

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

WCH16/01

Chemistry

International Advanced Level

UNIT 6: Practical Skills in Chemistry II

You must have:

Scientific calculator, ruler

Total Marks

Instructions

- Use **black** ink or **black** 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.
- 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 Compound **X** is a green crystalline solid that contains two cations, one anion and water of crystallisation. Tests were carried out on **X**.

(a) State what can be deduced about **X** from its colour.

(1)

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(b) About 2 cm³ of aqueous sodium hydroxide was added to a few crystals of **X** in a test tube and the mixture warmed gently. A pungent gas was evolved that turned damp red litmus paper blue.

Identify, by name or formula, the **cation** that is indicated by this test.

(1)

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(c) A spatula measure of **X** was dissolved in about 20 cm³ of distilled water to form a green solution **Y**. Portions of **Y** were tested.

Complete the table.

| | Test | Observation | Inference | |
|------|--|-------------------------|---|-----|
| (i) | 1 cm ³ of aqueous barium chloride was added to 5 cm ³ of Y | | As well as the sulfate ion, two of the anions that might give the same observation are | (3) |
| (ii) | 5 cm ³ of dilute hydrochloric acid was added to the reaction mixture in (c) (i) | | Sulfate ion is present | (1) |

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| | Test | Observation | Inference | |
|-------|--|--|---|-----|
| (iii) | A few drops of sodium hydroxide solution were added to 5 cm ³ of a fresh sample of Y | A green precipitate formed that remained unchanged on standing | A cation responsible for the green colour could be | (1) |
| (iv) | Sodium hydroxide solution was added to the mixture from (c) (iii), a little at a time, until there was no further change | The green precipitate dissolved to form a green solution | The formula of the ion responsible for the green colour of this solution is | (1) |
| (v) | Hydrogen peroxide solution was added to the green solution from (c) (iv) and the mixture was warmed | The green solution turned yellow | The ion responsible for the yellow colour of the solution is | (1) |
| (vi) | Dilute sulfuric acid was added to the yellow solution from (c) (v) | The yellow solution turned orange | The ion responsible for the orange colour of the solution is | (1) |

(d) State what can be deduced from the observation in (c) (iii) that the green precipitate does **not** change on standing. Justify your answer.

(2)

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(e) Give a possible formula of **X**. Water of crystallisation is not required.

(1)

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(Total for Question 1 = 13 marks)



P 6 8 7 9 4 A 0 3 1 6

- 2 Compound **P** is a white crystalline solid. The percentage composition by mass of **P** is carbon 60.87 %, hydrogen 4.35 % and oxygen 34.78 %.

The mass spectrum of **P** has a molecular ion peak at $m / z = 138$.

- (a) Determine the molecular formula of **P** using all these data.
You **must** show your working.

(4)

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(ii) Describe how you would ignite the sample of **solid P** to show that it burned with a smoky flame.
You may include a labelled diagram in your answer.

(3)

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(c) Use the information from (a) and (b) to draw **three** possible structures of compound **P**.

(2)

