

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Thursday 24 January 2019

Morning (Time: 1 hour 15 minutes)

Paper Reference **WCH06/01**

Chemistry

Advanced

Unit 6: Chemistry Laboratory Skills II

Candidates must have:
Scientific calculator

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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Pearson

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

1 The inorganic compounds **A** and **B** each contain one cation and one anion.

(a) **A** is a green solid.

Two tests were carried out on separate portions of an aqueous solution of **A**.

(i) Complete the table.

(2)

| Test | Observation | Inference |
|--|--|--|
| Test 1 A few drops of aqueous sodium hydroxide were added to a sample of the solution of A More of the sodium hydroxide was added until it was in excess | A green precipitate formed The precipitate dissolved to form a green solution | The formula of the cation in A is |
| Test 2 Dilute nitric acid and aqueous silver nitrate were added to a sample of the solution of A | | The formula of the anion in A is Cl^- |

(ii) Give the **formula** of the **anion** responsible for the green colour of the final solution in Test 1.

(1)

(iii) Write the **ionic** equation for the reaction in Test 2. Include state symbols.

(1)

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(b) **B** is a white solid.

Two tests were carried out on separate portions of an aqueous solution of **B**.

(i) Complete the table.

(3)

| Test | Observation | Inference |
|---|---|---|
| <p>Test 3</p> <p>A few drops of aqueous sodium hydroxide were added to a sample of the solution of B</p> <p>More of the sodium hydroxide was added until it was in excess</p> | <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> | <p>The formula of the cation in B is Zn^{2+}</p> |
| <p>Test 4</p> <p>Dilute hydrochloric acid and aqueous barium chloride were added to a sample of the solution of B</p> | <p>A white precipitate formed</p> | <p>The name or formula of the anion in B is</p> <p>.....</p> |

(ii) Write the **ionic** equations for the **two** reactions in Test 3. State symbols are not required.

(2)

(Total for Question 1 = 9 marks)



2 An ester **C** was hydrolysed by heating with aqueous sodium hydroxide.

The resulting mixture was distilled to give an organic liquid **D**.

The residue was acidified and the mixture purified to produce an organic liquid **E**.

(a) A spatula measure of phosphorus(V) chloride was added to separate portions of **D** and **E**.

They both gave off a gas which produced steamy fumes in air and turned damp blue litmus paper red.

Identify, by name or formula, the gas produced and the group in **D** and **E** indicated by this test.

(2)

Gas

Group

(b) **D** was oxidised to produce a carbonyl compound.

State what additional information this gives about **D**.

(1)

(c) In the mass spectrum of **D**, the molecular ion peak is at $m/e = 60$.

The low resolution proton nmr spectrum of **D** consists of three peaks with relative peak areas in the ratio 6 : 1 : 1.

Draw the structural or displayed formula of **D**.

(2)

(d) Aqueous sodium hydrogencarbonate was added to a portion of **E**.

There was immediate effervescence.

Identify, by name or formula, the gas produced and the functional group in **E**.

(2)

Gas

Functional group



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(e) In the mass spectrum of **E**, the molecular ion peak is also at $m/e = 60$.

Draw the structural or displayed formula of **E**.

(1)

(f) Draw the structural or displayed formula of the ester **C**.

(1)

(Total for Question 2 = 9 marks)



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3 This question is about compounds of manganese in different oxidation states.

- (a) Describe what you would **see** when aqueous sodium hydroxide is added to an aqueous solution containing manganese(II) ions and the mixture is left to stand for a few minutes.

(2)

- (b) A sample of an aqueous solution of manganate(VI) ions is prepared from an aqueous solution of manganate(VII) ions and solid manganese(IV) oxide under appropriate conditions.

The relevant standard electrode potentials are



- (i) Choose appropriate standard electrode potentials to calculate E_{cell}^\ominus for the formation of manganate(VI) ions in **acidic** solution. Use your calculated value of E_{cell}^\ominus to explain why manganate(VI) ions cannot be prepared under acidic conditions.

