Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Thursday 17 October 2024

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, 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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Pearson

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

1 (a) Solutions of three Group 2 chlorides, **X**, **Y** and **Z**, were treated with solutions containing different anions. The results are shown.

	Addition of NaOH solution	Addition of Na_2CO_3 solution	Addition of Na_2SO_4 solution
X	no visible change	white precipitate	white precipitate
Y	white precipitate	white precipitate	no visible change
Z	partial white precipitate	white precipitate	partial white precipitate

(i) Flame tests can be used to confirm the identity of the cations.

Complete the table to show a possible identity for the cations in **X**, **Y** and **Z**, and the colours of flame tests produced by each cation.

(4)

	Identity of cation	Colour of flame test
X		
Y		
Z		

(ii) Describe how the presence of chloride ions in the solutions of **X**, **Y** and **Z** could be identified and confirmed.

(3)

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(b) (i) Describe in outline an experiment to compare the thermal stability of Group 2 carbonates.

You may wish to include a diagram.

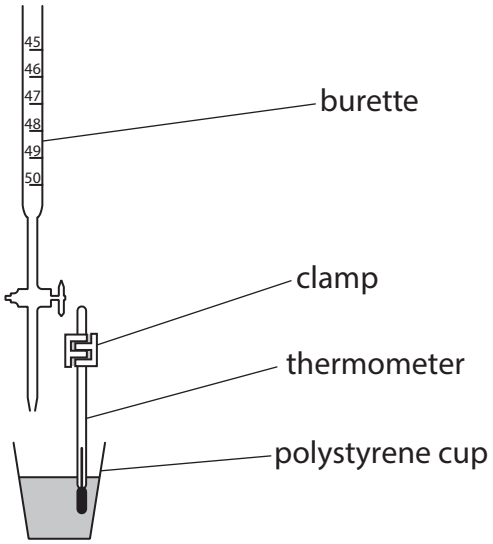
(4)

(ii) Give a reason why the experiment described in (b)(i) may not produce the expected results for all the Group 2 carbonates in a school laboratory.

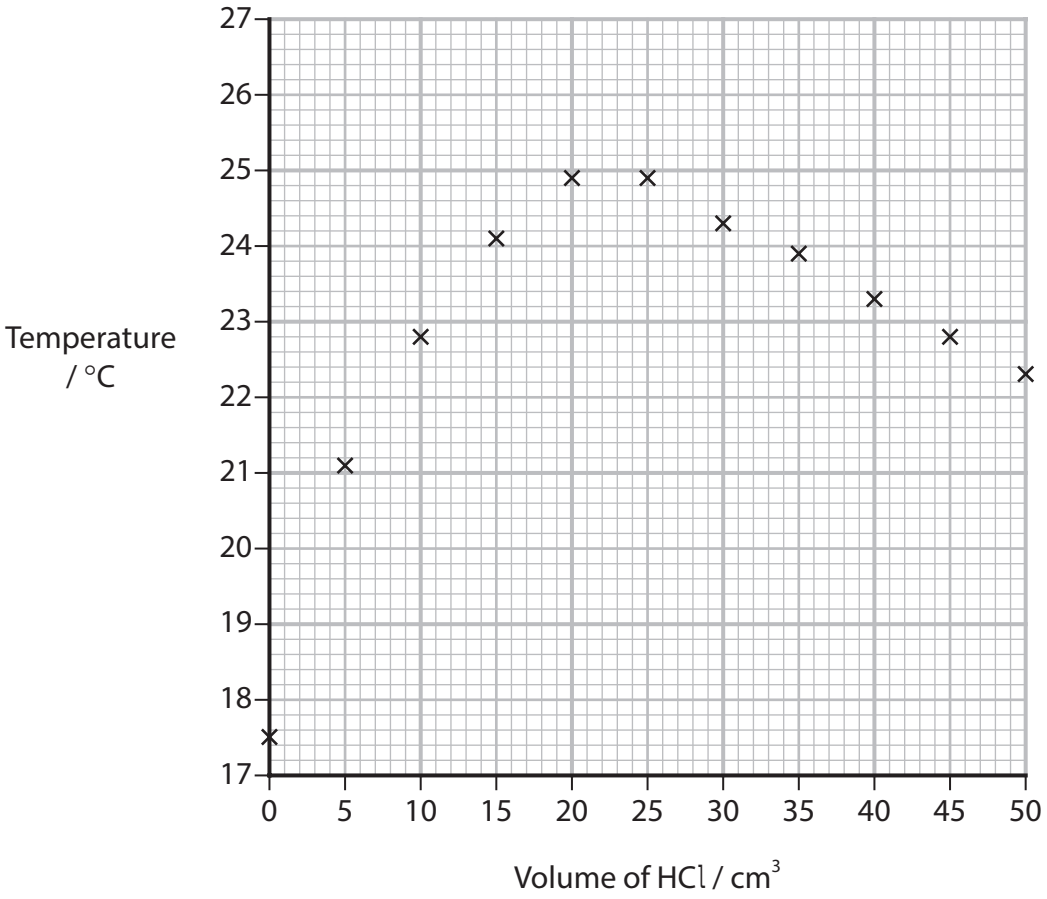
(1)

