GradeMax

* 0000800000001 * DFD

CAMBRIDGE
International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8970028214

CHEMISTRY **9701/44**

Paper 4 A Level Structured Questions **May/June 2026**

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.
- Important values, constants and standards are printed in the question paper.

This document has **28** pages. Any blank pages are indicated.

DC (SL/SW) 364869/4
© Cambridge University Press & Assessment 2026

[Turn over

GradeMax

1 **(a)** Dilute sodium hydroxide, NaOH(aq), is electrolysed.

Identify the gas produced at the anode, and write a half-equation for the reaction involved.

gas produced at the anode .....

half-equation .....

[2]

(b) Molten lead bromide, $PbBr_2(l)$, is electrolysed using a current of 2.40 A for 12.0 minutes.

Bromine gas, $Br_2(g)$, is produced at the anode.

(i) Calculate the amount, in mol, of $Br_2(g)$ produced.

amount of $Br_2(g)$ = ... mol [2]

(ii) The $Br_2(g)$ is collected and its volume is measured at a pressure of 101 kPa and a temperature of 380 °C.

Use the ideal gas equation to calculate the volume of $Br_2(g)$ collected under these conditions.

Give your answer in dm^3 to **three** significant figures.

Show your working.

volume of $Br_2(g)$ = ... dm^3 [1]

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

© Cambridge University Press & Assessment 2026

GradeMax

(c) In a different experiment, molten sodium chloride, NaC*l*(l), is electrolysed.

36 000 C of charge is transferred. 8.51 g of sodium metal is produced.

Calculate a value for the Avogadro constant, *L*.

Show your working.

Give your answer to **three** significant figures.

L = ... mol^{-1} [2]

[Total: 7]

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

© Cambridge University Press & Assessment 2026

GradeMax

2 **(a)** Define strong acid and weak acid.

strong acid .....

weak acid .....

[2]

(b) A 1.00 mol dm^{-3} solution of NaOH(aq) is slowly added to a solution containing ethanedioic acid, HOOCCOOH(aq), until the solution is alkaline.

During the addition of NaOH(aq), two organic conjugate acid–base pairs are formed in the mixture.

Use the formulas of the species involved to identify the **two** different **organic** conjugate acid–base pairs.

pair 1: ....

conjugate acid conjugate base

pair 2: ....

conjugate acid conjugate base

[1]

(c) A solution of ethanoic acid, $CH_3COOH(aq)$, mixed with calcium ethanoate, $Ca(CH_3COO)_2(aq)$, acts as a buffer solution.

(i) Write an equation for a reaction that has calcium ethanoate as one of the products.

..... [2]

(ii) Define buffer solution.

.....

.....

..... [1]

(iii) Write **two** equations to explain how a buffer solution containing $CH_3COOH(aq)$ and $Ca(CH_3COO)_2(aq)$ can control pH.

.....

..... [2]

© Cambridge University Press & Assessment 2026

DO NOT WRITE IN THIS MARGIN

GradeMax

(d) The pH of a solution of sodium hydroxide, NaOH, is 11.34.

Calculate the pH of a solution of barium hydroxide, $Ba(OH)_2$, of the same concentration.

pH = ... [3]

(e) **(i)** Define partition coefficient, K_{pc}.

.....

..... [1]

(ii) Equal volumes of butan-1-ol, $CH_3CH_2CH_2CH_2OH$, and water are added to a separating funnel. 6.00 g of substance **A** is added to this mixture.

The separating funnel is shaken until all of **A** has dissolved. It is left to stand until no further change takes place.

5.32 g of **A** is found to be dissolved in the aqueous layer.

Calculate the partition coefficient, K_{pc}, of **A** between butan-1-ol and water.

Your answer should be less than 1.00.

K_{pc} = ... [1]

(iii) A similar experiment is performed to find the partition coefficient, K_{pc}, of **A** between cyclohexane, C_6H_{12}, and water.

Predict whether this K_{pc} is greater than, equal to, or less than your answer to **2(e)(ii)**.

Explain your answer.

K_{pc} of **A** between C_6H_{12} and water is ..... my answer to **2(e)(ii)**.

explanation .....

.....

.....

[3]

[Total: 16]

© Cambridge University Press & Assessment 2026

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

3 Nitrogen dioxide reacts with fluorine as shown.

$$2NO_2(g) + F_2(g) \rightarrow 2NO_2F(g)$$

The rate equation for this reaction is shown.

$$\text{rate} = k[NO_2][F_2]$$

(a) Complete Table 3.1.

