GradeMax

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Monday 20 October 2025

Afternoon (Time: 1 hour 20 minutes)

Paper reference **WCH13/01**

Chemistry

International Advanced Subsidiary/Advanced Level
UNIT 3: Practical Skills in Chemistry I

You must have:
Scientific calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 50.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- A Periodic Table is printed on the back cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Show all your working in calculations and include units where appropriate.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Answer ALL the questions. Write your answers in the spaces provided.

1 Two organic liquids, **S** and **T**, are isomers and have the molecular formula C_3H_8O.
The table shows some chemical tests carried out on **S** and **T**.

(a) Complete the observations for **S** and **T**.

(2)

Test	**S**		**T**	
Heating isomer with acidified potassium dichromate(VI)	Observation	Result	Observation	Result
	....	positive	the same as the observation in **S**	positive
Method of heating	distillation		reflux	
Fehling's test on product of heating isomer with acidified potassium dichromate(VI)	Observation	Result	Observation	Result
	....	positive	no visible change	negative
Addition of sodium carbonate solution to the product	Observation	Result	Observation	Result
	no visible change	negative	no visible change	negative

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(b) The isomers **S** and **T** have the same functional group.

Identify the functional group.

(1)

(c) Draw the **skeletal formulae** for the isomers **S** and **T**.

(2)

Isomer **S**	Isomer **T**

(Total for Question 1 = 5 marks)

2 Two inorganic compounds, **U** and **V**, are Group 2 halides.

(a) (i) In a flame test, compound **U** produces a yellow-red or 'brick' red colour and compound **V** produces a pale green colour.

Give the formula of each of the Group 2 cations present in compounds **U** and **V**.

(2)

Cation in compound **U**

.....

Cation in compound **V**

.....

(ii) Suggest a chemical test and the expected result to confirm the Group 2 cation present in a solution of compound **V**.

(2)

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.....

(b) To test for the halide ions, a few drops of dilute nitric acid and aqueous silver nitrate are added to separate solutions of **U** and **V**.

(i) A solution of **U** forms a yellow precipitate and a solution of **V** forms a cream precipitate.

Give the formula of the halide ion present in a solution of **U** and the formula of the cream precipitate formed by a solution of **V**.

(2)

Formula of the **halide ion** present in **U**

.....

Formula of the **precipitate** formed by **V**

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(ii) Give a chemical test and its expected result to confirm the identity of the halide ion present in compound **V**.

(2)

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(Total for Question 2 = 8 marks)

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3 Washing soda is hydrated sodium carbonate ($Na_2CO_3 \cdot nH_2O$).
The value of n can be determined by titration.

A titration method was carried out using the following procedure.

Step **1** 4.29 g of $Na_2CO_3 \cdot nH_2O$ was weighed into a beaker.

Step **2** The $Na_2CO_3 \cdot nH_2O$ was dissolved in 50 cm^3 of deionised water.

Step **3** All of the solution was transferred to a 250 cm^3 volumetric flask.
The beaker was rinsed with deionised water and these washings were added to the volumetric flask.

Step **4** The volumetric flask was made up to the mark with deionised water.
The flask was stoppered and inverted several times.

Step **5** A burette, pipette and conical flask were all rinsed with deionised water.

Step **6** The burette was rinsed and then filled with 0.125 mol dm^{-3} hydrochloric acid solution.
The pipette was rinsed with the sodium carbonate solution and then used to transfer 25.0 cm^3 of the solution to the conical flask.

Step **7** A few drops of methyl orange were added to the conical flask.
The sodium carbonate solution was titrated with the hydrochloric acid.
This step was repeated until concordant titres were obtained.

(a) (i) Give a reason why the volumetric flask was inverted several times in Step **4**.

(1)

.....

.....

(ii) In Step **5**, the burette, pipette and conical flask were all rinsed with deionised water. In Step **6**, only the burette and pipette were rinsed again with their appropriate solutions.

Give a reason why it was not necessary to rinse the conical flask again.

(1)

.....

.....

.....

(iii) State the colour change at the end-point of the titration in Step **7**.

(1)

From ..... to .....

(b) (i) The following results were obtained in the titration.

