



**GCE A LEVEL**

**1410U50–1E**

**FRIDAY, 9 MAY 2025 – MORNING**

**CHEMISTRY – A2 UNIT 5**

**PRACTICAL METHODS AND ANALYSIS TASK**

**1 hour plus your additional time  
allowance**

**Surname:** \_\_\_\_\_

**First name(s):** \_\_\_\_\_

**Centre Number:** \_\_\_\_\_

**Candidate Number:** 2 \_\_\_\_\_

| <b>FOR EXAMINER'S USE ONLY</b> |                     |                     |
|--------------------------------|---------------------|---------------------|
| <b>Question</b>                | <b>Maximum Mark</b> | <b>Mark Awarded</b> |
| <b>1.</b>                      | <b>10</b>           |                     |
| <b>2.</b>                      | <b>8</b>            |                     |
| <b>3.</b>                      | <b>12</b>           |                     |
| <b>Total</b>                   | <b>30</b>           |                     |

**(Turn over)**

## **ADDITIONAL MATERIALS**

- A calculator and ruler
- Data Booklet supplied by WJEC

## **ITEMS INCLUDED WITH QUESTION PAPER**

A separate Diagram Booklet.

The Diagram Booklet **MUST** be handed in to the invigilators and sent for marking.

## **INSTRUCTIONS TO CANDIDATES**

Use black ink, black ball – point pen, black felt tip or your usual method.

Write your name, centre number and candidate number in the spaces on the front cover.

Answer **ALL** questions.

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

(Turn over)

**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.**

**Answer ALL questions.**

- 1. A student was given three sets of aqueous solutions as shown in the tables provided separately in the Diagram Booklet.**

**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 marks]**

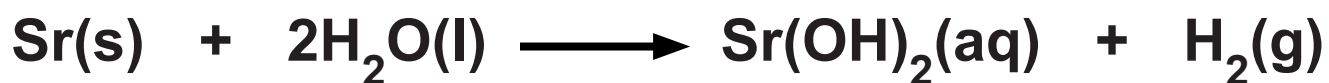
**(Total for Question 1 = 10 marks)**

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**(Turn over)**

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

Strontium reacts with water according to the following equation.



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  $19.8^\circ\text{C}$  to  $23.1^\circ\text{C}$ .

continued on the next page . . .

**Question 2 (a) (i) continued**

2. (a) (i) I. If the enthalpy change,  $\Delta H$ , for this reaction is  $-430 \text{ kJ mol}^{-1}$ , calculate the mass of strontium added to the calorimeter.

**Mass (by method 1) = \_\_\_\_\_ g**  
**[2 marks]**

**continued on the next page . . .**

**(Turn over)**

**Question 2 (a) (i) continued**

2. (a) (i) II. The uncertainty in both temperature readings is  $\pm 0.1^{\circ}\text{C}$ .

Calculate the maximum percentage error in the temperature change value.

You **MUST** show your working.

Maximum percentage error = \_\_\_\_\_ %  
[1 mark]

continued on the next page . . .

(Turn over)

**Question 2 (a) continued****2. (a) (ii) Method 2**

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

**Use this volumetric data to calculate the mass of strontium added to the calorimeter.**

**Space for working continues on the next page.**

**Question 2 (a) (ii) continued**

**Mass (by method 2) = \_\_\_\_\_ g**  
**[3 marks]**

**continued on the next page . . .**

**(Turn over)**

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

Method \_\_\_\_\_

Reasoning \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

[1 mark]

continued on the next page . . .

(Turn over)

**Question 2 continued**

2. (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.

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[1 mark]

(Total for Question 2 = 8 marks)

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(Turn over)

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. The equation for this reaction is shown in IMAGE 1 in the separate Diagram Booklet.**

**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. The equation for this reaction is shown in IMAGE 2 in the separate Diagram Booklet.**

**continued on the next page . . .**

**Question 3 continued**

**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.**

- (a) Refer to IMAGE 3 in the separate Diagram Booklet. Complete and balance the equation for the reaction of unreacted ethanoic anhydride with water to form ethanoic acid as the ONLY product.**

**[1 mark]**

**continued on the next page . . .**

**(Turn over)**

## Question 3 continued

3. (b) A student reacts  $2.99 \text{ g}$  of  
2-hydroxybenzenecarboxylic acid with excess  
ethanoic anhydride.

- (i) Calculate the minimum volume of ethanoic  
anhydride required for complete reaction.

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

Minimum volume = \_\_\_\_\_  $\text{cm}^3$

[3 marks]

continued on the next page . . .

(Turn over)

**Question 3 (b) continued**

3. (b) (ii) The student obtained **2.78 g** of aspirin.  
Calculate the percentage yield for the reaction.

**Percentage yield = \_\_\_\_\_ %**

**[2 marks]**

**continued on the next page . . .**

**(Turn over)**

**Question 3 continued**

3. (c) Aspirin that has been stored for a long time may have a vinegar – like smell and give a purple colour with aqueous  $\text{FeCl}_3$

**Explain these observations.**

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**[2 marks]**

**continued on the next page . . .**

**(Turn over)**

**Question 3 continued**

3. (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.

