

**Pearson Edexcel International Advanced Level**

**Monday 20 October 2025**

Afternoon (Time: 1 hour 20 minutes)

Paper  
reference

**WCH13/01A**

**Chemistry**

**International Advanced Subsidiary / Advanced Level**

**UNIT 3: Practical Skills in Chemistry I**

**Question Paper**

**You must have:**

Scientific calculator, ruler, Answer Booklet (sent separately).

Do not return the question paper with the answer book.

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

- 1** Experiments were carried out on a sample of hydrated barium nitrate crystals,  $\text{Ba}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ .
- (a) Describe how to carry out a flame test to show which cation is present in the sample.  
Include the expected result on the hydrated salt. (4)
- (b) The barium nitrate crystals were heated gently in a test tube. Fumes which looked like steam were given off.  
Identify a substance that could be used to test for the presence of steam in the fumes. Include the expected colour change for this test. (2)
- (c) On further heating of the sample, a mixture of two gases was evolved. One of the gases was coloured, the other was colourless.
- (i) Identify the coloured gas by name **and** colour. (1)
- (ii) Identify the colourless gas, stating how the gas would be tested, **with** the positive result. (1)
- (d) A white solid remained after complete decomposition.  
Complete the equation for this decomposition of the hydrated crystals.  
State symbols are not required. (1)
- (e) The white solid which remained in the test tube was allowed to cool to room temperature. Dilute hydrochloric acid was added to the solid and a solution formed.  
This solution is used in a common laboratory test for an anion.  
Give the **formula** of this anion **and** the positive result of the test. (2)

**(Total for Question 1 = 11 marks)**



- 2 A student carried out experiments to determine the enthalpy change for the hydration of anhydrous magnesium sulfate,  $\text{MgSO}_4$ , to form hydrated magnesium sulfate crystals,  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ .

To find the enthalpy change of solution of anhydrous magnesium sulfate,  $100.0\text{ cm}^3$  of deionised water was placed in a polystyrene cup and the temperature measured at one minute intervals.

After 2.5 minutes, 3.01 g of anhydrous magnesium sulfate was added and the mixture stirred continuously.

The results are shown.

Time / minutes	0	1	2	2.5	3	4	5	6	7	8
Temperature / °C	21.0	21.0	21.0	X	25.6	27.2	27.0	26.2	25.2	24.3

- (a) Plot a graph of temperature against time on the grid. (3)

- (b) Determine the maximum temperature change,  $\Delta T$ , using your graph.

You **must** show your working on the graph.

(2)

$$\Delta T =$$

- (c) The value of the enthalpy change from this experiment was  $-69.4\text{ kJ mol}^{-1}$ .

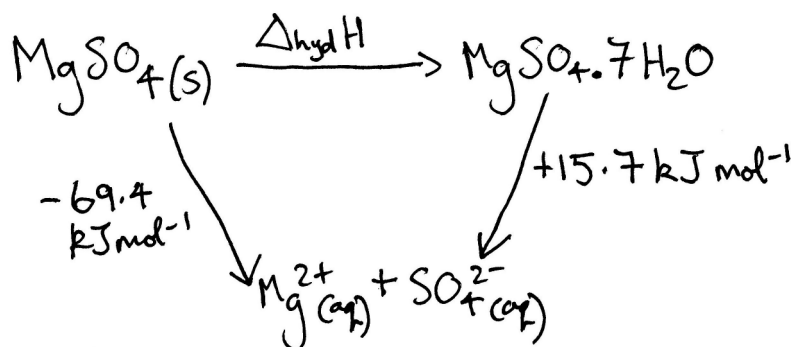
Give **one** possible reason why this value is different from a data book value of  $-103.0\text{ kJ mol}^{-1}$ .

(1)

(d) After another experiment to find the enthalpy change of solution of hydrated magnesium sulfate crystals, the student constructed the Hess cycle shown.

(i) Calculate the enthalpy change of hydration for the conversion of anhydrous magnesium sulfate to hydrated magnesium sulfate crystals.

(1)



(ii) Give **one** possible reason why the enthalpy change of hydration in (d)(i) could not be found directly by experiment.

