



Introduction to Organic Chemistry II

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(f)(i)	Homolytic fission: one electron from the bonding pair to each atom	Section 1 / Test 1
4.1.1(f)(ii)	Heterolytic fission: both bonding electrons to one atom	Section 1 / Test 1
4.1.1(g)	Radical definition, dot notation and radical equations	Section 2 / Test 2
4.1.1(h)	Curly arrows as movement of an electron pair; bond fission and bond formation	Section 3 / Test 3
4.1.1(i)	Mechanism diagrams with correct arrow origins, destinations and relevant dipoles	Sections 4–5 / Tests 4–5
4.1.3(c)	Stereoisomers, E/Z isomerism, cis–trans as a special case and CIP priorities	Sections 6–10 / Tests 6–10
4.1.3(d)	Determine and draw possible E/Z or cis–trans stereoisomers	Sections 7, 9–12 / Tests 7, 9–12

BOUNDARY This pack teaches the language and notation of mechanisms, bond fission, radicals and alkene stereoisomerism. Detailed reactions of alkanes, alkenes, haloalkanes, alcohols and other families remain in their own later units.

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

The big picture



YOU WILL MASTER How bonds split, where electron pairs move, how mechanisms are drawn and how E/Z stereoisomers are identified and constructed.

BREAK BONDS
homolytic · heterolytic

TRACK ELECTRONS
radical dots · pairs

DRAW MECHANISMS
arrows · dipoles

TEST E/Z
two groups on each C

APPLY CIP
rank · compare · label

Follow the electrons first. Name the outcome only after the arrows and structures are correct.

WHY IT MATTERS Mechanism marks are awarded for precise electron movement, not for a roughly correct-looking arrow. E/Z marks depend on checking eligibility and applying priority rules, not on visual size or guesswork.

ON EACH TEACHING PAGE	WHAT YOU DO
NOTES	Learn the exact OCR definition, convention, rule or process.
WORKED EXAMPLE	Follow a complete question and model answer.
TEST IT	Answer a fresh, standalone question in the space provided.
ANSWERS	Check every electron, charge, priority and label at the end.

OCR A BOUNDARY This pack covers 4.1.1(f–i) and 4.1.3(c–d). It uses generic examples to teach mechanism notation. Named reaction conditions, full family-specific mechanisms and alkene bonding or reaction chemistry are taught later.



✓ **DONE WHEN** You can connect bond breaking, electron movement, mechanism notation and stereochemical labels without importing later-topic chemistry.

1. Covalent bond fission



SPEC 4.1.1(f) Explain homolytic and heterolytic fission in terms of where the two bonding electrons go.



CRACK IT Count the two electrons in the bond. Homolytic means one to each atom; heterolytic means both to one atom.

TYPE	WHAT HAPPENS TO THE BONDING PAIR	TYPICAL PRODUCTS
homolytic fission	each bonded atom receives one electron from the pair	two radicals
heterolytic fission	one bonded atom receives both electrons from the pair	two ions

HOMOLYTIC FISSION



one bonding electron to each atom

HETEROLYTIC FISSION



both bonding electrons to Br

The products are decided by electron movement, not by the number of atoms.

WORKED EXAMPLE | Question: Show the heterolytic fission of H-Br.

DIPOLE $\text{H}\delta^+-\text{Br}\delta^-$ because Br attracts the bonding pair more strongly.

ARROW Start at the H-Br bond and finish on Br, the atom receiving both electrons.

PRODUCTS $\text{H}^+ + \text{Br}^-$. Atom count and overall charge are conserved.



TEST IT 1

- Define homolytic fission in terms of electrons. [2]
- Define heterolytic fission in terms of electrons. [2]
- Write the products of homolytic fission of Cl-Cl, using radical dots. [2]
- Write the products of heterolytic fission of H-Br and state which atom receives the pair. [2]

[8 marks]



✓ **DONE WHEN** You can predict radicals or ions by accounting for both electrons in the broken bond.

2. Radicals and radical equations



SPEC 4.1.1(g) Define a radical, use dots for single unpaired electrons and represent radical mechanisms as sequences of equations.



CRACK IT A radical dot belongs to the species that contains the unpaired electron. Track it through every equation.

DEFINITION TO LEARN A radical is a species with an unpaired electron.

RADICAL DOT



one dot = one unpaired electron

A RADICAL MECHANISM IS WRITTEN AS EQUATIONS



This is a notation preview only. The full radical substitution mechanism and its limitations are taught in Alkanes.

OCR RADICAL RULES

DOT REQUIRED Use $\cdot$ every time a species has one unpaired electron, including $\text{Cl}\cdot$ and $\text{CH}_3\cdot$.

EQUATIONS A radical mechanism is shown as a sequence of balanced equations, not with full curly arrows.