(2)

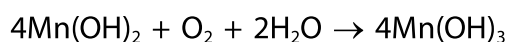
- (ii) Explain, in terms of standard electrode potentials, why manganate(VI) ions can be prepared in a **concentrated** alkaline solution.

(2)

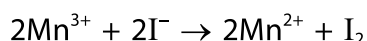


(c) An outline procedure for determining the amount of dissolved oxygen in pond water is given.

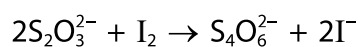
Step 1 Shake 100 cm³ of pond water with manganese(II) hydroxide in a closed container. The manganese(II) hydroxide is oxidised to manganese(III) hydroxide.



Step 2 Add excess acidified potassium iodide to the mixture. The manganese(III) ions oxidise iodide ions to iodine.



Step 3 Titrate the iodine with 0.0100 mol dm⁻³ sodium thiosulfate.



Step 4 Repeat the titration until concordant titres are obtained.

- (i) State a suitable indicator for this titration and give the colour change at the end-point.

(2)

Indicator.....

Colour change from..... to.....



(ii) Following this procedure, a mean titre of 16.20 cm^3 was recorded.

Calculate the volume of dissolved oxygen, in cm^3 , in the 100 cm^3 sample of pond water at room temperature and pressure.

[Molar volume of gas at room temperature and pressure = $24\,000 \text{ cm}^3 \text{ mol}^{-1}$]

(4)

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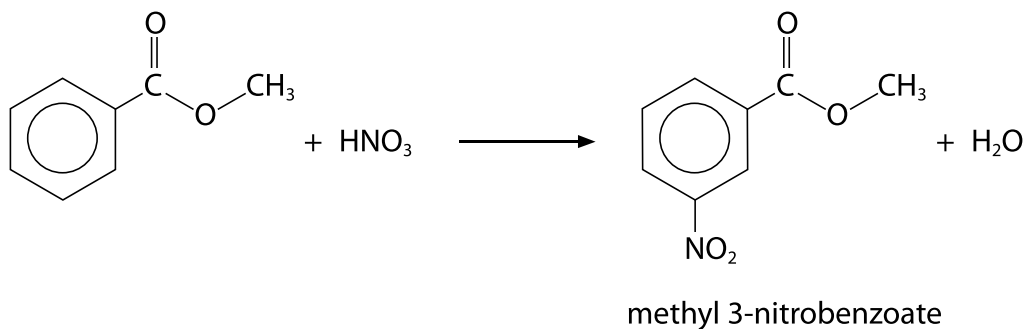
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(Total for Question 3 = 12 marks)



4 Two students carried out an experiment to nitrate methyl benzoate.



The following outline procedure was used.

- Step 1** Place 5.0 cm³ of concentrated sulfuric acid into a two-necked, round-bottomed flask and cool it to 5 °C. Slowly add 3.0 cm³ of methyl benzoate to the sulfuric acid, keeping the temperature at 5 °C.
- Step 2** Place 3.0 cm³ of concentrated nitric acid in a boiling tube and cool it to 5 °C. Slowly add 3.0 cm³ of concentrated sulfuric acid to the boiling tube, while mixing and keeping the temperature at 5 °C. This is the nitrating mixture.
- Step 3** Pour the nitrating mixture into a tap funnel. Place this **vertically** in the round-bottomed flask and put the flask in an ice-bath. Place a thermometer in the other neck of the flask.
- Step 4** Add the nitrating mixture, a drop at a time, to the mixture in the flask. Do not allow the temperature to rise above 15 °C. When all the nitrating mixture has been added, leave the mixture for about 10 minutes at room temperature.
- Step 5** Pour the mixture from the flask into a small beaker containing crushed ice.
- Step 6** Filter the impure solid methyl 3-nitrobenzoate under reduced pressure.
- Step 7** Recrystallise the methyl 3-nitrobenzoate using methanol as the solvent.
- Step 8** Dry the methyl 3-nitrobenzoate and find the mass of crystals obtained.
- Step 9** Determine the melting temperature of the crystals obtained.

