

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	
	Observation	Result	Observation	Result
Heating isomer with acidified potassium dichromate(VI)		positive	the same as the observation in S	positive
Method of heating	distillation		reflux	
	Observation	Result	Observation	Result
Fehling's test on product of heating isomer with acidified potassium dichromate(VI)		positive	no visible change	negative
	Observation	Result	Observation	Result
Addition of sodium carbonate solution to the product	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)

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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)

- (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**



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

(2)

(Total for Question 2 = 8 marks)

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- 3** Washing soda is hydrated sodium carbonate ($\text{Na}_2\text{CO}_3 \cdot n\text{H}_2\text{O}$).
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 $\text{Na}_2\text{CO}_3 \cdot n\text{H}_2\text{O}$ was weighed into a beaker.
- Step 2** The $\text{Na}_2\text{CO}_3 \cdot n\text{H}_2\text{O}$ 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 $0.125 \text{ mol dm}^{-3}$ 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)



- (iii) Calculate the value of n in the washing soda ($\text{Na}_2\text{CO}_3 \cdot n\text{H}_2\text{O}$), 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.

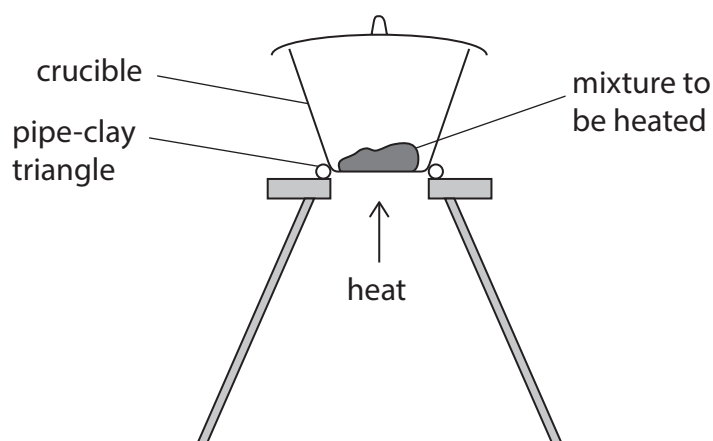
When anhydrous potassium hydrogencarbonate is heated, it is decomposed, producing potassium carbonate, carbon dioxide and steam.

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)

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

(1)



- (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)

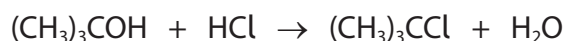
- (iv) Suggest why using a mass of 1.20 g of mixture would result in a less reliable answer.

(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.



Procedure

- Step 1** Measure 10 cm³ of 2-methylpropan-2-ol in a measuring cylinder and pour it into a separating funnel.
- Step 2** In a fume cupboard, add 20 cm³ of concentrated hydrochloric acid to the separating funnel, in portions of 3 cm³. 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 cm³ 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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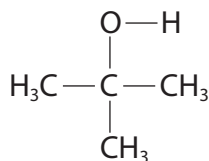
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(ii) Add to the diagram the dipole relevant to the mechanism in (a)(i).

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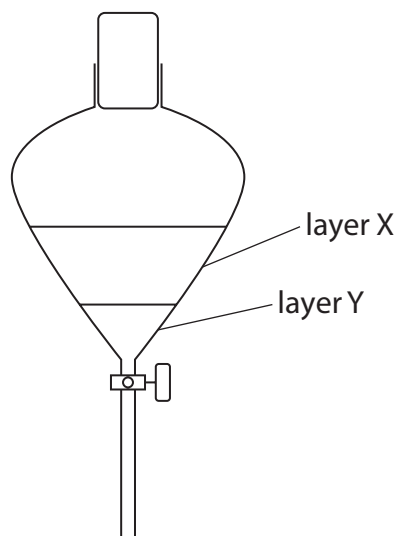
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(iii) The diagram shows the separating funnel in Step 4.

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)

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

(1)

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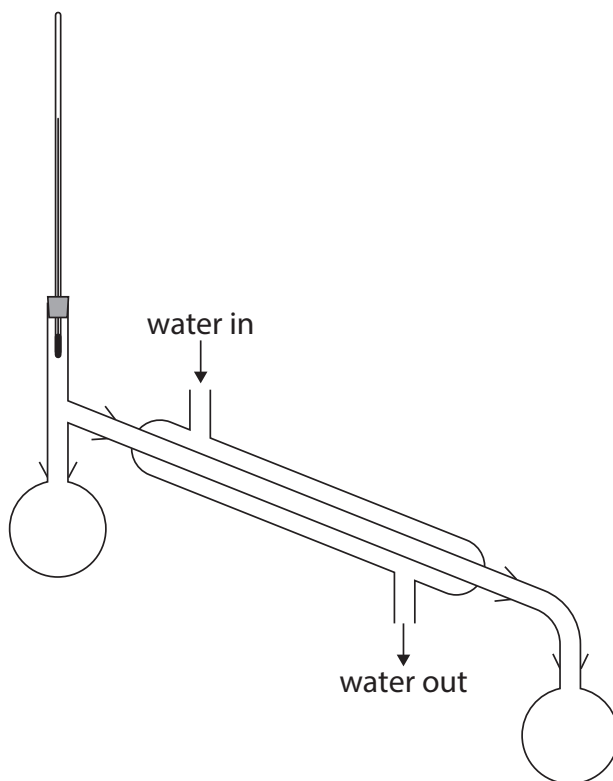
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- (vi) The diagram shows a version of the distillation apparatus used in Step 8 prior to the liquid and anti-bumping granules being added.