Table 3.1

order of the reaction with respect to $[NO_2]$	
order of the reaction with respect to $[F_2]$	
overall order of the reaction	

[1]

(b) Table 3.2 shows data from three experiments. The table is incomplete.

Table 3.2

experiment	$[NO_2]$ / mol dm^{-3}	$[F_2]$ / mol dm^{-3}	rate / mol dm^{-3} s^{-1}
1	0.0250	0.0300	3.45×10^{-6}
2	0.0250		1.38×10^{-5}
3	0.0125	0.1200	

(i) Complete Table 3.2, stating the concentration of F_2 in experiment 2 and the rate of the reaction in experiment 3. [2]

(ii) Calculate the rate constant, *k*, under these conditions. Include the units of *k*.

k = ...

units .....

[2]

© Cambridge University Press & Assessment 2026

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

GradeMax

(c) The experiment is performed again using a large excess of NO_2.

Under these conditions, the reaction behaves as if it is overall first order. The rate equation is shown.

$$\text{rate} = k'[F_2]$$

When the initial value of $[F_2]$ is 4.00×10^{-5} mol dm^{-3} and the rate of the reaction is measured in mol dm^{-3} s^{-1}, the value of k' is 0.0101.

Calculate the half-life of the reaction, $t_{\frac{1}{2}}$, under these conditions.

$t_{\frac{1}{2}}$ = ... s [1]

(d) Suggest a two-step mechanism for the reaction between nitrogen dioxide and fluorine.

Identify which of the two steps is the slower step.

$$2NO_2(g) + F_2(g) \rightarrow 2NO_2F(g)$$

$$\text{rate} = k[NO_2][F_2]$$

step 1 ..... → .....

step 2 ..... → .....

slower step .....
[2]

[Total: 8]

DO NOT WRITE IN THIS MARGIN

GradeMax

4 **(a)** **(i)** Define first electron affinity.

.....

..... [1]

(ii) Describe the trend in the first electron affinities of chlorine, bromine and iodine.

Explain your answer.

.....

.....

.....

.....

..... [2]

(b) The lattice enthalpy of potassium bromide, KBr, is $-670\,kJ\,mol^{-1}$.

Predict values, in $kJ\,mol^{-1}$, for the lattice enthalpies of sodium chloride, NaC*l*, and magnesium oxide, MgO. No calculations are needed.

Explain your predictions.

lattice enthalpy of NaC*l* = ... $kJ\,mol^{-1}$

explanation .....

.....

.....

lattice enthalpy of MgO = ... $kJ\,mol^{-1}$

explanation .....

.....

.....

[4]

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

© Cambridge University Press & Assessment 2026

GradeMax

(c) Magnesium reacts with chlorine as shown.

$$Mg(s) + Cl_2(g) \rightarrow MgCl_2(s) \qquad \Delta S^{\ominus} = -198.3\,J\,mol^{-1}\,K^{-1}$$

(i) Define entropy.

.....

..... [1]

(ii) Explain why the sign of the entropy change for this reaction is negative.

.....

..... [1]

(iii) Predict whether the reaction between magnesium and chlorine becomes more or less spontaneous as temperature increases.

Explain your answer.

The reaction becomes ..... spontaneous.

explanation .....

.....

.....

[2]

[Total: 11]

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

© Cambridge University Press & Assessment 2026

GradeMax

5 **(a)** The Group 2 nitrates undergo thermal decomposition.

(i) Write an equation for the thermal decomposition of anhydrous calcium nitrate.

..... [1]

(ii) Describe the trend in thermal stability of the nitrate compounds going down Group 2.

Explain your answer.

trend .....

explanation .....

.....

.....

.....

.....

[2]

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

© Cambridge University Press & Assessment 2026

GradeMax

(b) (i) A spatula measure of magnesium hydroxide, $Mg(OH)_2(s)$, is stirred into a beaker of $H_2SO_4(aq)$. A solution is formed with no solid remaining.

A spatula measure of barium hydroxide, $Ba(OH)_2(s)$, is stirred into a different beaker of $H_2SO_4(aq)$. A permanent precipitate is seen.

Explain these observations.

.....

.....