OCR DETAIL Dots are not required for species treated as diradicals, such as O , in this specification.

WORKED EXAMPLE | Question: What happens to the radical in $\text{Cl}\cdot + \text{CH}_4 \rightarrow \text{HCl} + \text{CH}_3\cdot$?

START $\text{Cl}\cdot$ contains the unpaired electron on the reactant side.

END $\text{CH}_3\cdot$ contains the unpaired electron on the product side.

CHECK Both sides contain one radical species and the atoms are balanced.



TEST IT 2

- Define a radical. [1]
- Add every required radical dot to: $\text{Cl}_2 \rightarrow 2\text{Cl}$ and $\text{Cl} + \text{CH}_4 \rightarrow \text{HCl} + \text{CH}_3$. [3]
- Identify the radical consumed and the radical formed in the second equation. [2]
- State how OCR represents a radical mechanism and why each radical dot matters. [2]

[8 marks]



✓ DONE WHEN Every species with one unpaired electron carries one visible dot in every radical equation.

3. Curly arrows track electron pairs



SPEC 4.1.1(h) Describe a curly arrow as movement of an electron pair and use it for heterolytic fission or covalent-bond formation.



CRACK IT The tail identifies the electron source. The arrowhead identifies the destination of that pair.

DEFINITION TO LEARN A curly arrow describes the movement of an electron pair.

LONE PAIR



start between the two dots

DOUBLE BOND



start at the double bond

SINGLE BOND



start at the bond that breaks

THE ARROW STARTS AT	THE ARROW ENDS AT	MEANING
midway between the lone-pair dots	an electron-deficient atom or new-bond position	a covalent bond forms
the middle of a double bond	an electron-deficient atom or new-bond position	one bonding pair forms a new bond
the middle of a single bond	the atom receiving both electrons	heterolytic fission occurs

EXAM TRAP A curly arrow does not show an atom, ion or charge moving. It shows where one electron pair moves. OCR does not require half-curly arrows.

WORKED EXAMPLE | Question: Where should the arrow be placed when a C–Br bond breaks heterolytically?

START At the centre of the C–Br bond, because that bond contains the moving pair.

END On Br, because Br receives both electrons and forms Br[−].



TEST IT 3

- State the meaning of a curly arrow. [1]
- Name the three electron-pair sources illustrated above. [3]
- For heterolytic C–Br fission, state exactly where the arrow starts and finishes. [2]
- Explain why an arrow beginning in empty space cannot gain the mechanism mark. [1]

[7 marks]



✓ DONE WHEN Every full curly arrow begins on a real electron pair and finishes at its chemically correct destination.

4. Building a mechanism diagram



SPEC 4.1.1(i) Use diagrams to show electron-pair movement with curly arrows and relevant dipoles.

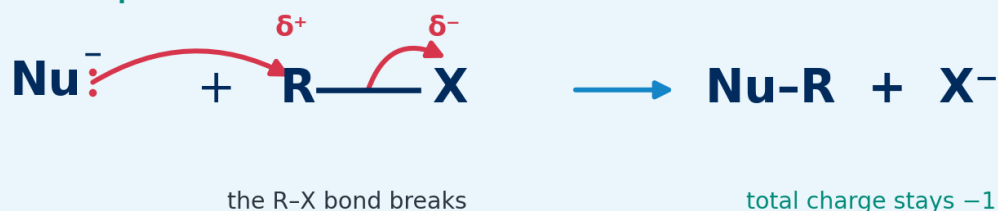


CRACK IT Annotate the reactants first: lone pairs, charges and relevant δ^+/δ^- symbols must be present before arrows are added.

THE FIVE-STAGE METHOD

- 1 MARK POLARITY** Add relevant δ^+ and δ^- symbols close to the correct atoms.
- 2 FIND THE PAIR** Locate the lone pair or bonding pair that supplies the electrons.
- 3 DRAW THE ARROW** Start between the lone-pair dots, touching neither, or at the bond centre; finish at the atom or new-bond position.
- 4 BREAK IF NEEDED** If a bond breaks heterolytically, move its pair to the atom that receives it.
- 5 AUDIT PRODUCTS** Check atom count, total charge, valency and every lone pair or ion shown.

electron-pair donor



Generic notation model: Nu is an electron-pair donor, R is an organic group and X receives the R-X bonding pair.

WORKED EXAMPLE | Question: Explain the two arrows in the model mechanism.

ARROW 1 The Nu⁻ lone pair moves to δ^+ R and forms a Nu-R bond.

ARROW 2 The R-X bonding pair moves to X, so the R-X bond breaks heterolytically and X⁻ forms.

TEST IT 4

Complete the mechanism model below.

