Please check the examination details below befo	re entering your candidate information
Candidate surname	Other names
Centre Number Candidate Number	
Pearson Edexcel Internation	ional Advanced Level
Friday 24 May 2024	
Morning (Time: 1 hour 20 minutes) Pap	er WCH13/01R
Chemistry	H-1
International Advanced Subsidual UNIT 3: Practical Skills in Che	•
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 ▶



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

1 Sodium sulfite reacts with dilute sulfuric acid, as shown.

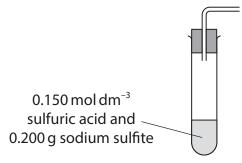
$$Na_2SO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + SO_2$$

A student carried out an experiment to measure the molar volume of sulfur dioxide. 0.200 g of sodium sulfite was added to 0.150 mol dm<sup>-3</sup> sulfuric acid in a boiling tube and the volume of gas given off was measured.

Sulfur dioxide is soluble in water, so collecting the gas over water **cannot** be used.

(a) Complete the diagram to show the apparatus that could be used to measure the volume of gas.

(1)



(b) Calculate the number of moles of sodium sulfite in 0.200 g.

(2)

(c) The reaction produced 29.5 cm<sup>3</sup> of sulfur dioxide.

Calculate the molar volume of sulfur dioxide, in dm<sup>3</sup>, from this result.

(2)



- (d) The molar volume calculated was less than expected so after checking for leaks, the student repeated the experiment. The volume produced was still less than expected, so the student decided the acid might not be in excess.
  - (i) Calculate the minimum volume of 0.150 mol dm<sup>-3</sup> acid that should be present in the boiling tube to fully react with 0.200 g of sodium sulfite. Use your answer to (b).

You should include units in your answer.

(1)

(ii) Suggest another reason for the molar volume being lower than expected.

(1)

(e) State why the experiment should be carried out in a fume cupboard.

(1)

(Total for Question 1 = 8 marks)



	uestion is about reactive metals and their compounds.	
(a) Lit	hium, sodium and potassium all react with water.	
(i)	Describe the differences you would see when this experiment is carried out with the three metals.	(3)
(ii)	State <b>two</b> precautions, other than wearing safety goggles, that should be taken during the experiment.	(2)
		(2)
(b) Gr	oup 2 metals all have soluble chloride salts.	
	oup 2 metals all have soluble chloride salts.  Write an <b>ionic</b> equation for the reaction of magnesium chloride solution with aqueous sodium hydroxide.	
	Write an <b>ionic</b> equation for the reaction of magnesium chloride solution with	(4)
	Write an <b>ionic</b> equation for the reaction of magnesium chloride solution with aqueous sodium hydroxide.	(1)
	Write an <b>ionic</b> equation for the reaction of magnesium chloride solution with aqueous sodium hydroxide.	(1)

(ii)	State what would be observed during this reaction.	(1)
(iii)	It is suspected that a bottle of magnesium chloride solution has been contaminated with barium chloride.  Describe a test and its result, other than a flame test, which could be used to confirm that the bottle contains traces of barium chloride.	(2)
(iv)	State the colours produced by the magnesium ions and barium ions in a flame test.	
	Magnesium	(2)
	Barium	
	(Total for Question 2 = 11 ma	rks)



**3** Maleic acid is a solid acid that can be used as a standard for titration.

maleic acid

A 5.00 g sample of maleic acid was dissolved in deionised water and made up to 250 cm<sup>3</sup> of solution. A 20.0 cm<sup>3</sup> portion of this solution was titrated against sodium hydroxide solution, producing the results shown.

Titration	Rough	1	2	3
Final reading / cm <sup>3</sup>	22.45	43.55	21.45	42.60
Initial reading / cm <sup>3</sup>	0.00	22.45	0.05	21.45
Titre / cm³	22.45	21.10	21.40	21.15

(a) Phenolphthalein indicator was used in the experiment.

State the colour change seen at the end-point.

(2)

(b) Calculate the mean titre of sodium hydroxide solution using the concordant results.

(1)

(c) Calculate the concentration of the maleic acid solution in mol dm<sup>-3</sup>.

 $[M_r \text{ maleic acid} = 116]$ 

(2)



(d) Use your answers to (b) and (c) to calculate the concentration of the sodium hydroxide solution in mol dm<sup>-3</sup>.

(3)

(e) Succinic acid is another solid acid.

