



Introduction to Organic Chemistry I

OCR A Chemistry A H432 | Specification-led student notes

[SPEC](#) → [CRACK IT](#) → [WORKED EXAMPLE](#) → [TEST IT](#) → [DONE](#)

SPECIFICATION COVERAGE

Every row below is taught explicitly, modelled in a worked answer and tested independently.

OCR A REF	EXACT COVERAGE IN THIS PACK	TAUGHT / TESTED
4.1.1(a)	Systematic nomenclature; first ten alkanes and corresponding alkyl groups	Sections 9–12 / Tests 9–12
4.1.1(b)	General, structural, displayed and skeletal formulae	Sections 3–5 / Tests 3–5
4.1.1(c)	Homologous series, functional group, alkyl group, R, aliphatic, alicyclic, aromatic, saturated and unsaturated	Sections 1–2, 6–7 / Tests 1–2, 6–7
4.1.1(d)	Use general formulae to predict the formula of a homologous-series member	Section 8 / Test 8
4.1.1(e)	Define structural isomers and determine possible structures from a molecular formula	Section 13 / Test 13
2.1.3(b)	Retrieve molecular and empirical formulae where they support organic representations	Sections 3–5 / Tests 3–5

BOUNDARY This pack teaches the language, representations, recognition, naming and structural isomerism needed at the start of OCR organic chemistry. Reactions, mechanisms, radicals, curly arrows and E/Z isomerism are taught later.

Mapped to OCR A Chemistry A H432, specification version 3.1 (May 2026)

The big picture



YOU WILL MASTER The definitions, formula languages, functional groups, naming rules and isomer skills that every later OCR organic topic assumes.



Understand the structure first. Name it only after the carbon skeleton and functional group are clear.

WHY IT MATTERS A reaction question is only manageable when you can first read the starting structure correctly. One missed carbon, functional group or locant changes the chemistry.

ON EACH TEACHING PAGE	WHAT YOU DO
NOTES	Learn the exact OCR meaning, rule or process.
WORKED EXAMPLE	Follow a complete question and model answer.
TEST IT	Answer a new, explicit question in the space provided.
ANSWERS	Check every response against the complete answers at the end.

OCR A BOUNDARY This pack covers 4.1.1(a–e). It identifies functional groups that appear across OCR A, but their detailed reactions remain in their later units.



✓ **DONE WHEN** You can explain how language, representation, interpretation, naming and isomerism connect.

1. Core organic language: full definitions



SPEC 4.1.1(c) Interpret and use the language of homologous series and functional groups accurately.



CRACK IT These are the definitions, not just topic labels. Learn the exact meaning of each term, then use the example to check that you can recognise it.

TERM	DEFINITION TO LEARN	EXAMPLE / USE
organic chemistry	the branch of chemistry concerned with carbon compounds: their structures, properties and reactions	ethanol and ethene are organic compounds
hydrocarbon	a compound that contains carbon and hydrogen atoms only	propane, C_3H_8
homologous series	a series of organic compounds with the same functional group in which each successive member differs by CH_2	ethene $\rightarrow$ propene adds CH_2
functional group	the atom or group of atoms responsible for the characteristic chemical reactions of an organic compound	$C=C$ in an alkene; $-OH$ in an alcohol
alkyl group	a group with general formula C_nH_{2n+1} , formed by removing one H atom from an alkane	CH_3- is methyl; C_2H_5- is ethyl
R	a symbol used to represent an alkyl group, or the rest of an organic molecule, when its exact identity is not important	$R-OH$ represents an alcohol
carbon skeleton	the framework made by the carbon atoms and the carbon-carbon bonds in an organic molecule	straight, branched or cyclic
heteroatom	an atom in an organic molecule that is not carbon or hydrogen	O in ethanol; Cl in chloroethane

DEFINITIONS State a definition as a complete sentence. Do not answer with an example alone. For homologous series, include both required ideas: same functional group and successive members differing by CH_2 .

WORKED EXAMPLE | Question: Why are ethane, propane and butane members of one homologous series?

SAME SERIES They are all alkanes, so they have the same general formula, C_nH_{2n+2} , and similar chemical properties.

SUCCESSIVE MEMBERS $C_2H_6 \rightarrow C_3H_8 \rightarrow C_4H_{10}$. Each step adds CH_2 .

ANSWER They are successive members of the alkane homologous series: each has the same general formula and similar chemical properties, and each successive member differs by CH_2 .

TEST IT 1



- What is a hydrocarbon? [1]
- What is the OCR definition of a homologous series? [2]
- What is meant by a functional group? [1]
- Why is CH_3- called an alkyl group, and what is its name? [2]

[6 marks]



✓ **DONE WHEN** You can state the definitions and explain how CH_2 links successive homologous-series members.

2. Classifying organic compounds



SPEC 4.1.1(c)(iv–vii) Interpret aliphatic, alicyclic, aromatic, saturated and unsaturated correctly.



CRACK IT Classify the carbon framework first, then decide whether multiple carbon–carbon bonding is present.