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(a) Give a reason why **benzene** should not be used in a school laboratory.

(1)

.....

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(b) Give a reason why the temperature is kept low in Steps **1** and **2**.

(1)

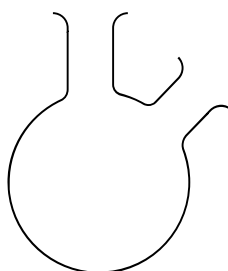
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(c) Complete the diagram to show the apparatus set up at the end of Step **3**.

(3)



- (d) The molar mass of methyl 3-nitrobenzoate is 181 g mol^{-1} . However, a small amount of a product with molar mass 226 g mol^{-1} is also formed if the temperature is allowed to rise above 15°C in Step 4.

Suggest the structure and name of a possible product with this molar mass.

(2)

Structure

Name

- (e) Give a reason why the methyl 3-nitrobenzoate is separated from the reaction mixture by filtration under reduced pressure, rather than normal filtration.

(1)

- (f) **Student 1** described how to carry out the recrystallisation in Step 7 to obtain a pure sample of methyl 3-nitrobenzoate.

Step A Dissolve the impure solid in some hot methanol.

Step B Cool the solution in an ice-bath.

Step C Separate the crystals using suction filtration.

Step D Dry the crystals by mixing them with solid anhydrous sodium sulfate in a stoppered boiling tube.



(i) The student's description of **Step A** omitted an important detail.
State how the method for **Step A** should be changed.
Justify your answer.

(2)

(ii) Describe what the student should do after **Step A** and before carrying out **Step B**.
Justify your answer.

(2)

(iii) Give a reason why **Step D** would not work and describe how the student
should dry the crystals.

(2)

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- (g) **Student 2** carried out the recrystallisation correctly and obtained 2.28 g of methyl 3-nitrobenzoate from 3.0 cm³ of methylbenzoate.

Calculate the percentage yield of methyl 3-nitrobenzoate.

Data

Density of methyl benzoate = 1.09 g cm⁻³

Molar mass of methyl benzoate = 136 g mol⁻¹

Molar mass of methyl 3-nitrobenzoate = 181 g mol⁻¹

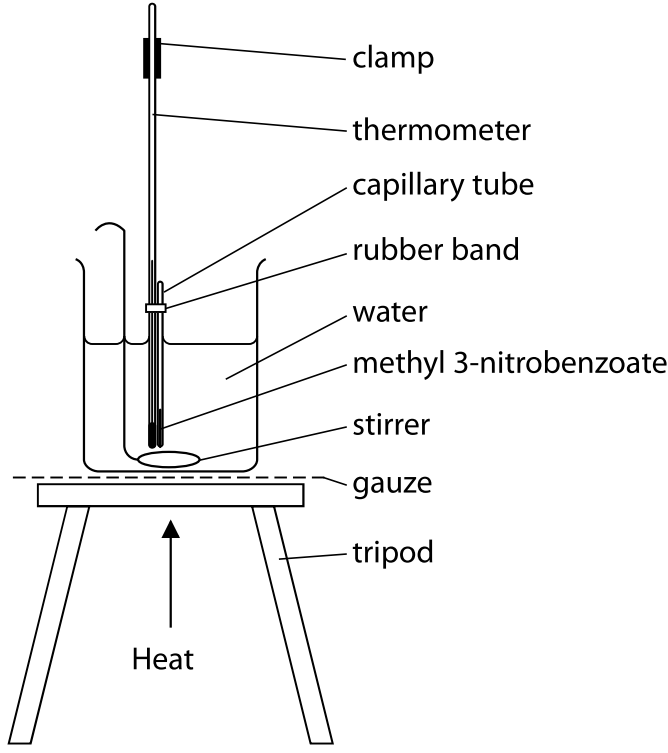
(3)



(h) The melting temperature of methyl 3-nitrobenzoate is 77°C.

