

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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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 ►

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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



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(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)



P 7 1 9 4 1 A 0 3 1 6

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)

(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

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(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)



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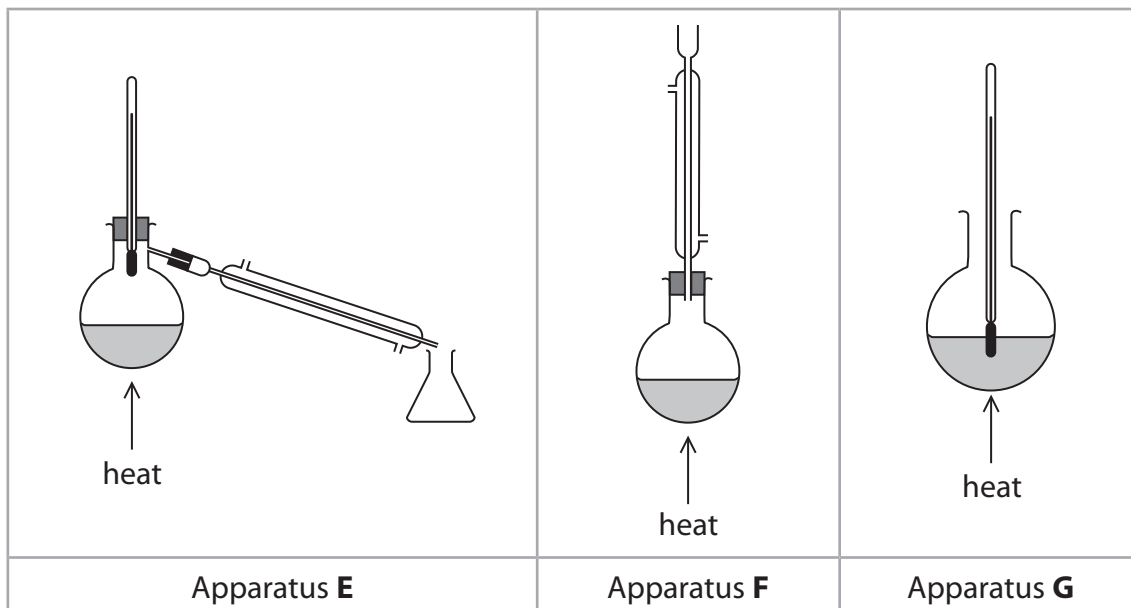
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3 This question is about some reactions of butan-1-ol.

- (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)

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

(1)

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

(2)

(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)

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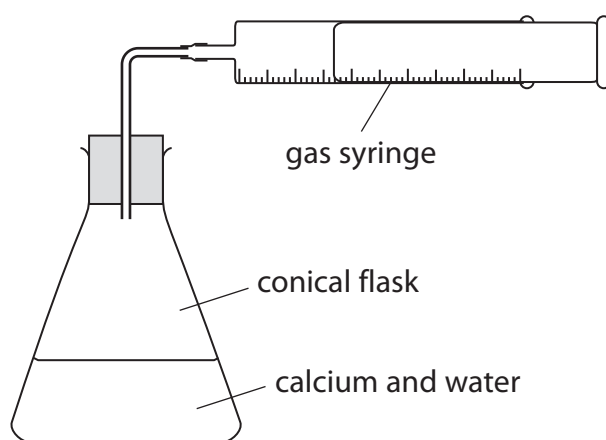
P 7 1 9 4 1 A 0 9 1 6

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

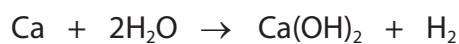
- Step 1 200 cm³ of distilled water (an excess) was transferred to a conical flask.
- Step 2 A small piece of calcium metal was placed in a pre-weighed weighing boat. The boat was then reweighed.
- Step 3 The calcium was dropped into the conical flask and a bung connected to a gas syringe was inserted.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

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- (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)

- (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)

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- (c) A third student carried out an experiment to determine the concentration of a saturated solution of calcium hydroxide, $\text{Ca}(\text{OH})_2$, 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)

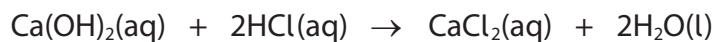
From to

- (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)

(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)

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(Total for Question 4 = 19 marks)

TOTAL FOR PAPER = 50 MARKS

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

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

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

* Lanthanide series
* Actinide series

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