TERM	DEFINITION TO LEARN	EXAMPLE
aliphatic	contains carbon and hydrogen joined in straight chains, branched chains or non-aromatic rings	propane, propene, cyclohexane
alicyclic	an aliphatic compound arranged in non-aromatic rings, with or without side chains	cyclohexane
aromatic	contains a benzene ring	benzene, methylbenzene
saturated	contains single carbon–carbon bonds only	propane, cyclohexane
unsaturated	contains multiple carbon–carbon bonds, including C=C, C≡C or aromatic rings	propene, benzene

EXAM TRAP Aliphatic does not mean saturated. Propene is aliphatic and unsaturated. Cyclohexane is alicyclic and saturated.

WORKED EXAMPLE | Question: How should benzene and cyclohexane be classified?

BENZENE Aromatic because it contains a benzene ring; unsaturated in OCR terminology.

CYCLOHEXANE Alicyclic because it is a non-aromatic ring; saturated because it has C–C single bonds only.

ANSWER Benzene is aromatic and unsaturated. Cyclohexane is alicyclic and saturated.



TEST IT 2

- What is meant by aliphatic, alicyclic and aromatic? [3]
- What is the difference between saturated and unsaturated? [2]
- How should propane, propene and cyclohexane each be classified? [3]

[8 marks]



✓ **DONE WHEN** You can classify a structure without treating aliphatic and saturated as synonyms.

3. Six formula languages for one molecule

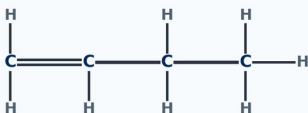


SPEC 4.1.1(b); 2.1.3(b) Interpret general, structural, displayed and skeletal formulae, with molecular and empirical formulae where relevant.



CRACK IT Every representation below uses but-1-ene. The general formula is the rule for the alkene series containing it.

SAME COMPOUND IN EVERY PANEL: BUT-1-ENE

<p>MOLECULAR</p> <p>C₄H₈</p> <p>actual number of each atom</p>	<p>EMPIRICAL</p> <p>CH₂</p> <p>simplest whole-number ratio</p>	<p>GENERAL</p> <p>C_nH_{2n}</p> <p>any acyclic alkene with one C=C</p>
<p>STRUCTURAL</p> <p>CH₂=CHCH₂CH₃</p> <p>minimal detail showing arrangement</p>	<p>DISPLAYED</p>  <p>all atoms and bonds shown</p>	<p>SKELETAL</p>  <p>carbon skeleton; C-H omitted</p>

The general formula is the alkene-series rule; the other five entries describe this one molecule.

TERM	DEFINITION TO LEARN
molecular formula	the actual number of atoms of each element in one molecule
empirical formula	the simplest whole-number ratio of atoms of each element
general formula	the simplest algebraic formula for a member of a homologous series
structural formula	the minimal detail that shows the arrangement of atoms in a molecule
displayed formula	the relative positions of atoms and all the bonds between them
skeletal formula	a simplified formula with H atoms removed from alkyl chains, leaving the carbon skeleton and associated functional groups

WORKED EXAMPLE | Question: But-2-ene is CH₃CH=CHCH₃. What are its molecular, empirical and general formulae?

COUNT The structure contains 4 C atoms and 8 H atoms, so the molecular formula is C₄H₈.

SIMPLIFY Divide 4:8 by 4, so the empirical formula is CH₂.

SERIES It is an alkene with one C=C, so the relevant general formula is C_nH_{2n}.

TEST IT 3



Pent-1-ene is CH₂=CHCH₂CH₂CH₃. What are its molecular formula, empirical formula and homologous-series general formula? [3]

What information does its structural formula show? [1]

What does a skeletal formula omit, and what must it retain? [2]

[6 marks]



✓ **DONE WHEN** You can say exactly what each formula shows and what it leaves out.

4. Converting between formulae



SPEC 4.1.1(b) Interpret and convert between structural, displayed and skeletal formulae without changing the molecule.



CRACK IT Count carbon atoms first. Restore enough H for each carbon to make four bonds. Then check every heteroatom and multiple bond.

CONVERSION PROCESS

- Trace the continuous carbon skeleton and count every line end and corner once.
- Use bond order: single = 1, double = 2 and triple = 3.
- Add enough H to carbon for a total bond order of four.
- Show O, N, halogens and any H attached to a heteroatom.
- Recount the final atoms to prove the formula represents the same molecule.

WORKED EXAMPLE | Question: $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$ is butan-2-ol. What is its molecular formula, and which formula keeps the –OH group visible?

COUNT 4 C; 10 H in total; 1 O.

MOLECULAR FORMULA $\text{C}_4\text{H}_{10}\text{O}$. A molecular formula gives totals, so it does not show which atom bears H.

GROUPED / STRUCTURAL FORM $\text{C}_4\text{H}_9\text{OH}$ or $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$ keeps –OH visible and identifies the compound as an alcohol.



structural formula



skeletal formula



structural formula

TEST IT 4



For A, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$, what is the molecular formula and what is its skeletal formula? [3]

For skeletal structure B, what are the molecular formula and structural formula? [3]

For C, $\text{CH}_3\text{CH}=\text{CHCH}_3$, what are the displayed formula and molecular formula? [4]

DRAWING SPACE FOR TEST 4

[10 marks]



✓ **DONE WHEN** Every conversion preserves atom count, connectivity and carbon valency.