..... [1]

(ii) A spatula measure of $Mg(OH)_2(s)$ is stirred into a beaker of water. Very little of the solid dissolves.

A spatula measure of $Ba(OH)_2(s)$ is stirred into a different beaker of water. A solution is formed with no solid remaining.

Explain these observations in terms of the energy changes involved.

.....

.....

.....

.....

..... [3]

[Total: 7]

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

GradeMax

6 Transition elements can form complex ions.

(a) Define complex.

.....

..... [1]

(b) Rhodium ions, Rh^{3+}, form ten different octahedral complexes with chloride and ammonia ligands, including isomers.

These complexes have the formula $[Rh(NH_3)_xCl_y]^n$ where *x* and *y* can be any integer from zero to six, and *n* represents a charge between 3– and 3+.

(i) Complexes **B** and **C** both contain Rh^{3+}, chloride and ammonia ligands.

B has a 2– charge. **C** has a 1+ charge.

State the values of *x* and *y* in **B** and in **C**.

x in **B** = ... *y* in **B** = ...

x in **C** = ... *y* in **C** = ...

[2]

(ii) Complex **D**, $[Rh(NH_3)_3Cl_3]$, is uncharged. It exists as a pair of isomers.

State the coordination number of Rh^{3+} in **D**.

..... [1]

(iii) Complete the three-dimensional diagrams in Figure 6.1 to show the two isomers of **D**, $[Rh(NH_3)_3Cl_3]$.

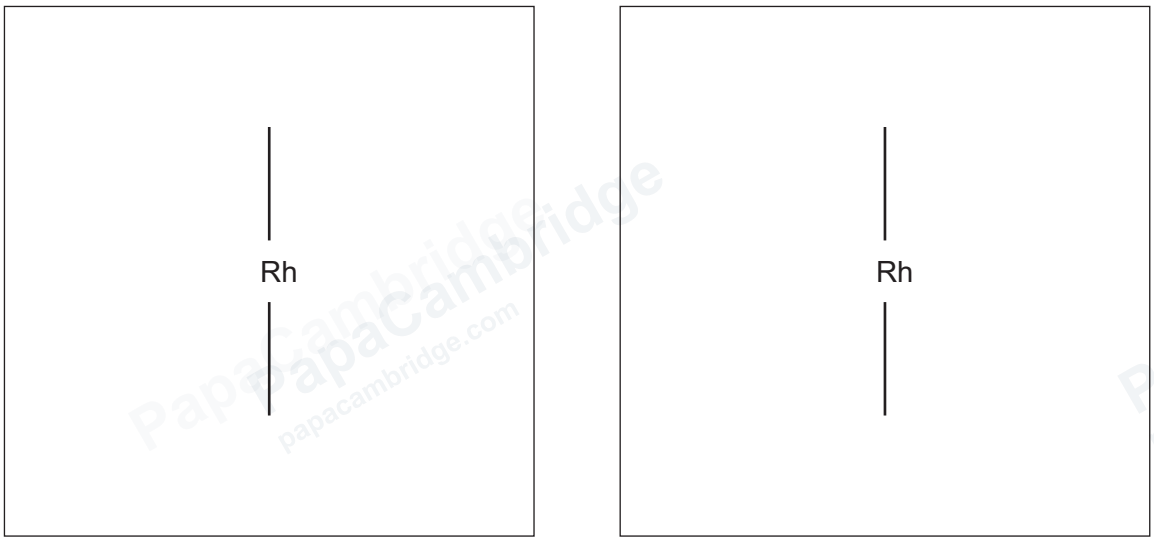


Figure 6.1

[2]

© Cambridge University Press & Assessment 2026

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

GradeMax

(iv) Complete Table 6.1 by placing **one** tick (✓) in **each** row to indicate whether the type of isomerism is shown in **D**.

Table 6.1

type of isomerism	shown in D	
	yes	no
stereoisomerism		
optical isomerism		
geometrical isomerism		

[1]

(c) Nickel(II) salts dissolve in water to form the $[Ni(H_2O)_6]^{2+}$ complex.

Nickel can also form complex **E**, $[Ni(NH_3)_6]^{2+}$. The expression for K_{stab} of **E** is shown.

$$K_{stab} = \frac{[[Ni(NH_3)_6]^{2+}]}{[[Ni(H_2O)_6]^{2+}][NH_3]^6} = 4.80 \times 10^7 \text{ (units not shown)}$$

(i) Define stability constant, K_{stab}.

