

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

Pearson Edexcel International Advanced Level

Friday 26 May 2023

Morning (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

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 ►

P71941A

©2023 Pearson Education Ltd.
N:1/1/1/1/1/




Pearson

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

1 This question is about two ionic compounds, **A** and **B**.

(a) Compound **A** is a white crystalline solid that contains one cation and one anion.

(i) A flame test was carried out on solid **A** and a pale green colour was observed.

Identify, by name or formula, the cation present in **A**.

(1)

(ii) Aqueous silver nitrate, acidified with dilute nitric acid, was added to a sample of solid **A** dissolved in distilled water.

A yellow precipitate formed.

Identify, by name or formula, the anion present in **A**.

(1)

(iii) Give the **formula** of **A**.

(1)

(iv) The **anion** present in **A** can be shown by a **different** test on solid **A**.

Give a suitable different test with the expected result to show the identity of this **anion**.

(2)

Test	Expected result

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



(b) Solid **B** is ammonium sulfate.

(i) Give a test, with the expected result, to confirm the presence of the ammonium ion in **B**.

(2)

Test	Expected result

(ii) Give a test, with the expected result, to confirm the presence of the sulfate ion in **B**.

(3)

Test	Expected result

(iii) Write the **ionic** equation for the reaction taking place in (b)(ii). Include state symbols.

(1)

(Total for Question 1 = 11 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



2 Tests are carried out to identify two liquid organic compounds, **C** and **D**.

(a) A small amount of phosphorus(V) chloride, PCl_5 , is added to separate 2 cm^3 samples of each compound.

Observations	
C	D
Misty fumes are given off	Misty fumes are given off

Identify, by name or formula, the misty fumes.

(1)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) 2 cm^3 of aqueous sodium hydrogencarbonate, $\text{NaHCO}_3(\text{aq})$, is added to separate 2 cm^3 samples of each compound.

Any gas given off is tested with limewater.

Observations	
C	D
Bubbles of a colourless gas Limewater turns cloudy	No change

Identify, by name or formula, the gas produced by compound **C**.

(1)



(c) 2 cm³ of Benedict's or Fehling's solution is added to separate 2 cm³ samples of each compound. The test tubes are placed in a warm water bath.

Observations	
C	D
No change	Positive result

Give the expected observation for the positive result produced by liquid **D**. Include the initial and final appearance of the contents of the test tube.

(2)

.....

.....

(d) Both **C** and **D** have the molecular formula C₃H₆O₂.

(i) Deduce the structure of **C** and the **two** possible structures of **D**. Use the molecular formula and the results from (a), (b) and (c).

(3)

Structure of C

Possible structure of D	Possible structure of D

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



P 7 1 9 4 1 A 0 5 1 6

(ii) Some infrared data are given in the table.

Group	Wavenumber range / cm^{-1}
O—H stretching in alcohols	3750–3200
O—H stretching in carboxylic acids	3300–2500
C=O stretching in aldehydes	1740–1720
C=O stretching in ketones	1720–1700
C=O stretching in carboxylic acids	1725–1700
C—H stretching in aldehydes	2900–2820, 2775–2700
C—H stretching in alkanes	2962–2853

State the wavenumber range for one peak that would be present in the infrared spectra of **both C** and **D**, identifying the bond responsible for this peak.

(1)

(iii) A student suggested that the structure of **D** could be identified using mass spectrometry because only one of the possible structures of **D** would have a peak at $m/z = 15$.

Identify which of the possible structures of **D** would be expected to give this peak. Justify your answer.

(2)

(Total for Question 2 = 10 marks)



