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

Mark schemes

Alcohols and haloalkanes · 10 questions

Q1 · June 2022 · Paper 3 (Unified chemistry) · Q3 · [10 marks]

OCR MARK SCHEME

3(a)

Level 3 (5–6 marks)

Diagram showing reflux with most labels

AND

A CORRECT calculation of the % yield of 1-bromobutane

AND

A detailed description of most purification steps.

There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Level 2 (3–4 marks)

Diagram showing reflux with some labels

AND

Calculates the % yield of 1-bromobutane with some errors

OR

Diagram showing reflux with most labels

AND

describes some purification steps, with some detail

OR

Calculates the % yield of 1-bromobutane with some errors

AND

describes some purification steps, with some detail

There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.

Level 1 (1–2 marks)

Diagram showing reflux

EXAMINER GUIDANCE

Indicative scientific points may include:

Diagram

Diagram draw with condenser above flask

Labels including

- condenser
- water in at bottom and out at top
- pear-shaped or round-bottom flask

Calculation of % yield of 1-bromobutane

- n(butan-1-ol) $= \frac{9.25}{74.0} = 0.125$ (mol)
- mass 1-bromobutane = 6.10 × 1.268 = 7.7348 g
- n(1-bromobutane) $= \frac{7.7348}{136.9} = 0.0565$ (mol)
- % yield = $\frac{0.0565}{0.125} \times 100 =$ 45.2%

ALLOW *45.2 ± 0.2 for small slip/rounding*

NOTE Use of 6.1 g (omission of density)

OR

Attempts to calculate the % yield of 1-bromobutane

OR

Describes few purification steps.

There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.

0 marks No response or no response worthy of credit.

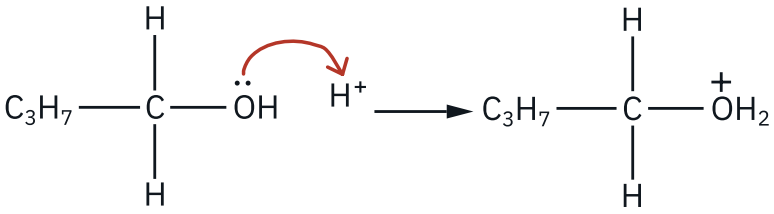
[6 marks]

3(b)

Step 1 The oxygen atom of the alcohol group accepts a proton to form a positively-charged intermediate.

2 marks

Curly arrow ✓



Intermediate ✓

Step 2 Bromide ions react with the intermediate by nucleophilic substitution to form 1-bromobutane.

2 marks

2 possible routes:

EITHER

Curly arrow ✓

- n(1-bromobutane) $= \frac{6.10}{136.9} = 0.044558...$ (mol)
- % yield $= \frac{0.044558...}{0.125} \times 100 =$ 35.6%

Purification

- In separating funnel, **organic layer is on bottom**
- Drying with an **anhydrous salt by formula or name**, e.g. $MgSO_4$, Na_2SO_4, $CaCl_2$
- Redistil **at 102°C**

Examples of detail in **bold** (**NOT INCLUSIVE**)

***NOTE**: 'Use a separating funnel', dry, and 'redistil' on their own are **NOT** detailed descriptions*

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

For $CH_3CH_2CH_2$, **ALLOW** $CH_3(CH_2)_2$, C_3H_7

***IGNORE** dipoles*

***ALLOW** curly arrow to H of H–O–SO_3H **OR** H–Br*

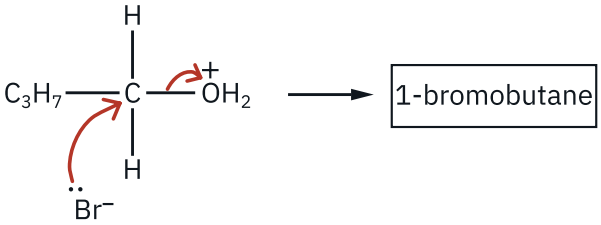
***IGNORE** absence of curly arrow from H–O or from H–Br*

+ charge MUST be on O of intermediate

Curly arrow must

- start from, **OR** be traced back to any point across width of lone pair on :Br^- **OR** :OH **OR** start from – charge on Br^-