.....

..... [1]

(ii) State the units of K_{stab} for **E**.

..... [1]

(iii) **F** is an aqueous solution containing ammonia, NH_3, **E** and $[Ni(H_2O)_6]^{2+}$.

In solution **F**, $[NH_3] = 0.455\,\text{mol dm}^{-3}$ and $[\mathbf{E}] = 0.0762\,\text{mol dm}^{-3}$.

Calculate the concentration, in mol dm^{-3}, of $[Ni(H_2O)_6]^{2+}$ in **F**.

concentration of $[Ni(H_2O)_6]^{2+}$ in **F** = ... mol dm^{-3} [2]

© Cambridge University Press & Assessment 2026

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

GradeMax

(iv) Complete the equation for the reaction between $[Ni(H_2O)_6]^{2+}$ and NH_3 forming **E**.

$[Ni(H_2O)_6]^{2+}$ + ... NH_3 → ..... $[Ni(NH_3)_6]^{2+}$ + ... [1]

(v) Name the type of reaction described in **6(c)(iv)**.

..... [1]

[Total: 13]

PapaCambridge papacambridge.com

DO NOT WRITE IN THIS MARGIN

GradeMax

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

Turn over

© Cambridge University Press & Assessment 2026

GradeMax

7 **(a)** The molecular formula of benzene is C_6H_6. The six carbon atoms in benzene form a six-membered ring.

(i) State the C–C–H bond angle in benzene and the hybridisation of each carbon atom.

bond angle .....

hybridisation .....

[1]

(ii) The bonds between neighbouring carbon atoms in benzene involve two types of orbital overlap, giving σ and π bonds.

Name the orbitals involved, and describe the orbital overlap, in σ and π bonds.

orbitals involved in σ bonds .....

orbital overlap in σ bonds .....

orbitals involved in π bonds .....

orbital overlap in π bonds .....

[2]

(b) Figure 7.1 describes a four-step synthesis of phenol, starting with benzene.