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

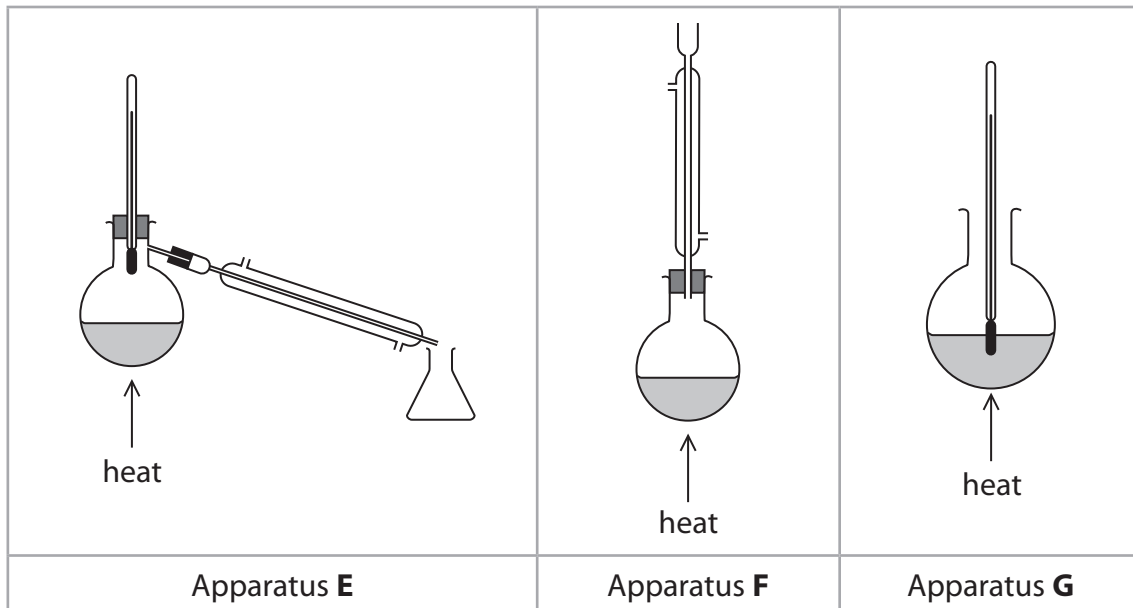
<https://britishstudentroom.com/>

BLANK PAGE



3 This question is about some reactions of butan-1-ol.

(a) A group of students was required to oxidise butan-1-ol to butanoic acid. The students suggested three different types of apparatus for this reaction.



Their teacher told them they should use apparatus F.

(i) Explain why apparatus E is **not** suitable for the oxidation of butan-1-ol to butanoic acid.

(2)

.....

.....

.....

.....

(ii) Give a **different** reason why apparatus G is also **not** suitable for the oxidation of butan-1-ol to butanoic acid.

(1)

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



(iii) Explain why, in apparatus **F**, the water should flow in from the bottom of the condenser.

(2)

<https://britishstudentroom.com/>

(iv) State the reaction **mixture** that can be used to oxidise the butan-1-ol to butanoic acid.

(1)

(v) Give the colour change observed in the flask during this oxidation.

(1)

From to

(b) Butan-1-ol can also form the alkene but-1-ene in an elimination reaction.

(i) Name a suitable chemical reagent to carry out this elimination reaction.

(1)

(ii) Give a chemical test, including the expected result, to confirm the presence of the C=C double bond in but-1-ene.

(2)

(Total for Question 3 = 10 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



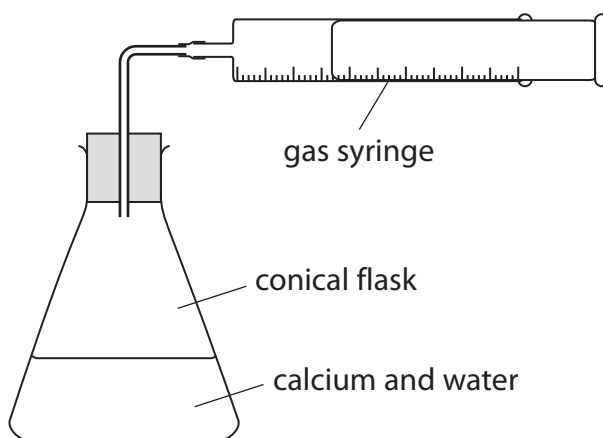
P 7 1 9 4 1 A 0 9 1 6

4 This question is about calcium and calcium hydroxide, $\text{Ca}(\text{OH})_2$.

A student reacted calcium with water to determine a value for the molar volume of hydrogen at room temperature and pressure.

Procedure

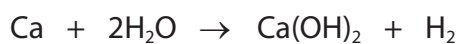
- Step 1 200 cm³ of distilled water (an excess) was transferred to a conical flask.
- Step 2 A small piece of calcium metal was placed in a pre-weighed weighing boat. The boat was then reweighed.
- Step 3 The calcium was dropped into the conical flask and a bung connected to a gas syringe was inserted.
- Step 4 The volume of hydrogen collected was recorded.



Results

Mass of weighing boat / g	1.657
Mass of weighing boat and calcium / g	1.783
Volume of hydrogen collected / cm ³	72.0

The equation for the reaction in the conical flask is shown.



(a) (i) State **two** observations when this reaction takes place.

(2)

.....

.....

.....