(a) Draw both curly arrows from their exact starting points. [2]

(b) Add any relevant dipoles. [2]

(c) Draw the two products and confirm the overall charge. [3]



electron-pair donor



[7 marks]



✓ DONE WHEN Your mechanism conserves atoms and charge, and every arrow can be traced back to a specific electron pair.

5. The mechanism marking audit



SPEC 4.1.1(h-i) Draw mechanisms with precise electron-pair movement, correct structures and relevant dipoles.



CRACK IT A chemically sensible product cannot rescue a badly placed curly arrow. Audit the diagram one mark at a time.

COMMON ERROR	WHY IT LOSES THE MARK	EXACT FIX
arrow begins away from the lone pair	the electron source is not identified	start midway between the dots, touching neither
bond-breaking arrow begins on an atom	the moving pair came from the bond	start at the centre of the bond
arrowhead points to the wrong atom	electrons are delivered to the wrong species	finish on the atom receiving the pair
relevant dipoles are missing	the electron-deficient site is not shown	place δ^+ and δ^- close to the correct atoms
product valency or charge is wrong	the electron bookkeeping is inconsistent	recount bonds and total charge

A



electron pair forms a bond

B



arrow starts in empty space

C



bond pair moves to Br

The diagrams are deliberately different. Judge the exact origin and destination of each arrow.

WORKED EXAMPLE | Question: Why is panel B invalid?

ERROR The arrow tail begins in empty space, so no electron pair is identified.

FIX Move the tail midway between the lone-pair dots beside Nu^- , touching neither dot; keep the arrowhead at C^+ .

TEST IT 5

For panels A–C above:

- Identify the two panels whose arrow origins are valid. [2]
- Explain the electron movement shown in each valid panel. [2]
- Identify and correct the precise error in the remaining panel. [2]
- State one final product check that should follow every mechanism. [1]



[7 marks]



✓ **DONE WHEN** You check arrow origin, arrow destination, dipoles, valency and charge before accepting a mechanism.

6. From structural isomerism to stereoisomerism



SPEC 4.1.3(c)(i) Explain stereoisomers and E/Z isomerism in terms of arrangement in space and restricted rotation around C=C.



CRACK IT Compare compounds with the same molecular formula. Structural isomers have different structural formulae; stereoisomers have the same structural formula but a different arrangement in space.

TYPE	SAME	DIFFERENT
structural isomers	molecular formula	structural formula
stereoisomers	structural formula	arrangement of atoms in space

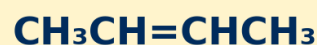
DEFINITION TO LEARN Stereoisomers are compounds with the same structural formula but with a different arrangement in space.

STRUCTURAL ISOMERS



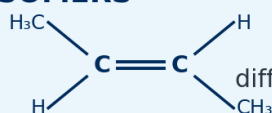
but-1-ene

same molecular formula
different structural formulae



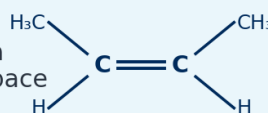
but-2-ene

STEREISOMERS



E-but-2-ene

same structural formula
different arrangement in space



Z-but-2-ene

WHY E/Z EXISTS The C=C bond has restricted rotation. If each carbon of the double bond carries two different groups, two arrangements can be locked in place. The detailed σ/π bonding model is taught in Alkenes.

WORKED EXAMPLE | Question: Why are E-but-2-ene and Z-but-2-ene stereoisomers?

SAME They have the same structural formula, $\text{CH}_3\text{CH}=\text{CHCH}_3$.

DIFFERENT Their groups have different arrangements in space around the C=C bond.



TEST IT 6

- Define stereoisomers. [2]
- Explain why an E/Z pair is not a pair of structural isomers. [2]
- State the two features of a C=C bond that allow E/Z isomerism. [2]
- Classify but-1-ene/but-2-ene and E-/Z-but-2-ene as structural isomers or stereoisomers. [2]

[8 marks]



✓ **DONE WHEN** You distinguish different structural formulae from the same structural formula with different arrangements in space.

7. Does an alkene show E/Z isomerism?



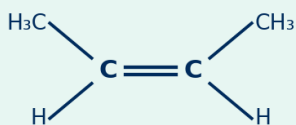
SPEC 4.1.3(c)(i), (d) Apply the structural requirement for E/Z isomerism and determine whether stereoisomers are possible.



CRACK IT Inspect the two alkene carbons separately. Each one must have two different attached groups.

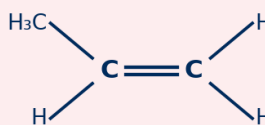
THE NON-NEGOTIABLE TEST E/Z isomerism is possible only when two different groups are attached to each carbon atom of the C=C group.

E/Z POSSIBLE



two different groups on each C

NO E/Z



one C has two identical H groups

THE THREE-CHECK PROCESS

- 1 **FIND C=C** Do not test a single C–C bond or a carbonyl C=O bond.
- 2 **CHECK LEFT C** List its two attached groups. They must be different.
- 3 **CHECK RIGHT C** List its two attached groups. They must also be different.