HO——O HO

succinic acid

maleic acid

(i) Describe a laboratory test that could be used to distinguish between solutions of these acids.

(2)

(ii) State the IUPAC name for maleic acid.

(1)

(Total for Question 3 = 11 marks)

- **4** An experiment was carried out to compare the rates of hydrolysis of different halogenoalkanes. The method and results are shown.
  - Step **1** Set up a water bath using a 250 cm<sup>3</sup> beaker.
  - Step 2 Add 5 cm<sup>3</sup> of ethanol to a test tube.
  - Step 3 Add four drops of 1-iodobutane to the test tube.
  - Step 4 Loosely place a bung in the test tube and place it in the water bath.
  - Step **5** Pour 5 cm<sup>3</sup> of silver nitrate solution into a clean test tube and place it in the water bath.
  - Step **6** When the solutions have reached the temperature of the water bath, add the silver nitrate solution to the 1-iodobutane in ethanol solution. Replace the bung and shake. Start the timer as you do so.
  - Step **7** As soon as the solution becomes cloudy, stop the timer.
  - Step 8 Repeat steps 2 to 7 using a bromoalkane and a chloroalkane instead of 1-iodobutane.

Halogen element in halogenoalkane	Time taken for precipitate to form / s
lodine	51
Bromine	85
Chlorine	594

(a	) Justify an appropriate temperature for the water bath.	(2)
(b	Suggest, by name or formula, a bromoalkane and a chloroalkane suitable for this experiment, justifying your answers.	(2)

(e)	Under these conditions, all the silver halide precipitates can appear to be white.  Identify, by name or formula, a compound, the solutions of which can be used to distinguish between the silver halide precipitates.	(1)
(d)	State why it is not necessary to repeat these experiments for each halogenoalkane.	(1)
		(1)
(c)	State how the results of this experiment could be converted into a value that can be used as a measure of rate.	(4)



**5** The alcohol, 2-methylpropan-2-ol can be converted into 2-chloro-2-methylpropane using concentrated hydrochloric acid.

The individual steps of the method are listed.

- **A** The alcohol and concentrated hydrochloric acid are mixed. The flask is sealed and swirled for 20 minutes, with the bung removed occasionally.
- **B** Sodium hydrogencarbonate solution is added. The mixture is swirled and any pressure released.
- **C** The organic liquid is distilled and a fraction between 50 °C and 52 °C is collected.
- **D** The aqueous layer is run off and discarded. The organic layer is run into a small conical flask and shaken with anhydrous sodium sulfate.
- **E** When the solution is clear, the organic liquid is decanted into a round-bottomed flask.
- **F** Anhydrous calcium chloride is added to the flask and swirled until dissolved. The mixture is poured into a separating funnel and the lower layer is discarded.
- (a) Complete the list to show the correct order of the steps.

(2)

A

Include state symbols in your answer.

(b) (i) Write an equation to show the reaction taking place in Step **B**.

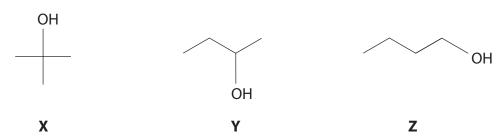
(2)

(ii) State the purpose of adding anhydrous sodium sulfate in Step **D**.

(1)



(c) The experiment was repeated using three different alcohols,  ${\bf X}$ ,  ${\bf Y}$  and  ${\bf Z}$ .



(i) The C-O bond is broken in the mechanism.

Using your knowledge of carbocations, explain which alcohol may react fastest in the experiment.

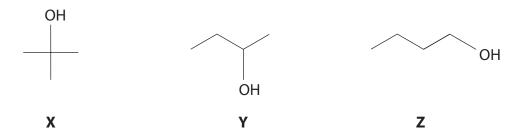

(3)

(5)

(ii) Describe how a solution of acidified potassium dichromate(VI) and subsequent chemical tests could be used to distinguish between alcohols **X**, **Y** and **Z**.

You may assume that the usual laboratory glassware and chemicals are available.

Include the colour change(s) seen.