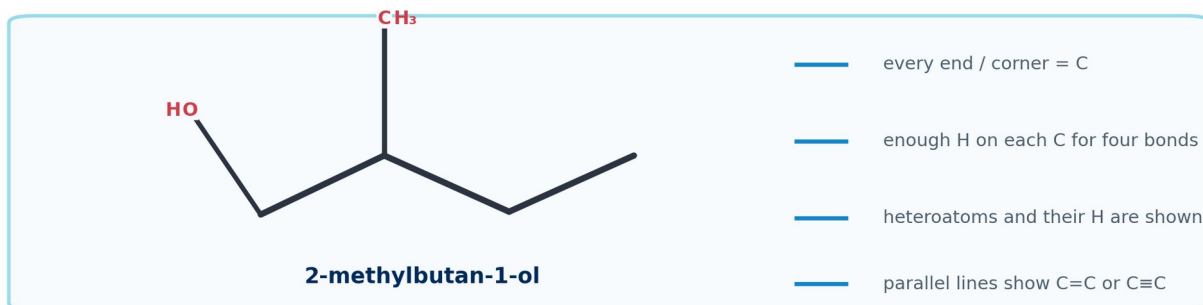
5. Skeletal formulae without guesswork



SPEC 4.1.1(b)(iv) Interpret and construct skeletal formulae using the OCR convention.



CRACK IT Ends and corners are carbon atoms. Hydrogen on carbon is hidden; functional groups are not.



SKELETAL RULES

- Every unlabelled line end and corner represents C.
- Each C has enough omitted H to make four bonds.
- O, N and halogens are written, together with H bonded to O or N.
- Two or three parallel lines show C=C or C≡C, not extra carbon atoms.

WORKED EXAMPLE | Question: A four-carbon skeletal chain has one C=C bond and no ring. What is its molecular formula?

CARBON There are 4 line ends/corners, so $n = 4$.

HYDROGEN An acyclic alkene with one C=C follows C_nH_{2n} .

ANSWER C_4H_8 . The double bond makes it unsaturated.

TEST IT 5



What is the skeletal formula of 2-methylbutan-1-ol? [2]

What is the skeletal formula of pent-2-ene? [2]

An acyclic hydrocarbon has six carbon atoms and one C=C bond. What are its molecular formula and classification? [3]

DRAWING SPACE FOR TEST 5

[7 marks]



✓ **DONE WHEN** You can count hidden C and H atoms and show every functional group correctly.

6. Functional groups: the core set



SPEC 4.1.1(a,c) Recognise a functional group before naming the compound or studying its later reactions.



CRACK IT Read the atoms and bonds, not just the molecular formula. The defining atoms and bonds are highlighted in red.

COMPOUND CLASS	DEFINITION TO LEARN	GENERAL STRUCTURE
alkene	an unsaturated hydrocarbon containing at least one carbon–carbon double bond	$\text{R}-\text{C}=\text{C}-\text{R}'$ H H
haloalkane	a compound in which one or more H atoms of an alkane have been replaced by halogen atoms	$\text{R}-\text{X}$
alcohol	an organic compound containing a hydroxyl group, $-\text{OH}$, bonded to a saturated carbon atom	$\text{R}-\text{O}-\text{H}$
nitrile	an organic compound containing the nitrile group, $-\text{C}\equiv\text{N}$; the nitrile carbon is part of the carbon chain	$\text{R}-\text{C}\equiv\text{N}$
aldehyde	an organic compound containing a terminal carbonyl group in which the carbonyl carbon is bonded to H	$\text{R}-\overset{\text{O}}{\underset{\text{ }}{\text{C}}}-\text{H}$
ketone	an organic compound containing a carbonyl group within a chain; the carbonyl carbon is bonded to two C atoms	$\text{R}-\overset{\text{O}}{\underset{\text{ }}{\text{C}}}-\text{R}'$
carboxylic acid	an organic compound containing the carboxyl functional group	$\text{R}-\overset{\text{O}}{\underset{\text{ }}{\text{C}}}-\text{OH}$
ester	an organic compound containing the ester linkage, with a carbonyl carbon bonded to $-\text{O}-$	$\text{R}-\overset{\text{O}}{\underset{\text{ }}{\text{C}}}-\text{OR}'$

CARBONYL A carbonyl group is $\text{C}=\text{O}$. In an aldehyde it is terminal and the carbonyl carbon is bonded to H. In a ketone it lies within the chain and is bonded to two carbon atoms.

WORKED EXAMPLE | Question: What functional groups are present in $\text{CH}_3\text{CH}_2\text{CHO}$ and CH_3COCH_3 ?

FIRST STRUCTURE $\text{CH}_3\text{CH}_2\text{CHO}$ has terminal $-\text{CHO}$, so it is an aldehyde.

SECOND STRUCTURE CH_3COCH_3 has an internal $>\text{C}=\text{O}$, so it is a ketone.

ANSWER Both contain $\text{C}=\text{O}$, but their different carbonyl positions give different functional groups.



TEST IT 6

What compound class is represented by each formula: $\text{CH}_2=\text{CHCH}_3$, $\text{CH}_3\text{CH}_2\text{Cl}$, $\text{CH}_3\text{CH}_2\text{OH}$, $\text{CH}_3\text{CH}_2\text{C}\equiv\text{N}$, $\text{CH}_3\text{CH}_2\text{CHO}$, CH_3COCH_3 , CH_3COOH and $\text{CH}_3\text{COOCH}_3$? [8]

Which two listed compounds contain a carbonyl group but belong to different homologous series, and why? [3]

[11 marks]



✓ DONE WHEN You identify alkene, haloalkane, alcohol, nitrile, aldehyde, ketone, acid and ester from structure.