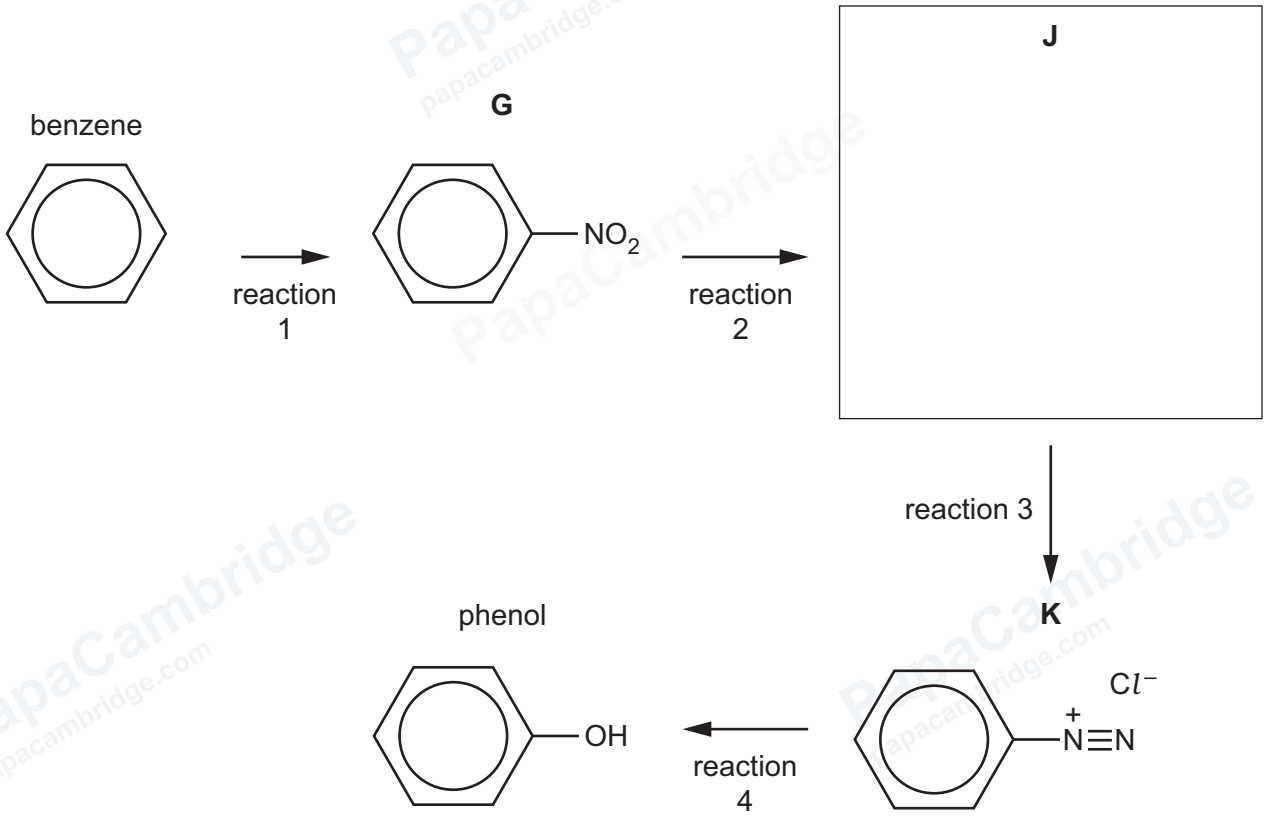


Figure 7.1

© Cambridge University Press & Assessment 2026

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

GradeMax

(i) State the reagents and conditions for reaction 1 in Figure 7.1.

..... [1]

(ii) The reagents and conditions for reaction 2 are concentrated HC*l* and Sn, heated under reflux.

Draw the structure of compound **J** in Figure 7.1. [1]

(iii) State the reagents and conditions for reactions 3 and 4 in Figure 7.1.

reaction 3 .....

reaction 4 .....

[2]

(c) Benzene reacts with ethanoyl chloride, CH_3COCl, in the presence of an $AlCl_3$ catalyst.

In this reaction, the electrophile is the CH_3C^+O ion.

(i) Complete the mechanism in Figure 7.2 for this reaction.

Include all relevant curly arrows and charges.

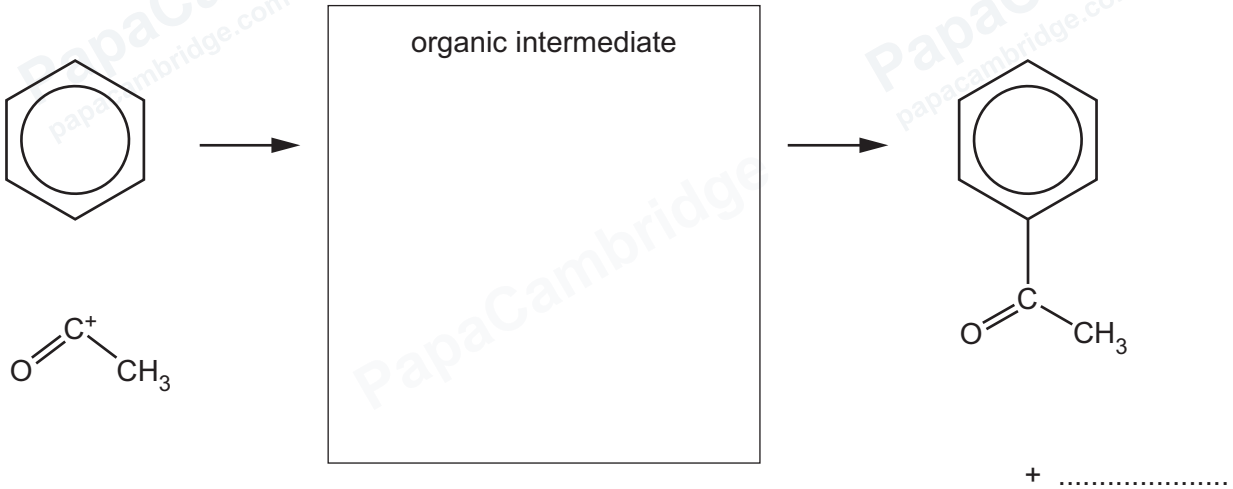


Figure 7.2

[3]

(ii) The product of the reaction shown in Figure 7.2, $C_6H_5COCH_3$, can be oxidised by heating with alkaline $KMnO_4$.

The reaction mixture is then acidified. Benzoic acid, C_6H_5COOH, is produced.

Complete the equation for the overall reaction, where [O] represents one atom of oxygen from the oxidising agent.