Titration	Rough	1	2	3
Final burette reading / cm^3	24.45	48.50	24.95	29.05
Initial burette reading / cm^3	0.15	24.45	1.00	5.05
Titre / cm^3	24.30			

Complete the table and calculate the mean titre, using all concordant values.

(1)

(ii) Complete the equation for the reaction between sodium carbonate and hydrochloric acid.
State symbols are **not** required.

(1)

Na_2CO_3 +

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(iii) Calculate the value of n in the washing soda ($Na_2CO_3 \cdot nH_2O$), using your answers from (b)(i) and (b)(ii).
You **must** show your working.

[Data: A_r H = 1.0 C = 12.0 O = 16.0 Na = 23.0]

(5)

(Total for Question 3 = 10 marks)

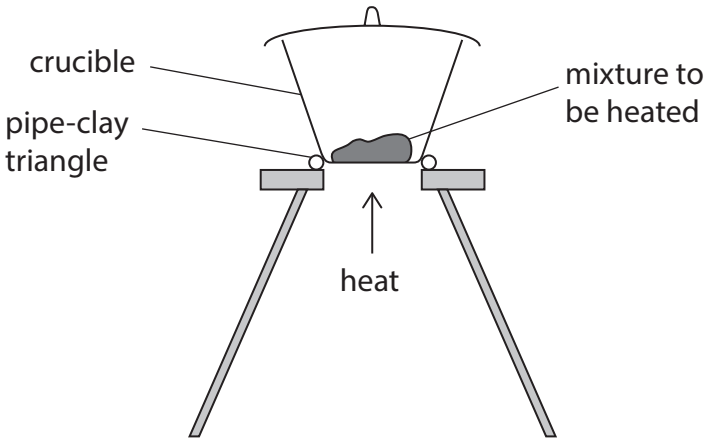
4 A student was provided with a mixture of anhydrous potassium carbonate and anhydrous potassium hydrogencarbonate and carried out an experiment to determine the percentage composition of this mixture.

When anhydrous potassium hydrogencarbonate is heated, it is decomposed, producing potassium carbonate, carbon dioxide and steam.
Anhydrous potassium carbonate is unaffected by heating in this experiment.

(a) Write a balanced equation for the thermal decomposition of potassium hydrogencarbonate.
Include state symbols.

(2)

(b) The student used the apparatus shown.



(i) State why the crucible has a lid and it is important that it is loose-fitting.

(1)

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(ii) Give the reason why this mixture was heated to constant mass.

(1)

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(iii) 12.00 g of a mixture of anhydrous potassium hydrogencarbonate and anhydrous potassium carbonate was weighed by the student.
After heating to constant mass, 8.90 g of solid remained.

Calculate the percentage by mass of anhydrous potassium carbonate present in the initial mixture.
Give your answer to **three** significant figures.

[Data: A_r H = 1.0 C = 12.0 O = 16.0 K = 39.1]

(6)

(iv) Suggest why using a mass of 1.20 g of mixture would result in a less reliable answer.

(1)

.....

.....

.....

(Total for Question 4 = 11 marks)

5 The halogenoalkane 2-chloro-2-methylpropane may be prepared from 2-methylpropan-2-ol using concentrated hydrochloric acid.

$$(CH_3)_3COH + HCl \rightarrow (CH_3)_3CCl + H_2O$$

Procedure

Step **1** Measure 10 cm^3 of 2-methylpropan-2-ol in a measuring cylinder and pour it into a separating funnel.

Step **2** In a fume cupboard, add 20 cm^3 of concentrated hydrochloric acid to the separating funnel, in portions of 3 cm^3.
After each addition, stopper the funnel and invert it several times.
Open and close the tap after each inversion.

Step **3** Allow the separating funnel to stand in the fume cupboard for about 20 minutes. Gently shake it at intervals.

Step **4** Allow the layers to separate in the funnel. Dispose of the aqueous layer.

Step **5** Add sodium hydrogencarbonate solution in 2 cm^3 portions to the separating funnel.
Shake the funnel after each addition, invert and open the tap.
Continue until no more bubbles of carbon dioxide are seen.

Step **6** Allow the layers to separate in the funnel.
Again, dispose of the aqueous layer. Run off the organic layer into a clean conical flask and add anhydrous sodium sulfate.
Stopper the flask, shake the contents and allow this to stand until the liquid becomes clear.