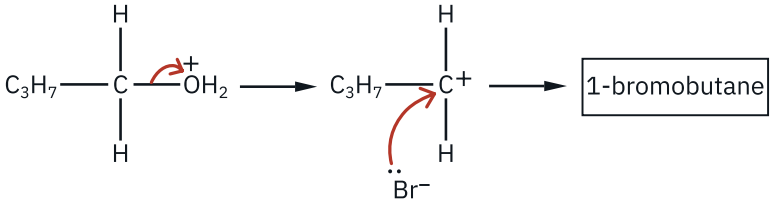
(Lone pair **NOT** needed if curly arrow shown from – charge on Br^-)



Curly arrow ✓

OR

Curly arrow ✓



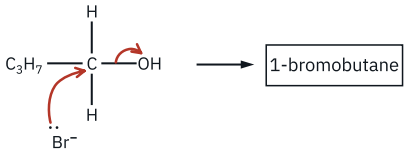
Curly arrow ✓

IGNORE *final products: 1-bromobutane and* H_2O

IF $C_3H_7CH_2–O^+H_2$ *is not shown,* ***ALLOW*** *intermediate mark for carbocation:* $C_3H_7CH_2^+$

ALLOW *2 marks max for mechanism without positively charge intermediate, i.e.*

Curly arrow ✓



Curly arrow ✓

[4 marks]

Q2 · June 2023 · AS Paper 1 (Breadth in chemistry) · Q26 · [5 marks]

OCR MARK SCHEME

26

Correct structural isomers of C_3H_8O 1 mark

$CH_3CH_2CH_2OH$ AND $CH_3CHOHCH_3$ ✓

Reaction conditions 1 mark

Distillation for aldehyde

AND reflux for carboxylic acid **OR** ketone ✓

Functional group of organic product 2 marks

$CH_3CH_2CH_2OH$ → aldehyde

OR → carboxylic acid ✓

$CH_3CHOHCH_3$ → ketone ✓

One correct equation 1 mark

$CH_3CH_2CH_2OH + [O] \rightarrow CH_3CH_2CHO + H_2O$

OR

$CH_3CHOHCH_3 + [O] \rightarrow CH_3COCH_3 + H_2O$

OR

$CH_3CH_2CH_2OH + 2[O] \rightarrow CH_3CH_2COOH + H_2O$ ✓

[5 marks]

EXAMINER GUIDANCE

Throughout,

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

IF functional group is ***NOT*** *given,*

ALLOW *propanal / RCHO*

ALLOW *propanoic acid / RCOOH*

ALLOW *propanone / ..... RCOR*

IGNORE *small slips in formulae (assessed in equation)*

Q3 · June 2024 · AS Paper 1 (Breadth in chemistry) · Q19 · [1 mark]

Answer: **B**

IR causes CFC molecules to produce chlorine radicals that initiate ozone breakdown in the upper atmosphere.

Q4 · June 2024 · AS Paper 1 (Breadth in chemistry) · Q25 · [11 marks]

OCR MARK SCHEME

25(a)

$C_5H_{12}O + 7½\ O_2 \rightarrow 5CO_2 + 6H_2O$

CO_2 AND H_2O products ✓

Complete equation balanced ✓

[2 marks]

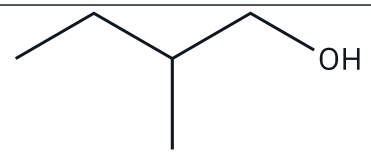
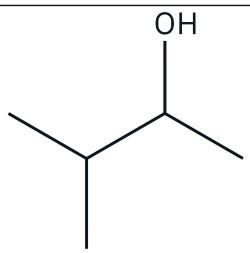
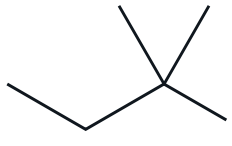
EXAMINER GUIDANCE

ALLOW *multiples*

e.g. $2C_5H_{12}O + 15O_2 \rightarrow 10CO_2 + 12H_2O$

Watch for 15/2 **OR** 7.5 for 7½

25(b)

Alcohol	Structure
A	
B	
C	

✓✓✓

[3 marks]

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

DO NOT ALLOW *structure if H(s) are missing from ONE structural formula*

..... BUT **ALLOW** any further omissions as ECF

Take care with numbers of carbons, the branches and the position of branching .... especially for C