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

(3)



Error 1

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.....

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Error 2

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.....

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Error 3

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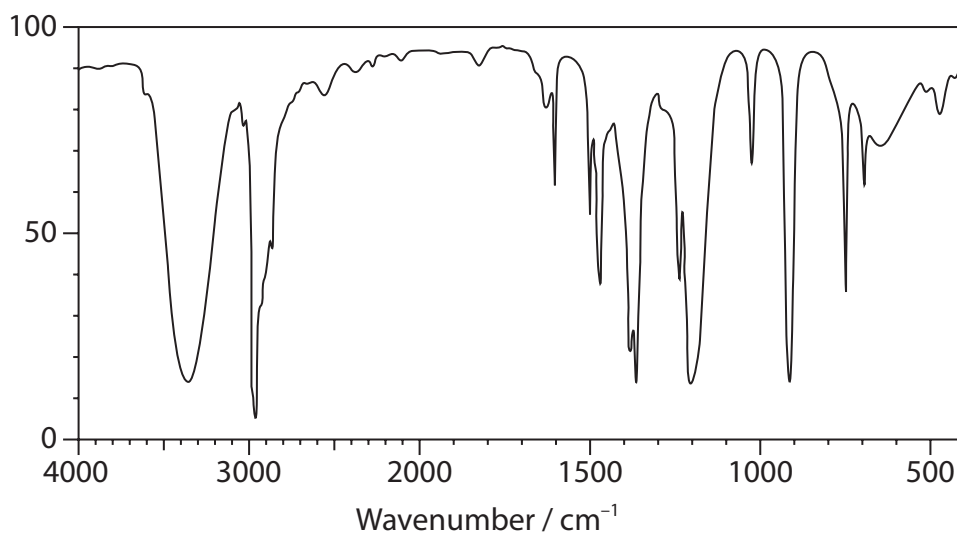
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- (c) Describe a significant difference between these spectra and how this difference could be used to monitor the progress of the reaction.

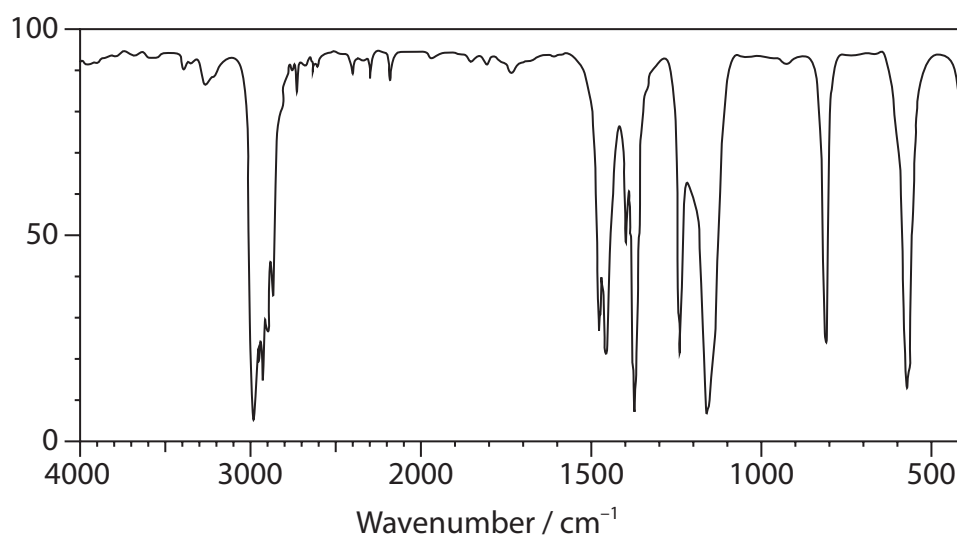
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Transmittance / %



2-methylpropan-2-ol

Transmittance / %



2-chloro-2-methylpropane

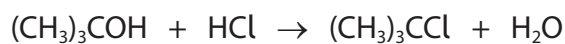
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- (d) A student started with 10.0 cm^3 of 2-methylpropan-2-ol. They synthesised and collected 5.60 g of pure 2-chloro-2-methylpropane.



[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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