

Past-paper walk-through

Isomerism: structural isomerism and stereoisomerism ■ 13.4

eXercise

Questions in this set

- 9701/11 N25 Q25 ■ 1 mark
- 9701/12 N25 Q26 ■ 1 mark
- 9701/14 N25 Q26 ■ 1 mark
- 9701/21 N25 Q4 ■ 15 marks
- 9701/22 N25 Q4 ■ 16 marks
- 9701/24 N25 Q4 ■ 16 marks

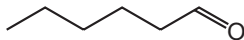
Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

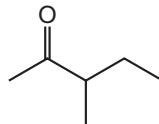
Question 25

9701/11 N25 ■ Q25 ■ 1 mark

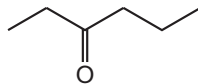
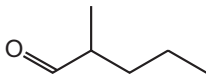
25 The diagrams show skeletal formulas of some isomers of $\text{C}_6\text{H}_{12}\text{O}$.



1



2



3

4

Which statement is correct?

- A** 1 and 3 are chain isomers of each other and positional isomers of each other.
- B** 2 and 3 are functional group isomers of each other and both have a chiral centre.
- C** 1 and 4 are functional group isomers of each other and both have a chiral centre.
- D** 2 and 4 are positional isomers of each other and functional group isomers of each other.

Solution 25

Answer: **B**

Why

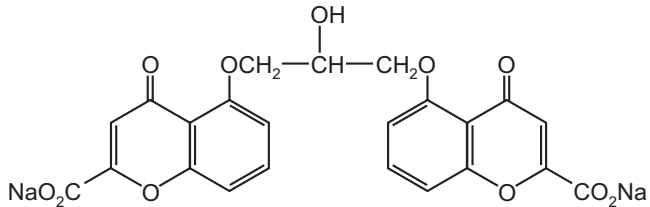
- A functional group isomer has the same molecular formula but a different functional group – here an aldehyde or ketone against an alcohol or ether.
- A chiral centre needs a carbon carrying four *different* groups.
- Check each pair for both conditions; only one pair satisfies them together.

Question 26

9701/12 N25 ■ Q26 ■ 1 mark

26 The structure of disodium cromoglycate is shown.

disodium cromoglycate



How many chiral centres are there in this molecule?

Question 26

A 0

B 1

C 2

D 3

Solution 26

Answer: **A**

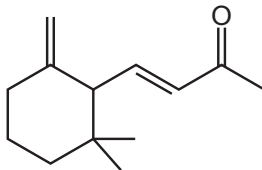
Why

- A chiral centre needs a carbon carrying four *different* groups.
- The CH(OH) here sits between two CH₂O– chains that lead to identical halves of the molecule.
- Two identical groups means it is not a chiral centre, so the molecule has none at all.

Question 26

9701/14 N25 ■ Q26 ■ 1 mark

26 The structure of the compound γ -ionone is shown.

 γ -ionone

Including γ -ionone, how many stereoisomers exist with this molecular formula?

Question 26

A 1

B 2

C 4

D 8

Solution 26

Answer: **C**

Why

- Count the features that can be fixed two ways: each C=C able to show E/Z and each chiral carbon doubles the total.
- Two such features give $2^2 = 4$ stereoisomers.
- A double bond inside a small ring does not count – the ring locks its geometry.

Question 4

9701/21 N25 ■ Q4 ■ 15 marks

- 4 Fig. 4.1 shows a possible synthesis of propene, C_3H_6 .

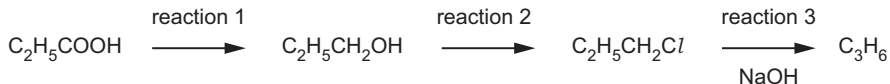


Fig. 4.1

- (a) (i) Identify the type of reaction that occurs in reaction 1.

Question 4

- (ii) Suggest a suitable reagent for reaction 2.

Question 4

(iii) Reaction 3 is an elimination reaction.

Write an equation for this reaction and identify the solvent and conditions used.

Question 4

Question 4

[2]

- (iv) $\text{C}_2\text{H}_5\text{CH}_2\text{OH}$ can be directly converted to C_3H_6 .

Suggest the reagent and conditions for this conversion.

Question 4

(b) Under suitable conditions, propene polymerises to form poly(propene).

Poly(propene) exhibits stereoisomerism.

(i) Identify the type of polymerisation that forms poly(propene) from propene.

