OCR A-Level Chemistry A

Alkanes mark scheme · goes with “Alkanes” · whiteboardchemistry.com/revision/exam-questions/ocr-a-level-chemistry/

# Mark schemes

Alkanes · 9 questions

**Q1 · June 2022 · AS Paper 1 (Breadth in chemistry) · Q14 · [1 mark]**

Answer: **D**

OCR MARK SCHEME

9

EXAMINER GUIDANCE

***ALLOW*** *9*

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**Q2 · June 2023 · AS Paper 1 (Breadth in chemistry) · Q25 · [8 marks]**

OCR MARK SCHEME

**25(a)**

Each marking point is independent

Chain length: interaction between molecules

Chain length (in pentane) is longer

AND

more (surface) contact

OR greater surface area/SA ✓

London forces: strength and energy

Stronger / more London forces

OR more energy to break London forces ✓

**[2 marks]**

EXAMINER GUIDANCE

Comparisons needed throughout

***ORA*** *throughout*

*Assume the following for longer chain*

- larger/bigger molecule
- more C (and H)
- more atoms
- more electrons

BUT ‘branching’ is a CON

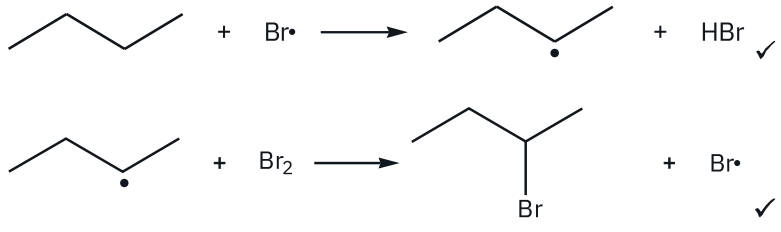
***IGNORE*** *comments about packing*

***ALLOW*** *induced dipole(–dipole) interactions for London forces*

***IGNORE*** *van der Waals’/vdw forces*

**25(b)**

Skeletal formulae required




✓

✓

**[2 marks]**

***ALLOW*** *1 mark (**ECF**) for 2 ‘correct’ equations with dot omitted or incorrectly positioned*

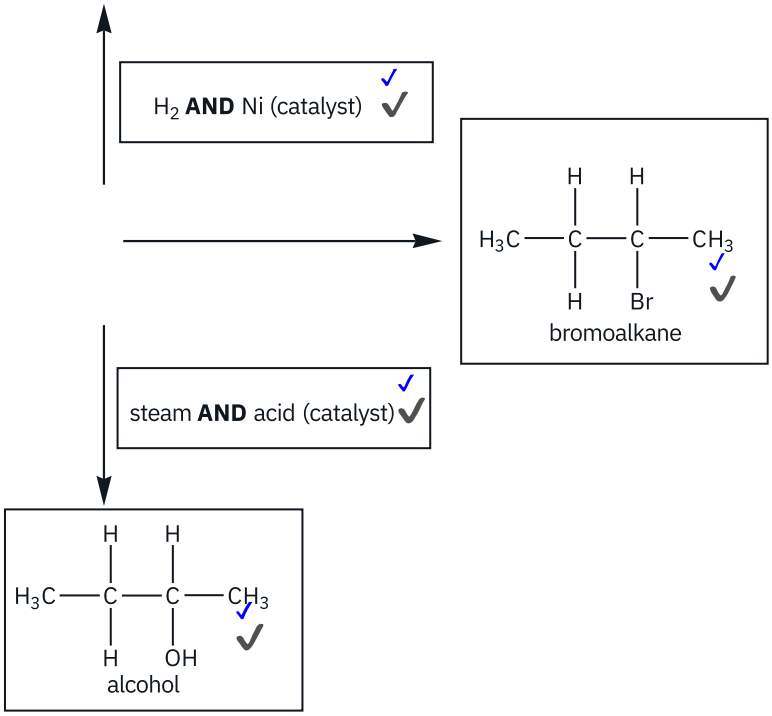
***ALLOW*** *1 mark for forming 1-bromobutane with dots correct for 1-bromobutane*

e.g.