WORKED EXAMPLE | Question: Can 3-methylpent-2-ene show E/Z isomerism?

LEFT C Groups are CH₃ and H: different.

RIGHT C Groups are CH₃ and CH₂CH₃: different.

ANSWER Yes. Both alkene carbons pass the test.



TEST IT 7

State whether each compound can show E/Z isomerism: [6]

(i) ethene (ii) propene (iii) but-2-ene (iv) 2-methylpropene

(v) pent-2-ene (vi) 3-methylpent-2-ene

Explain your decisions for propene and 3-methylpent-2-ene. [2]

[8 marks]



✓ **DONE WHEN** You test the two substituents on each alkene carbon before attempting an E or Z label.

8. Cahn–Ingold–Prelog priority rules



SPEC 4.1.3(c)(ii) Use CIP priority rules to identify the higher-priority group on each carbon of a C=C bond.



CRACK IT Priority is based on atomic number, not mass, group size, chain length or alphabetical order.

STEP	RULE
1	Compare the atoms directly attached to the same alkene carbon.
2	The atom with the higher atomic number has higher priority.
3	If those atoms tie, compare the next atoms outward, excluding the atom you came from, and list them in descending atomic number.
4	The first point of difference decides the higher-priority group.

USEFUL ATOMIC NUMBERS H 1 C 6 N 7 O 8 F 9 Cl 17 Br 35 I 53

Br vs Cl

higher priority: **Br**

35 > 17

CH₃ vs H

higher priority: **CH₃**

C > H

CH₂CH₃ vs CH₃

higher priority: **CH₂CH₃**

(C,H,H) > (H,H,H)

CH₂Cl vs CH₂OH

higher priority: **CH₂Cl**

(Cl,H,H) > (O,H,H)

OCR LIMIT You are not required to assign CIP priorities to double or triple bonds inside R groups.

WORKED EXAMPLE | Question: Which has higher priority, CH₂OH or CH₃?

FIRST ATOM Both groups attach through C, so this is a tie.

NEXT LAYER CH₂OH gives (O,H,H); CH₃ gives (H,H,H). O has the higher atomic number.

ANSWER CH₂OH has higher priority.



TEST IT 8

Choose the higher-priority group in each pair. [5]

(a) Br / Cl (b) CH₃ / H (c) CH₂CH₃ / CH₃ (d) CH₂Cl / CH₂OH (e) NH₂ / OH

Explain the decisions in (c) and (d) using the first point of difference. [2]

[7 marks]



✓ DONE WHEN You compare atomic numbers systematically and move outward only when the first attached atoms tie.

9. Assigning E and Z



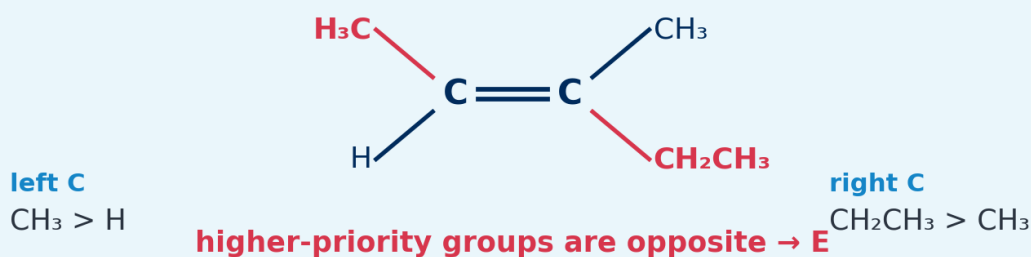
SPEC 4.1.3(c)(ii), (d) Assign priorities and identify E or Z stereoisomers from structural formulae.



CRACK IT Choose one winner on each alkene carbon. Compare only those two winning groups.

STEP	ACTION
1	Confirm that the alkene is eligible for E/Z isomerism.
2	Assign the higher-priority group on the left alkene carbon.
3	Assign the higher-priority group on the right alkene carbon.
4	Higher-priority groups on the same side → Z; on opposite sides → E.

3-METHYLPENT-2-ENE



MEMORY AID Z comes from zusammen (German for together): higher-priority groups on the same side. E comes from entgegen (opposite): higher-priority groups on opposite sides.

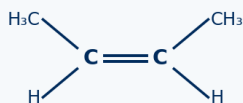
EXAM TRAP The physically larger-looking group is not automatically higher priority. Apply atomic number at the first point of difference.