- (ii) Calculate the value for the molar volume of hydrogen under these conditions, using the student's results.

Give your answer to an appropriate number of significant figures and include units.

(4)

<https://Britishstudentroom.com/>

- (b) A second student using this method obtained a value of $21.8 \text{ dm}^3 \text{ mol}^{-1}$ for the molar volume of hydrogen.

- (i) Calculate the percentage error in this student's value.
The data book value for the molar volume of hydrogen under these conditions is $23.9 \text{ dm}^3 \text{ mol}^{-1}$.

(1)

- (ii) Give **two** possible reasons why this student obtained a value below the data book value.
Assume the method was followed correctly and there were no measurement errors.

(2)

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



P 7 1 9 4 1 A 0 1 1 1 6

(c) A third student carried out an experiment to determine the concentration of a saturated solution of calcium hydroxide, Ca(OH)_2 , in water at room temperature.

25.0 cm^3 of a saturated solution of calcium hydroxide was pipetted into a conical flask. Three drops of methyl orange indicator were added and the solution was titrated with $0.0400\text{ mol dm}^{-3}$ hydrochloric acid.

The procedure was repeated until concordant titres were obtained.

The results are shown in the table.

Titration	1	2	3	4
Final burette reading / cm^3	26.85	31.25	34.55	27.15
Initial burette reading / cm^3	0.00	5.00	8.00	1.00
Titre / cm^3				
Concordant results (✓)				

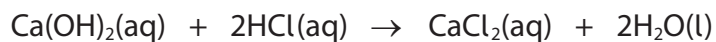
(i) State the colour change observed in the conical flask at the end-point of the titration. (2)

From to

(ii) Complete the table and use the concordant results to calculate the mean titre. (2)



(iii) The reaction taking place in this titration is



Calculate the concentration of the calcium hydroxide solution in g dm^{-3} .

(4)

<https://britishstudentroom.com/>

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(d) Dissolving calcium hydroxide in water is an exothermic process.

Describe what you would see if the saturated solution of calcium hydroxide was heated from room temperature to 50°C . Justify your answer.

(2)

.....

.....

.....

.....

.....

.....

(Total for Question 4 = 19 marks)

TOTAL FOR PAPER = 50 MARKS



P 7 1 9 4 1 A 0 1 3 1 6

BLANK PAGE



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

<https://britishstudentroom.com/>

BLANK PAGE



P 7 1 9 4 1 A 0 1 5 1 6

The Periodic Table of Elements

1 2 3 4 5 6 7 0 (8) (18)

1.0
H
hydrogen
1

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)																					
6.9 Li lithium 3	9.0 Be beryllium 4	23.0 Na sodium 11	24.3 Mg magnesium 12	39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	48.9 V vanadium 23	50.9 Cr chromium 24	52.0 Mn manganese 25	54.9 Fe iron 26	55.8 Co cobalt 27	58.9 Ni nickel 28	58.7 Cu copper 29	63.5 Zn zinc 30	65.4 Ga gallium 31	69.7 Ge germanium 32	72.6 As arsenic 33	74.9 Se selenium 34	79.0 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	[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[227] La* lanthanum 57	[261] Hf hafnium 72	[261] Rf rutherfordium 104	[262] Ta tantalum 73	[262] Db dubnium 105	[266] W tungsten 74	[266] Sg seaborgium 106	[268] Ir iridium 77	[268] Mt meitnerium 109	[271] Pt platinum 78	[271] Ds darmstadtium 110	[272] Au gold 79	[272] Rg roentgenium 111	[277] Os osmium 76	[277] Hs hassium 108	[277] Ru ruthenium 44	[277] Os osmium 76	[277] Hs hassium 108
132.9 Cs caesium 55	137.3 Ba barium 56	178.5 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	209.0 Po polonium 84	209.0 At astatine 85	[222] Rn radon 86	[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[227] La* lanthanum 57	[261] Hf hafnium 72	[261] Rf rutherfordium 104	[262] Ta tantalum 73	[262] Db dubnium 105	[266] W tungsten 74	[266] Sg seaborgium 106	[268] Ir iridium 77	[268] Mt meitnerium 109	[271] Pt platinum 78	[271] Ds darmstadtium 110	[272] Au gold 79	[272] Rg roentgenium 111	[277] Os osmium 76	[277] Hs hassium 108	[277] Ru ruthenium 44	[277] Os osmium 76	[277] Hs hassium 108

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	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	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	[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

<https://britishstudent.com>

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