Describe how the students should use the apparatus shown to determine the melting temperature **range** of a sample of their crystallised methyl 3-nitrobenzoate.

(3)



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(Total for Question 4 = 20 marks)

TOTAL FOR PAPER = 50 MARKS

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The Periodic Table of Elements

1 2 3 4 5 6 7 0 (8)

| | |
|----------|---|
| 1.0 | H |
| hydrogen | 1 |

| | | | | | | | |
|-----------|-----------|-----------|-----------|------------|-----------|-----------|-----------|
| (1) 6.9 | (2) 9.0 | (13) 10.8 | (14) 12.0 | (15) 14.0 | (16) 16.0 | (17) 19.0 | (18) 4.0 |
| Li | Be | B | C | N | O | F | He |
| lithium | beryllium | boron | carbon | nitrogen | oxygen | fluorine | helium |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 | 2 |
| 23.0 | 24.3 | 27.0 | 28.1 | 31.0 | 32.1 | 35.5 | 20.2 |
| Na | Mg | Al | Si | P | S | Cl | Ne |
| sodium | magnesium | aluminium | silicon | phosphorus | sulfur | chlorine | neon |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 10 |
| 39.1 | 40.1 | 69.7 | 72.6 | 74.9 | 79.0 | 79.9 | 83.8 |
| K | Ca | Ga | Ge | As | Se | Br | Kr |
| potassium | calcium | gallium | germanium | arsenic | selenium | bromine | krypton |
| 19 | 20 | 31 | 32 | 33 | 34 | 35 | 36 |
| 85.5 | 87.6 | 114.8 | 118.7 | 121.8 | 127.6 | 126.9 | 131.3 |
| Rb | Sr | In | Sn | Sb | Te | I | Xe |
| rubidium | strontium | indium | tin | antimony | tellurium | iodine | xenon |
| 37 | 38 | 49 | 50 | 51 | 52 | 53 | 54 |
| 132.9 | 137.3 | 204.4 | 207.2 | 209.0 | [209] | [210] | [222] |
| Cs | Ba | Tl | Pb | Bi | Po | At | Rn |
| caesium | barium | thallium | lead | bismuth | polonium | astatine | radon |
| 55 | 56 | 81 | 82 | 83 | 84 | 85 | 86 |
| [223] | [226] | [208.284] | [208.286] | [208.384] | [209] | [210] | [222] |
| Fr | Ra | | | | | | |
| francium | radium | | | | | | |
| 87 | 88 | | | | | | |

Key

| |
|------------------------|
| relative atomic mass |
| atomic symbol |
| name |
| atomic (proton) number |

Elements with atomic numbers 112-116 have been reported but not fully authenticated

| | | | | | | | | | | | | |
|-----------|--------------|-----------|-----------|-----------|------------|-----------|-------------|-------------|-----------|--------------|-----------|------------|
| 140 | 141 | 144 | 150 | 152 | 157 | 159 | 163 | 165 | 167 | 169 | 173 | 175 |
| Ce | Pr | Nd | Sm | Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu |
| cerium | praseodymium | neodymium | samarium | europium | gadolinium | terbium | dysprosium | holmium | erbium | thulium | ytterbium | lutetium |
| 58 | 59 | 60 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 |
| 232 | [231] | 238 | [242] | [243] | [247] | [245] | [251] | [254] | [253] | [256] | [254] | [257] |
| Th | Pa | U | Pu | Am | Cm | Bk | Cf | Es | Fm | Md | No | Lr |
| thorium | protactinium | uranium | plutonium | americium | curium | berkelium | californium | einsteinium | fermium | mendeleevium | nobelium | lawrencium |
| 90 | 91 | 92 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 |

* Lanthanide series

* Actinide series