$C_6H_5COCH_3$ + ... [O] → C_6H_5COOH + ... + ... [1]

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

GradeMax

(d) Figure 7.3 describes a two-step synthesis of C_6H_5COOH.

$C_6H_5COCH_3$ is treated with two reagents, firstly reagent **M** and secondly reagent **N**, producing C_6H_5COOH.



Figure 7.3

Identify **M** and **N**, neither contains MnO_4^- or $Cr_2O_7^{2-}$.

reagent **M** .....

reagent **N** .....

[2]

[Total: 13]

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

© Cambridge University Press & Assessment 2026

GradeMax

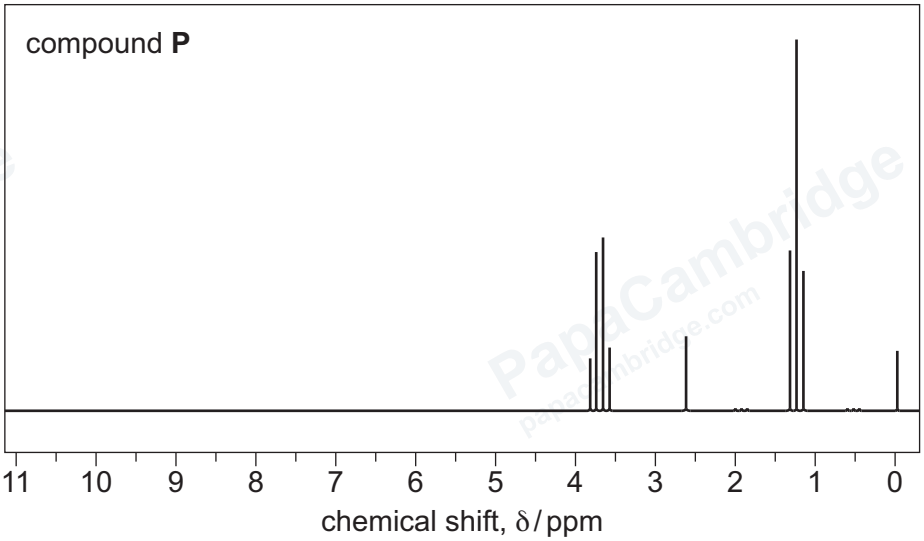
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

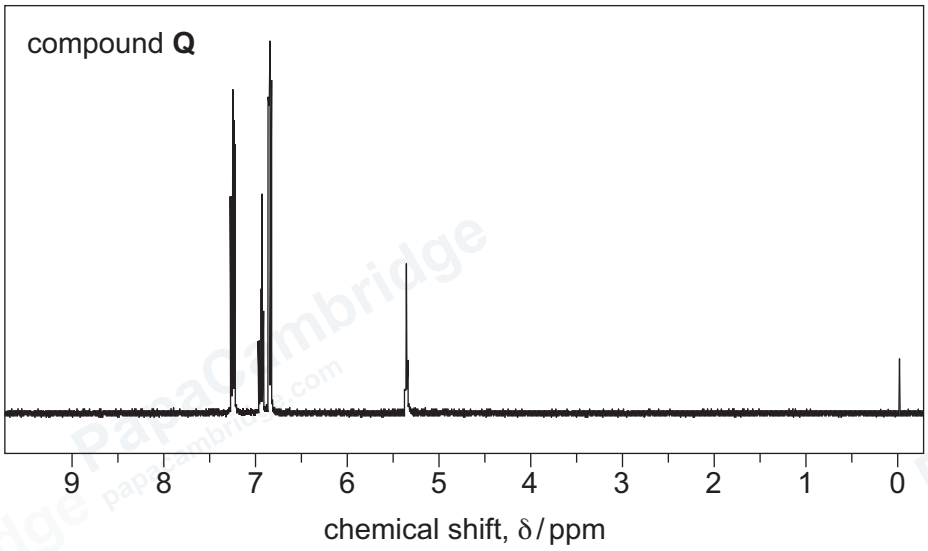
Turn over

© Cambridge University Press & Assessment 2026

GradeMax

8 The proton (^{1}H) NMR spectra of three compounds, **P**, **Q** and **R**, are shown in Figure 8.1. The solvent used is $CDCl_3$ in each case.





