Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Tuesday 17 October 2023

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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P 7 5 0 6 2 A 0 1 2 0

Pearson

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

1 A student is given three solid compounds **A**, **B** and **C**.
Each solid contains one cation and one anion.

Two of the cations are known to be sodium and potassium.

(a) The student carried out flame tests on separate samples of each solid to identify the cation in each.

(i) Describe the method for carrying out a flame test.

(3)

(ii) Complete the table of results.

(2)

Compound	Flame colour	**Formula** of cation present
A		Na^+
B		K^+
C	pale green	

(b) The student prepared separate solutions of **A**, **B** and **C** using distilled water and then added dilute nitric acid followed by aqueous silver nitrate to each solution. A precipitate formed in all three mixtures.

(i) Identify, by name or formula, the **three** anions that could be present.

(1)

(ii) Compounds **A**, **B** and **C** each contain a different anion.

Describe the **chemical** tests on the precipitates formed in (b) that could be used to confirm which anion was present in each compound.
Give the results of each test.

(4)

(Total for Question 1 = 10 marks)

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2 The molar volume of carbon dioxide may be determined using the reaction between calcium carbonate and ethanoic acid.
The equation for this reaction is shown.

$$CaCO_3(s) + 2CH_3COOH(aq) \rightarrow Ca(CH_3COO)_2(aq) + H_2O(l) + CO_2(g)$$

Procedure

Step **1** Place 30 cm^3 of 1 mol dm^{-3} ethanoic acid in a boiling tube.

Step **2** Set up an apparatus to collect the carbon dioxide produced over water in a measuring cylinder.

Step **3** Place approximately 0.10 g of calcium carbonate powder in a clean dry weighing bottle.

Step **4** Weigh the weighing bottle and its contents accurately.

Step **5** Remove the bung from the boiling tube and tip the calcium carbonate into the boiling tube.
Quickly replace the bung in the boiling tube.

Step **6** When the reaction is finished, measure the volume of gas collected in the measuring cylinder.

Step **7** Reweigh the weighing bottle.

Step **8** Repeat the experiment five more times, increasing the mass of calcium carbonate by about 0.05 g each time.
Do **not** exceed 0.40 g of calcium carbonate.

(a) Draw a diagram of the apparatus used to carry out the reaction and collect the carbon dioxide produced **over water** in a 100 cm^3 measuring cylinder.
Do **not** show stands or clamps.

(3)

(b) Explain why ethanoic acid is used and not hydrochloric acid.

(2)

(c) A student suggested that the mass of calcium carbonate could be measured by weighing the weighing bottle empty and then when containing the solid.

Give a reason why the method described in Step **4** and Step **7** is preferred.