Question 4

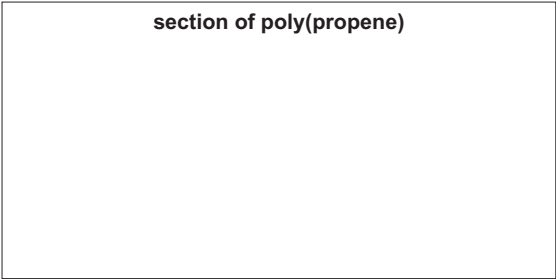
(ii) Define stereoisomerism.

Question 4

- (iii) Draw a section of poly(propene), showing **two** repeat units.

Use your diagram to identify the type of stereoisomerism shown by poly(propene).
Explain your answer.

section of poly(propene)



Question 4

[3]

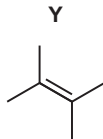
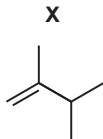
- (iv) State **two** difficulties associated with the disposal of poly(propene).

Question 4

Question 4

[2]

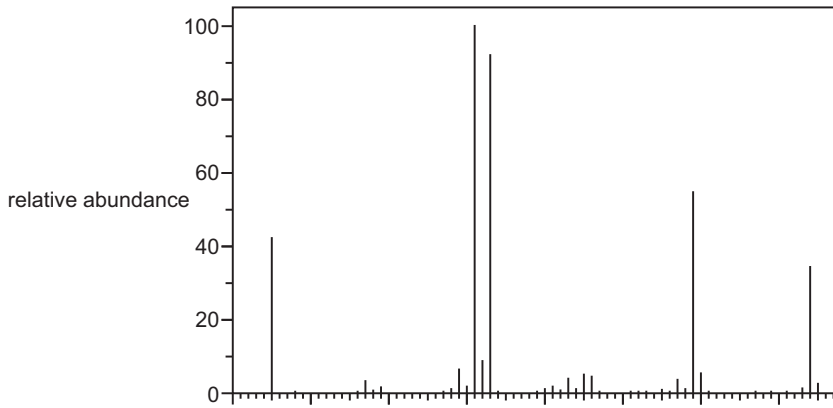
(c) Under different conditions, two molecules of propene can combine to form compounds **X** and **Y**.



(i) Name **X**.

Question 4

(ii) Fig. 4.2 shows the mass spectrum of either compound **X** or compound **Y**.



Question 4

10 20 30 40 50 60 70 80

Question 4



Fig. 4.2

Identify which of **X** and **Y** gives this mass spectrum.

Give **one** reason for your answer, referring to the fragmentation pattern.

Question 4

- (iii) The molecular ion peak in the spectrum in Fig. 4.2 has relative abundance 34.7.
- Calculate the relative abundance of the $[M+1]^+$ peak in this spectrum.

Question 4

[Total: 16] -

Important values, constants and standards

molar gas constant	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
Faraday constant	$F = 9.65 \times 10^4 \text{ C mol}^{-1}$
Avogadro constant	$L = 6.02 \times 10^{23} \text{ mol}^{-1}$
electronic charge	$e = -1.60 \times 10^{-19} \text{ C}$
molar volume of gas	$V_m = 22.4 \text{ dm}^3 \text{ mol}^{-1}$ at s.t.p. (101 kPa and 273 K) $V_m = 24.0 \text{ dm}^3 \text{ mol}^{-1}$ at room conditions
ionic product of water	$K_w = 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ (at 298 K (25 °C))
specific heat capacity of water	$c = 4.18 \text{ kJ kg}^{-1} \text{ K}^{-1}$ (4.18 J g ⁻¹ K ⁻¹)

18	2	He helium 4.0	10	Ne neon 20.2	18	Ar argon 39.9	36	Kr krypton 83.8	54	Xe xenon 131.3	86	Rn radon -	118	Og oganeson -
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Question 4

The Periodic Table of Elements

Group

Key	1	
	atomic number	atomic symbol
	name	relative atomic mass
	1	H hydrogen 1.0

5	6	7	8	9	10	11
23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5
41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium —	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9
73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0
105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —

59	60	61	62	63	64	65
Pr praseodymium 140.9	Nd neodymium 144.2	Pm promethium —	Sm samarium 150.4	Eu europium 152.0	Gd gadolinium 157.3	Tb terbium 158.9
91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkeleyium —

Question 4

1	2		
3	4	at re	
Li lithium 6.9	Be beryllium 9.0		
11	12	3	4
Na sodium 23.0	Mg magnesium 24.3		
19	20	21	22
K potassium 39.1	Ca calcium 40.1	Sc scandium 45.0	Ti titanium 47.9
37	38	39	40
Rb rubidium 85.5	Sr strontium 87.6	Y yttrium 88.9	Zr zirconium 91.2
55	56	57-71 lanthanoids	72
Cs caesium 132.9	Ba barium 137.3		Hf hafnium 178.5
87	88	89-103 actinoids	104
Fr francium -	Ra radium -		Rf rutherfordium -

lanthanoids

57	58
La lanthanum 138.9	Ce cerium 140.1
89	90
Ac actinium –	Th thorium 232.0

actinoids

Solution 4

(a)(i)

Mark scheme

- reduction
- 1

Solution 4

(a)(ii)

Mark scheme

- PCl_5 / PCl_3 / SOCl_2
- OR KCl / NaCl AND conc. H_2SO_4 / conc. H_3PO_4
- 1 (M1)
- $\text{C}_2\text{H}_5\text{CH}_2\text{Cl} + \text{NaOH} \rightarrow \text{C}_3\text{H}_6 + \text{H}_2\text{O} + \text{NaCl}$ (M2)
- ethanol (solvent) AND heat / reflux
- 2

Solution 4

(a)(iv)

Mark scheme

- conc. H_2SO_4 OR conc. H_3PO_4 OR Al_2O_3 AND heat
- 1

Solution 4

(b)(i)

Mark scheme

- addition
- 1

Solution 4

(b)(ii)

Mark scheme

- M1 (molecules that have the) same structural formula (and same molecular formula) **M2**
- but different 3D / spatial arrangement of atoms / groups
- 2

Solution 4

(b)(iii)

Mark scheme

- M2 optical isomerism **M3**
- the methylated carbon has four different groups attached
- 3

Solution 4

(b)(iv)

Mark scheme

- M1 non-biodegradability **M2**
- harmful combustion products
- 2

Solution 4

(c)(i)

Mark scheme

- 2,3-dimethylbut-1-ene
- 1
- 9701/21
- October/November 2025

Solution 4

(c)(ii) Mark scheme

- (The spectrum is of) X
- AND
- 41 is $[\text{CH}_2=\text{CCH}_3]^+$ / 41 is C_3H_5^+
- OR 43 is $[\text{CH}_3\text{CHCH}_3]^+$ / 43 is C_3H_7^+
- OR X would NOT have significant peak at 54 / $[(\text{CH}_3)_2\text{C}=\text{C}^+]$ / C_4H_6^+
- OR X would NOT have significant peak at 42 due to $[(\text{CH}_3)_2\text{C}^+]$ / C_3H_6^+
- 1

Solution 4

(c)(iii)

Mark scheme

- $([M+1]^+ / 34.7 \times 100 / 1.1 = 6)$

$$M+1^+ = 2.29$$

- 1

Question 4

9701/22 N25 ■ Q4 ■ 16 marks

- 4 Fig. 4.1 shows how propane, C_3H_8 , can be converted to propanoic acid, $\text{CH}_3\text{CH}_2\text{COOH}$.

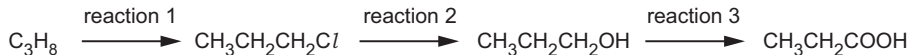
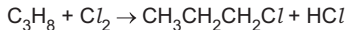


Fig. 4.1

- (a) Reaction 1 in Fig. 4.1 takes place in the presence of sunlight.



The reaction takes place via initiation, propagation and termination steps.

- (i) Name the mechanism shown by reaction 1.

Question 4

- (ii) Complete the mechanism for reaction 1.

Construct equations to describe the steps of the mechanism.



Question 4

Question 4

Question 4

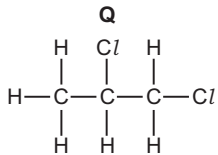
- - - [3]

(iii) Reaction 1 is initiated by the bond fission of Cl_2 .

State the type of bond fission shown in the initiation step.

Question 4

(iv) Compound **Q** is a by-product of reaction 1.



Name **Q**.

Question 4

- (v) The molecular formula of **Q** is $\text{C}_3\text{H}_6\text{Cl}_2$.

Identify the types of structural isomerism and stereoisomerism that a molecule with molecular formula $\text{C}_3\text{H}_6\text{Cl}_2$ can show.

Question 4

Question 4

[2]

(b) State the reagent and solvent required for reaction 2.