No credit for responses using molecular formulae for organic structures

**25(c)**




[4 marks]

***ALLOW*** *any combination of skeletal OR structural OR displayed formula as long as unambiguous*

***ALLOW*** *Pt OR Pd for Ni*

***ALLOW*** *$H_2O(g)$ for steam*

*(g) OR temperature >100°C required*

For acid,

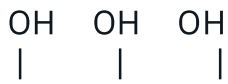
***ALLOW*** *$H^+/H_2SO_4/H_3PO_4$*

***ALLOW*** *small slip in acid formula*

e.g. phosphoric acid as $H_2PO_3$, etc

***ALLOW*** *vertical bond to any part of OH,*

i.e.




BUT **DO NOT ALLOW** –HO OR OH–

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**Q3 · June 2023 · Paper 2 (Synthesis and analytical techniques) · Q8 · [1 mark]**

Answer: **B**

hexane

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**Q4 · June 2024 · AS Paper 1 (Breadth in chemistry) · Q16 · [1 mark]**

Answer: **C**

Low polarity of σ-bonds.

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**Q5 · June 2024 · AS Paper 1 (Breadth in chemistry) · Q4 · [1 mark]**

Answer: **C**

3.00 $dm^3$ CO and 2.00 $dm^3$ $O_2$

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**Q6 · June 2024 · Paper 2 (Synthesis and analytical techniques) · Q8 · [1 mark]**

Answer: **C**

$CCl_2F_2 \rightarrow \bullet Cl + \bullet CClF_2$

**Q7 · June 2025 · AS Paper 1 (Breadth in chemistry) · Q16 · [1 mark]**

Answer: **D**

$ClO\bullet + O \rightarrow Cl\bullet + O_2$

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**Q8 · June 2025 · AS Paper 2 (Depth in chemistry) · Q4 · [17 marks]**

OCR MARK SCHEME

**4(a)**

Trend:

Boiling point increases (down the series)

AND

As chain length increases ✓

Explanation:

More (surface) contact / interaction (between molecules) ✓

More /stronger induced dipole(–dipole) interactions/ London (dispersion) forces (between molecules) ✓

More energy to break induced dipole(–dipole) interactions/London forces/intermolecular forces/intermolecular bonds ✓

**[4 marks]**

EXAMINER GUIDANCE

Comparisons needed throughout

***ORA*** *throughout*

***IGNORE*** *references to Enthalpy of Combustion*

***ALLOW*** *the following for 'chain length increases'*

- Longer molecule/alkane
- Number of carbons increases (question says they are straight chain alkanes)

***DO NOT ALLOW*** *reference to presence of branching*

Surface area alone is not sufficient, must have idea of contact.

***IGNORE*** *comments about packing*

***ALLOW*** *more electrons (as chain length increases)*

***IGNORE*** *van der Waals'/vdw forces*

***DO NOT ALLOW*** *reference to other intermolecular forces e.g. permanent dipole(-dipole) or hydrogen bonding.*

***ALLOW*** *'more energy to break intermolecular forces' if intermolecular forces are not identified or incorrect.*

***IGNORE*** *harder to overcome/break intermolecular forces (no reference to energy)*

***IGNORE*** *just 'bonds' intermolecular/London forces required*

***DO NOT ALLOW*** *Covalent bonds break*

**4(b)(i)**

$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$ ✓

**[1 mark]**

***IGNORE*** *state symbols*

***DO NOT ALLOW*** *multiples*

**4(b)(ii)**

FIRST CHECK THE ANSWER ON THE ANSWER LINE

*If answer = 0.063* ***OR*** *0.0627(g) award 2 marks*

Mass $CO_2$ produced from one mole $C_5H_{12}$

= 5 x 44.0 **OR** 220 (g) ✓

Mass of $CO_2$ produced per 1.00 kJ

$= \frac{220}{3509} = 0.0627$ (g) ✓

**[2 marks]**

***ALLOW ECF*** *from incorrect mole ratio in equation (b)(i)*

calculator value 0.06269592476

***IGNORE*** *significant figures, marks can be awarded based on correct method e.g.* ***ALLOW*** *0.06 for final answer provided working is shown*

Alternative approaches:

The calculation has 3 steps which can be done in any order:

- X 5
- X 44
- Divide by 3509

Need 2 steps for first mark, and final step scores second mark.