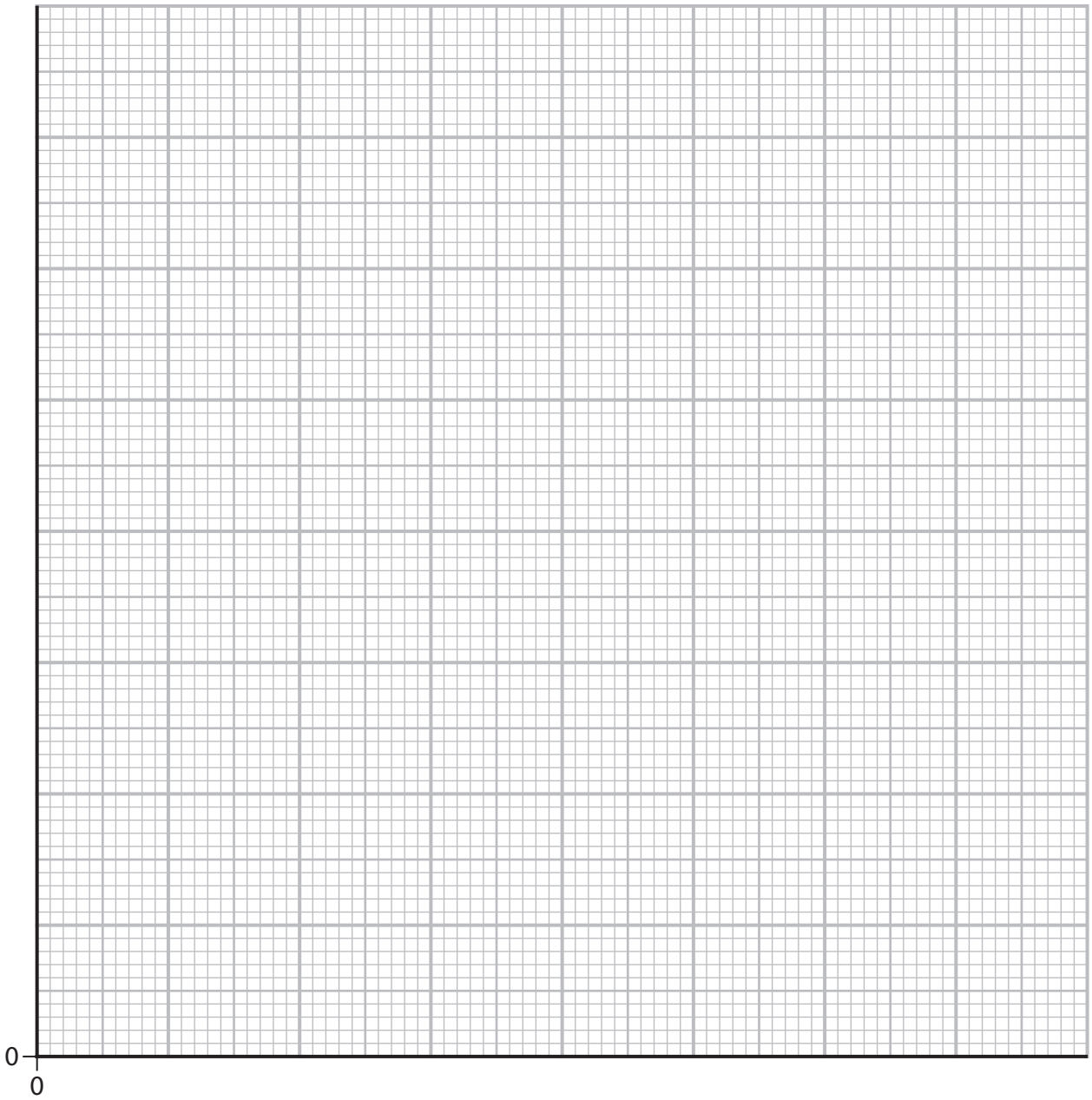
(1)

(d) The results of the experiment are shown.

Mass of calcium carbonate / g	Volume of carbon dioxide / cm^3
0.11	23
0.14	29
0.20	48
0.27	57
0.31	65
0.36	76

(i) Plot the data on the grid.

(3)



(ii) Use the graph to determine the volume of carbon dioxide formed when 0.25 g of calcium carbonate is used.
You **must** show your working on the graph.

(2)

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.....

.....

(iii) Calculate a value for the molar volume of carbon dioxide, using your volume from (d)(ii) and the equation for the reaction.

(3)

(e) Give **two** reasons why the molar volume obtained by this method is **lower** than the Data Booklet value.
Assume that the experiment is carried out correctly and that the gas volume is measured at room temperature and pressure.

(2)

(Total for Question 2 = 16 marks)

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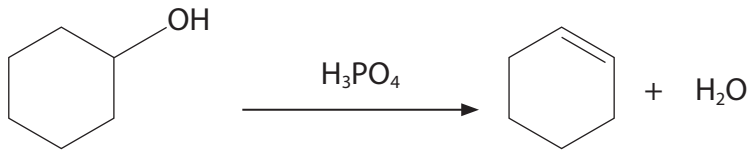
3 Cyclohexene may be prepared from cyclohexanol using 85% phosphoric(V) acid.



A simplified procedure for this preparation is shown.

Step **1** Accurately weigh about 4 g of cyclohexanol into a pear-shaped flask.

Step **2** Add about 0.5 cm^3 of 85% phosphoric(V) acid and a few anti-bumping granules to the flask.

Step **3** Set up the apparatus for fractional distillation.

Step **4** Heat the flask and collect the distillate that contains impure cyclohexene and water.

Step **5** Separate the impure cyclohexene and water, using a separating funnel.

Step **6** Add a few granules of anhydrous calcium chloride to the impure cyclohexene and allow the mixture to stand.

Step **7** Decant the impure cyclohexene into a clean pear-shaped flask. Distil the cyclohexene and weigh the distillate.

Data

Compound	Molar mass / g mol^{-1}	Boiling temperature / °C	Density / g cm^{-3}
cyclohexanol	100	162	0.96
cyclohexene	82	83	0.81

(a) Bottles of cyclohexanol and cyclohexene have the hazard labels shown.

Compound	cyclohexanol	cyclohexene
Hazard symbol		
Hazard		

(i) Complete the table by identifying the hazards.