(1)

(Total for Question 2 = 8 marks)



**3** Borax is hydrated sodium tetraborate,  $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ . It is a primary standard and may be used to determine the concentration of a solution of hydrochloric acid.

- (a) Sodium hydroxide is not suitable to be used as a primary standard because the solid absorbs moisture from the air.

The mass of pure sodium hydroxide required to make a solution of known concentration is calculated. The mass is weighed out and dissolved to make a solution.

State how the absorption of moisture from the air affects the concentration of this solution. Justify your answer.

(1)

- (b) The mass of an empty weighing bottle was measured and then it was reweighed containing a sample of borax. The mass of the borax was 9.53 g.

The sample was dissolved in deionised water and transferred, with washings, to a  $500\text{ cm}^3$  volumetric flask.

The mixture was made up to the mark with deionised water and mixed thoroughly.

- (i) A two-decimal point balance with a measurement uncertainty of  $\pm 0.01\text{ g}$  was used for each measurement.

Give the possible numerical range for a mass of 9.53 g using this balance.

(1)

- (ii)  $25.0\text{ cm}^3$  of the borax solution was pipetted into each of three conical flasks.

Calculate the number of moles of borax in each conical flask.

(3)

(c) A few drops of methyl orange indicator were added to each conical flask.

A hydrochloric acid solution of unknown concentration was placed in a burette and titrated against the borax solution.

The titration results obtained are shown.

Titration	1	2	3
Final burette reading / cm <sup>3</sup>	17.00	33.25	16.35
Initial burette reading / cm <sup>3</sup>	0.00	17.00	0.00
Titre / cm <sup>3</sup>	17.00	16.25	16.35

(i) State the colour change at the end-point.

(1)

(ii) 1 mol of borax reacts with water to produce 2 mol of sodium hydroxide, which then neutralises the hydrochloric acid.

Calculate the concentration of hydrochloric acid in g dm<sup>-3</sup>, giving your answer to an appropriate number of significant figures.

You will need to use

- your answer to (b)(ii)
- the mean titre calculated from the results table.

(3)

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**(Total for Question 3 = 9 marks)**



4 This question is about three organic liquids, **Q**, **R** and **S**.

(a) Tests were carried out on **Q** and **R**.

Each liquid contained **one** functional group.

(i) Test 1

A spatula measure of phosphorus(V) chloride,  $\text{PCl}_5$ , was added to  $1\text{ cm}^3$  of each liquid in separate test tubes.

Any gas evolved was tested with damp blue litmus paper.

<b>Q</b>	<b>R</b>
Misty fumes were given off	Misty fumes were given off
Damp blue litmus paper turned red	Damp blue litmus paper turned red

Give the **formula** of the steamy fumes produced in Test 1.

(1)

(ii) Test 2

About  $1\text{ cm}^3$  of sodium hydrogencarbonate solution was added to  $1\text{ cm}^3$  of each liquid in separate test tubes.

<b>Q</b>	<b>R</b>
No reaction	A colourless gas was given off that turned limewater cloudy

Identify, by name or formula, the gas produced in Test 2.

(1)

(iii) **Name** the functional groups present in **Q** and **R**.

Use the results from Tests 1 and 2 and the information at the start of the question.

(2)

(iv) **Q** and **R** both have a molar mass of  $60 \text{ g mol}^{-1}$ .

Draw a possible structure of **Q** and the structure of **R** using **displayed** formulae.

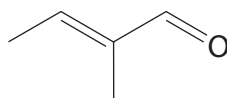
(2)

(v) State whether or not it is possible to distinguish between **Q** and **R** using infrared spectra. Justify your answer.

Wavenumber values are not required.

(1)

(b) The organic liquid **S** is a pheromone which has been shown to stimulate weight gain in pigs.



State the initial and final appearance of each mixture when the tests described were carried out on liquid **S**.

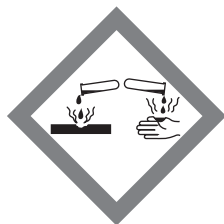
(4)

**(Total for Question 4 = 11 marks)**

- 5 The halogenoalkane 2-chloro-2-methylpropane may be prepared from 2-methylpropan-2-ol.