Moles of $CO_2$ per 1.00 kJ

$= (\frac{1.00}{3509}) \times 5$ **OR** $1.4249... \times 10^{-3}$ ✓

Mass of $CO_2$ produced per 1.00 kJ

$= 1.4249... \times 10^{-3} \times 44 = 0.0627$ (g) ✓

**OR**

Mass of $CO_2$ per mol per 1.00 kJ

$= \frac{44}{3509}$ **OR** 0.012539... ✓

Mass of $CO_2$ produced per 1.00 kJ

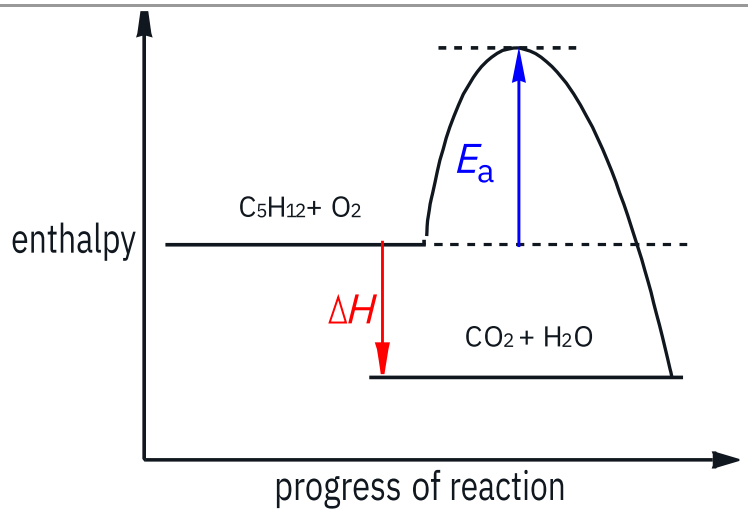
= 0.012539... x 5 = 0.0627 (g) ✓

**4(b)(iii)**

***IGNORE*** *state symbols*

***ALLOW*** *1 mark for a correctly labelled endothermic diagram*

***IGNORE*** *stoichiometry even if incorrect*




Reactants, products and $E_a$

Reactants on LHS $C_5H_{12} + O_2$

AND

Products on RHS $CO_2 + H_2O$

AND

Activation energy correctly labelled / $E_a$ ✓

$\Delta H$

$\Delta H$ labelled with product below reactant

AND

Arrow downwards ✓

**[2 marks]**

***ALLOW ECF*** *from incorrect reactant and products in equation (b)(i)*

For Ea, **ALLOW** AE **OR** $A_E$

***ALLOW*** *arrowheads at each end of* $E_a$ *line* ***OR*** *no arrowhead*

BUT **DO NOT ALLOW** arrowhead down

$E_a$ line must reach maximum (or near to maximum) on curve

***DO NOT ALLOW*** *–ΔH*

***DO NOT ALLOW*** *double headed arrow on ΔH*

***ALLOW*** *ΔH arrow even with small gap at the top and bottom, i.e. line does not quite reach reactant or product line.*