TEST IT 9

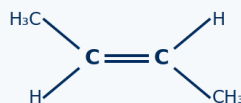
Assign E or Z to structures A–D. [4]

For C and D, state the higher-priority group on each alkene carbon before assigning the label. [4]

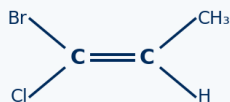
A



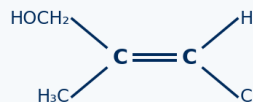
B



C



D



[8 marks]



✓ DONE WHEN Your E/Z label follows two explicit CIP decisions, one on each carbon of C=C.

10. Cis–trans is a special case of E/Z



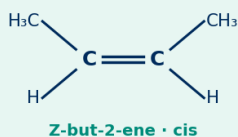
SPEC 4.1.3(c)(i), (d) Explain cis–trans isomerism as a special case of E/Z and determine when cis/trans labels are valid.



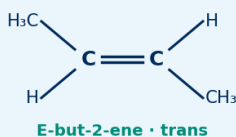
CRACK IT Cis/trans needs an identical group attached to each alkene carbon. E/Z does not.

DEFINITION TO LEARN Cis–trans isomerism is a special case of E/Z isomerism in which two substituent groups attached to the two carbon atoms of C=C are the same.

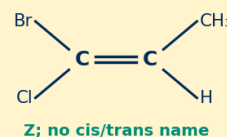
same group: same side



same group: opposite sides



no repeated group across C=C



LABEL	POSITION OF THE IDENTICAL GROUPS
cis	on the same side of the C=C bond
trans	on opposite sides of the C=C bond

OCR WARNING Do not automatically translate E as trans or Z as cis. First compare an identical group for cis/trans, then compare the two CIP winners for E/Z.

WORKED EXAMPLE | Question: Why can but-2-ene use both naming systems?

ELIGIBLE Each alkene carbon has H and CH₃, so E/Z is possible.

SPECIAL CASE The same group, CH₃, occurs on each carbon, so cis/trans is also valid.



TEST IT 10

- Explain what makes cis–trans isomerism a special case of E/Z isomerism. [2]
- Give both valid labels for each but-2-ene structure shown above. [4]
- Explain why the Br/Cl/H/CH₃ alkene can use E/Z but cannot use cis/trans. [2]

[8 marks]



✓ DONE WHEN You use cis/trans only when an identical substituent can be compared across the two alkene carbons.

11. Drawing possible stereoisomers



SPEC 4.1.3(d) Determine and draw possible E/Z or cis–trans stereoisomers from a structural formula.



CRACK IT Keep the same structural formula. Swap only the relative positions of groups around C=C, then label using CIP.

THE DRAWING PROCESS

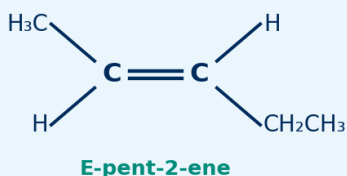
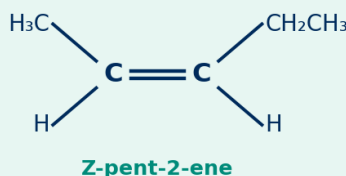
- TEST ELIGIBILITY** Confirm two different groups on each alkene carbon.
- DRAW C=C** Keep each group attached to the same alkene carbon so the structural formula stays the same.
- MAKE THE PARTNER** Move the groups on one alkene carbon to the opposite sides.
- LABEL** Apply CIP to each drawing; do not label by visual guesswork.
- CHECK** Both structures must have the same structural formula and different spatial arrangements.

WORKED EXAMPLE | Question: Draw the two stereoisomers of pent-2-ene.

GROUPS Left C: CH₃ and H. Right C: CH₂CH₃ and H.

PRIORITIES CH₃ > H and CH₂CH₃ > H.

DRAW Put the higher-priority groups opposite for E and on the same side for Z.



TEST IT 11

- Draw and label the E and Z stereoisomers of 3-methylpent-2-ene. [4]
- State the higher-priority group on each alkene carbon. [2]
- CHCl=CHCl has E/Z isomers. State whether cis/trans labels are also valid and explain. [2]

11(a) · first stereoisomer

11(a) · second stereoisomer

[8 marks]



✓ DONE WHEN You draw both arrangements with the same structural formula, then label each one correctly.

12. Mixed mastery



SPEC 4.1.1(f-i); 4.1.3(c-d) Combine bond fission, radical notation, curly-arrow rules, E/Z eligibility and CIP priorities.



CRACK IT Treat this as two audits: electron bookkeeping for mechanisms and substituent bookkeeping for E/Z.

WORKED EXAMPLE | Question: What must be checked before accepting either answer type?

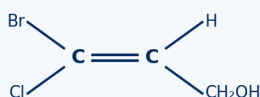
MECHANISM Origin and destination of every electron pair; dipoles; atom count; valency; total charge.

E/Z Eligibility on both alkene carbons; one CIP winner per carbon; relative side of the two winners.

