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| Candidate surname | | | | | Other names | | | | |
| Centre Number | | | | | Candidate Number | | | | |
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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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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 ₂ CO ₃ solution | Addition of Na ₂ SO 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)

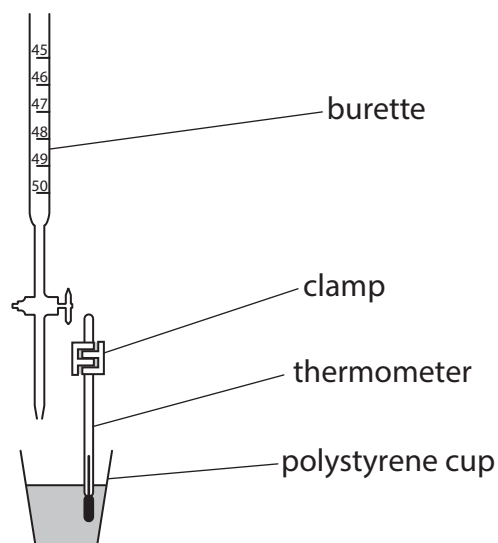
- (ii) Give a reason why the experiment described in (b)(i) may not produce the expected results for all the Group 2 carbonates in a school laboratory.

(1)

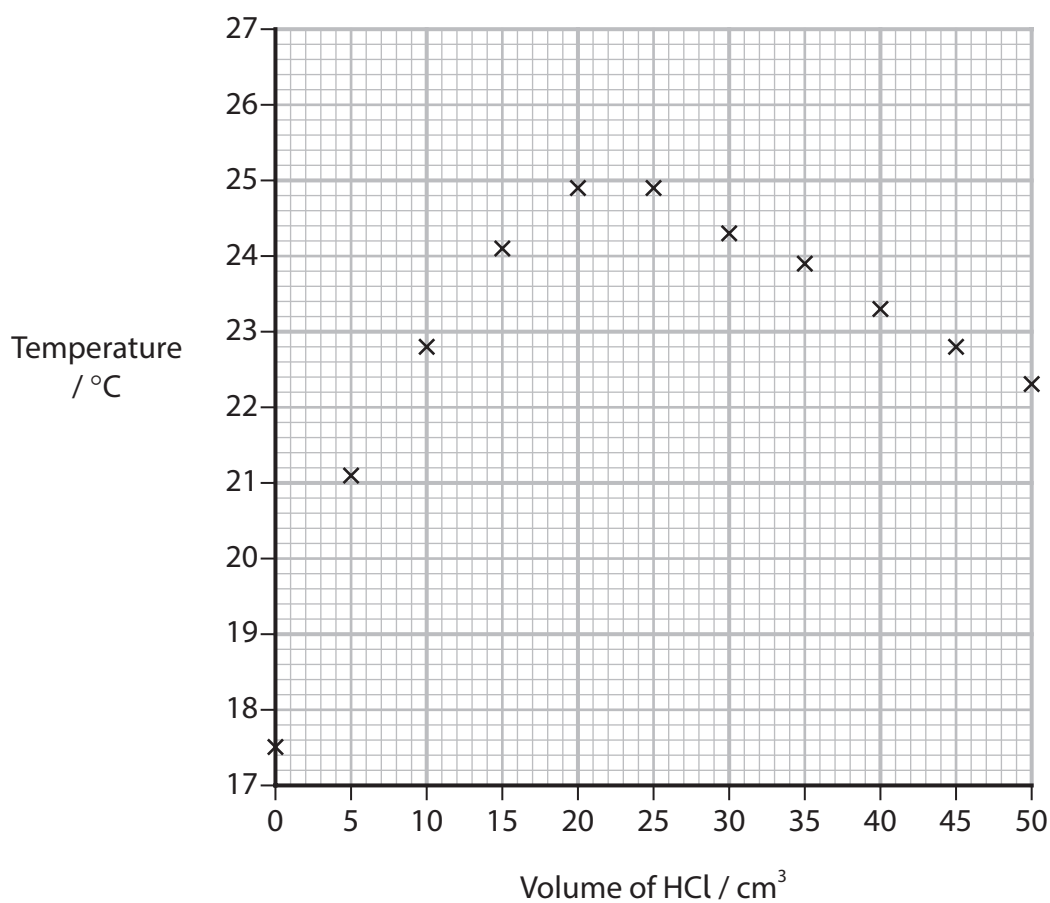
(Total for Question 1 = 12 marks)



- 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 $^{\circ}\text{C}$

- (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 $4.18 \text{ J g}^{-1} ^{\circ}\text{C}^{-1}$ 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 $-55.84 \text{ kJ mol}^{-1}$.