Question 4

- (c) Reaction 3 takes place when $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ is heated under reflux with acidified potassium dichromate(VI) solution.
- (i) State the colour change that takes place in the reaction mixture.

Question 4

- (ii) Construct an equation to represent reaction 3. Use [O] to represent an atom of oxygen from the oxidising agent.

Question 4

(d) $\text{CH}_3\text{CH}_2\text{COOH}$ reacts with an unsaturated alcohol **R** to form unsaturated ester **S**.

(i) State the **type** of reaction that forms **S**.

Question 4

- (ii) The infrared spectrum of **S** is shown in Fig. 4.2.

Question 4

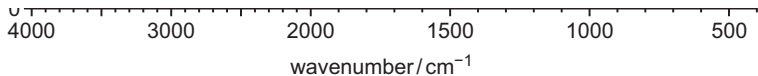


Fig. 4.2

Three absorptions in the infrared spectrum in Fig. 4.2 confirm that **S** is an ester and is unsaturated.

- Write **1**, **2** or **3** on Fig. 4.2 against each of these three absorptions.
- Complete Table 4.1 to show which bond is responsible for each absorption that you have identified in Fig. 4.2.

Table 4.1

absorption	1	2	3
bond responsible			

Question 4

[3]

Question 4

Table 4.2

bond	functional groups containing the bond	characteristic infrared absorption range (in wavenumbers)/cm ⁻¹
C–O	hydroxy, ester	1040–1300
C=C	aromatic compound, alkene	1500–1680
C=O	amide carbonyl, carboxyl ester	1640–1690 1670–1740 1710–1750
C≡N	nitrile	2200–2250
C–H	alkane	2850–2950
N–H	amine, amide	3300–3500
O–H	carboxyl hydroxy	2500–3000 3200–3650

Question 4

| | nyaroxy

|

3200–3650

|

Question 4

- (iii) The mass spectrum of **S** shows the following peaks.

Table 4.3

peak	relative abundance
M^+	4.7
$[M+1]^+$	0.31

Use Table 4.3 to calculate the number of carbon atoms in **S**.

Question 4

[Total: 16]

Important values, constants and standards

molar gas constant	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
Faraday constant	$F = 9.65 \times 10^4 \text{ C mol}^{-1}$
Avogadro constant	$L = 6.02 \times 10^{23} \text{ mol}^{-1}$
electronic charge	$e = -1.60 \times 10^{-19} \text{ C}$
molar volume of gas	$V_m = 22.4 \text{ dm}^3 \text{ mol}^{-1}$ at s.t.p. (101 kPa and 273 K) $V_m = 24.0 \text{ dm}^3 \text{ mol}^{-1}$ at room conditions
ionic product of water	$K_w = 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ (at 298 K (25 °C))
specific heat capacity of water	$c = 4.18 \text{ kJ kg}^{-1} \text{ K}^{-1}$ ($4.18 \text{ J g}^{-1} \text{ K}^{-1}$)

18	2	1e	alium	4.0	10	1e	neon	20.2	18	Ar	argon	39.9	36	Kr	rypton	83.8	54	xe	krypton	31.3	86	zn	zinc	65.4	118	og	oganesson	289
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Question 4

[illegible]

Question 4

The Periodic Table of Elements

Group

Key mic number ic symbol ame e atomic mass	1 H hydrogen 1.0
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5	6	7	8	9	10	11
23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5
41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium —	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9
73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0
105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —

59	Pr	neodymium	140.9	60	Nd	neodymium	144.2	61	Pm	promethium	—	62	Sm	samarium	150.4	63	Eu	euroium	152.0	64	Gd	gadolinium	157.3	65	Tb	terbium	158.9
91	Pa	protactinium	231.0	92	U	uranium	238.0	93	Np	neptunium	—	94	Pu	plutonium	—	95	Am	americium	—	96	Cm	curium	—	97	Bk	berkelium	—

Question 4

1	2			
3	4			atom relativ
Li lithium 6.9	Be beryllium 9.0			
11	12	3	4	
Na sodium 23.0	Mg magnesium 24.3			
19	20	21	22	
K potassium 39.1	Ca calcium 40.1	Sc scandium 45.0	Ti titanium 47.9	
37	38	39	40	
Rb rubidium 85.5	Sr strontium 87.6	Y yttrium 88.9	Zr zirconium 91.2	
55	56	57–71	72	
Cs caesium 132.9	Ba barium 137.3	lanthanoids	Hf hafnium 178.5	
87	88	89–103	104	
Fr francium –	Ra radium –	actinoids	Rf rutherfordium –	

lanthanoids

57	58	pre
La lanthanum 138.9	Ce cerium 140.1	
89	90	p
Ac actinium –	Th thorium 232.0	

actinoids

Solution 4

(a)(i)