COMMON LOST MARKS Missing radical dots; curly arrows starting beside a bond or lone pair; omitted δ^+/δ^- ; using group size instead of atomic number; assigning E/Z before checking eligibility; calling every Z isomer cis.

TEST IT 12

- (a) Draw heterolytic fission of H–Br, including relevant dipoles, one curly arrow and both ions. [4]
 (b) Write homolytic fission of Cl₂ with radical dots and explain how the bonding pair is divided. [3]
 (c) For the alkene below: confirm E/Z eligibility, state the higher-priority group on each carbon and assign E or Z. [4]
 (d) Explain why this alkene cannot be named using cis/trans. [2]
 (e) State two valid origins for a curly arrow. [2]



[15 marks]



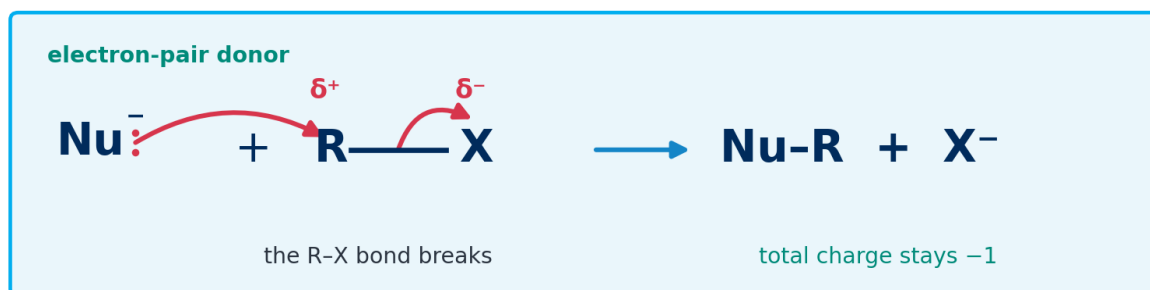
✓ **DONE WHEN** You can complete a mixed OCR question without confusing radical notation, electron-pair arrows or stereochemical labels.

TEST IT answers

HOW TO USE THESE ANSWERS Check the chemistry before the wording. For mechanisms, trace every arrow and charge. For E/Z, repeat the eligibility and CIP process rather than memorising the label.

TEST	COMPLETE ANSWER	MARKS
1	(a) Each bonded atom receives one electron from the bonding pair. (b) One bonded atom receives both electrons from the bonding pair. (c) $\text{Cl}\cdot + \text{Cl}\cdot$. (d) $\text{H}^+ + \text{Br}^-$; Br receives both electrons.	8
2	(a) A species with an unpaired electron. (b) $\text{Cl}_2 \rightarrow 2\text{Cl}\cdot$; $\text{Cl}\cdot + \text{CH}_4 \rightarrow \text{HCl} + \text{CH}_3\cdot$. (c) $\text{Cl}\cdot$ is consumed; $\text{CH}_3\cdot$ is formed. (d) As a sequence of equations; each dot identifies a species with one unpaired electron.	8
3	(a) Movement of an electron pair. (b) A lone pair, a double bond and a single bond. (c) Start at the centre of C–Br; finish on Br. (d) Empty space is not an electron source.	7

Test 4 model mechanism

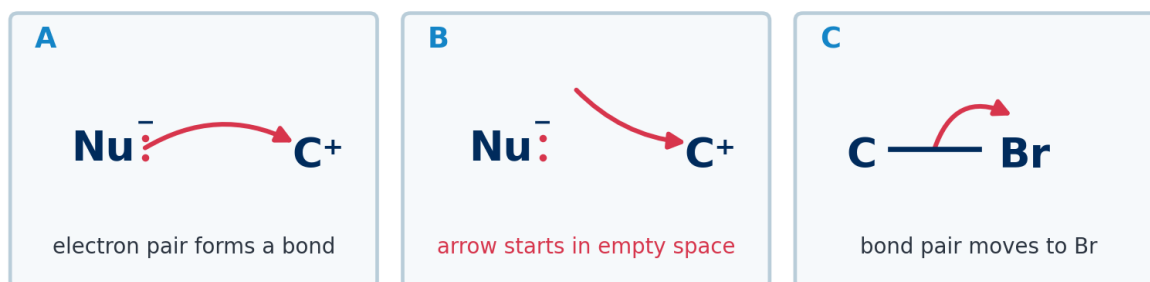


TEST 4 ANSWER The first arrow starts at the Nu^- lone pair and ends at δ^+ R. The second starts at the R–X bond and ends on X. The products are Nu–R and X^- ; the overall charge is -1 on both sides.

SELF-CHECK Keep the lone pair close to Nu^- . Start its arrow midway between the dots, touching neither. Start the bond-breaking arrow at the centre of R–X.