(Total for Question 1 = 12 marks)

2 A student carried out an experiment to find the enthalpy change of neutralisation between a solution of sodium hydroxide and hydrochloric acid.
25.00 cm^3 of sodium hydroxide solution was pipetted into a polystyrene cup. 5.00 cm^3 portions of 2.00 mol dm^{-3} hydrochloric acid were added at regular intervals and the maximum temperature of the reaction mixture measured after each addition.



A graph of the results is shown.



(a) (i) Draw two lines of best-fit to determine the maximum temperature change at the point of neutralisation.

(3)

Volume of hydrochloric acid at neutralisation ..... cm^3

Maximum temperature change ..... °C

(ii) Calculate the concentration of the sodium hydroxide solution, using an answer from (a)(i) and information from the procedure.

(2)

(iii) Calculate the enthalpy change of neutralisation, in **kJ mol^{-1}**.

(4)

Assume the value of the specific heat capacity of the solution is 4.18 J g^{-1} $°C^{-1}$ and the density of the solution is 1.00 g cm^{-3}.

Include a sign in your answer.

(b) The published value for the enthalpy change of neutralisation is $-55.84\,kJ\,mol^{-1}$.

The student's value is significantly different from the published value. This is because the procedure does not allow the maximum possible temperature to be reached.

Give **two** reasons why the maximum temperature is not reached in this experiment.

(2)

(c) (i) Give an improvement to the experimental method that will increase the accuracy of the calculated titre value.

(1)

(ii) Give an improvement to the experimental method that will increase the accuracy of the calculated enthalpy change of neutralisation.

(1)

(Total for Question 2 = 13 marks)

3 A student purified a sample of an organic liquid by distillation.

(a) Draw a labelled diagram of the distillation apparatus including a thermometer.

(3)

(b) (i) The purified product was treated with a small volume of bromine water and shaken. The bromine water was **not** decolourised.

State the most likely conclusion that can be made from this information.

(1)

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(ii) The purified product was also treated with Fehling's reagent. No colour change was observed.

State the most likely conclusion that can be made from this information.

(1)

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(c) (i) The purified organic liquid was refluxed with acidified potassium dichromate(VI) solution.

A colour change was observed while refluxing.
The resulting solution was distilled.

The student concluded that the final product must be a ketone.

Discuss why the student is incorrect, using all the information above, and giving an alternative identity for the final product.

(4)

(ii) Explain how information, easily obtained from the distillation experiment, could be used to confirm the identity of the final product.

(2)

(Total for Question 3 = 11 marks)

