answer

(i)

- **Saturated hydrocarbons** (e.g., alkanes) produce a **clean blue flame** because they have a higher proportion of hydrogen relative to carbon and burn completely in sufficient air.
- **Unsaturated hydrocarbons** (e.g., alkenes, alkynes) produce a **yellow, sooty flame** because they have a higher carbon content and a higher C:H ratio, leading to incomplete combustion and release of unburnt carbon particles (soot).

(ii) Even a saturated hydrocarbon that normally burns cleanly will produce a sooty, yellow flame if the **supply of air (oxygen) is limited**. Insufficient oxygen causes incomplete combustion, depositing unburnt carbon as soot.

Source: Chapter 4, Section 4.3.1 Combustion

Explanation

- The key textbook line is: *"Saturated hydrocarbons will generally give a clean flame while unsaturated carbon compounds will give a yellow flame with lots of black smoke."*
- The reason examiner expects: unsaturated compounds have higher carbon content → incomplete combustion → soot.
- For part (ii), the textbook explicitly states: *"limiting the supply of air results in incomplete combustion of even saturated hydrocarbons giving a sooty flame."* — quote or paraphrase this directly for full marks.
- Avoid writing lengthy chemistry; these two points, stated clearly, earn all 3 marks.

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Q20. medium | initial-understanding | § 4.3.2 Oxidation **[3]**

Ethanol is converted to ethanoic acid using alkaline potassium permanganate. (i) What type of chemical reaction is this? Give one reason to justify your answer. (ii) What is the role of alkaline potassium permanganate in this reaction?

◆ Carbon and its Compounds

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Model Answer

(i) This is an **oxidation reaction**.

Reason: Ethanol (CH_3CH_2OH) is converted to ethanoic acid (CH_3COOH) by the addition of oxygen to the starting material (alcohol). Since oxygen is added, it is an oxidation reaction.

(ii) Alkaline potassium permanganate acts as an **oxidising agent**. It supplies oxygen to ethanol, converting it into ethanoic acid. It is capable of adding oxygen to other substances, hence it is classified as an oxidising agent.

Source: Chapter 4, Section 4.3.2 – Oxidation

Explanation

- **(i)** requires naming the reaction type AND giving a reason — both are needed for full marks. The key point is: addition of oxygen = oxidation.
- **(ii)** The textbook explicitly states $KMnO_4$ is an oxidising agent because it adds oxygen to alcohols to form acids. Use the exact term "oxidising agent" and briefly explain what it does.
- Do not confuse with combustion — this is a *controlled* oxidation producing carboxylic acid, not CO_2 and H_2O.

Q21. straightforward | initial-understanding | § 4.3.3 Addition Reaction **[1]**

What type of compound is formed when hydrogen is added to an unsaturated hydrocarbon? Name one catalyst used for this reaction.

◆ Carbon and its Compounds

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Model Answer

A **saturated hydrocarbon** is formed. One catalyst used is **nickel** (Ni).

Explanation

The examiner expects two points: (1) product type — saturated hydrocarbon, and (2) one catalyst — nickel or palladium. Both fit in one line for 1 mark. Palladium is also acceptable.

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Q22. straightforward | initial-understanding | § 4.3.4 Substitution Reaction **[1]**

Methane reacts with chlorine in the presence of sunlight to form chloromethane (CH_3Cl) and HCl. What type of reaction is this? Give a reason for your answer.

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Model Answer

It is a **substitution reaction** because chlorine replaces one hydrogen atom of methane — one type of atom takes the place of another.

Source: Chapter 4, Section 4.3.4 – Substitution Reaction

Explanation

For a 1-mark question, name the reaction type AND give the reason (what "substitution" means) in one line. Examiners award the mark for correctly identifying it as a substitution reaction with a valid reason. Avoid writing extra details about sunlight or products — that wastes time and adds no marks.