Step **7** Decant the liquid into a clean distillation flask.

Step **8** Distil the liquid, collecting the fraction boiling in the range 47–53 °C.

Step **9** Measure the mass of the 2-chloro-2-methylpropane collected.

[Data: 2-methylpropan-2-ol density = 0.78 g cm^{-3}
2-chloro-2-methylpropane density = 0.87 g cm^{-3}]

(a) (i) Name the type and mechanism for this reaction.

(1)

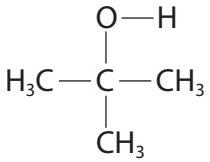
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(ii) Add to the diagram the dipole relevant to the mechanism in (a)(i).

(1)



(b) (i) Step **2** should be carried out in a fume cupboard.

Give a reason why this precaution is necessary.

(1)

.....

.....

(ii) Explain why it is necessary to open the tap of the separating funnel after each inversion in Step **2**.

(2)

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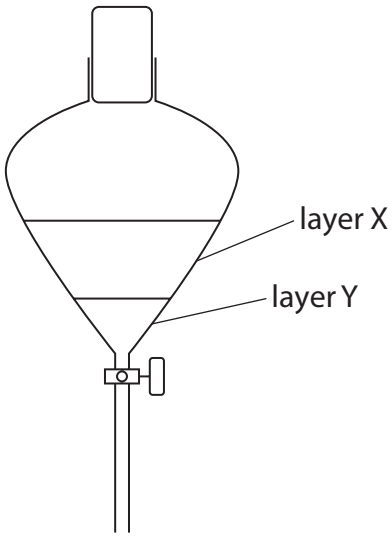
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(iii) The diagram shows the separating funnel in Step **4**.

State, with a reason, which layer, X or Y, is the aqueous layer.

(1)



.....

.....

(iv) Give the reason why sodium hydrogencarbonate was added to the separating funnel in Step **5**.

(1)

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(v) Give the reason why anhydrous sodium sulfate was added in Step **6**.

(1)

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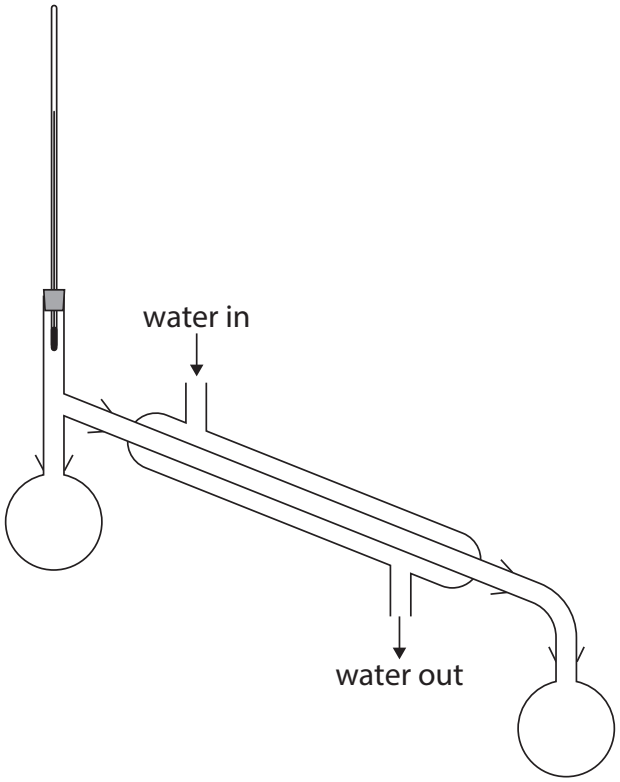
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(vi) The diagram shows a version of the distillation apparatus used in Step **8** prior to the liquid and anti-bumping granules being added.

Identify the three errors, in each case describing the problem that would occur due to this error.