***ALLOW*** *–3509 for ΔH*

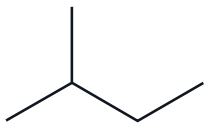
**4(b)(iv)**

–2900 (kJ $mol^{-1}$) ✓

**[1 mark]**

Must be 2 SF with negative sign

**4(c)**

| | |
|---|---|
|  |  |
| (2-)methylbutane | (2,2-)dimethylpropane |

✓✓

**[2 marks]**

ALL 4 points → 2 marks

2 **OR** 3 points → 1 mark

Structures must be skeletal

Numbers in names are not required but if given must be correct

***IGNORE*** *lack of hyphens, extra hyphens, or addition of commas*

***DO NOT ALLOW*** *the following for methyl: methy, meth, methly*

**4(d)(i)**

$C_3H_8 + Br_2 \rightarrow C_3H_7Br + HBr$ ✓

***IGNORE*** *state symbols*

**[1 mark]**

**4(d)(ii)**

(covalent/Br-Br) bond breaks

AND

each (bonding) atom / Br receives one electron from the bonding / shared pair ✓

**[1 mark]**

***ALLOW*** *the breaking of (a covalent/Br-Br) bond where each atom keeps one of the bonding electrons*

***ALLOW*** *when a bond breaks one electron from the bond goes to each product / species / radical*

***DO NOT ALLOW*** *'molecule' or 'compound' or 'particle' or 'element' for 'atom'*

***IGNORE*** *homolytic fission equations*

**4(d)(iii)**

$C_3H_8 + Br\bullet \rightarrow \bullet C_3H_7 + HBr$ ✓

$\bullet C_3H_7 + Br_2 \rightarrow C_3H_7Br + Br\bullet$ ✓

**[2 marks]**

***ALLOW*** *dot at any position on the radical*

***ALLOW*** *1 mark if both equations correct but any dots omitted from radicals*

**4(d)(iv)**

Br can substitute at different positions along (carbon) chain

**OR**

two different radicals form $CH_3CH_2CH_2$ AND $CH_3CHCH_3$ ✓

**[1 mark]**

***ALLOW*** *AW*

e.g

***ALLOW*** *Br can replace an end H or a middle H*

***ALLOW*** *Br can substitute at any C*

***IGNORE*** *position of radical dot on radical structures*

***IGNORE*** *references to minor/major product*

***DO NOT ALLOW*** *stability of carbocations/haloalkanes*

**Q9 · June 2025 · Paper 2 (Synthesis and analytical techniques) · Q16 · [12 marks]**

OCR MARK SCHEME

EXAMINER GUIDANCE

**16(a)**

2-methylpent-2-ene ✓

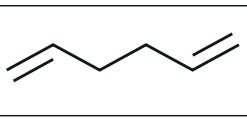
**[1 mark]**

***IGNORE*** *lack of hyphens, or addition of commas*

***DO NOT ALLOW*** *the following for methyl: methy, meth, methly, methyle, methanyl*

***DO NOT ALLOW*** *2-methylpentan-2-ene*

**16(b)**

| |  |  |
|---|---|---|
| Molecular formula | $C_6H_{10}$ | $C_6H_{10}$ |
| Number of σ bonds | 15 | 16 |
| Number of π bonds | 2 | 1 |

One row correct ✓

Two rows correct ✓✓

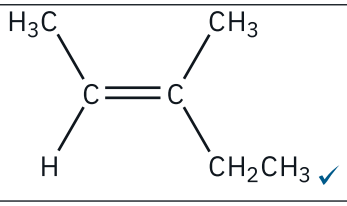
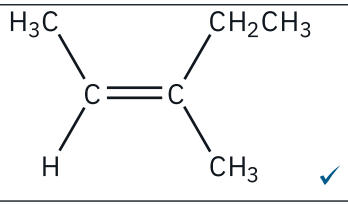
Three rows correct ✓✓✓

**[3 marks]**

One mark per row

*If no other marks awarded, **ALLOW** 1 mark for a correct column*

**16(c)(i)**

|  |  |
|---|---|
| ***E*** | ***Z*** |

**[2 marks]**

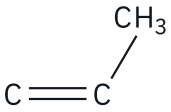
***ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous*

***ALLOW** one mark if both stereoisomers of compound A are shown but in the incorrect columns*

***ALLOW** $-C_2H_5$ for ethyl group*

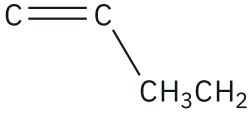
***ALLOW** connectivity to any part of methyl or $CH_2$ in ethyl*

e.g.



**BUT DO NOT ALLOW** ethyl group bonded via $CH_3$

e.g. $-CH_3CH_2$



**16(c)(ii)**

C=C / double bond does not rotate

**OR** restricted rotation of the C=C/double bond ✓

***ALLOW** π/pi bond does not rotate*

***ALLOW** C=C / double bond does not twist*

Each carbon atom in C=C/double bond has (two) different groups/atoms (bonded) ✓

**[2 marks]**

***IGNORE*** *groups are fixed in position*

***IGNORE*** *'bond does not move'* ***OR*** *'bond has restricted movement'*

***ALLOW*** *each end of the π/pi -bond is bonded to different groups/atoms*

***DO NOT ALLOW*** *'functional groups'* ***OR*** *'molecules'* ***OR*** *'compounds'* ***OR*** *'species' for 'groups'*

***IGNORE*** *C=C bond has two different groups*

***IGNORE*** *two different groups either side of the double bond (could be above or below must be clear it is on each C)*