TEST IT answers · continued

TEST	COMPLETE ANSWER	MARKS
5	(a) A and C. (b) A: the Nu ⁻ lone pair moves towards C ⁺ to form a bond. C: the C–Br bonding pair moves to Br as the bond breaks. (c) B begins in empty space; move the tail midway between the Nu ⁻ lone-pair dots, touching neither. (d) Any one: atom count, total charge or valency.	7
6	(a) Compounds with the same structural formula but with a different arrangement in space. (b) An E/Z pair has the same structural formula; structural isomers have different structural formulae. (c) Restricted rotation about C=C and two different groups on each alkene carbon. (d) But-1-ene/but-2-ene: structural isomers; E-/Z-but-2-ene: stereoisomers.	8
7	Ethene no; propene no; but-2-ene yes; 2-methylpropene no; pent-2-ene yes; 3-methylpent-2-ene yes. Propene has two H atoms on one C of C=C. In 3-methylpent-2-ene, each alkene carbon has two different groups.	8



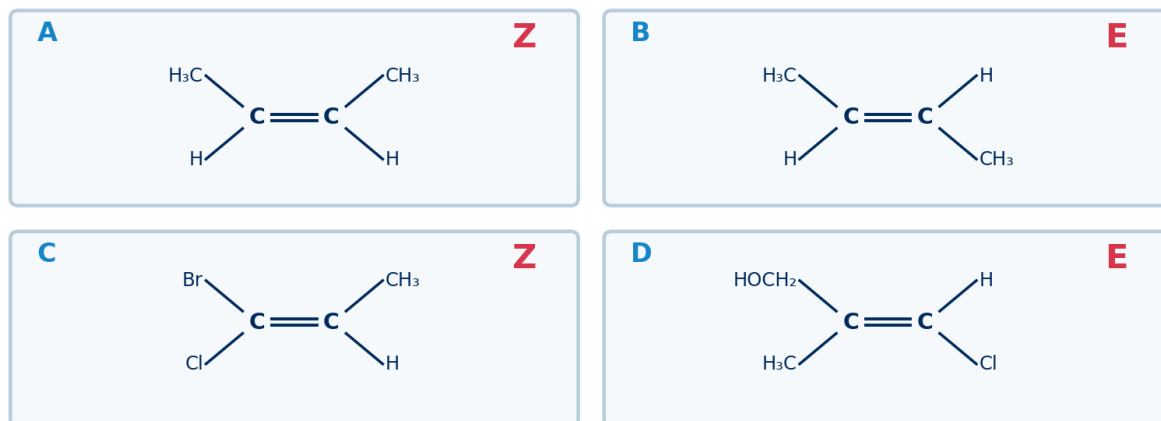
Test 5: A and C have valid arrow origins; B does not.

ELIGIBILITY CHECK Never decide E/Z from the molecular formula alone. Inspect the two attached groups on each carbon of the C=C bond.

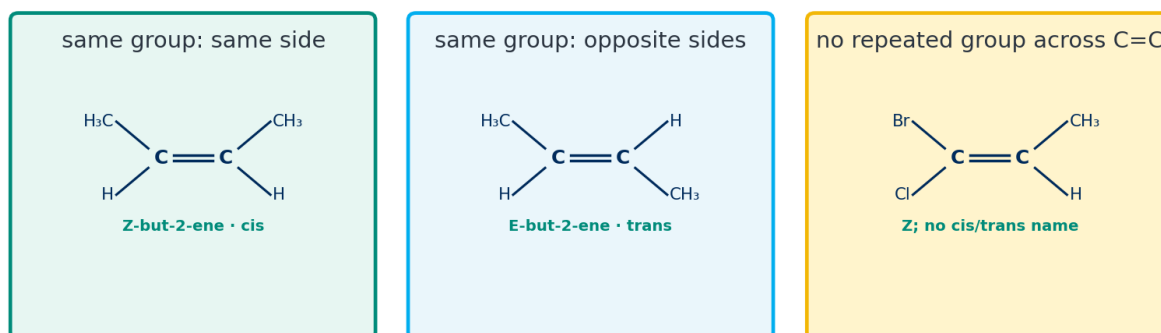


TEST IT answers · continued

TEST	COMPLETE ANSWER	MARKS
8	(a) Br. (b) CH ₃ . (c) CH ₂ CH ₃ . (d) CH ₂ Cl. (e) OH. For (c), C/C ties then (C,H,H) outranks (H,H,H). For (d), C/C ties then (Cl,H,H) outranks (O,H,H).	7
9	A Z; B E; C Z; D E. C priorities: Br on the left, CH ₃ on the right; both are above C=C. D priorities: CH ₂ OH on the left, Cl on the right; they are on opposite sides.	8
10	(a) The same substituent group occurs on both alkene carbons, allowing same-side or opposite-side comparison. (b) Same-side CH ₃ : cis and Z; opposite-side CH ₃ : trans and E. (c) All four groups differ, so no identical group can be compared across C=C.	8



