

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

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.
- **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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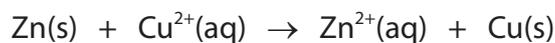
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Pearson

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

- 1 An experiment is carried out to determine the enthalpy change for the reaction between zinc and copper(II) sulfate solution.



Procedure

- weigh 4.50 g of zinc powder into a weighing bottle
- use a measuring cylinder to transfer 50.0 cm³ of 1.00 mol dm⁻³ aqueous copper(II) sulfate into a polystyrene cup, held in a 250 cm³ beaker
- stir the solution with a thermometer, record the temperature to the nearest 0.5 °C and start a timer
- continue to stir the solution, recording the temperature every minute
- at exactly 3.5 minutes, add the zinc powder to the aqueous copper(II) sulfate, stirring continuously
- record the temperature of the solution every minute from 4.0 to 9.0 minutes.

The results are shown.

Time / min	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0
Temperature / °C	21.5	22.5	22.0	22.0	60.5	63.0	60.5	58.5	57.0	55.5

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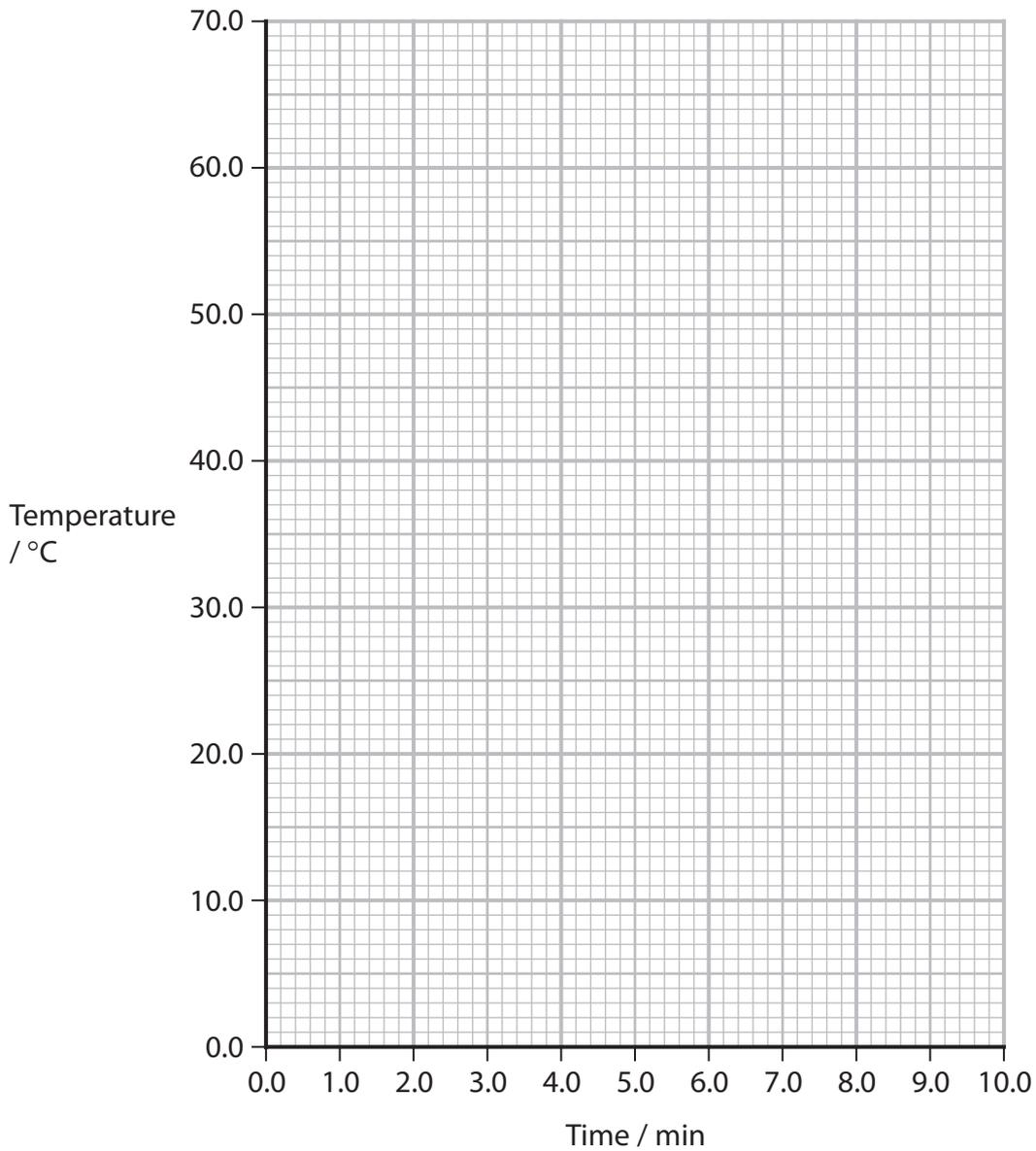
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(a) (i) Plot a graph of temperature against time on the grid.