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[1 mark]

continued on the next page . . .

(Turn over)

**Question 3 continued**

3. (e) Refer to IMAGE 4 in the separate Diagram Booklet.

Aspirin and compound **A** are isomers.

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

Reagent(s) \_\_\_\_\_

Observation \_\_\_\_\_

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[1 mark]

continued on the next page . . .

(Turn over)

**Question 3 (e) continued**

3. (e) (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**.

Reagent(s) \_\_\_\_\_

Observation \_\_\_\_\_

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[1 mark]

continued on the next page . . .

(Turn over)

**Question 3 (e) continued**

3. (e) (iii) Give the number of peaks in the low resolution  $^1\text{H}$  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.

Aspirin \_\_\_\_\_

Compound A \_\_\_\_\_

[1 mark]

(Total for Question 3 = 12 marks)

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END OF PAPER

TOTAL 30 MARKS

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(Turn over)

[illegible]

**(Turn over)**

[illegible]

**(Turn over)**

[illegible]



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**CHEMISTRY – A2 UNIT 5**

**PRACTICAL METHODS AND ANALYSIS TASK**

# **Diagram Booklet**

**This Diagram Booklet MUST be handed in  
to the invigilators and sent for marking.**

**Surname:** \_\_\_\_\_

**First name(s):** \_\_\_\_\_

**Centre Number:** \_\_\_\_\_

**Candidate Number:** 2 \_\_\_\_\_

**TABLE 1**

| <b>SET 1</b>         |                                                                                              |
|----------------------|----------------------------------------------------------------------------------------------|
| <b>Solutions</b>     | <b>A</b> iron(II) chloride<br><b>B</b> iron(III) chloride<br><b>C</b> chromium(III) chloride |
| <b>Chemical test</b> |                                                                                              |
| <b>Observations</b>  |                                                                                              |
| <b>Equation</b>      |                                                                                              |

**TABLE 2**

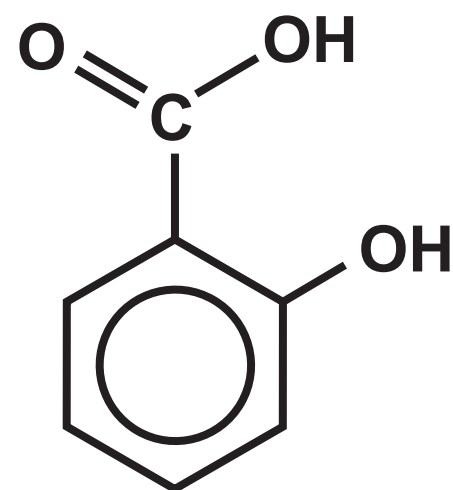
| <b>SET 2</b>                                           |                                                       |
|--------------------------------------------------------|-------------------------------------------------------|
| <b>Solutions</b>                                       | <b>D</b> lithium chloride<br><b>E</b> barium chloride |
| <b>Chemical test<br/>(apart from a<br/>flame test)</b> |                                                       |
| <b>Observations</b>                                    |                                                       |
| <b>Equation</b>                                        |                                                       |

**TABLE 3**

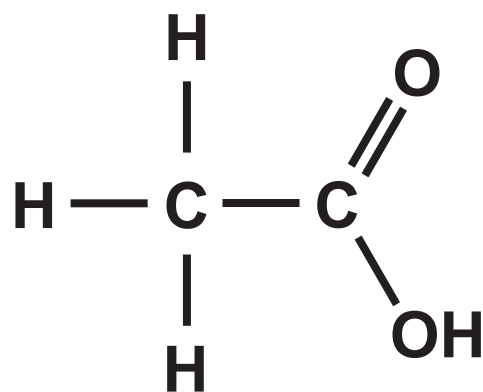
| <b>SET 3</b>         |                                     |
|----------------------|-------------------------------------|
| <b>Solutions</b>     | <b>F</b> bromine<br><b>G</b> iodine |
| <b>Chemical test</b> |                                     |
| <b>Observations</b>  |                                     |
| <b>Equation</b>      |                                     |

# IMAGE 1

2 – hydroxybenzenecarboxylic  
acid ( $\text{C}_7\text{H}_6\text{O}_3$ )



+



aspirin ( $\text{C}_9\text{H}_8\text{O}_4$ )