Q23. medium | initial-understanding | § 4.4 SOME IMPORTANT CARBON COMPOUNDS – ETHANOL AND ETHANOIC ACID **[3]**

Ethanol reacts with sodium metal to release hydrogen gas. Based on this observation, what can you say about the O–H bond in ethanol? How is this reaction similar to or different from the reaction of water with sodium?

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Model Answer

O–H bond in ethanol: When ethanol reacts with sodium, hydrogen gas is released, which shows that the O–H bond in ethanol is polar. Sodium displaces hydrogen from the O–H bond, indicating that this bond can be broken, similar to how water reacts with sodium.

$$2Na + 2CH_3CH_2OH \rightarrow 2CH_3CH_2O^-Na^+ + H_2\uparrow$$

Similarity with water: Both ethanol and water have an O–H bond, and both react with sodium to release hydrogen gas.

Difference: Water reacts more vigorously with sodium than ethanol, showing that the O–H bond in water is more reactive (more polar) than in ethanol.

Source: Chapter 4, Section 4.4.1 – Reactions of Ethanol

Explanation

- Examiners expect you to **link the observation (H_2 release) to the conclusion (O–H bond is polar/reactive)** — this is the key inference.
- Write the balanced equation; it earns a mark.
- Clearly state **one similarity and one difference** with water's reaction — the question explicitly asks for both.
- "More vigorous reaction with water" is the standard NCERT-expected difference here.

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Q24. straightforward | initial-understanding | § 4.4.1 Properties of Ethanol **[1]**

When ethanol reacts with sodium metal, what are the two products formed?

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Model Answer

When ethanol reacts with sodium metal, the two products formed are **sodium ethoxide** ($CH_3CH_2O^-Na^+$) and **hydrogen gas** (H_2).

Explanation

The equation from the textbook directly gives both products: `$2Na + 2CH_3CH_2OH \rightarrow 2CH_3CH_2O^-Na^+ + H_2$`. Examiners expect both products named; writing the chemical formula alongside the name is ideal for 1 mark.

Q25. medium | initial-understanding | § 4.4.1 Properties of Ethanol **[2]**

What is the role of concentrated sulphuric acid when ethanol is heated with it at a high temperature? Name the organic product formed and give the name of this type of reaction.

◆ Carbon and its Compounds

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Model Answer

Concentrated sulphuric acid acts as a **dehydrating agent**. It removes water from ethanol when heated at 443 K.

$$CH_3CH_2OH \xrightarrow{\text{Hot Conc. } H_2SO_4} CH_2 = CH_2 + H_2O$$

The organic product formed is **ethene** (an unsaturated hydrocarbon). This type of reaction is called **dehydration**.

Source: Properties of Ethanol, Chapter 4, Section 4.4.1

Explanation

Examiners expect three things here: (1) the role of H_2SO_4 — *dehydrating agent*, (2) the product — *ethene*, and (3) the name of the reaction type — *dehydration*. Writing the equation earns full credit and shows understanding. Note the condition: excess concentrated H_2SO_4 at 443 K (high temperature). Do not confuse this with esterification, where H_2SO_4 acts as a catalyst at lower temperature.

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Q26. medium | initial-understanding | § 4.4.2 Properties of Ethanoic Acid **[2]**

Both ethanoic acid and hydrochloric acid are acids, yet they differ in strength. Explain why ethanoic acid is classified as a weak acid while hydrochloric acid is a strong acid.

◆ Carbon and its Compounds

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Model Answer

Hydrochloric acid (HCl) is a **strong acid** because it **completely ionises** in water, producing a high concentration of H^+ ions.

Ethanoic acid (CH_3COOH) is a **weak acid** because it is a carboxylic acid and **does not completely ionise** in water, producing fewer H^+ ions. Hence, at the same concentration, ethanoic acid has a higher pH than HCl.

Source: Chapter 4, Section 4.4.2 — Properties of Ethanoic Acid

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Explanation

- The key distinction examiners look for is **complete vs. partial/incomplete ionisation**.
- Mentioning that HCl is a mineral acid and CH_3COOH is a carboxylic acid strengthens the answer.
- Referring to pH difference or the universal indicator result (from Activity 4.7) is a good supporting point.
- Avoid writing lengthy definitions — two focused sentences are sufficient for 2 marks.

