



GCE A LEVEL

1410U50–1A

WEDNESDAY, 7 MAY 2025

**CHEMISTRY – A2 UNIT 5
PRACTICAL EXAMINATION**

**EXPERIMENTAL TASK
TEST 1**

**3 hours plus your additional time
allowance**

Surname: _____

First name(s): _____

Centre Number: _____

Candidate Number: 2 _____

FOR TEACHER'S USE ONLY

**Award a mark of 0 or 1
for each of the following**

**Working safely
(PARTS A & B)**

**Making up a solution
(PART A)**

FOR EXAMINER'S USE ONLY

Mark Awarded

TOTAL

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.

Write your answers in the spaces provided.

(Turn over)

INFORMATION FOR CANDIDATES

The total number of marks available for this task is 30.

Your teacher will directly assess your practical skills in PARTS A and B.

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

You are reminded of the necessity for orderly presentation in your answers.

(Turn over)

THIS PRACTICAL EXAMINATION IS IN TWO PARTS:

**PART A – DETERMINE THE MOLAR MASS OF
ETHANEDIOIC ACID AND HENCE THE VALUE OF X IN
 $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$**

**Ethanedioic acid is a common industrial cleaner, often
used to remove corrosion from metal surfaces. It is
usually bought in the form of a hydrated salt –
 $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$**

**In order to prepare a solution of known concentration,
the value of X must be found.**

**A solution of sodium hydroxide is standardised by
titrating against hydrochloric acid of known
concentration. Ethanedioic acid is then titrated against
the standardised sodium hydroxide solution to find its
molar mass and hence the value of X.**

continued on the next page . . .

(Turn over)

**PART B – QUALITATIVE ORGANIC TESTS ON THE
REACTION MIXTURE AT EACH STAGE OF THE
PRODUCTION OF ETHANEDIOIC ACID**

Ethanedioic acid is produced from ethene in a three – step process. This three – step process is shown separately in the Diagram Booklet.

A series of tests is carried out to identify one of the functional groups present in the reaction mixture at each stage of the process.

Record all observations in the spaces provided and then use the results in the analysis section later in the paper.

The apparatus and chemicals required are listed on the following pages.

(Turn over)

**PART A – DETERMINE THE MOLAR MASS OF
ETHANEDIOIC ACID AND HENCE THE VALUE OF x IN
 $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$**

APPARATUS

Note that ethanedioic acid is toxic and appropriate care should be taken when handling the solid and the solution.

You will need eye protection, gloves and the following apparatus:

1 × weighing bottle + lid containing approximately 2.0 g of $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$ (toxic)

2 × 100 cm³ beaker

1 × large funnel (to transfer ethanedioic acid solution to volumetric flask)

1 × stirring rod

1 × 25 cm³ measuring cylinder

1 × 250 cm³ volumetric flask

1 × wash bottle containing deionised water

1 × 50 cm³ burette

1 × burette stand

continued on the next page . . .

(Turn over)

PART A continued

1 × small funnel (to fill burette)

2 × 25 cm³ volumetric pipette

1 × pipette filler

2 × 250 cm³ conical flask

1 × plastic dropping pipette

Ready access to a weighing balance

CHEMICALS

In addition to approximately 2.0 g of (COOH)₂·xH₂O in the weighing bottle, you will need:

approximately 200 cm³ of approximately

**0.15 mol dm⁻³ hydrochloric acid solution, HCl(aq)
(irritant)**

**approximately 200 cm³ of sodium hydroxide solution,
NaOH(aq), of unknown concentration (irritant)**

phenolphthalein indicator (flammable)

deionised water

**You will be told the EXACT CONCENTRATION of the
hydrochloric acid solution by your teacher.**

RECORD THIS ON PAGE 23

(Turn over)

PART B – QUALITATIVE ORGANIC TESTS ON THE REACTION MIXTURE AT EACH STAGE OF THE PRODUCTION OF ETHANEDIOIC ACID

APPARATUS

You will need eye protection and the following apparatus:

4 × plastic dropping pipette

1 × test tube rack

1 × spatula

CHEMICALS

You will need:

1 × stoppered test tube labelled 1, containing approximately 3 cm³ of reaction mixture from step 1

1 × stoppered test tube labelled 2, containing approximately 3 cm³ of reaction mixture from step 2

1 × stoppered test tube labelled 3, containing approximately 3 cm³ of reaction mixture from step 3

continued on the next page . . .