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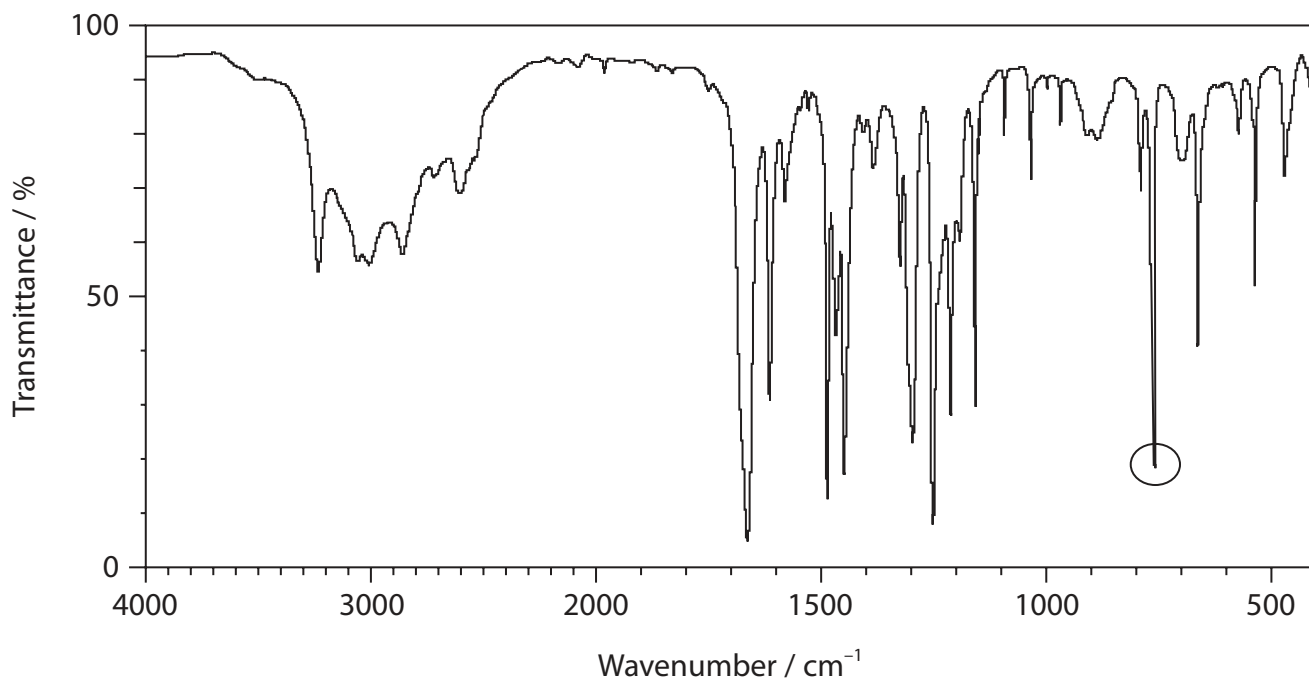


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(d) The infrared spectrum of **P** is shown. One of the peaks has been circled.



Infrared data for some organic functional groups

| Group | Wavenumber range / cm^{-1} |
|-----------------------------------|-------------------------------------|
| C—H stretching vibrations | |
| Alkane | 2962 – 2853 |
| Alkene | 3095 – 3010 |
| Alkyne | 3300 |
| Arene | 3030 |
| C—H bending vibrations | |
| Alkane | 1485 – 1365 |
| Arene (5 adjacent hydrogen atoms) | 750 and 700 |
| Arene (4 adjacent hydrogen atoms) | 750 |
| Arene (3 adjacent hydrogen atoms) | 780 |
| Arene (2 adjacent hydrogen atoms) | 830 |
| Arene (1 isolated hydrogen atom) | 880 |

Explain how the circled peak in the IR spectrum and the table of infrared data may be used to deduce the structure of **P**.

(2)

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(Total for Question 2 = 15 marks)

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P 6 8 7 9 4 A 0 9 1 6

(ii) State the colour of the solution at the end-point of the titration.

(1)

(iii) In an experiment, 2.02 g of iron(II) ethanedioate was used to prepare the solution and potassium manganate(VII) solution of concentration $0.0195 \text{ mol dm}^{-3}$ was used in the titration. The mean titre was 34.25 cm^3 .

Calculate the value of x in $\text{FeC}_2\text{O}_4 \cdot x\text{H}_2\text{O}$, giving your answer to an appropriate number of significant figures.

(5)