7. Functional groups: the complete OCR map



SPEC 4.1.1(a) OCR nomenclature is limited to functional groups encountered across the specification.



CRACK IT Recognise these groups now. The defining atoms and bonds are highlighted in red; their reactions remain in later OCR units.

COMPOUND CLASS	DEFINITION TO LEARN	GENERAL STRUCTURE
arene	an aromatic compound containing at least one benzene ring	
phenol	an organic compound in which an –OH group is bonded directly to a benzene ring	
acyl chloride	a carboxylic-acid derivative containing an acyl group bonded to chlorine	
acid anhydride	a carboxylic-acid derivative containing two acyl groups joined by an oxygen atom	
amine	an organic derivative of ammonia in which one or more H atoms are replaced by organic groups	
amide	an organic compound in which N is bonded directly to a carbonyl carbon	
amino acid	an organic compound containing both an amino group and a carboxylic-acid group	
nitro compound	an organic compound containing a nitro group bonded to carbon	

KEY DISTINCTIONS An amide has N directly beside C=O; an amine does not. An alcohol has –OH on an aliphatic carbon; phenol has –OH directly on a benzene ring.

WORKED EXAMPLE | Question: What groups are present in $\text{H}_2\text{NCH}_2\text{COOH}$, and why is CH_3CONH_2 not an amine?

AMINO ACID $\text{H}_2\text{NCH}_2\text{COOH}$ contains $-\text{NH}_2$ and $-\text{COOH}$, so it is an amino acid.

AMIDE In CH_3CONH_2 , N is bonded directly to a carbonyl carbon.

ANSWER CH_3CONH_2 is an amide, not an amine; $\text{H}_2\text{NCH}_2\text{COOH}$ contains amine and carboxylic-acid groups.



TEST IT 7

What class is represented by each formula: C_6H_6 , $\text{C}_6\text{H}_5\text{OH}$, CH_3COCl , $(\text{CH}_3\text{CO})_2\text{O}$, CH_3NH_2 , CH_3CONH_2 , $\text{H}_2\text{NCH}_2\text{COOH}$ and $\text{C}_6\text{H}_5\text{NO}_2$? [8]

Why is $\text{C}_6\text{H}_5\text{OH}$ a phenol rather than an alcohol? [2]

What is the structural difference between an amine and an amide? [2]

[12 marks]



✓ DONE WHEN You recognise arenes, phenols, acyl chlorides, anhydrides, amines, amides, amino acids and nitro compounds.

8. General formulae and homologous series



SPEC 4.1.1(c–d) Use the general formula of a homologous series to predict the formula of any member.



CRACK IT A general formula works only when the structural conditions stated for that series are satisfied.

SERIES	GENERAL FORMULA	CONDITION
alkanes	C_nH_{2n+2}	acyclic and saturated
alkenes	C_nH_{2n}	acyclic with one $C=C$
haloalkanes	$C_nH_{2n+1}X$	acyclic, saturated and one halogen
alcohols	$C_nH_{2n+2}O$	acyclic, saturated and one $-OH$
aldehydes / ketones	$C_nH_{2n}O$	acyclic, saturated and one $C=O$
carboxylic acids / esters	$C_nH_{2n}O_2$	acyclic, saturated and one acid or ester group
nitriles	$C_nH_{2n-1}N$	acyclic saturated chain plus one $C\equiv N$; n includes nitrile C
primary amines	$C_nH_{2n+3}N$	acyclic, saturated and one $-NH_2$

WORKED EXAMPLE | Question: What are the formulae of a six-carbon alkene and a four-carbon alcohol?

ALKENE $n = 6$ in C_nH_{2n} gives C_6H_{12} .

ALCOHOL $n = 4$ in $C_nH_{2n+2}O$ gives the molecular formula $C_4H_{10}O$.

SHOW THE GROUP C_4H_9OH is a useful grouped form because it keeps $-OH$ visible; the strict molecular formula is $C_4H_{10}O$.

TEST IT 8



What is the molecular formula of a seven-carbon alkane? [1]

What are the molecular formula and grouped $-OH$ form of a five-carbon alcohol? [2]

What is the formula of a five-carbon nitrile? [1]

Why does C_4H_8 alone not prove that a compound is an alkene? [2]

[6 marks]



✓ **DONE WHEN** You substitute n correctly and state the structural condition before trusting the result.

9. Carbon-chain roots and naming vocabulary



SPEC 4.1.1(a) Recall the first ten alkanes and their corresponding alkyl groups.



CRACK IT The carbon count selects the root. Removing one H changes an alkane ending from –ane to the alkyl ending –yl.

C ATOMS	ALKANE	ALKYL GROUP
1	methane	methyl
2	ethane	ethyl
3	propane	propyl
4	butane	butyl
5	pentane	pentyl
6	hexane	hexyl
7	heptane	heptyl
8	octane	octyl
9	nonane	nonyl
10	decane	decyl

NAMING TERM	DEFINITION TO LEARN
systematic name	an unambiguous name constructed using an agreed set of naming rules
parent chain	the carbon chain used as the basis of the name; it must contain the principal functional group and relevant multiple bond
substituent	an atom or group attached to the parent chain in place of a hydrogen atom
locant	a number showing the position of a substituent, multiple bond or functional group
prefix	the part placed before the parent name to identify a substituent or secondary functional group
suffix	the ending of a name that identifies the principal functional group or homologous series
IUPAC	the International Union of Pure and Applied Chemistry, which develops systematic chemical naming rules

WORKED EXAMPLE | Question: What are the names and formulae of the five-carbon alkane and its alkyl group?