Mark scheme

- free-radical substitution
- 1
- 9701/22
- October/November 2025

Solution 4

(a)(ii) Mark scheme

- M1 $\text{C}_3\text{H}_8 + \text{Cl} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2 + \text{HCl}$
- OR $\text{C}_3\text{H}_8 + \text{Cl} \rightarrow \text{C}_3\text{H}_7 + \text{HCl}$ M2
- $\text{CH}_3\text{CH}_2\text{CH}_2 + \text{Cl}_2 \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} + \text{Cl}$
- OR $\text{C}_3\text{H}_7 + \text{Cl}_2 \rightarrow \text{C}_3\text{H}_7\text{Cl} + \text{Cl}$ etc M3
- $\text{CH}_3\text{CH}_2\text{CH}_2 + \text{Cl} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$
- OR $\text{C}_3\text{H}_7 + \text{Cl} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$
- 3

Solution 4

(a)(iii)

Mark scheme

- homolytic
- 1

(a)(iv)

Mark scheme

- 1,2-dichloropropane
- 1

Solution 4

(a)(v)

Mark scheme

- M1 (type of structural isomerism) positional **M2**
- (type of stereoisomerism) optical
- 2

Solution 4

(b)

Mark scheme

- sodium hydroxide AND water
- 1

Solution 4

(c)(i)

Mark scheme

- orange to green
- 1

(c)(ii)

Mark scheme

- $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + 2[\text{O}] \rightarrow \text{CH}_3\text{CH}_2\text{COOH} + \text{H}_2\text{O}$
- 1

Solution 4

(d)(i)

Mark scheme

- condensation
- 1

Solution 4

(d)(ii)

Mark scheme

- M1 absorption labelled at approx. 1750 cm^{-1} identified as $\text{C}=\text{O}$ **M2**
- absorption labelled at approx. 1650 cm^{-1} identified as $\text{C}=\text{C}$ **M3**
- absorption labelled at approx. 1170 cm^{-1} identified as $\text{C}-\text{O}$
- 3

Solution 4

(d)(iii)

Mark scheme

- $(0.31 / 4.7 \times 100 / 1.1) = 6$ carbon atoms
- 1

Question 4

9701/24 N25 ■ Q4 ■ 16 marks

- 4 Compounds **P** and **Q** are structural isomers.



Fig. 4.1

- (a) (i) Define structural isomerism.

Question 4

(ii) **P** shows geometrical isomerism.

Draw the geometrical isomer of **P**. Explain why the two isomers are **not** identical.

geometrical isomer of **P**

Question 4

[2]

(iii) Both **P** and **Q** react with aqueous bromine.

Name the mechanism of this reaction.

Question 4

- (iv) **Q** is oxidised by hot concentrated acidified $\text{KMnO}_4(\text{aq})$, forming two different organic products.

Construct an equation for this reaction. Use $[\text{O}]$ to represent an atom of oxygen from the oxidising agent.

Question 4

(v) **Q** reacts with HBr(g) to produce two structural isomers, **R** and **S**, as shown in Fig. 4.2.

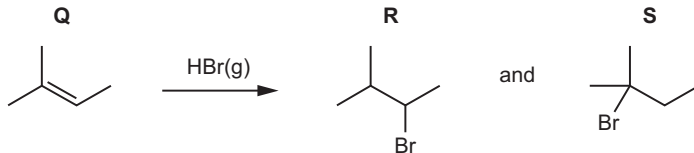


Fig. 4.2

State and explain why isomer **S** is the major product of the reaction.

Question 4

(vi) The mass spectrum of **R** shows peaks at $m/e = 150$ and $m/e = 152$.

Suggest structures for the ions responsible for these peaks.

peak at $m/e = 150$

peak at $m/e = 152$

Question 4

[2]

(b) Fig. 4.3 shows a synthesis starting from **T**, a different isomer of **R** and **S**.

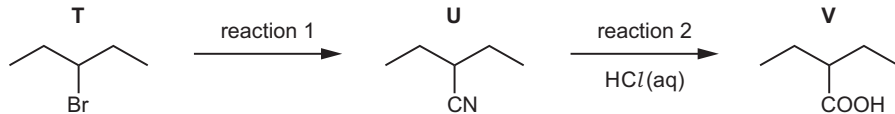


Fig. 4.3

(i) Identify the reagent and conditions for reaction 1.