(Turn over)

PART B continued

deionised water

approximately 10 cm^3 of 1 mol dm^{-3} nitric acid

solution, $\text{HNO}_3(\text{aq})$ (corrosive)

approximately 2 cm^3 of 0.1 mol dm^{-3} silver nitrate

solution, $\text{AgNO}_3(\text{aq})$ (irritant)

approximately 5 cm^3 of 1 mol dm^{-3} sodium hydroxide

solution, $\text{NaOH}(\text{aq})$ (corrosive)

approximately 1 g of solid sodium carbonate,

$\text{Na}_2\text{CO}_3(\text{s})$ (irritant)

approximately 2 cm^3 of 0.002 mol dm^{-3} acidified

potassium manganate(VII), $\text{KMnO}_4 / \text{H}^+(\text{aq})$ (irritant)

(Turn over)

**PART A – DETERMINE THE MOLAR MASS OF
ETHANEDIOIC ACID AND HENCE THE VALUE OF X IN
 $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$**

You will standardise a solution of sodium hydroxide by titrating against hydrochloric acid of known concentration. You will then make up a solution of ethanedioic acid and titrate this against the standardised sodium hydroxide solution. From your results you will calculate the molar mass of the hydrated ethanedioic acid and hence the value of x .

PROCEDURE

- **WEAR EYE PROTECTION AT ALL TIMES AND GLOVES WHEN HANDLING TOXIC ETHANEDIOIC ACID**
- **ASSUME THAT ALL SOLUTIONS ARE TOXIC AND CORROSIVE**

continued on the next page . . .

PART A continued**STANDARDISING SODIUM HYDROXIDE SOLUTION
USING HYDROCHLORIC ACID OF KNOWN
CONCENTRATION**

1. Draw an appropriate table on page 16 to record the results of your titration.
2. Fill a burette with the sodium hydroxide solution provided and record the initial burette reading.
3. Use a volumetric pipette to transfer 25.0 cm^3 of hydrochloric acid to the conical flask.
4. Add a few drops of phenolphthalein indicator and titrate until a permanent colour change is seen.
5. Record the final burette reading and the titre.
6. Wash the conical flask and rinse with deionised water. Repeat the titration until you have TWO concordant titre values (within a range of 0.20 cm^3).

continued on the next page . . .

(Turn over)

PART A continued

**AS A GUIDELINE, THE ACCURATE TITRES
SHOULD LIE BETWEEN 15 cm^3 and 25 cm^3**

- 7. Calculate the mean titre. Show clearly which values you have selected to carry out the calculation.**

MAKING UP A SOLUTION OF ETHANEDIOIC ACID

- 8. Weigh the weighing bottle containing $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$ and record the mass on page 13**
- 9. Transfer the contents to the beaker and reweigh the bottle and lid.**
- 10. Record the mass on page 13 and calculate the exact mass of $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$ transferred to the beaker.**
- 11. Add about 50 cm^3 of deionised water to the solid in the beaker and stir to dissolve.**
- 12. Transfer the solution to the volumetric flask. Make sure that all the washings are transferred.**

continued on the next page . . .

(Turn over)

PART A continued

13. Make the solution in the flask up to the mark with deionised water. Use the plastic dropping pipette to add the last few drops.
14. Put the stopper in the flask and invert a few times to ensure that the solution is completely mixed.

WEIGHING DATA

Mass of weighing bottle, lid and $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$
= _____ g

Mass of empty weighing bottle and lid = _____ g

Mass of $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$ = _____ g

continued on the next page . . .