***IGNORE*** *references to 'priority' (even if incorrect)*

***IGNORE*** *attempts to give definition of stereoisomerism e.g. same structural formula but different arrangement of atoms in space*

**16(d)**

$C_6H_{14} + 6O_2 \rightarrow 5CO + C + 7H_2O$ ✓

**[1 mark]**

***DO NOT ALLOW*** *any equations which show $H_2$ as a product*

***ALLOW*** *$C_6H_{14} + 6O_2 \rightarrow 2CO_2 + CO + 3C + 7H_2O$*

***ALLOW*** *$C_6H_{14} + 6O_2 \rightarrow CO_2 + 3CO + 2C + 7H_2O$*

***ALLOW*** *multiples that show a 1:6 ratio*

e.g. $2C_6H_{14} + 12O_2 \rightarrow 10CO + 2C + 14H_2O$

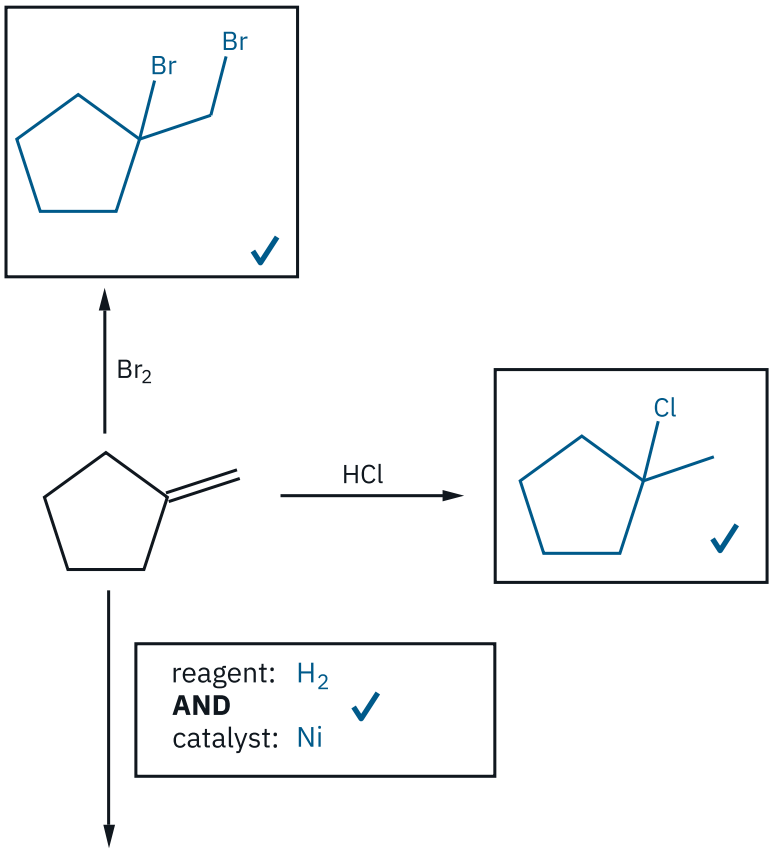
**OR** $2C_6H_{14} + 12O_2 \rightarrow 5CO_2 + 7C + 14H_2O$

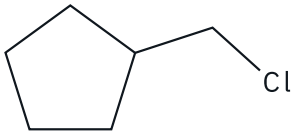
**16(e)**

***ALLOW*** *any combination of skeletal* ***OR*** *structural* ***OR*** *displayed formula as long as unambiguous*

***ALLOW*** *names for reagents e.g. hydrogen, if no formulae given*

***DO NOT ALLOW*** *minor product, i.e.*




***ALLOW*** *reagent and catalyst on either answer line*

For catalyst **ALLOW** Pt / Pd or any suitable non-specification alternative

***IGNORE*** *state symbols*

***IGNORE*** *conditions i.e. temp and pressure*

**[3 marks]**

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