Question 4

(ii) Reaction 2 is a hydrolysis reaction.

Construct an equation for reaction 2.

Question 4

- (iii) **V** reacts with propan-2-ol in the presence of a catalytic amount of H_2SO_4 to form organic compound **W**.

Complete Table 4.1 to give details of this reaction.

Table 4.1

	reaction of V with propan-2-ol
type of reaction	
functional group formed	
molecular formula of organic product W	

Question 4

131

Question 4

[3]

[Total: 16]

Important values, constants and standards

molar gas constant	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
Faraday constant	$F = 9.65 \times 10^4 \text{ C mol}^{-1}$
Avogadro constant	$L = 6.02 \times 10^{23} \text{ mol}^{-1}$
electronic charge	$e = -1.60 \times 10^{-19} \text{ C}$
molar volume of gas	$V_m = 22.4 \text{ dm}^3 \text{ mol}^{-1}$ at s.t.p. (101 kPa and 273 K) $V_m = 24.0 \text{ dm}^3 \text{ mol}^{-1}$ at room conditions
ionic product of water	$K_w = 1.00 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$ (at 298 K (25 °C))
specific heat capacity of water	$c = 4.18 \text{ kJ kg}^{-1} \text{ K}^{-1}$ (4.18 $\text{J g}^{-1} \text{ K}^{-1}$)

| | | | | | | | | |

Question 4

Question 4

The Periodic Table of Elements

Group

Key											
	atomic number	atomic symbol	name	relative atomic mass							
	1	H	hydrogen	1.0							

5	6	7	8	9	10	11
23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5
41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium —	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9
73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0
105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —

59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium —	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9
91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —

Question 4

1		2					
3		4					
Li lithium 6.9		Be beryllium 9.0					
11		12					
Na sodium 23.0		Mg magnesium 24.3		3		4	
19		20		21		22	
K potassium 39.1		Ca calcium 40.1		Sc scandium 45.0		Ti titanium 47.9	
37		38		39		40	
Rb rubidium 85.5		Sr strontium 87.6		Y yttrium 88.9		Zr zirconium 91.2	
55		56		57–71		72	
Cs caesium 132.9		Ba barium 137.3		lanthanoids		Hf hafnium 178.5	
87		88		89–103		104	
Fr francium —		Ra radium —		actinoids		Rf rutherfordium —	

at
re

lanthanoids

57	58
La lanthanum 138.9	Ce cerium 140.1
89	90
Ac actinium -	Th thorium 232.0

actinoids

Solution 4

(a)(i)

Mark scheme

- M1 (molecules with the) same molecular formula / same number of atoms of each element **M2**
- different structural formulae/structures
- 2

Solution 4

(a)(ii)

Mark scheme

- M2 restricted / lack of / no rotation about $C=C$
- 2

Solution 4

(a)(iii)

Mark scheme

- electrophilic addition
- 1
- 9701/24
- October/November 2025

Solution 4

(a)(iv)

Mark scheme

- M1 $\text{CH}_3\text{COCH}_3 + \text{CH}_3\text{COOH}$ as products M2
- $(\text{CH}_3)_2\text{C} = \text{CHCH}_3 + 3[\text{O}] \rightarrow \text{CH}_3\text{COCH}_3 + \text{CH}_3\text{COOH}$
- 2

Solution 4

(a)(v)

Mark scheme

- M1 (reaction proceeds via a) more stable intermediate / carbocation M2
- because of greater positive inductive effect of more alkyl groups
- 2

(a)(vi)

Mark scheme

- 2

Solution 4

(b)(i)

Mark scheme

- KCN in ethanol (and heat)
- 1

(b)(ii)

Mark scheme

- $(\text{C}_2\text{H}_5)_2\text{CHCN} + 2\text{H}_2\text{O} + \text{HCl} \rightarrow (\text{C}_2\text{H}_5)_2\text{CHCOOH} + \text{NH}_4\text{Cl}$
- 1

Solution 4

(b)(iii) Mark scheme

- reaction of V with
- propan-2-ol
- type of reaction (M1)
- condensation
- functional group formed (M2)
- ester
- molecular formula of
- organic product W (M3)

Solution 4

- $\text{C}_9\text{H}_{18}\text{O}_2$

- 3