(1)



(ii) Use the graph to determine the maximum temperature change, ΔT , in this experiment. You **must** show your working on the graph.

(3)

$\Delta T = \dots\dots\dots$ °C



(iii) State why using a series of measurements gives a more accurate temperature change than taking the initial and highest temperatures.

(1)

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(b) (i) Show by calculation that the zinc powder is in excess.

(2)

(ii) Calculate the energy transferred in the reaction, in joules.

Assume that the specific heat capacity of the solution is $4.2 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$.

(1)

(iii) State a second assumption, other than the specific heat capacity of the solution, that you have made in your calculation in (b)(ii).

(1)

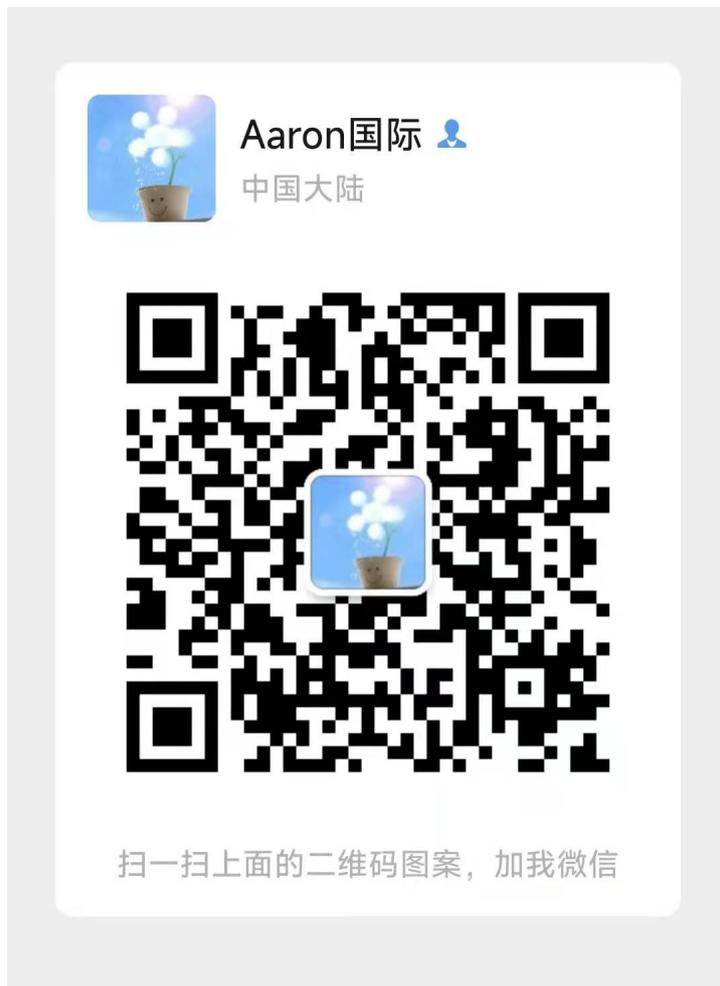
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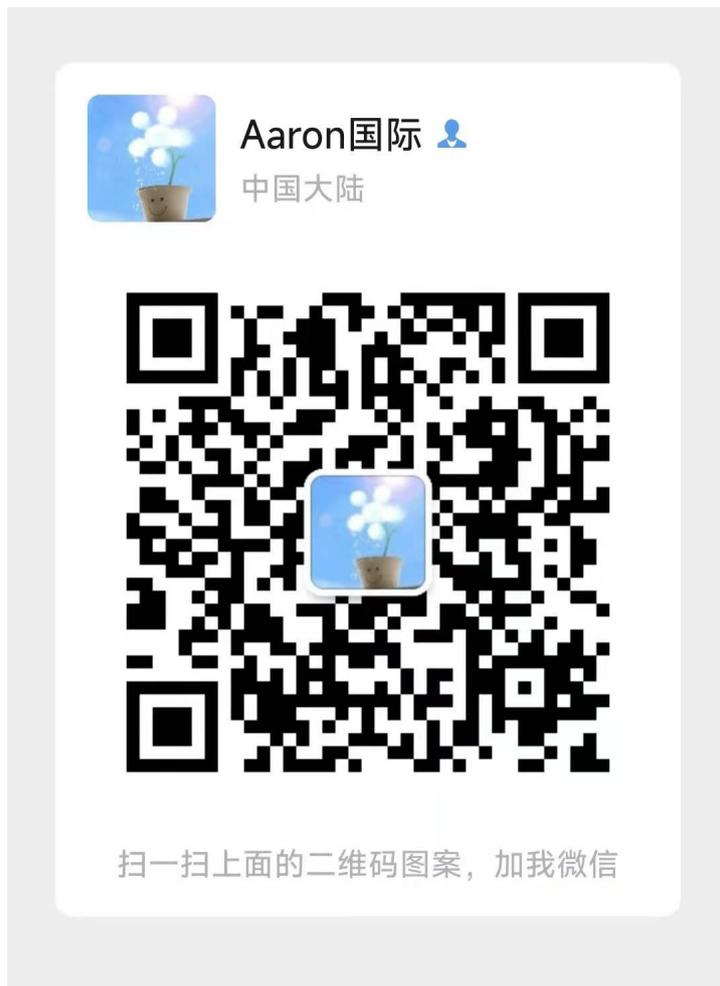
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- 2 The hydrogencarbonate of an unknown Group 1 metal, MHCO_3 , is a white solid. Two students carried out a titration experiment using hydrochloric acid.