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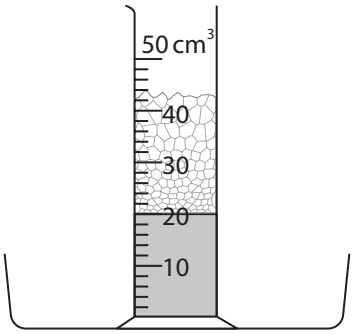
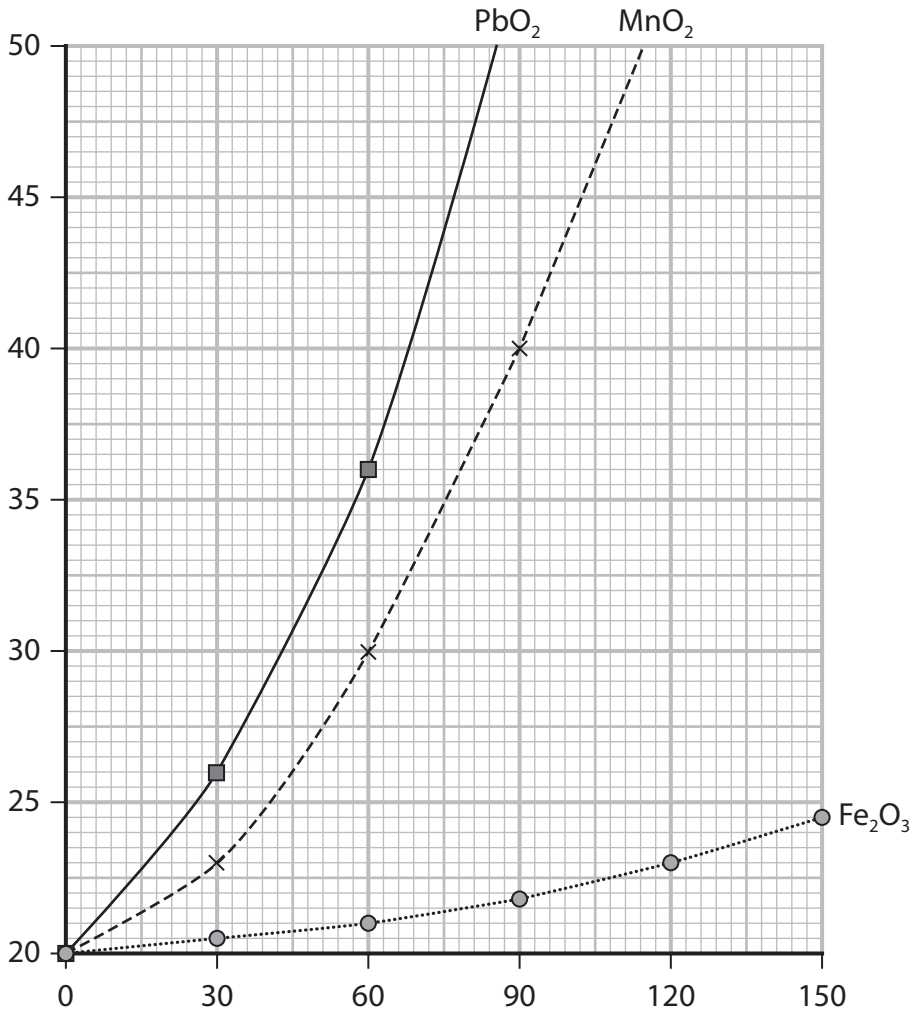
4 Hydrogen peroxide slowly decomposes to form oxygen and water.
Many different compounds can act as a catalyst for the reaction.

In order to compare the catalytic effect of different compounds, an experiment was carried out by a student.
0.5 g of each solid catalyst powder and a drop of washing up liquid were added to separate 50 cm^3 measuring cylinders.
20 cm^3 of hydrogen peroxide solution was then added to each measuring cylinder.
At 30 s intervals, the volume reached by the foam was recorded.



The results are displayed in a graph.



(a) Label the axes of the graph.

(2)

(b) (i) State how PbO_2 can be identified as the best catalyst under these conditions.

(1)

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.....

(ii) Calculate the maximum rate of foam production measured for PbO_2.
Include units with your answer.

(3)

Units .....

(iii) Suggest why the value calculated from the graph may not be accurate.

(1)

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(c) (i) In most kinetics experiments the rate of reaction decreases with time.

Suggest a reason why the rate of reaction seems to increase in this experiment.

(1)

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(ii) In a repeat experiment, a larger measuring cylinder was used so that it contained all the foam produced.

Sketch the expected graph of the volume reached by the foam until the reaction is complete, using MnO_2 as the catalyst.

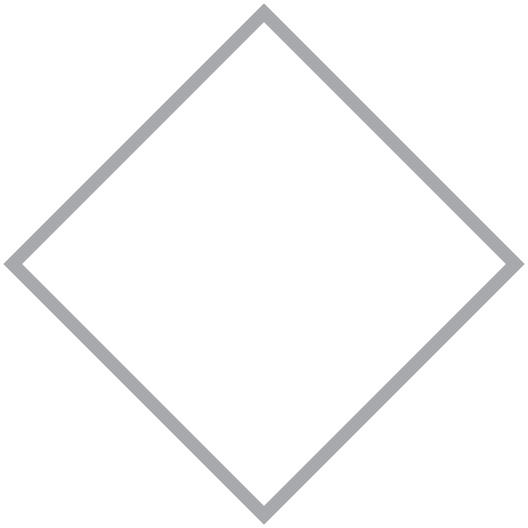
You **do not** need to label the axes.

(2)

(d) The hydrogen peroxide used is corrosive.

(i) Draw the hazard symbol that should be displayed on the bottle of hydrogen peroxide.

(1)



(ii) State **one** safety precaution that should be taken when using the hydrogen peroxide, other than wearing a lab coat and safety spectacles.

(1)

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(iii) The risk of harm to students needs to be reduced before they carry out this experiment in class.

Suggest another control measure to reduce the risk for students.

(1)

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(iv) Give a reason why, during the experiment, the measuring cylinders should be placed in a tray.

(1)

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(Total for Question 4 = 14 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

* 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