

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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Candidate Number

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Wednesday 15 May 2019

Afternoon (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 This question is about five inorganic compounds (**A**, **B**, **C**, **D** and **E**).

(a) Compounds **A** and **B** contain s-block elements.

(i) In flame tests, **A** gave a yellow colour and **B** gave a yellow-red colour.

Identify the s-block metal ions in **A** and **B**.

(1)

The metal ion in **A**

The metal ion in **B**

(ii) Give the colour of the precipitate formed when concentrated sodium hydroxide solution is added to an aqueous solution of **B**.

(1)

(iii) Compound **A** is a carbonate.

Write an **ionic** equation for the reaction that takes place when dilute hydrochloric acid is added to an aqueous solution of **A**. Include state symbols.

(2)

(iv) Compound **B** is a halide.

Identify, by name or formula, a reagent that may be used to test for halide ions in an **aqueous** solution of **B**.

(1)

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(b) Compounds **C**, **D** and **E** are nitrates of d-block elements.

Aqueous sodium hydroxide is added, drop by drop, until in excess to separate solutions of **C**, **D** and **E**.

(i) Compound **C** forms an off-white precipitate which darkens on standing in air.

Identify the precipitate, by name or formula, and explain why it darkens.

(2)

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(ii) Compound **D** forms a white precipitate which dissolves in excess sodium hydroxide to form a colourless solution containing a complex ion.

Write the **formula** of this complex ion.

(1)

.....

(iii) Compound **E** forms a green precipitate which does **not** dissolve in excess sodium hydroxide.

The precipitate turns brown on standing in air.

Identify, by name or formula, the compound **E** and the brown solid.

(2)

Compound **E**.....

Brown solid.....

(Total for Question 1 = 10 marks)

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- 2 This question is about three organic compounds: **X**, **Y** and **Z**.
X, **Y** and **Z** have the same molecular formula, $C_6H_{12}O$.

The table shows the observations made in some chemical tests on **X**, **Y** and **Z**.

Compound	Observations with reagent				
	Sodium metal	Bromine water	Acidified sodium dichromate(VI)	Brady's reagent (2,4-DNPH)	Iodine in aqueous sodium hydroxide
X	No change	No change	No change	Orange precipitate	Pale yellow precipitate
Y	Effervescence	Decolourises	Turns green	No change	No change
Z	Effervescence	No change	No change	No change	No change

(a) Use information from the table to answer the following questions.

- (i) State what can be deduced about **X** from the positive test results.

(2)

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- (ii) Name the functional **groups** present in **Y**.

(2)

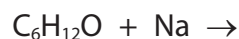
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- (iii) Complete the equation for the reaction between **Z** and sodium metal.
State symbols are not required.

(1)



- (b) The **high** resolution proton nmr spectrum of compound **X** has only two peaks which are singlets with relative peak areas of 1 : 3.

- (i) State what can be deduced from the presence of only two peaks in the nmr spectrum.

(1)

- (ii) State what can be deduced from the fact that these peaks are singlets.

(1)

- (iii) Use the nmr information, your answer to (a)(i) and the molecular formula to deduce the structure of **X**.

(1)



P 5 6 1 3 2 A 0 5 1 6

(c) Compound **Y** is straight-chained and does **not** have geometric or optical isomers.

(i) State what can be deduced from the fact that **Y** does not exist as geometric isomers. (1)

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(ii) State what can be deduced from the fact that **Y** does not have optical isomers. (1)

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(iii) Use information about **Y**, your answer to (a)(ii) and the molecular formula to deduce the structure of **Y**. (1)

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(d) (i) Deduce the type and classification of the functional group present in **Z**, using observations from the table. (1)

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(ii) Compound **Z** contains a five-membered carbon ring. Deduce the structure of **Z** using this information, your deduction in (d)(i) and the molecular formula. (1)

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(Total for Question 2 = 13 marks)

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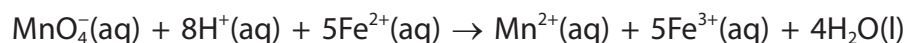
- 3 This question is about the analysis of iron supplements used to prevent or treat iron deficiency anaemia.

A student used the following procedure to analyse iron tablets containing iron in the form of hydrated iron(II) sulfate, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$.

Procedure

- Step 1 Grind up **two** iron tablets with a little dilute sulfuric acid using a pestle and mortar.
- Step 2 Transfer the resulting paste into a 100.0 cm^3 volumetric flask. Rinse the apparatus used with dilute sulfuric acid, transferring all washings to the volumetric flask.
- Step 3 Add sufficient dilute sulfuric acid to the volumetric flask to make up the solution to exactly 100.0 cm^3 . Stopper the flask and invert it several times.
- Step 4 Using a pipette, transfer 10.0 cm^3 of the solution to a conical flask and titrate it with $0.00500\text{ mol dm}^{-3}$ potassium manganate(VII) solution.
- Step 5 Repeat Step 4 until concordant results are obtained.