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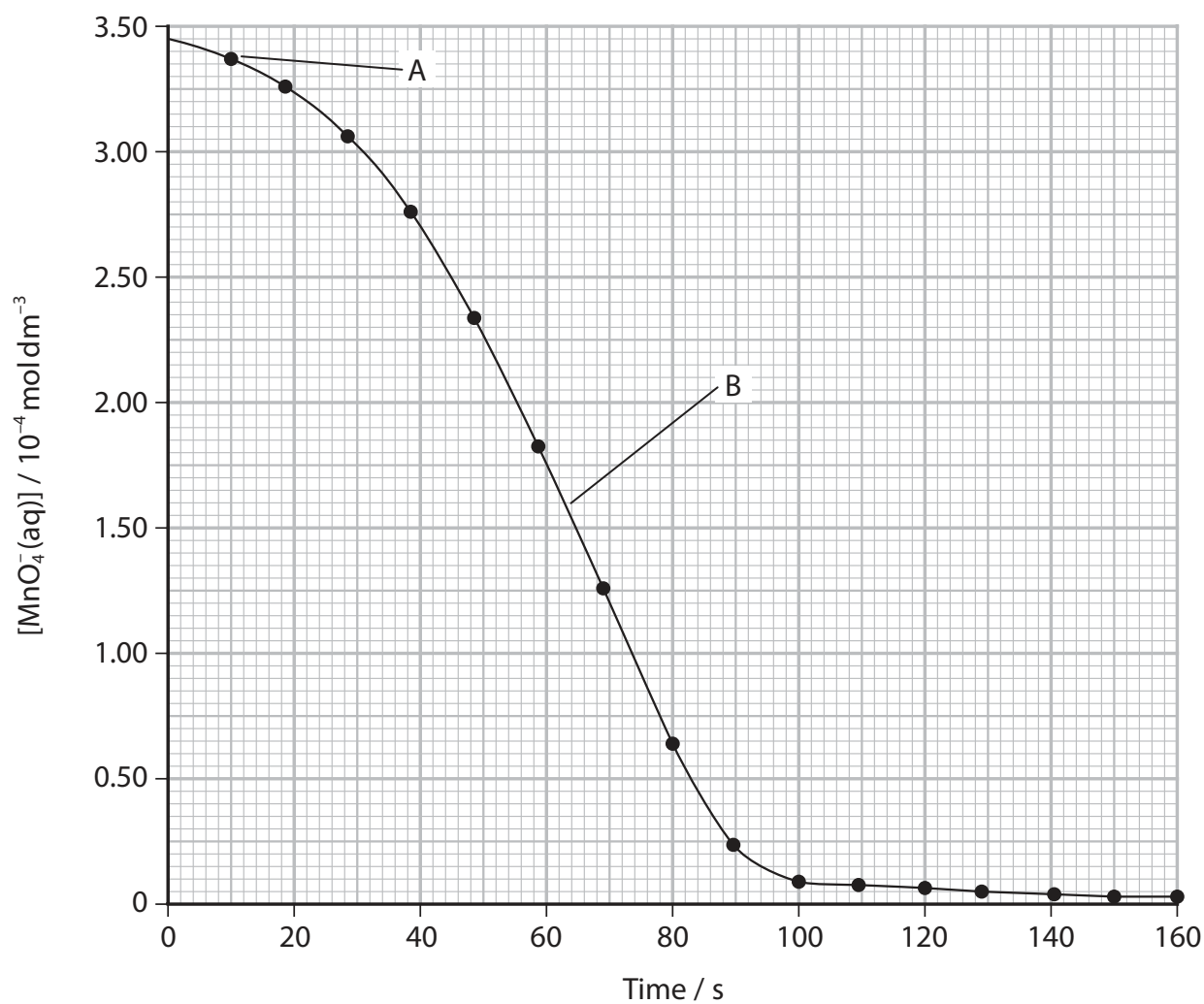
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- (b) Another experiment followed the progress over time of the reaction of ethanedioate ions with manganate(VII) ions in acid. The results are shown.



(i) Describe in outline a **continuous** monitoring method for obtaining results such as these. Practical details are not required but any essential apparatus should be named and the means of obtaining concentrations from the measurement should be stated.

(3)

(ii) Determine the rate of reaction at point **A** and at point **B**. You must show your working on the graph and include units with your answers.

(2)

Rate at point **A**

Rate at point **B**

(iii) Explain why the values obtained in (b) (ii) are different from the results of typical rate experiments.

(2)

(Total for Question 3 = 16 marks)

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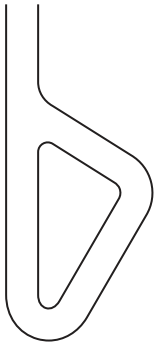


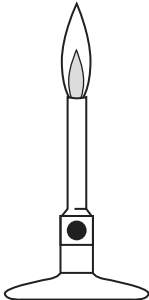
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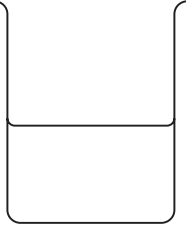


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P 6 8 7 9 4 A 0 1 3 1 6

- 4 The identity and purity of an organic compound may be checked by measuring its melting temperature. Students were asked to determine the melting temperature of samples of a solid organic compound using the apparatus shown.

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|---|---|---|---|
|  |  |  |  |
| Thiele tube | thermometer | capillary tube | Bunsen burner |

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|  |  |  |
| beaker containing a clear mineral oil | rubber band | solid sample on a watch glass |

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- (a) Give the steps of the procedure to determine the melting temperature of the solid organic compound, using the apparatus shown. You may include a diagram in your answer. You do **not** need to show how the apparatus is clamped in position.

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- (b) State how the melting temperature of an impure sample of an organic compound would differ from that of the pure compound.

(1)

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(Total for Question 4 = 6 marks)

TOTAL FOR PAPER = 50 MARKS