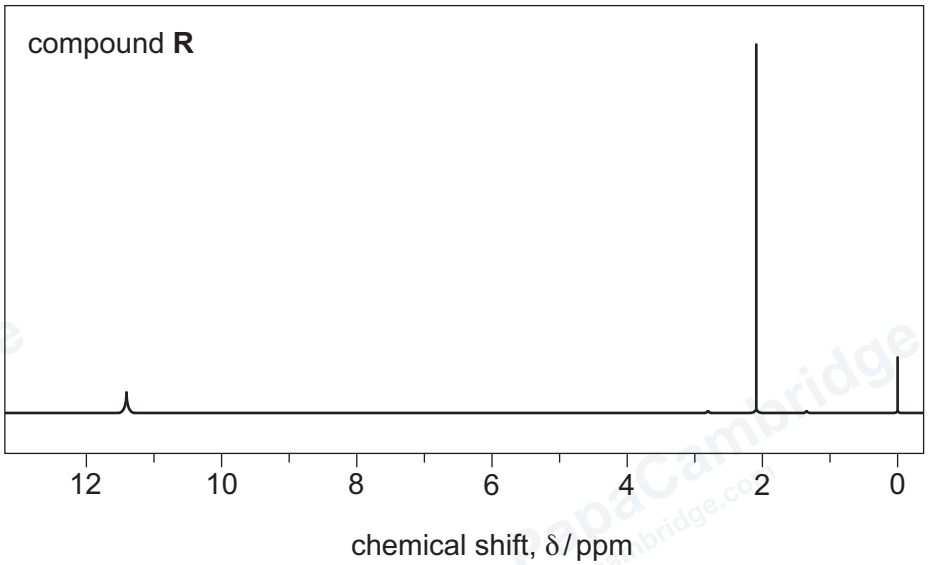


Figure 8.1

© Cambridge University Press & Assessment 2026

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

GradeMax

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

Table 8.1

environment of proton	example	chemical shift range δ/ppm
alkane	–C**H**$_3$, –C**H**$_2$–, >C**H**–	0.9–1.7
alkyl next to C=O	C**H**$_3$–C=O, –C**H**$_2$–C=O, >C**H**–C=O	2.2–3.0
alkyl next to aromatic ring	C**H**$_3$–Ar, –C**H**$_2$–Ar, >C**H**–Ar	2.3–3.0
alkyl next to electronegative atom	C**H**$_3$–O, –C**H**$_2$–O, –C**H**$_2$–Cl	3.2–4.0
attached to alkene	=C**H**R	4.5–6.0
attached to aromatic ring	**H**–Ar	6.0–9.0
aldehyde	**H**COR	9.3–10.5
alcohol	RO**H**	0.5–6.0
phenol	Ar–O**H**	4.5–7.0
carboxylic acid	RCOO**H**	9.0–13.0
alkyl amine	R–N**H**–	1.0–5.0
aryl amine	Ar–N**H**$_2$	3.0–6.0
amide	RCON**H**R	5.0–12.0

(a) Identify the substance responsible for the peak at δ = 0 ppm on each spectrum.

..... [1]

(b) **P**, **Q** and **R** are phenol, ethanol and ethanoic acid, but not necessarily in this order.

(i) Identify which compound is phenol.

Explain your answer, identifying the protons responsible for the peaks in the relevant spectrum.

phenol is compound .....

explanation .....

.....

.....

[2]

© Cambridge University Press & Assessment 2026

GradeMax

(ii) The spectrum of **P** has peaks at δ = 1.2 ppm and δ = 3.7 ppm.

Name the splitting pattern of each of these peaks and give a reason why the peaks are split in this way.

splitting pattern of the peak at δ = 1.2 ppm .....

reason for this splitting pattern .....

.....

splitting pattern of the peak at δ = 3.7 ppm .....

reason for this splitting pattern .....

.....

[2]

(c) The spectrum of **Q** dissolved in D_2O is obtained.

Describe how this spectrum differs from the spectrum of **Q** shown in Figure 8.1.

Explain your answer.

difference .....

explanation .....

[1]

(d) Compare the acidities of phenol, ethanol and ethanoic acid.

Explain your answer.

....

most acidic least acidic

explanation .....

.....

.....

.....

.....

.....

[4]

[Total: 10]

© Cambridge University Press & Assessment 2026 9701/44/M/J/26

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

9 **(a)** Using a gel buffered at pH 7.6, electrophoresis is performed on a mixture of three amino acids: asparagine, histidine and lysine.