The results were used to determine a value for the relative formula mass, M_r , of MHCO_3 and thus obtain a value for the relative atomic mass, A_r , of M.

Both students made solutions containing 2.00 g of MHCO_3 .

The **first** student made a 250.0 cm^3 standard solution.

The **second** student made a solution by placing the MHCO_3 in a beaker, dissolving the solid in a little deionised water, and then filling the beaker to the 250 cm^3 mark.

Both students titrated 25.0 cm^3 portions of their solution using hydrochloric acid with a concentration of $0.150 \text{ mol dm}^{-3}$. They used the same method and equipment.

The students repeated their titrations until they achieved concordant titres.

The **first** student obtained a mean titre of 13.35 cm^3 .

- (a) Calculate the value for the A_r of the metal M from the data of the **first** student.

MHCO_3 and HCl react in a 1:1 ratio.

You must show your working. Give your answer to **two** decimal places.

(4)



- (b) **Both** students calculated values of the relative atomic mass of M.
Using their calculations and the total percentage uncertainty of their experiments, they deduced that M was potassium.

The value for A_r calculated by the second student was 37.52.

- (i) Calculate the experimental error for the **second** student.

[A_r of potassium = 39.1]

(1)

- (ii) The **second** student calculated the A_r value of M to be 37.52 with a total percentage uncertainty of 4.5%.

Comment on the value of 37.52 obtained by this student by calculating the range of values of A_r .

(3)

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- (iii) The **first** student suggested that the burette was the biggest source of experimental uncertainty.

Explain how the percentage uncertainty of the burette reading could be reduced without changing the apparatus or simply repeating the experiment.

(2)

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- (iv) The **second** student was told that using a beaker to prepare their standard solution was incorrect.

Describe the steps the student should take to make a standard solution as accurately as possible.

Assume that the student is supplied with 2.00 g of MHCO_3 in a weighing bottle and the usual laboratory glassware.