(Turn over)

PART A continued**TITRATING ETHANEDIOIC ACID WITH STANDARDISED SODIUM HYDROXIDE**

15. Draw an appropriate table on page 17 to record the results of your titration.
16. Repeat steps 2 – 6 (on page 11) using the ethanedioic acid solution in place of hydrochloric acid.

AS A GUIDELINE, THE ACCURATE TITRES SHOULD LIE BETWEEN 12 cm^3 AND 20 cm^3

17. Calculate the mean titre. Show clearly which values you have selected to carry out the calculation.

Use your results in the ANALYSIS OF RESULTS section after you have completed PART B of the Experimental Task.

(Turn over)

RESULTS SHEET

**PART A – DETERMINE THE MOLAR MASS OF
ETHANEDIOIC ACID AND HENCE THE VALUE OF x IN
 $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$**

**Draw your results tables in the spaces on pages
16 and 17**

**Make sure that you include titles and units and that you
record your data to the appropriate number of decimal
places.**

continued on the next page . . .

PART A continued

**STANDARDISING SODIUM HYDROXIDE SOLUTION
USING HYDROCHLORIC ACID OF KNOWN
CONCENTRATION**

Mean titre = _____ cm³

continued on the next page . . .

(Turn over)

PART A continued

**TITRATING ETHANEDIOIC ACID WITH STANDARDISED
SODIUM HYDROXIDE**

Mean titre = _____ cm³

continued on the next page . . .

(Turn over)

PART A continued**EXAMINER ONLY**

RESULTS – RECORDING	
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[4 marks]

RESULTS – ACCURACY	
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[6 marks]**(Turn over)**

PART B – QUALITATIVE ORGANIC TESTS ON THE REACTION MIXTURE AT EACH STAGE OF THE PRODUCTION OF ETHANEDIOIC ACID

Ethanedioic acid is produced from ethene in a three-step process. This three – step process is shown separately in the Diagram Booklet.

The contents of test tubes **1, 2 and 3** represent the organic compounds present **AFTER** steps **1, 2 and 3**

The tests carried out provide evidence of the identity of the functional group in one of the compounds present after each reaction.

Carry out the tests on pages 20 and 21 and record your observations in the table in the separate Diagram Booklet. For each of the tests, if there is no apparent change, you should write ‘no observable change’.

You are **NOT** required to identify the functional groups present until the **ANALYSIS OF RESULTS** section.

continued on the next page . . .

(Turn over)

PART B continued**PROCEDURE**

- **Wear eye protection at all times**
- **Assume that all substances are toxic and corrosive**

TEST TUBE 1

1. **Add a few drops of acidified potassium manganate(VII).**
2. **Replace the stopper, shake gently and allow to stand for a few minutes.**

TEST TUBE 2

1. **Add approximately 4 cm^3 of sodium hydroxide.**
2. **Replace the stopper, shake gently and allow to stand for a few minutes.**
3. **Add approximately 8 cm^3 of nitric acid and again shake gently.**
4. **Add a few drops of silver nitrate solution.**

continued on the next page . . .

(Turn over)

PART B continued

TEST TUBE 3

1. Add approximately half a spatula of solid sodium carbonate.

DO NOT REPLACE THE STOPPER IN THIS TUBE.

**PART B – QUALITATIVE ORGANIC TESTS ON THE
REACTION MIXTURE AT EACH STAGE OF THE
PRODUCTION OF ETHANEDIOIC ACID**

**Record your observations in the table provided
separately in the Diagram Booklet.**

**Use these observations in the ANALYSIS OF RESULTS
section.**

EXAMINER ONLY

RESULTS – OBSERVATIONS	
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[3 marks]

continued on the next page . . .