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Q27. medium | initial-understanding | § 4.4.2 Properties of Ethanoic Acid **[3]**

When ethanoic acid reacts with ethanol in the presence of a few drops of concentrated sulphuric acid, a new compound is formed. (i) Name this type of reaction and identify the product formed. (ii) What happens when this product is treated with sodium hydroxide solution?

◆ Carbon and its Compounds

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Model Answer

(i) This is called an **esterification reaction**. When ethanoic acid reacts with ethanol in the presence of concentrated H_2SO_4 (as acid catalyst), an ester called **ethyl ethanoate ($CH_3COOC_2H_5$)** is formed along with water.

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

Esters are sweet-smelling substances used in perfumes and flavouring agents.

(ii) When ethyl ethanoate is treated with NaOH solution, it is converted back to **ethanol and sodium ethanoate (sodium salt of ethanoic acid)**. This reaction is called **saponification**.

$$CH_3COOC_2H_5 + NaOH \rightarrow C_2H_5OH + CH_3COONa$$

Source: Chapter 4, Section 4.4.2 (Properties of Ethanoic Acid – Esterification Reaction)

Explanation

- **Part (i)** carries ~2 marks: name the reaction (esterification), name the product (ethyl ethanoate), and write the equation. Don't forget to mention the role of H_2SO_4 as a catalyst.
- **Part (ii)** carries ~1 mark: name the reaction (saponification) and state both products. Writing the equation adds precision.
- Examiners specifically look for the term *saponification* — it connects to soap-making and is a key vocabulary word in this chapter.

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Q28. medium | initial-understanding | § 4.5 SOAPS AND DETERGENTS **[3]**

What is a micelle? Describe how the structure of a micelle helps soap to clean oily dirt from clothes.

◆ Carbon and its Compounds

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Model Answer

Micelle: A micelle is a cluster of soap molecules in water where the hydrophobic (hydrocarbon) tails are directed towards the interior and the hydrophilic (ionic) ends face outwards towards water.

Cleaning action:
Soap molecules have two ends — a hydrophilic ionic end that interacts with water, and a hydrophobic carbon-chain end that interacts with oil/grease. When soap is added to oily clothes in water, the hydrophobic tails of soap molecules surround the oily dirt, while the ionic ends face outward into water. This forms a micelle with dirt trapped at its centre. The micelles remain suspended as a colloid (emulsion) and are rinsed away with water, thus cleaning the clothes.

Source: Chapter 4, Section 4.5 Soaps and Detergents

Explanation

- **1 mark** for defining micelle correctly (cluster, hydrophobic inward, hydrophilic outward).
- **2 marks** for explaining the cleaning mechanism: dual nature of soap → surrounds oily dirt → micelle formation → dirt washed away.
- Examiners expect the terms **hydrophilic**, **hydrophobic**, **ionic end**, **hydrocarbon tail**, and **emulsion/colloid** to appear.
- A labelled diagram of micelle formation (if drawn correctly) can substitute for some description, but always write the key steps in words too.

Q29. straightforward | initial-understanding | § 4.5 SOAPS AND DETERGENTS **[1]**

Why does soap fail to produce a good lather and instead form a white curdy precipitate when used with hard water?

◆ Carbon and its Compounds

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Model Answer

Soap reacts with calcium and magnesium salts present in hard water to form insoluble precipitates (scum/curdy white solid), leaving little soap available to form lather.

Source: Chapter 4, Section 4.5 – Soaps and Detergents

Explanation

The key point examiners look for is **two things**: (1) the reaction of soap with Ca^{2+}/Mg^{2+} ions in hard water, and (2) the result — insoluble precipitate forms, reducing lather. At 1 mark, just one crisp sentence covering both points is enough. Avoid writing extra detail about micelles or detergents — that wastes time and marks are not awarded for extra content.

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