ALKANE Five carbons gives the root pent-. The alkane is pentane, C_5H_{12} .

REMOVE H Removing one H gives $C_5H_{11}-$.

ANSWER Pentane is C_5H_{12} ; the corresponding alkyl group is pentyl, $C_5H_{11}-$.

TEST IT 9



What are the alkane and alkyl-group names for chains containing 3, 5, 7, 9 and 10 carbon atoms? [5]

What is the formula of a saturated seven-carbon alkyl group? [1]

What can R represent in an organic formula? [2]

[8 marks]



✓ **DONE WHEN** You recall meth- to dec- and change –ane to –yl correctly.

10. Naming branched compounds

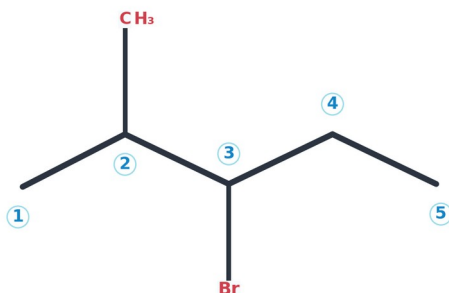


SPEC 4.1.1(a) Apply IUPAC rules systematically and use locants that make the structure unambiguous.



CRACK IT Use the same process every time: longest chain → substituents → numbering → alphabetise → punctuation.

3-bromo-2-methylpentane



- 1 longest chain = 5 → pentane
- 2 lowest set of locants = 2,3
- 3 substituents: bromo + methyl
- 4 alphabetise: bromo before methyl
- 5 assemble punctuation exactly

EXAMINER TIP Use commas between numbers and hyphens between numbers and words. Alphabetise different prefixes, but ignore di-, tri- and tetra- when deciding that order.

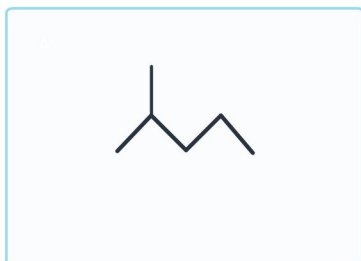
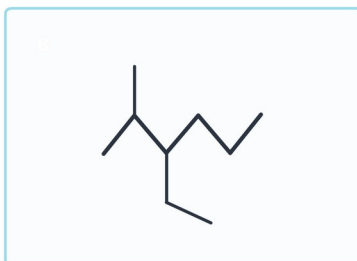
WORKED EXAMPLE | Question: What is the systematic name of $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{Br})\text{CH}_2\text{CH}_3$?

PARENT The longest chain contains five carbons: pentane.

NUMBER Numbering from the left gives locants 2 and 3, lower than 3 and 4.

ASSEMBLE Bromo is written before methyl alphabetically.

ANSWER 3-bromo-2-methylpentane.



TEST IT 10



What are the systematic names of structures A, B and C? [7]

For structure B, why is the parent chain numbered from the chosen end, and how does alphabetical order affect the name? [3]

[10 marks]



✓ **DONE WHEN** Your name identifies one structure only, with the correct chain, locants, order and punctuation.

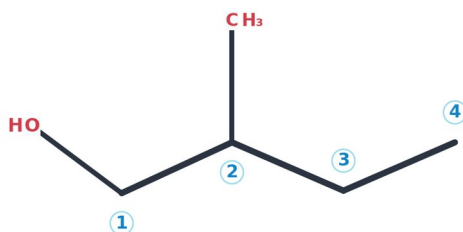
11. Naming compounds with functional groups



SPEC 4.1.1(a) Apply systematic nomenclature to functional groups encountered in the OCR specification.



CRACK IT Choose a parent containing the suffix group. Give that group the lowest permitted locant before numbering branches.



2-methylbutan-1-ol

SUFFIX FIRST

the -OH carbon
must be C1

then locate
the methyl group

GROUP	NAME FORM	EXAMPLE
C=C	-ene	pent-2-ene
-OH	-ol	butan-2-ol
-CHO	-al; carbonyl carbon is C1	propanal
>C=O	-one	butan-2-one
-COOH	-oic acid; acid carbon is C1	propanoic acid
-C≡N	-nitrile; nitrile carbon is in chain	propanenitrile
-COO-	alkyl alkanoate	ethyl ethanoate
-NH ₂	-amine	ethanamine
-CONH ₂	-amide	ethanamide

WORKED EXAMPLE | Question: What is the systematic name of CH₃CH(CH₃)CH₂OH?

PARENT The longest chain containing -OH has three carbons: propan-.

NUMBER Number from -OH, so it is propan-1-ol and the methyl group is on C2.

ANSWER 2-methylpropan-1-ol.



TEST IT 11

What are the systematic names of CH₃CH₂CHO, CH₃COCH₂CH₃, CH₃CH₂C≡N, CH₃COOCH₂CH₃, CH₃CH₂NH₂ and CH₃CONH₂? [6]

Why is the carbon of -CHO, -COOH or -C≡N included as carbon 1 of the parent chain? [2]

[8 marks]



✓ **DONE WHEN** You let the suffix group control the parent chain and numbering.