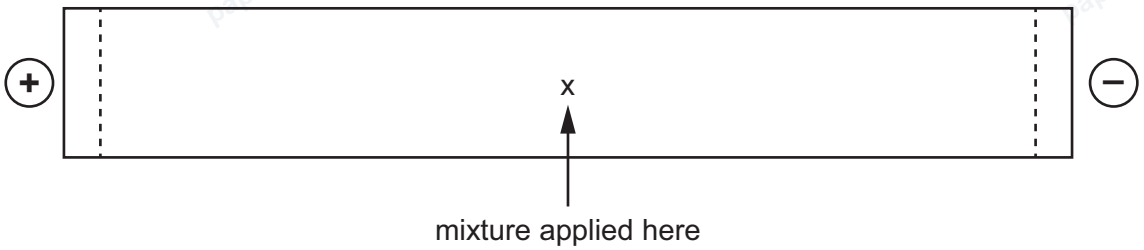


Figure 9.1

The isoelectric points of these amino acids are given in Table 9.1.

Table 9.1

amino acid	isoelectric point
asparagine	5.4
histidine	7.6
lysine	9.7

Describe the direction of movement of each amino acid during the electrophoresis.

Explain your answers.

asparagine .....

.....

histidine .....

.....

lysine .....

.....

[3]

(b) Serine, $H_2NCH(CH_2OH)COOH$, is an amino acid. It exists as a pair of optical isomers.

(i) Draw diagrams in Figure 9.2 to show the three-dimensional structures of the two optical isomers of serine.

Figure 9.2

[1]

(ii) Give the name for a mixture containing equal amounts of the two optical isomers.

..... [1]

(iii) Describe **two** properties that are different for the two optical isomers.

.....

.....

..... [2]

(iv) Serine is treated with an excess of phosphorus pentachloride, PCl_5.

The phosphorus-containing product of this reaction is $POCl_3$.

Complete the equation for this reaction. Use the structural formula of the organic product.

$H_2NCH(CH_2OH)COOH$ + ... $PCl_5 \rightarrow$ .....

..... [2]

[Total: 9]

© Cambridge University Press & Assessment 2026

GradeMax

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

DO NOT WRITE IN THIS MARGIN

GradeMax

10 C*l*OCCOC*l* can be used to make many polymers.

(a) Suggest the name of C*l*OCCOC*l*.

..... [1]

(b) **(i)** C*l*OCCOC*l* reacts with $H_2N(CH_2)_4NH_2$ to form a polymer.

Draw a section of the polymer showing only **one** repeat unit.

Any functional groups should be fully displayed.

[2]

(ii) State the type of polymerisation involved and the linkage between the monomers.

type of polymerisation .....

linkage .....

[1]

(c) When $H_2NCO(CH_2)_2CONH_2$ reacts with a suitable reagent, $H_2N(CH_2)_4NH_2$ forms.

Identify this reagent.

..... [1]

(d) 1,4-dibromobutane can be used to form $H_2N(CH_2)_4NH_2$.

Describe the reagents and conditions used.

.....

..... [1]

[Total: 6]

DO NOT WRITE IN THIS MARGIN

© Cambridge University Press & Assessment 2026

GradeMax



BLANK PAGE

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

© Cambridge University Press & Assessment 2026



GradeMax

DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN
DO NOT WRITE IN THIS MARGIN

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	$L = 6.022 \times 10^{23}\,\text{mol}^{-1}$
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	$c = 4.18\,\text{kJ kg}^{-1}\,\text{K}^{-1}$ ($4.18\,\text{J g}^{-1}\,\text{K}^{-1}$)

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (Cambridge University Press & Assessment) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in our Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge International Education is the name of our awarding body and a part of Cambridge University Press & Assessment, which is a department of the University of Cambridge.

© Cambridge University Press & Assessment 2026

© Cambridge University Press & Assessment 2026

The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1.0										2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	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	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	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	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	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	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 138.9	58 Ce cerium 140.1	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	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0
actinoids	89 Ac actinium –	90 Th thorium 232.0	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 –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

DO NOT WRITE IN THIS MARGIN DO NOT WRITE IN THIS MARGIN DO NOT WRITE IN THIS MARGIN DO NOT WRITE IN THIS MARGIN DO NOT WRITE IN THIS MARGIN

GradeMax