(1)

(ii) For each compound, state **one** way in which the risk due to the hazard shown could be reduced when carrying out this preparation.

(2)

Cyclohexanol

.....

.....

Cyclohexene

.....

.....

(b) State how anti-bumping granules make liquids boil more smoothly.

(1)

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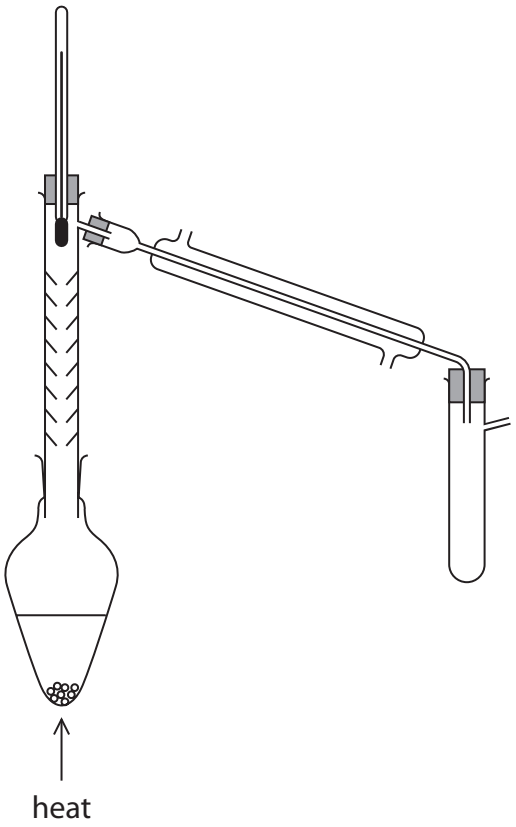
(c) The diagram shows the apparatus used for fractional distillation in Step **4**.



Suggest **two** reasons why fractional distillation is used rather than simple distillation.

(2)

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.....

.....

.....

.....

(d) Draw a diagram of the separating funnel and its contents in Step **5**, labelling each layer.

(2)

(e) Explain the change in appearance of the **liquid** when it is allowed to stand with anhydrous calcium chloride in Step **6**.

(2)

.....

.....

.....

.....

(f) State a suitable temperature **range** for collecting the distillate in Step **7**.

(1)

.....

(g) In this preparation, 3.96 g of cyclohexanol reacted to form 2.09 g of cyclohexene.

Calculate the percentage yield, by mass, in this preparation.

(2)

(h) Separate samples of cyclohexanol and the cyclohexene product were tested with phosphorus(V) chloride and with bromine water.

Complete the table to show the observations.

(2)

Test	Observations	
	cyclohexanol	cyclohexene
addition of phosphorus(V) chloride		
addition of bromine water		

(Total for Question 3 = 15 marks)

4 A student is required to determine the concentration of hydrochloric acid using a solution of sodium carbonate of concentration 0.105 mol dm^{-3}.

Outline procedure

Step **1** Fill a clean burette with the hydrochloric acid.

Step **2** Pipette 25.0 cm^3 of the sodium carbonate solution into a conical flask and add a few drops of methyl orange indicator.

Step **3** Carry out a rough titration.

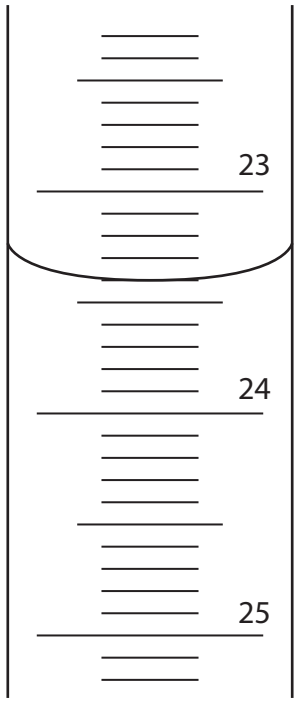
Step **4** Carry out accurate titrations until concordant results are obtained.

(a) State the colour change of the indicator at the end-point of the titration.

(2)

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

(b) The diagram shows the burette at the end-point of the rough titration.



Give the burette reading for this rough titration.

(1)

.....

(c) The student refilled the burette and prepared a second conical flask by adding sodium carbonate solution and methyl orange indicator.

Describe how an accurate titration should then be carried out.

(3)

(d) The mean titre from two accurate titrations was 22.65 cm^3.

Calculate the concentration of the hydrochloric acid, in mol dm^{-3}.
The equation for the reaction is shown.

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$

(3)

(Total for Question 4 = 9 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

* Lanthanide series	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
* Actinide series	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