12. From structure to name, and name to structure



SPEC 4.1.1(a–b) Translate accurately in both directions between systematic names and organic structures.



CRACK IT Naming reads the structure. Drawing reverses the process: parent → functional group → multiple bond → branches → valency check.

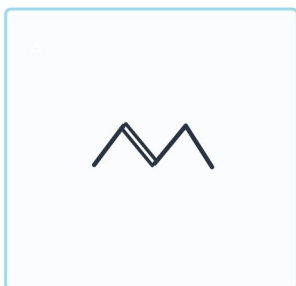
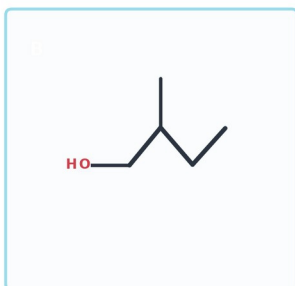
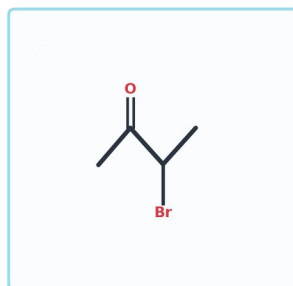
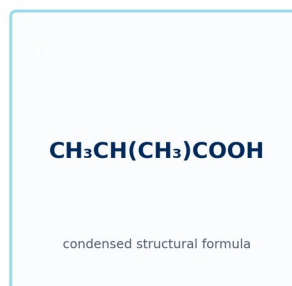
WORKED EXAMPLE | Question: What structural formula represents 2-bromobutan-1-ol?

PARENT Draw a four-carbon chain for butan-.

SUFFIX Place –OH on C1.

PREFIX Place Br on C2.

ANSWER HOCH₂CH(Br)CH₂CH₃, equivalently CH₃CH₂CH(Br)CH₂OH when read from the other end.



TEST IT 12



What are the systematic names of structures A, B, C and D? [4]

What is the skeletal formula of 3-methylpentane? [1]

What is the skeletal formula of 2-bromobutan-1-ol? [1]

What is the skeletal formula of pent-2-ene? [1]

What displayed or structural formula represents ethyl ethanoate? [1]

DRAWING SPACE FOR TEST 12

[8 marks]

FINAL CHECK Count the parent-chain carbons, confirm every locant and make sure every carbon has a total bond order of four.



✓ **DONE WHEN** You can name a structure and reconstruct the same structure from its name.

13. Structural isomerism

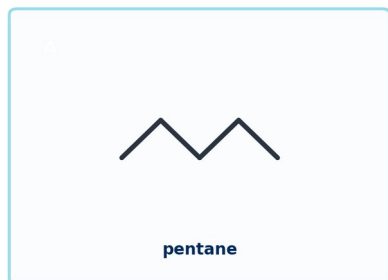
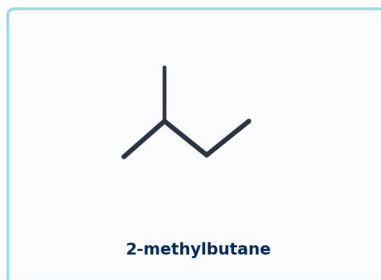


SPEC 4.1.1(e) Explain structural isomers and determine possible structural formulae from a molecular formula.



CRACK IT Same molecular formula is essential. Different connectivity is what makes the structures different.

DEFINITION TO LEARN Structural isomers are compounds with the same molecular formula but different structural formulae.



All three have molecular formula C_5H_{12} but different structural formulae.

SYSTEMATIC ISOMER PROCESS

- Draw the longest possible carbon chain first.
- Shorten the parent by one carbon and move the branch only through unique positions.
- Increase branching only after simpler skeletons are exhausted.
- Name every candidate; identical names reveal duplicates.
- Recount atoms to confirm the molecular formula has not changed.

WORKED EXAMPLE | Question: Are propanal, CH_3CH_2CHO , and propanone, CH_3COCH_3 , structural isomers?

MOLECULAR FORMULAE Both contain C_3H_6O .

CONNECTIVITY Propanal has terminal $-CHO$; propanone has an internal carbonyl group.

ANSWER Yes. They have the same molecular formula but different structural formulae.



TEST IT 13

What is the definition of structural isomers? [2]

What are all the structural isomers of C_6H_{14} ? Draw and name each one. [10]

Are butan-1-ol and ethoxyethane structural isomers? Justify your answer using formulae and connectivity. [3]

DRAWING SPACE FOR TEST 13

[15 marks]



✓ DONE WHEN You can generate unique isomers systematically and prove why each pair is or is not isomeric.

14. Mixed mastery



SPEC 4.1.1(a–e) Combine representation, functional-group recognition, nomenclature and structural isomerism.



CRACK IT Do not guess the name first. Trace the parent, identify the suffix group, number it, then count atoms.

WORKED EXAMPLE | Question: What are the systematic name and molecular formula of $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{OH}$?

PARENT The longest chain containing —OH has four carbons.

NUMBER Number from —OH : butan-1-ol; two methyl groups are on C2.

NAME 2,2-dimethylbutan-1-ol.