(Total for Question 5 = 13 marks)

**TOTAL FOR PAPER = 50 MARKS** 



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# The Periodic Table of Elements

0 (8)	(18)	4.0	Ā	helium	2
7					(17)
9					(14)
2					(15)
4					(14)
က					(13)
	Г			_	
	,	0.	I	hydrogen	_
					Kev
7					(2)
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<b>H</b>	helium 2	20.2	Ne	neon	10	39.9	Αr	argon 18	83.8	궃	krypton 36	131.3	Xe	xenon	24	[222]	찜	radon 86		ted		
	(17)	19.0	L	fluorine	6	35.5	ರ	chlorine 17	79.9	Br	bromine 35	126.9	_	iodine	53	[210]	Αt	astatine 85		seen repor		
	(16)	16.0	0	oxygen	8	32.1	S	sulfur 16	79.0	Se	selenium 34	127.6	Б	tellurium	52	[506]	8	polonium 84		116 have t	nticated	
	(15)	14.0		eu		31.0	۵	phosphorus 15	74.9	As	arsenic 33	121.8	Sb	antimony	51	209.0	Bi	bismuth 83		mbers 112-	but not fully authenticated	
	(14)	12.0	U	carbon	9	28.1	Si		72.6	g	germanium 32	118.7	Sn	tin	20	207.2	Pp	lead 82		atomic nu	but not f	
	(13)	10.8	В	boron	5	27.0	¥	aluminium 13	2.69	Ğ	gallium 31	114.8	드	mnipui	49	204.4	F	thallium 81		Elements with atomic numbers 112-116 have been reported		
								(12)	65.4	Zu	zinc	112.4	В	cadmium	48	200.6	Ę	mercury 80		Elen		
								(11)	63.5	ŋ	copper	107.9	Ag	silver	47	197.0	Αn	gold 79	[272]	Rg	roentgenium	
								(10)	58.7	Z	nickel	106.4	Pd	palladium	46	195.1	ቷ	platinum 78	[271]	Ds	meitnerium damstadtium	2
								(6)	58.9	ვ	cobalt 27	102.9	뫈	rhodium	45	192.2	<u>_</u>	iridium 77	[268]	Mt	meitnerium	6
<b>T</b>	1							(8)	55.8	Fe	iron 26	101.1	Ru	ruthenium	4	190.2	õ	osmium 76	[277]	¥	hassium	801
								(7)	54.9	W	chromium manganese	[88]	<u></u> 2	molybdenum technetium ruthenium	43	186.2	Re	rhenium 75	[264]	絽	bohrium 107	20
		mass	pol		number			(9)	52.0	ъ	chromium 24	95.9	Wo	molybdenum	42	183.8	≯	tungsten 74	[366]	Sg	n seaborgium b	82
	Kev	relative atomic mass	atomic symbol	name	atomic (proton) number			(5)	50.9	>	vanadium	92.9	å	niobium	41	180.9	Тa	tantalum 73	[292]	В	dubnium	
		relati	ato		atomic			(4)	47.9	ï	titanium 22	91.2	Zr	zirconium	40	178.5	Ξ	hafnium 72	[261]	₹	rutherfordium	104
								(3)	45.0	S	scandium 24	88.9	>	yttrium	39	138.9	Ľa*	lanthanum 57	[227]	Ac*	F	
	(0)	9.0	Be	beryllium	4	24.3	Mg	magnesium 12	40.1	g	calcium	87.6	Sr	strontium	38	137.3	Ba	barium 56	[526]	Ra	radium	8
	(1)	6.9	:=	lithium	3	23.0	Na	sodium 11	39.1	¥	potassium 10	85.5	æ	rubidium	37	132.9	ర	caesium 55	[223]	ቴ	francium 87	ò
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		jas	anthanide series	
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140	141	144	[147]	150	152	157	159	163		167	169	173	175
ဗ	<u>ڄ</u>	P	Pa	Sm	Eu	В	Т	2	운	Ъ	Ē	Х	3
cerium	praseodymium	neodymium	promethium	samarium	europium	gadolinium	terbium	dysprosium	_	erbium	thulium	ytterbium	lutetium
28	29	09	61	62	63	64	92	99		89	69	70	71
232	[231]	238	[237]	[242]	[243]	[247]	[245]	[251]	[254]	[253]	[256]	[254]	[257]
ᆮ	Pa	_	å	Pu	Am	5	쓞	ຽ	ß	F	PW	2	۲
thorium	protactinium	uranium	neptunium	plutonium	americium	anium	berkelium	californium	einsteinium	fermium	mendelevium	nobelium	lawrencium
8	2	92	93	8	95	96	4	86	66	100	101	102	103