Surname	Centre Number	Candidate Number
First name(s)		2

GCE A LEVEL

S25-1410U50-1E

1410U50-1E

FRIDAY, 9 MAY 2025 – MORNING

CHEMISTRY – A2 unit 5
Practical Methods and Analysis Task

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**8**	
3.	**12**	
Total	**30**	

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01

ADDITIONAL MATERIALS

- A calculator, pencil and ruler
- **Data Booklet** supplied by WJEC

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The maximum mark for this paper is 30.

Your answers must be relevant and must make full use of the information given to be awarded full marks for a question.

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Answer **all** questions.

1. A student was given three sets of aqueous solutions as shown in the following tables.

He was asked to carry out a chemical test on each set that would allow him to distinguish between the solutions in each set.

For each set of solutions:

- Describe **one** chemical test the student could use.
- Give the observations made with **all** solutions.
- Give an equation for **one** reaction that gives an observable change. State symbols are **not** required. [10]

Set 1	
Solutions	**A** iron(II) chloride **B** iron(III) chloride **C** chromium(III) chloride
Chemical test	
Observations	
Equation	

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Set 2	
Solutions	**D** lithium chloride **E** barium chloride
Chemical test (apart from a flame test)	
Observations	
Equation	

Set 3	
Solutions	**F** bromine **G** iodine
Chemical test	
Observations	
Equation	

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03

10

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2. (a) A sample of strontium metal of unknown mass was added to exactly 200 cm^3 (an excess) of water in an insulated calorimeter.

Strontium reacts with water according to the following equation.

$$Sr(s) + 2H_2O(l) \longrightarrow Sr(OH)_2(aq) + H_2(g)$$

It is possible to determine the mass of strontium added by several methods.

(i) Method **1**

When the strontium was added to the calorimeter, the temperature increased from 19.8°C to 23.1°C.

I. If the enthalpy change, ΔH, for this reaction is $-430\,kJ\,mol^{-1}$, calculate the mass of strontium added to the calorimeter. [2]

Mass (by method **1**) = ... g

II. The uncertainty in both temperature readings is ±0.1°C.

Calculate the maximum percentage error in the temperature change value.

You **must** show your working. [1]

Maximum percentage error = ... %

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(ii) Method **2**

25.0 cm^3 of the 200 cm^3 of strontium hydroxide solution formed in the calorimeter was transferred to a conical flask and titrated against 0.0950 mol dm^{-3} hydrochloric acid. It needed 17.10 cm^3 of acid for complete reaction.

Use this volumetric data to calculate the mass of strontium added to the calorimeter. [3]

Mass (by method **2**) = ... g

(iii) State which of the two methods gives the more accurate value for the mass of strontium added. Give your reasoning. [1]

Method .....

Reasoning .....

.....

(b) The mass of strontium added to an excess of water can also be determined by collecting the hydrogen gas formed in a gas syringe.

State how the volume of gas collected would be used to calculate the mass of strontium added to the water. [1]

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8

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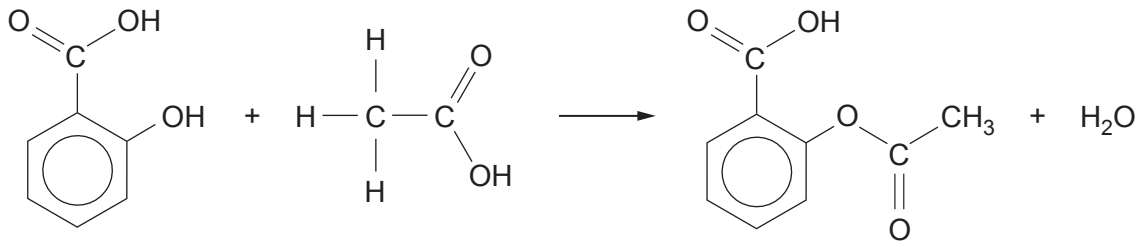
05

3. Aspirin is an effective analgesic (pain reliever), antipyretic (fever reducer) and anti-inflammatory agent. It is one of the most widely used non-prescription drugs.

Aspirin can be made by reacting 2-hydroxybenzenecarboxylic acid with ethanoic acid in the presence of a phosphoric acid catalyst.