IGNORE *connectivity,*

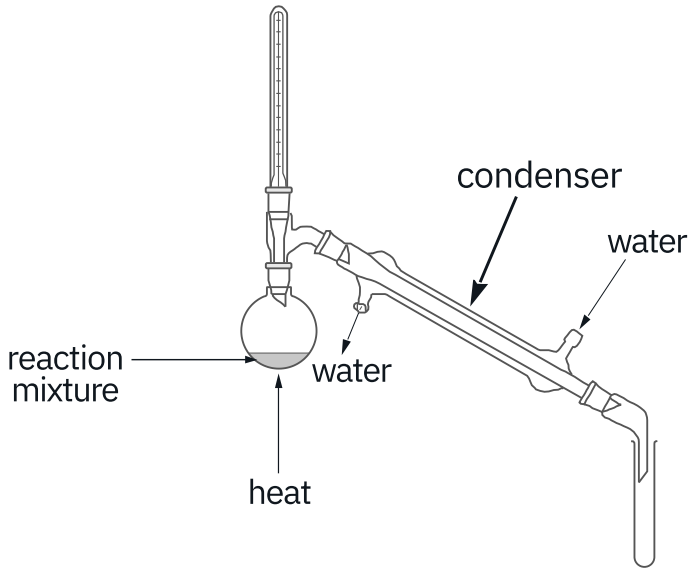
e.g.

ALLOW



BUT **DO NOT ALLOW** –HO

25(c)



DO NOT ALLOW *ANY MARKS FOR A REFLUX SET UP*

IGNORE

- no heat *question about apparatus*
- no thermometer *stopper is fine*

Workable set up

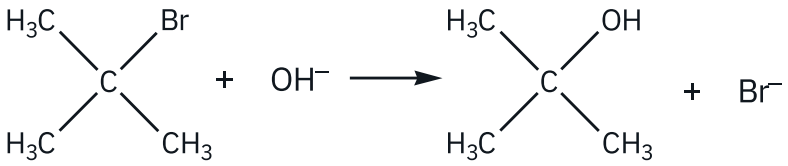
- Flask with 'horizontal' **OR** 'angled down' condenser ✓
- **NOT** a sealed system for collection vessel
- **NOT** open at the top above flask

Key labels for distillation set up

- Water in at bottom and out at top
- AND condenser label ✓

[2 marks]

25(d)(i)



Structure of BOTH organic compounds ✓

DO NOT ALLOW *if H(s) are missing*

OH^- on left AND Br^- on right ✓

ALLOW *NaOH/KOH with NaBr/KBr*

[2 marks]

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

IGNORE *state symbols*

ALLOW *OH^- AND Br^- in a balanced mechanism*

ALLOW *OH^- over the arrow for LHS of equation*

DO NOT ALLOW *unbalanced charges,*

e.g. OH^- with Br

DO NOT ALLOW *H_2O AND HBr*

question specifies aqueous alkali.

DO NOT ALLOW *2nd mark if a CON reagent is present,*

e.g. an acid

25(d)(ii)

Rates of hydrolysis of all 3 haloalkanes

Fastest RI > RBr > RCl slowest ✓

Bond enthalpies/strength of bonds for any one RX

Strongest: C–Cl > C–Br > C–I weakest ✓

MUST refer to C–X bond in some way

[2 marks]

IGNORE *reactivity of halogens*

ALLOW *unambiguous comparison of two haloalkanes*

e.g. RI is fastest AND RCl is slowest

ALLOW *C–Cl is strongest bond*

ALLOW *R–Cl, etc BUT* ***NOT*** *RCl > RBr > RI no bonds*

DO NOT ALLOW *just 'strongest bond enthalpy*

iodine has weakest bond

Q5 · June 2024 · Paper 2 (Synthesis and analytical techniques) · Q3 · [1 mark]

Answer: **D**

Yellow

Q6 · June 2025 · AS Paper 1 (Breadth in chemistry) · Q17 · [1 mark]

Answer: **C**

OCR MARK SCHEME

3

EXAMINER GUIDANCE

ALLOW 3

Q7 · June 2025 · AS Paper 1 (Breadth in chemistry) · Q18 · [1 mark]

Answer: **B**

The C–I bond enthalpy is less than the C–Br bond enthalpy.