**Procedure**

- Step 1** Add 35 cm<sup>3</sup> of concentrated hydrochloric acid to 8.00 g of 2-methylpropan-2-ol in a conical flask.  
Swirl the mixture gently for 20 minutes.
- Step 2** Two distinct layers form. The upper (organic) layer contains the required product. The lower aqueous layer is removed using a separating funnel.
- Step 3** Add a solution of sodium hydrogencarbonate to the organic layer.  
Swirl gently. Stopper the separating funnel and shake it.  
Invert the separating funnel and open the tap.
- Step 4** Return the separating funnel to the upright position, remove the stopper and discard the aqueous layer.  
Transfer the organic layer into a clean conical flask.
- Step 5** Add some anhydrous calcium chloride.  
Leave the flask to stand and decant off the liquid.
- Step 6** Distil the liquid, collecting the product between 50 °C and 52 °C.
- (a) (i) The concentrated hydrochloric acid used in Step 1 was labelled with the two diagrams shown.



Suggest **two** safety precautions, other than wearing safety spectacles and a laboratory coat, to minimise the risk when using this reagent in Step 1.

(2)

- (ii) State why the tap of the separating funnel must be opened in Step 3.

(1)

- (iii) Describe the change in appearance of the organic layer when anhydrous calcium chloride is added in Step 5.

(1)

- (iv) Draw the apparatus required to distil the product and collect the distillate between 50 °C and 52 °C in Step 6.

(4)

- (b) The chloroalkane produced is used in an experiment to compare its rate of hydrolysis with two other halogenoalkanes.

A student dissolves separate  $1.0\text{ cm}^3$  samples of each halogenoalkane in ethanol and adds  $2\text{ cm}^3$  of silver nitrate solution.

The time taken for a precipitate to form is recorded. The results are shown.

Halogenoalkane	Time / s
2-chloro-2-methylpropane	5
1-chloro-2-methylpropane	320
1-bromo-2-methylpropane	140

The student concludes that both the structure of the halogenoalkane and the identity of the halogen affect the rate of hydrolysis.

Explain how the results support this conclusion.

(3)

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(Total for Question 5 = 11 marks)

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**TOTAL FOR PAPER = 50 MARKS**



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Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

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**Pearson Edexcel International Advanced Level**

**Monday 20 October 2025**

Afternoon (Time: 1 hour 20 minutes)

Paper  
reference

**WCH13/01A**

**Chemistry**

**International Advanced Subsidiary /Advanced Level**

**UNIT 3: Practical Skills in Chemistry I**

**Answer Book**

**You must have:**

Question paper (sent separately), 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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Answer ALL the questions. Write your answers in the spaces provided.

1

(a)

(4)

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.....

.....

.....

.....

.....

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Expected result.....

(b)

(2)

Identity of substance.....

Colour change.....

(c)

(i)

(1)

Identity of gas.....

Colour of gas.....

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(ii)

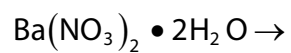
(1)

Identity of gas.....

Test and positive result.....

(d)

(1)



(e)

(2)

Formula.....

Positive test result.....