(3)



Error 1

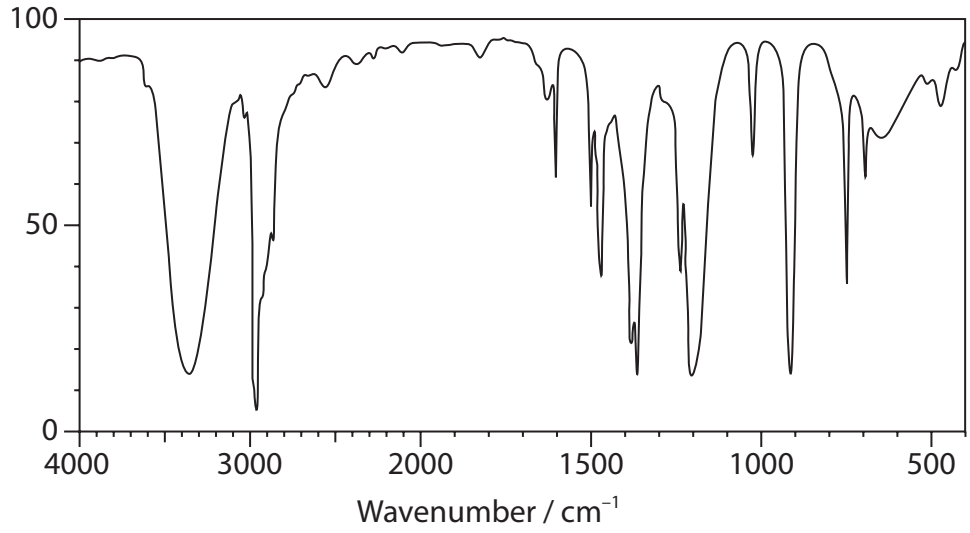
Error 2

Error 3

(c) Describe a significant difference between these spectra and how this difference could be used to monitor the progress of the reaction.

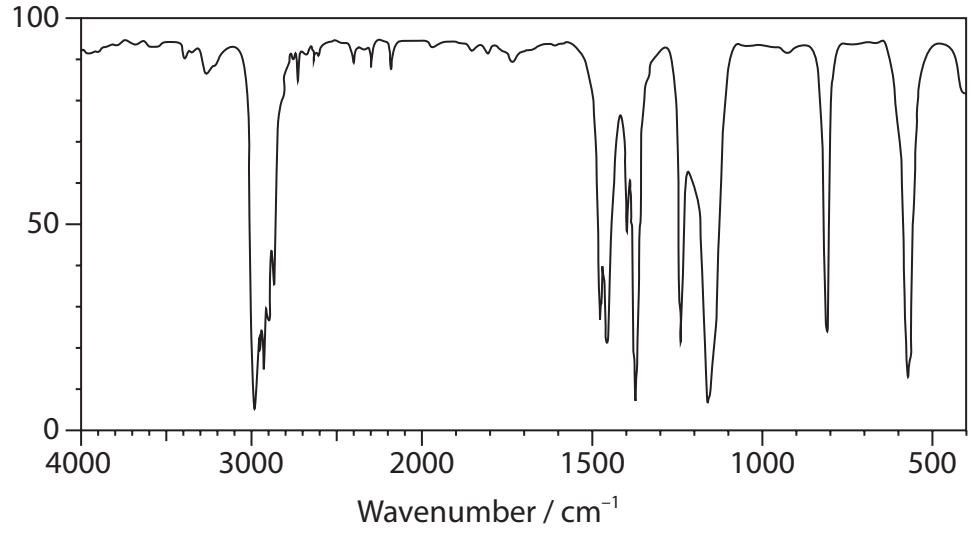
(2)

Transmittance / %



2-methylpropan-2-ol

Transmittance / %



2-chloro-2-methylpropane

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(d) A student started with 10.0 cm^3 of 2-methylpropan-2-ol. They synthesised and collected 5.60 g of pure 2-chloro-2-methylpropane.

$$(CH_3)_3COH + HCl \rightarrow (CH_3)_3CCl + H_2O$$

[Data: 2-methylpropan-2-ol density = 0.78 g cm^{-3}
2-chloro-2-methylpropane density = 0.87 g cm^{-3}]

Calculate the percentage yield.

(3)

(Total for Question 5 = 16 marks)

TOTAL FOR PAPER = 50 MARKS

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8) (18)
							1.0 H hydrogen 1										4.0 He helium 2
(1)	(2)											(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4											10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111							

Key: relative atomic mass / **atomic symbol** / name / atomic (proton) number

Elements with atomic numbers 112-116 have been reported but not fully authenticated

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
232 Th thorium 90	[231] Pa protactinium 91	238 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103

* Lanthanide series

* Actinide series

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