Q8 · June 2025 · Paper 2 (Synthesis and analytical techniques) · Q19 · [9 marks]

OCR MARK SCHEME

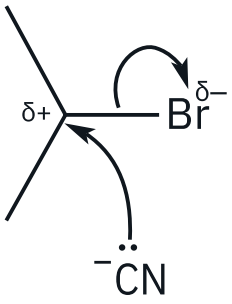
19(a)(i)

Curly arrow from CN^- to $C^{(\delta+)}$ of C–Br bond ✓

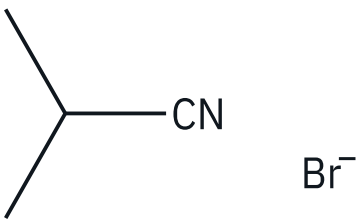
Dipole shown on C–Br bond, $C^{\delta+}$ and $Br^{\delta-}$

AND

curly arrow from C–Br bond to Br atom ✓



Correct organic product **AND** Br^- ✓



[3 marks]

EXAMINER GUIDANCE

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

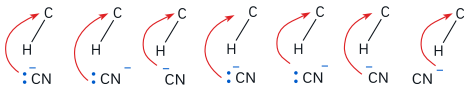
NOTE*: curly arrows can be straight, snake-like etc., but* ***NOT*** *double headed or half headed arrows*

1st curly arrow must:

- go to C of C–Br

AND

- start from, **OR** be traced back to any point across width of the lone pair on C of CN^-
- **OR** start from – charge on C of ^-CN



✓ ✓ ✓ ✓ ✗ ✗ ✗

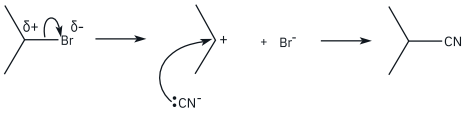
2nd curly arrow must start from, **OR** be traced back to, any part of C–Br bond and go to Br

IGNORE *presence of* K^+

BUT KBr does **NOT** show Br^-

ALLOW *S_N1 mechanism:*

- Dipole on C–Br bond **AND** curly arrow from the C–Br bond to Br ✓
- Correct carbocation **AND** Curly arrow from CN^- to C^+ on carbocation ✓
- Correct organic product **AND** Br^- ✓



19(a)(ii)

Nucleophilic substitution ✓

[1 mark]

19(b)(i)

NaBr **AND** H_2SO_4 ✓

[1 mark]

ALLOW *HBr (**IGNORE** additional acid if given e.g HBr and H_2SO_4)*

ALLOW *KBr instead of NaBr*

ALLOW *H_3PO_4 **OR** HNO_3 in place of H_2SO_4 **BUT NOT** HCl*

ALLOW *PBr_3*

ALLOW *names if no formulae given*

IGNORE *conc **OR** dilute **OR** (aq)*

IGNORE *H^+/Acid (must be clear which acid should be used)*

19(b)(ii)

Step 1

(Add to) separating funnel ✓

(Use of) bottom layer (containing 1-bromopropane / organic) ✓

Step 2

Dry with (one of the following)

- an anhydrous salt
- $MgSO_4$ /magnesium sulfate
- $CaCl_2$ /calcium chloride ✓

Step 3

Mark each step in order but then don't mark any further if response refers to purification of a solid

e.g. dissolve in minimum amount of hot solvent, evaporate off water to allow solid to crystalise

IGNORE *use of base/carbonate (to remove excess acid) **OR** (saturated) NaCl*

ALLOW *(remove) aqueous layer on the top*

(Re)Distil (and collect the fraction) at 71°C ✓

[4 marks]

ALLOW *description that aqueous layer can be determined by adding water and seeing which layer increases in size*

IGNORE *distillation* ***OR*** *filtration prior to* ***step 1 OR step 2***

ALLOW *'to remove water' instead of 'dry'*

IGNORE *any other salt*

IGNORE *filtration to remove anhydrous salt after step 2*

ALLOW *temperature range of 70 – 72°C for distillation*

DO NOT ALLOW *if forms a solid product*

Q9 · June 2025 · Paper 2 (Synthesis and analytical techniques) · Q4 · [1 mark]

Answer: **A**

Q10 · June 2025 · Paper 2 (Synthesis and analytical techniques) · Q7 · [1 mark]

Answer: **B**

$CH_3CH_2COOH + CH_3NH_3^+$

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