(Turn over)

ANALYSIS OF RESULTS

RESULTS FOR PART A – DETERMINE THE MOLAR MASS OF ETHANEDIOIC ACID AND HENCE THE VALUE OF x IN $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$

**Exact concentration of hydrochloric acid solution
= _____ mol dm^{-3}
(provided by your teacher)**

- (i) Use the mean titre from the titration of hydrochloric acid and sodium hydroxide to calculate the concentration of the sodium hydroxide solution.**

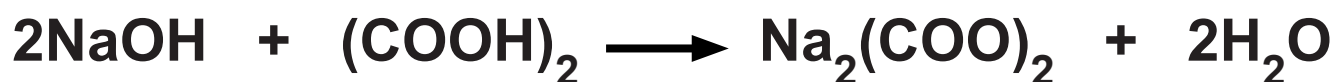
**Concentration = _____ mol dm^{-3}
[2 marks]**

continued on the next page . . .

(Turn over)

RESULTS FOR PART A continued

- (ii) Use your answer to part (i) and the following equation to calculate the number of moles of $(\text{COOH})_2$ in the 250 cm^3 volumetric flask.



Number of moles = _____ mol
[3 marks]

continued on the next page . . .

(Turn over)

RESULTS FOR PART A continued

- (iii) Use your answer to part (ii) and the mass of solid hydrated ethanedioic acid transferred to the beaker to calculate the molar mass of $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$ and hence the value of x . Give your answer to 1 decimal place.

$x =$ _____

[2 marks]

continued on the next page . . .

(Turn over)

RESULTS FOR PART A continued

(iv) Briefly explain why ethanedioic acid is soluble in water.

[2 marks]

continued on the next page . . .

(Turn over)

**PART B – QUALITATIVE ORGANIC TESTS ON THE
REACTION MIXTURE AT EACH STAGE OF THE
PRODUCTION OF ETHANEDIOIC ACID**

- (v) Use your results from the table in the Diagram Booklet to explain what the observations tell you about the composition of the reaction mixture after each step.**

Step 1

Step 2

Step 3

[3 marks]

continued on the next page . . .

(Turn over)

PART B continued

- (vi) A student suggested that using IR spectroscopy would be a better way to monitor the progress of the reactions.

Use the DATA BOOKLET to suggest how the IR spectrum of the reaction mixture would change as the reaction in each step progresses.

Step 1

Step 2

continued on the next page . . .

(Turn over)

PART B (vi) continued

Step 3

[3 marks]

END OF PAPER

TOTAL 30 MARKS

(Turn over)

[illegible]

(Turn over)

[illegible]

(Turn over)

[illegible]



GCE A LEVEL

1410U50 – 1A

WEDNESDAY, 7 MAY 2025

**CHEMISTRY – A2 UNIT 5
PRACTICAL EXAMINATION**

**EXPERIMENTAL TASK
TEST 1**

Diagram Booklet

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

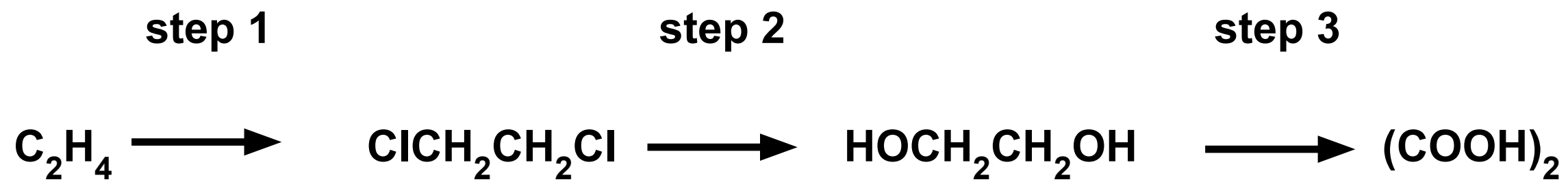
Surname: _____

First name(s): _____

Centre Number: _____

Candidate Number: 2 _____

PART B



PART B

Table

	OBSERVATION(S)
TEST TUBE 1	
TEST TUBE 2	
TEST TUBE 3	