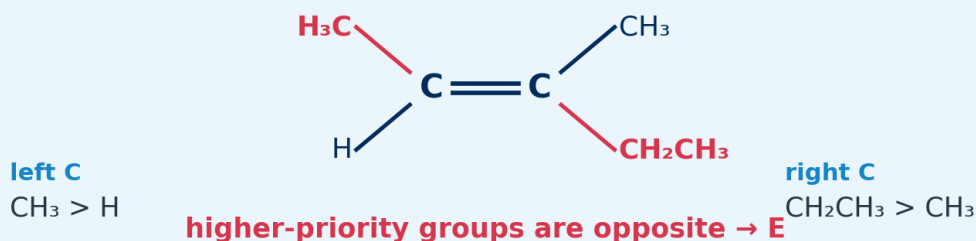
Test 9 model labels



Test 10: cis/trans is available only for the special repeated-group case.

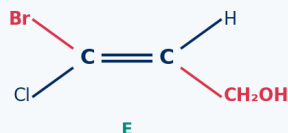
TEST IT answers · continued

TEST 11 (a) Both model drawings have the structural formula of 3-methylpent-2-ene. On the left alkene carbon, CH_3 has higher priority than H. On the right, CH_2CH_3 has higher priority than CH_3 . Draw one arrangement with these winners opposite (E) and one with them on the same side (Z). (c) $\text{CHCl}=\text{CHCl}$ can use cis/trans because Cl occurs once on each alkene carbon; same-side Cl is cis/Z and opposite-side Cl is trans/E.

3-METHYLPENT-2-ENE

The worked arrangement is E-3-methylpent-2-ene. Swap the groups on one alkene carbon to obtain Z.

TEST 12 (a) $\text{H}\delta^+ - \text{Br}\delta^-$ with a curly arrow from the H-Br bond to Br, giving $\text{H}^+ + \text{Br}^-$. (b) $\text{Cl}_2 \rightarrow 2\text{Cl}^\bullet$; one bonding electron goes to each Cl atom. (c) E/Z is possible: Br/Cl are different and H/ CH_2OH are different. Br is higher priority than Cl; CH_2OH is higher than H. The winners are opposite, so E. (d) No identical group occurs on both alkene carbons, so cis/trans is unavailable. (e) Any two of: a lone pair, a single bond, a double bond.



Test 12(c): the two CIP winners are highlighted; their opposite positions give E.

FINAL ANSWER AUDIT For every mechanism: electron source → arrowhead → product charge. For every E/Z label: eligibility → two CIP winners → same or opposite side.

Final mastery checklist

- ☐ I can define homolytic and heterolytic fission in terms of the bonding pair.
- ☐ I can define a radical and place one dot on every species with one unpaired electron.
- ☐ I can state that a curly arrow shows the movement of an electron pair.
- ☐ I can start a curly arrow at a lone pair or a bond and finish it correctly.
- ☐ I can include relevant dipoles and audit atom count, valency and total charge.
- ☐ I can distinguish structural isomers from stereoisomers.
- ☐ I can decide whether a C=C bond can produce E/Z isomers.
- ☐ I can apply CIP priorities using atomic number and the first point of difference.
- ☐ I can assign and draw E and Z arrangements.
- ☐ I can use cis/trans only when the repeated-group condition is satisfied.

Mastery map

AREA	TESTS	MARKS
Bond fission and radicals	1–2	16
Curly arrows and mechanism diagrams	3–5	21
Stereoisomerism and E/Z eligibility	6–7	16
CIP, E/Z and cis–trans	8–11	31
Mixed mastery	12	15
TOTAL		99

OCR A SCOPE CHECK Covered in full: 4.1.1(f–i) and 4.1.3(c–d). Held back: detailed alkane, alkene, haloalkane, alcohol and other family-specific reactions and mechanisms.



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

Final quick-reference card

MECHANISMS

- Homolytic: one bonding electron to each atom → radicals.
- Heterolytic: both bonding electrons to one atom → ions.
- Radical: species with an unpaired electron; show •.
- Full curly arrow: movement of an electron pair.
- Arrow starts between lone-pair dots or at a bond centre.
- Add relevant dipoles; check valency and total charge.

E/Z ISOMERISM

- Each C of C=C must have two different groups.
- CIP: higher atomic number = higher priority.
- If tied, move outward to the first point of difference.
- Winners same side → Z; opposite sides → E.
- Cis/trans needs an identical group on the two C atoms.
- Cis/trans is only a special case of E/Z.

STOP HERE Specific named mechanisms and reaction conditions now belong in the later organic-family units.