FORMULA $\text{C}_6\text{H}_{14}\text{O}$. Grouped form $\text{C}_6\text{H}_{13}\text{OH}$ keeps —OH visible.

COMMON LOST MARKS Wrong parent chain; numbering from the nearest branch instead of the suffix group; missing commas or hyphens; a carbon with five bonds; counting a double bond as another carbon.

TEST IT 14



For $\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{OH}$, what are the systematic name and molecular formula? [3]

What are both structural isomers of C_4H_{10} ? Draw and name them. [4]

But-1-ene and cyclobutane both have molecular formula C_4H_8 . Why do they belong to different homologous series? [4]

What functional group and systematic name are present in $\text{CH}_3\text{CH}_2\text{COOCH}_3$? [2]

DRAWING SPACE FOR TEST 14(b)

[13 marks]

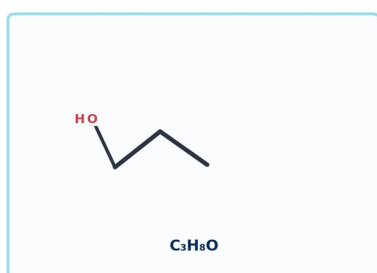
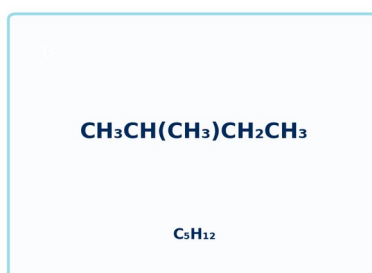
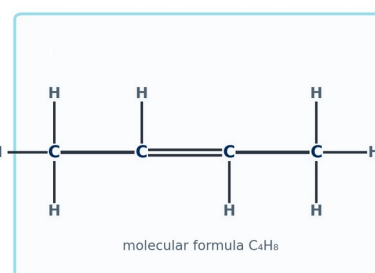


✓ **DONE WHEN** You can complete a mixed OCR question without being told which rule to use.

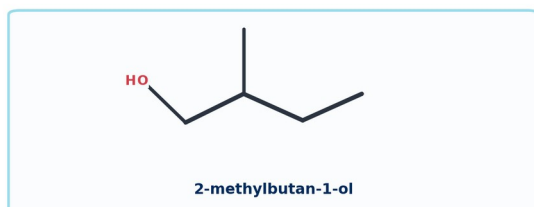
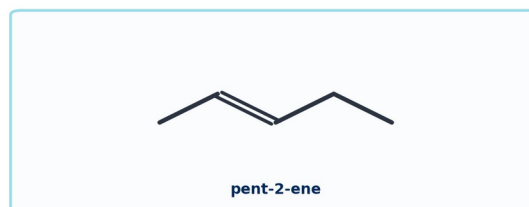
TEST IT answers

HOW TO USE THESE ANSWERS Check the chemical idea first, then spelling, locants, punctuation, atom count and carbon valency. Redraw any structure that is ambiguous.

TEST	COMPLETE ANSWER	MARKS
1	(a) A compound containing carbon and hydrogen only. (b) A series of organic compounds having the same functional group, with each successive member differing by CH_2 . (c) A group of atoms responsible for characteristic reactions. (d) CH_3- is methyl; it is methane minus H and fits $\text{C}_n\text{H}_{2n+1}$.	6
2	(a) Aliphatic: straight, branched or non-aromatic-ring carbon/hydrogen framework; alicyclic: aliphatic non-aromatic ring; aromatic: contains a benzene ring. (b) Saturated has C–C single bonds only; unsaturated contains multiple C–C bonding. (c) Propane aliphatic and saturated; propene aliphatic and unsaturated; cyclohexane alicyclic and saturated.	8
3	Pent-1-ene: molecular C_5H_{10} ; empirical CH_2 ; general C_nH_{2n} . Structural formula shows atom arrangement. Skeletal formula omits C symbols and H bonded to C but retains the carbon skeleton, multiple bonds, heteroatoms and functional groups.	6
4	A: $\text{C}_3\text{H}_8\text{O}$ plus the propan-1-ol skeletal formula. B: C_5H_{12} and $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$. C: displayed but-2-ene and C_4H_8 . Model drawings are below.	10



TEST	COMPLETE ANSWER	MARKS
5	Model drawings are below. Six-carbon acyclic alkene: C_6H_{12} and unsaturated because it contains $\text{C}=\text{C}$.	7