**(Total for Question 1 = 11 marks)**

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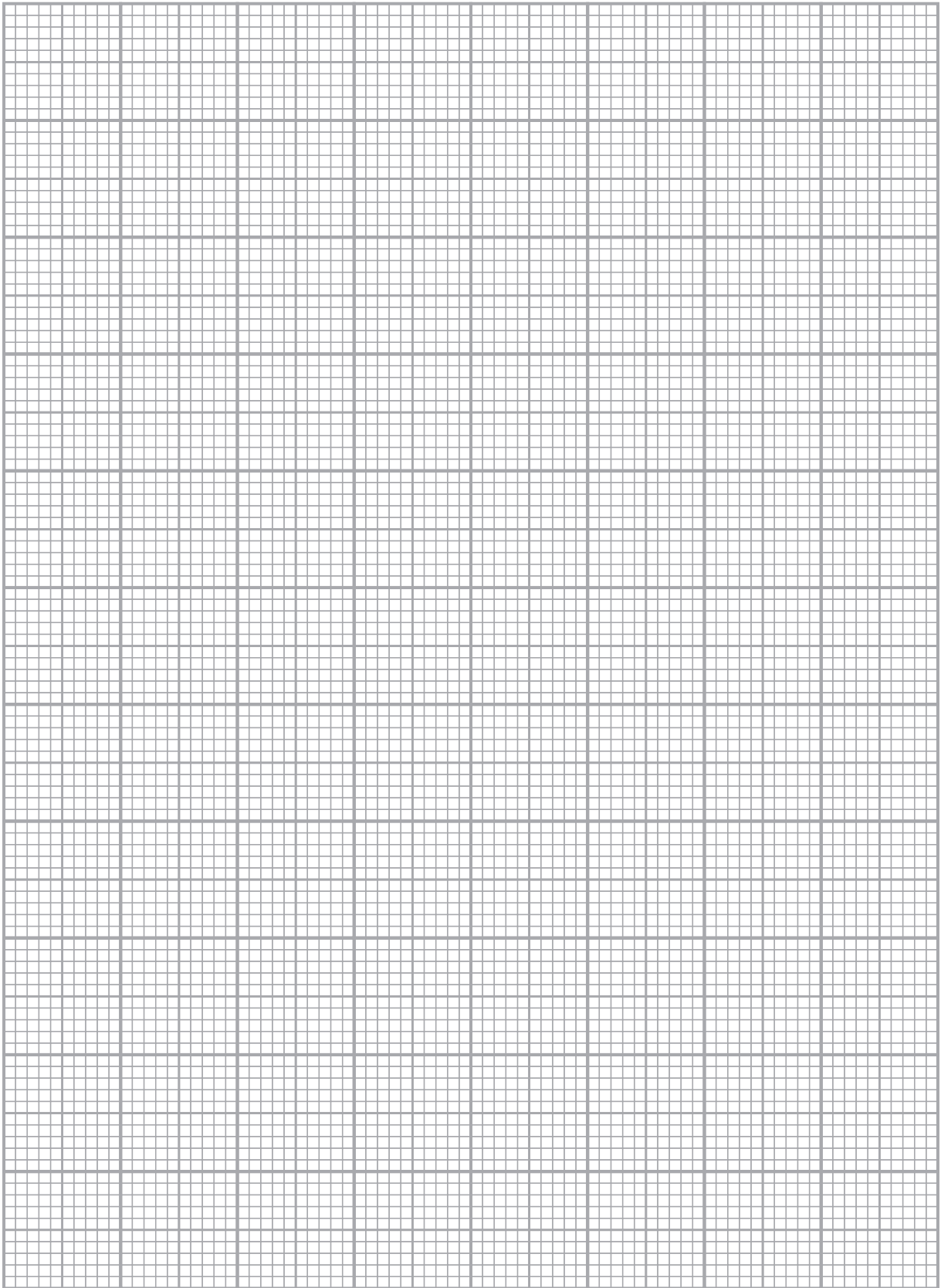
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2

(a)

(3)



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4





3

(a)

(1)

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(b)

(i)

(1)

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(ii)

(3)

(c)

(i)

(1)

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6



(ii)

(3)

(Total for Question 3 = 9 marks)

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4

(a)

(i) (1)

(ii) (1)

(iii) (2)

Functional group in <b>Q</b>	Functional group in <b>R</b>

(iv) (2)

<b>Q</b>	<b>R</b>

(v) (1)

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(b)

(4)

Tests	Observations
A few drops of S were shaken with bromine water	
In a test tube, a few drops of S were added to 1 cm <sup>3</sup> of Benedict's or Fehling's solution.  The mixture was warmed in a water bath	

(Total for Question 4 = 11 marks)

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5

(a)

(i)

(2)

(ii)

(1)

(iii)

(1)

(iv)

(4)

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(b)

(3)

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**(Total for Question 5 = 11 marks)**

**TOTAL FOR PAPER = 50 MARKS**



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