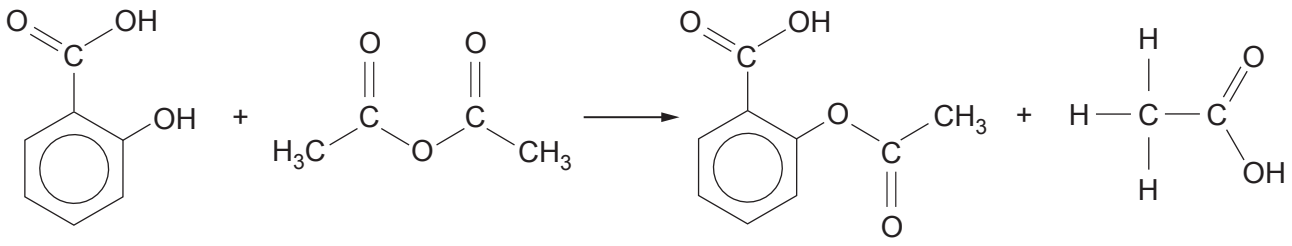
The phenol group on the 2-hydroxybenzenecarboxylic acid forms an ester with the carboxyl group of the ethanoic acid. However, this reaction is slow and has a relatively low yield.



2-hydroxybenzenecarboxylic acid
$C_7H_6O_3$

aspirin
$C_9H_8O_4$

When ethanoic anhydride is used instead of ethanoic acid, the reaction is much faster because ethanoic anhydride is much more reactive than ethanoic acid. The reaction also has a higher yield.



When the esterification reaction is complete, water is added to the reaction mixture. This causes the aspirin to precipitate. Water also reacts with any unreacted ethanoic anhydride to form ethanoic acid.

Solid aspirin is collected using vacuum filtration. Any other soluble substances present pass through the filter paper.

The aspirin collected is purified by recrystallisation using ethanol as a solvent.

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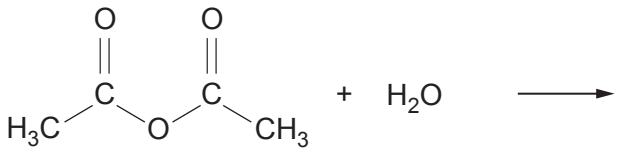
(a) Complete and balance the equation for the reaction of unreacted ethanoic anhydride with water to form ethanoic acid as the **only** product. [1]



(b) A student reacts 2.99 g of 2-hydroxybenzenecarboxylic acid with excess ethanoic anhydride.

(i) Calculate the minimum volume of ethanoic anhydride required for complete reaction. [3]

density of ethanoic anhydride = 1.08 g cm^{-3}

Minimum volume = ... cm^3

(ii) The student obtained 2.78 g of aspirin. Calculate the percentage yield for the reaction. [2]

Percentage yield = ... %

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(c) Aspirin that has been stored for a long time may have a vinegar-like smell and give a purple colour with aqueous $FeCl_3$.

Explain these observations. [2]

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(d) Aspirin can be formed using ethanoyl chloride instead of ethanoic anhydride. However, this reaction is not used in industry despite having a higher atom economy.

Suggest a reason why this is the case. [1]

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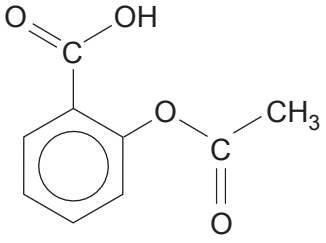
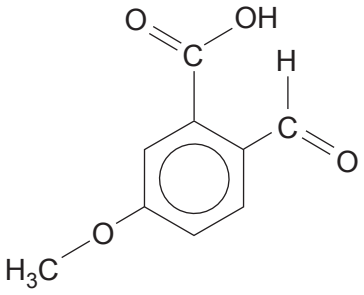
(e) Aspirin and compound **A** are isomers.



aspirin



compound **A**

(i) State a chemical test that will give a positive result for both aspirin and compound **A**. Give the reagent(s) and observation. [1]

Reagent(s) .....

Observation .....

(ii) State a chemical test that will give a positive result for compound **A** but **not** for aspirin. Give the reagent(s) and the observation for compound **A**. [1]

Reagent(s) .....

Observation .....

Examiner only

(iii) Give the number of peaks in the low resolution ^{1}H NMR spectrum of aspirin and compound **A**.

Assume that all aromatic protons are equivalent. You do not need to refer to chemical shift values or peak areas. [1]

Aspirin .....

Compound **A** .....

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END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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