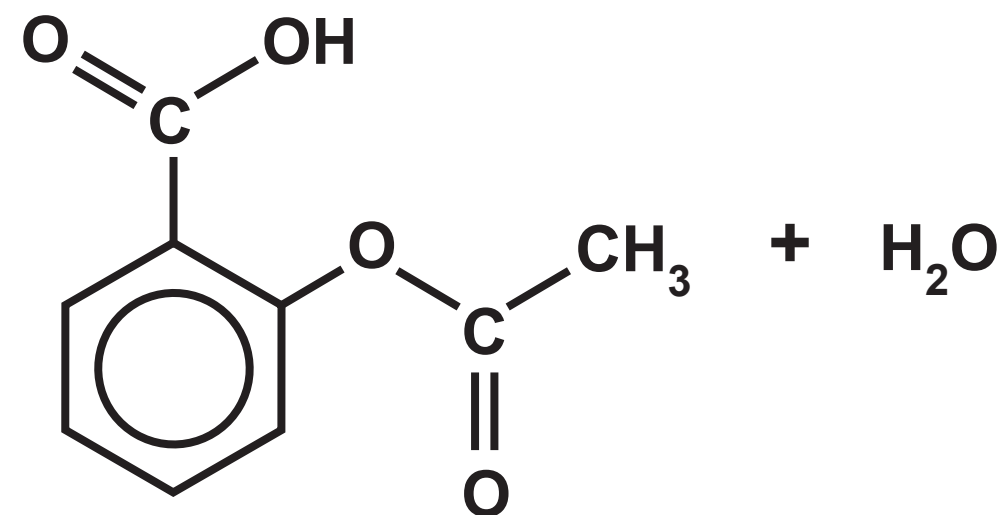


IMAGE 2

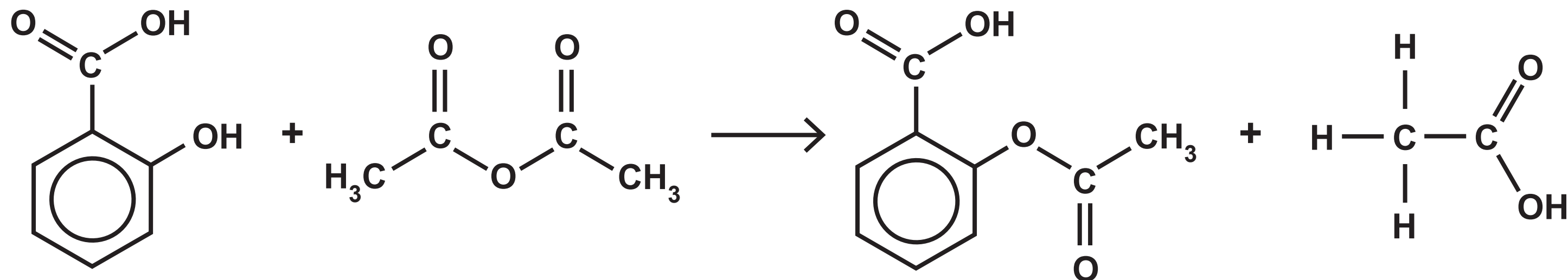
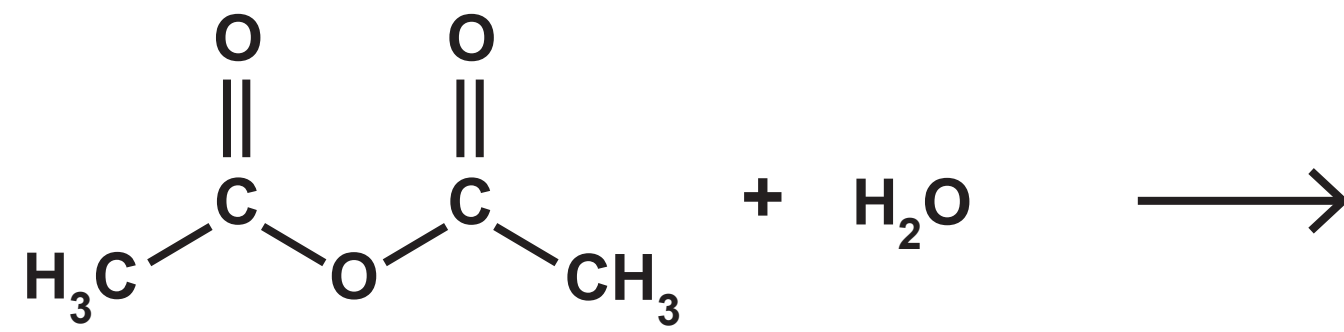
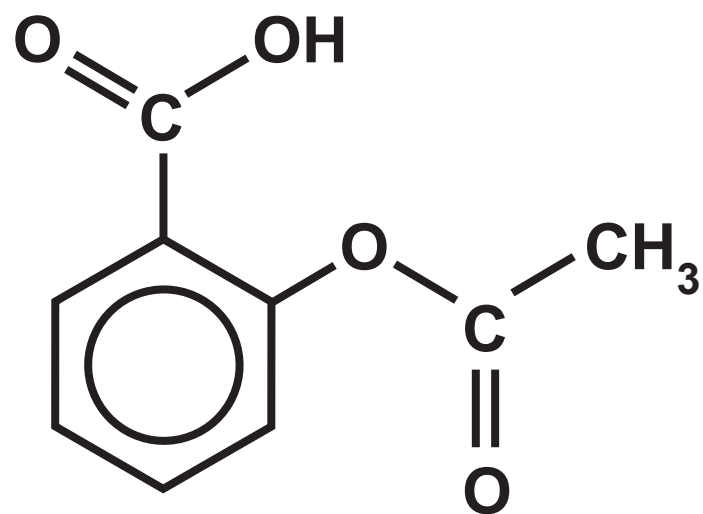


IMAGE 3



## IMAGE 4

aspirin



compound A