(4)

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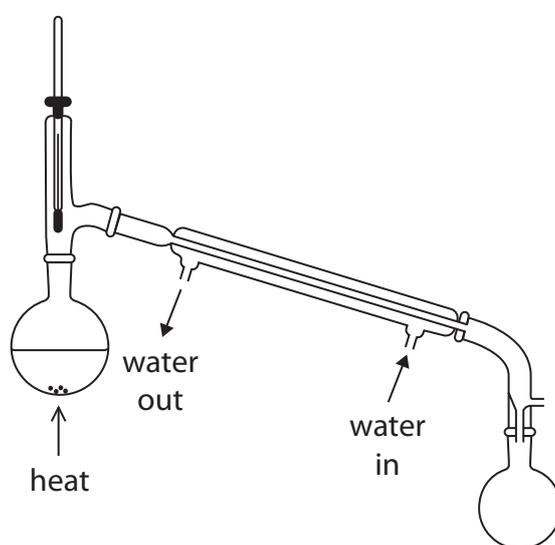


- 3 Cyclohexene, C_6H_{10} , was prepared by dehydrating cyclohexanol, $C_6H_{11}OH$, using concentrated phosphoric(V) acid, H_3PO_4 .



Procedure

- Step 1** Approximately 12 cm^3 of cyclohexanol was measured into a small flask.
- Step 2** 5 cm^3 of concentrated phosphoric(V) acid was added slowly to the flask with cooling and swirling.
- Step 3** Some anti-bumping granules were added to the mixture.
- Step 4** The flask was set up for distillation, using the apparatus shown, and the distillate was collected between 80°C and 90°C .



- Step 5** The distillate was transferred to a separating funnel and washed with an aqueous solution of sodium carbonate.
- Step 6** The crude organic product was separated from the mixture, placed in a clean separating funnel and washed with deionised water.
- Step 7** The organic layer was separated and dried using a suitable drying agent.
- Step 8** The dried organic layer was distilled, over a narrow range of temperature, to give pure cyclohexene.

Substance	Boiling temperature / $^\circ\text{C}$	Density / g cm^{-3}
Cyclohexanol	162	0.96
Cyclohexene	83	0.81
Water	100	1.00



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(a) Give the most suitable piece of apparatus for measuring the cyclohexanol in Step 1.

(1)

(b) Explain why adding phosphoric(V) acid slowly, with cooling and swirling, in Step 2 results in a higher yield of cyclohexene.

(2)

(c) In Step 3 anti-bumping granules are present to promote smooth boiling in the mixture.

Give a reason, other than damage to equipment, why bumping should be avoided.

(1)



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

(d) Explain why, in Step 4, the distillate is collected in a temperature range of 80 °C to 90 °C.

(2)

Substance	Boiling temperature / °C
Cyclohexanol	162
Cyclohexene	83
Water	100

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(e) (i) State what is removed by washing the mixture with sodium carbonate solution in Step 5. Include an **ionic** equation for the reaction. State symbols are not required.

(2)

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(ii) After the washing in Step 5, the separating funnel contains two layers.

Draw a diagram of the separating funnel, labelling its contents.

(2)

Substance	Density / g cm^{-3}
Cyclohexanol	0.96
Cyclohexene	0.81
Water	1.00

(iii) Suggest what might be removed by washing the product with deionised water in Step 6.

(1)

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(f) Identify from the list shown **one** substance that could be used as a drying agent in Step 7 of this procedure. Justify your choice.

(2)

$\text{C}_2\text{H}_5\text{OH}(\text{l})$ $\text{Ca}(\text{OH})_2(\text{s})$ $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}(\text{s})$
 $\text{H}_2\text{SO}_4(\text{l})$ $\text{MgSO}_4(\text{s})$ $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}(\text{s})$

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(g) Chemical tests may be used to show whether or not reactants and products are present during the course of the procedure.

(i) State a chemical test and the expected observation for a C=C double bond.

(2)

(ii) State a chemical test and the expected observation for an -OH group.

(2)

(iii) State whether or not the test in (g)(ii) could be used on the organic product to show if cyclohexanol remains when Step 5 is complete. Justify your answer.

(1)

(Total for Question 3 = 18 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
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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	106.4	106.4	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	83.8
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	131.3
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	darmstadtium	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
140	141	144	150	152	157	163	165	167	169	173	175
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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