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)

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

(1)

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

(1)

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(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)

(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)



- (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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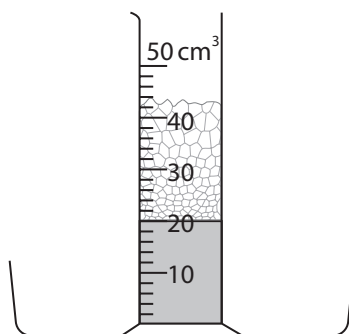


- 4 Hydrogen peroxide slowly decomposes to form oxygen and water. Many different compounds can act as a catalyst for the reaction.

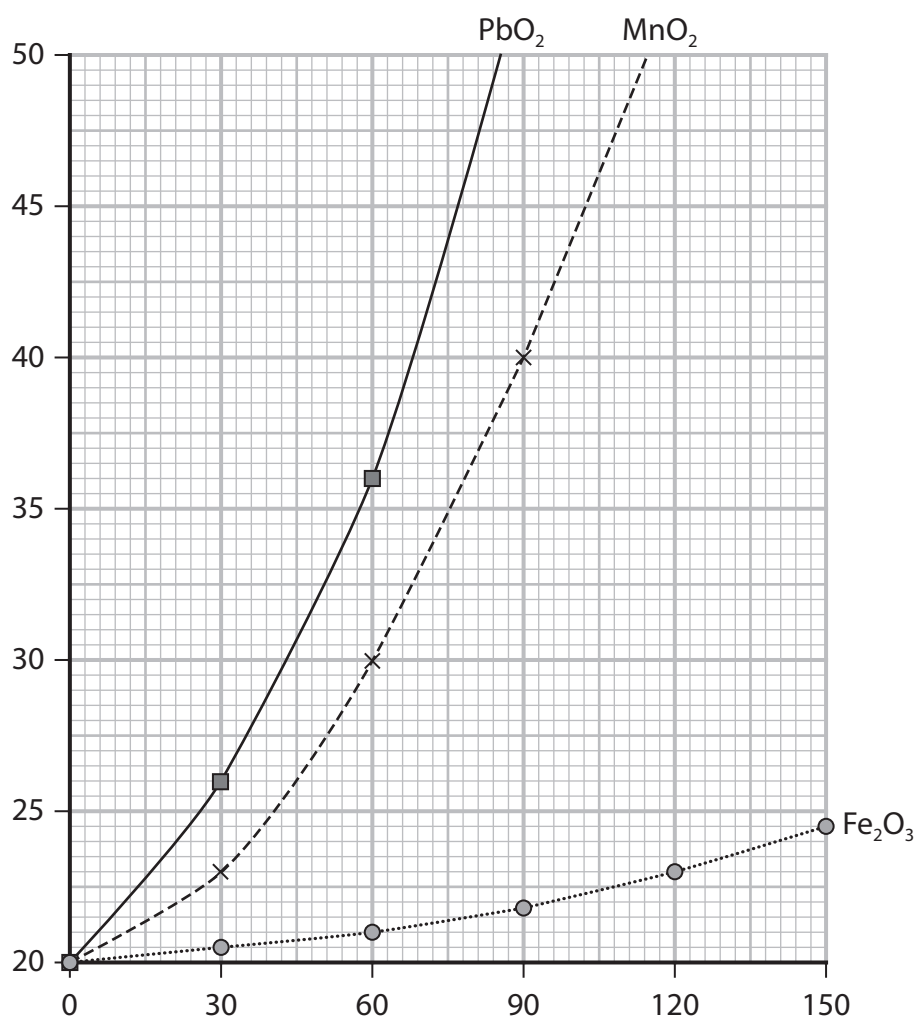
In order to compare the catalytic effect of different compounds, an experiment was carried out by a student.

0.5 g of each solid catalyst powder and a drop of washing up liquid were added to separate 50 cm³ measuring cylinders.

20 cm³ 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)

(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)

(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)

(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.

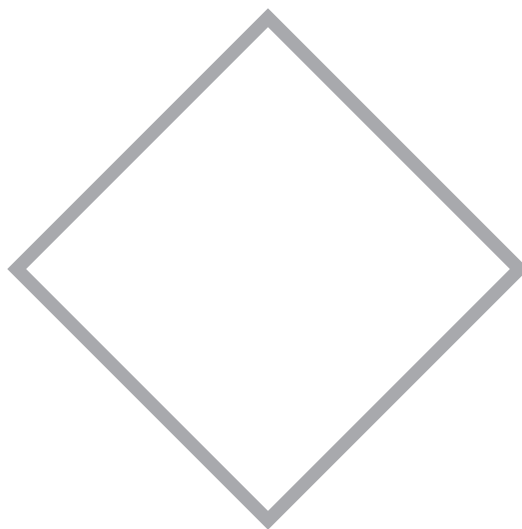
(2)



(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)

- (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)

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

(1)

(Total for Question 4 = 14 marks)

TOTAL FOR PAPER = 50 MARKS



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