TEST 5 | Model skeletal formulae

TEST IT answers

TEST	COMPLETE ANSWER	MARKS
6	Alkene; haloalkane; alcohol; nitrile; aldehyde; ketone; carboxylic acid; ester. $\text{CH}_3\text{CH}_2\text{CHO}$ and CH_3COCH_3 both contain $\text{C}=\text{O}$. The first has terminal $-\text{CHO}$; the second has an internal carbonyl carbon bonded to two carbons.	11
7	Arene; phenol; acyl chloride; acid anhydride; amine; amide; amino acid; nitro compound. $\text{C}_6\text{H}_5\text{OH}$ is phenol because $-\text{OH}$ is bonded directly to a benzene ring. In an amide, N is bonded directly to a carbonyl carbon; an amine lacks that adjacent $\text{C}=\text{O}$.	12
8	C_7H_{16} . Five-carbon alcohol: $\text{C}_5\text{H}_{12}\text{O}$; grouped $\text{C}_5\text{H}_{11}\text{OH}$. Five-carbon nitrile: $\text{C}_5\text{H}_9\text{N}$. C_4H_8 may be an alkene or a cycloalkane, so a structure or stated condition is needed.	6
9	3 propane/propyl; 5 pentane/pentyl; 7 heptane/heptyl; 9 nonane/nonyl; 10 decane/decyl. Seven-carbon alkyl group $\text{C}_7\text{H}_{15}-$. R can represent an alkyl group or another unchanged organic fragment.	8
10	A 2-methylpentane. B 3-ethyl-2-methylhexane; locants 2,3 are lower than 4,5 and ethyl comes before methyl alphabetically. C 2,2-dimethylbutane.	10
11	Propanal; butan-2-one; propanenitrile; ethyl ethanoate; ethanamine; ethanamide. In $-\text{CHO}$, $-\text{COOH}$ and $-\text{C}\equiv\text{N}$, that functional-group carbon is part of the parent carbon skeleton and is numbered C1.	8

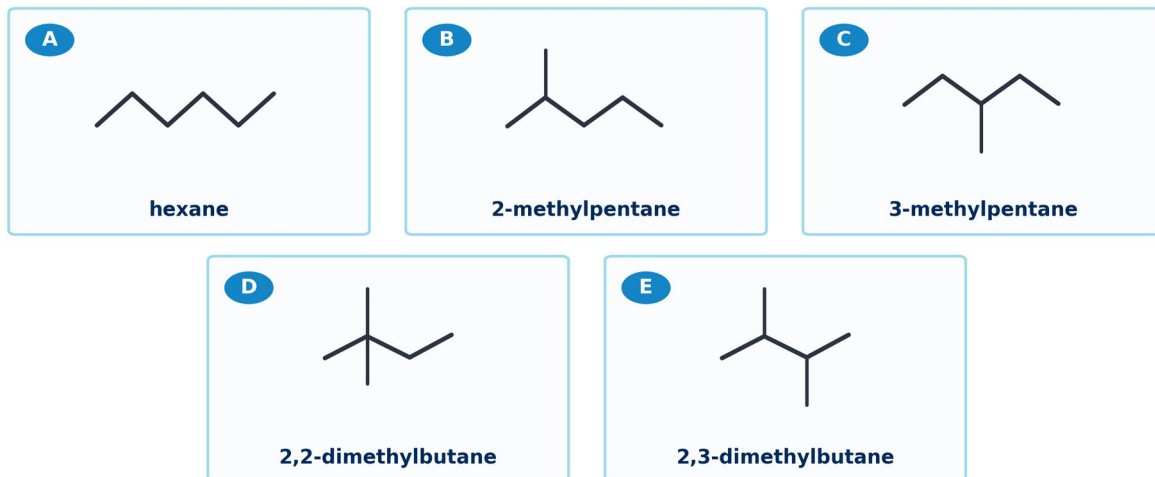
TEST	COMPLETE ANSWER	MARKS
12	A pent-2-ene; B 2-methylbutan-1-ol; C 3-bromobutan-2-one; D 2-methylpropanoic acid. Model drawings for the requested structures are below.	8



SELF-CHECK If a name is wrong, diagnose the exact stage: parent, suffix, numbering, alphabetical order or punctuation.

TEST IT answers

TEST	COMPLETE ANSWER	MARKS
13	Structural isomers have the same molecular formula but different structural formulae. C_6H_{14} gives hexane, 2-methylpentane, 3-methylpentane, 2,2-dimethylbutane and 2,3-dimethylbutane. Butan-1-ol and ethoxyethane both have $C_4H_{10}O$ but different connectivity, so they are structural isomers.	15



All five have molecular formula C_6H_{14} but different structural formulae.

TEST	COMPLETE ANSWER	MARKS
14	(a) 2,2-dimethylbutan-1-ol; $C_6H_{14}O$. (b) Butane and 2-methylpropane; model drawings below. (c) But-1-ene has $C=C$ and is an alkene; cyclobutane is a saturated non-aromatic ring and is a cycloalkane. (d) Ester; methyl propanoate.	13



TEST 14 | Both structural isomers of C_4H_{10}

Final mastery checklist

- ☐ I can state every introductory OCR organic definition and meaning explicitly.
- ☐ I can distinguish molecular, empirical, general, structural, displayed and skeletal formulae.
- ☐ I can convert between formula representations without changing atom count or connectivity.
- ☐ I can recognise every functional group or compound class encountered across OCR A.
- ☐ I can use a general formula only when its structural conditions are satisfied.
- ☐ I can recall the first ten alkanes and corresponding alkyl groups.
- ☐ I can name and draw branched and functionalised compounds with correct locants and punctuation.
- ☐ I can define and generate structural isomers without duplicates.

Mastery map

AREA	TESTS	MARKS
Organic language and classification	1–2	14
Formula languages and conversion	3–5	23
Functional groups and general formulae	6–8	29
Roots and nomenclature	9–12	34
Structural isomerism and mixed mastery	13–14	28
TOTAL	1–14	128

OCR A SCOPE CHECK Covered in full: 4.1.1(a–e), with molecular and empirical formula retrieval from 2.1.3(b). Held back: reaction chemistry, mechanisms, radicals, curly arrows and E/Z stereoisomerism.



READY Reattempt the lowest-scoring Test It section without looking at the notes, then mark it again.