The overall equation for the reaction occurring in the titration is



- (a) (i) Give the reason why the titration in Step 4 does **not** require the addition of an indicator.

(1)

- (ii) Give the colour **change** at the end-point.

(1)



(b) The student decided to take the burette readings from the top of the liquid level rather than from the bottom of the meniscus.

Suggest the effect of this, if any, on the titre values. Justify your answer.

(2)

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(c) Results of the titrations are given in the table.

Titration number	1	2	3	4
Burette reading (final) / cm ³	10.85	21.40	31.60	42.40
Burette reading (initial) / cm ³	0.00	10.85	21.40	32.10
Titre / cm ³	10.85			

(i) Complete the table and use the concordant values to calculate the mean titre.

(2)

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- (ii) Use your mean titre and information from the procedure to calculate the mass of hydrated iron(II) sulfate, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, present in **one** iron tablet.

Give your answer to an appropriate number of significant figures.

(5)

- (d) The uncertainties in the burette and pipette measurements are $\pm 0.05 \text{ cm}^3$ and $\pm 0.06 \text{ cm}^3$ respectively.

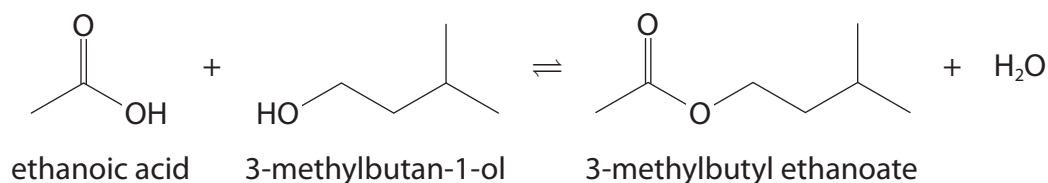
Calculate which of these pieces of apparatus gives the greater percentage uncertainty in this experiment.

(2)

(Total for Question 3 = 13 marks)



- 4 This question is about the laboratory preparation of 3-methylbutyl ethanoate, an ester used as a banana flavouring in foods.



Procedure

- Step 1** Add 7.5 cm³ of 3-methylbutan-1-ol, 10 cm³ of ethanoic acid and 2 cm³ of concentrated sulfuric acid to a round-bottom flask.
- Step 2** Add a few anti-bumping granules and heat the mixture under reflux for 35 minutes.
- Step 3** Transfer the cooled reaction mixture to a separating funnel. Add 30 cm³ of distilled water and washings from the flask. Shake the mixture, allow to separate and discard the aqueous layer.
- Step 4** Wash the organic layer with 15 cm³ of sodium hydrogencarbonate solution, releasing the build up of pressure. Discard the aqueous layer and repeat until the aqueous layer is slightly alkaline.
- Step 5** Transfer the organic layer to a boiling tube and dry with anhydrous magnesium sulfate.
- Step 6** Decant the organic layer into a clean round-bottom flask and distil. Collect the fraction boiling between 140°C and 144°C in a pre-weighed test tube.

Data

Compound	Molar mass / g mol ⁻¹	Density / g cm ⁻³	Boiling temperature / °C
3-methylbutan-1-ol	88.0	0.81	131
ethanoic acid	60.0	1.05	118
3-methylbutyl ethanoate	130.0	0.88	142

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(a) State the purpose of the concentrated sulfuric acid and of the anti-bumping granules added to the round-bottom flask.

(2)

Concentrated sulfuric acid in Step 1

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Anti-bumping granules in Step 2

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(b) Draw a labelled diagram of the apparatus used to heat the reaction mixture under reflux in Step 2.

(2)

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(c) Draw a diagram of the separating funnel in Step **3**, clearly labelling the aqueous and organic layers.

(2)

(d) Give the reason why the organic layer is washed with sodium hydrogencarbonate solution in Step **4** and suggest how the alkalinity of the aqueous layer should be confirmed.

(2)

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(e) Explain why the distillate is **not** collected below 140 °C in Step 6.

(2)

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(f) A student prepared 4.75 g of 3-methylbutyl ethanoate starting with 7.5 cm³ of 3-methylbutan-1-ol and excess ethanoic acid.

(i) Calculate the percentage yield of 3-methylbutyl ethanoate.

(3)

(ii) Give the main reason why the yield is significantly less than 100%.

Do not consider errors in the experimental procedure or transfer losses.

(1)

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(Total for Question 4 = 14 marks)

TOTAL FOR PAPER = 50 MARKS



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