



GCE A LEVEL

1410U50-1D



S25-1410U50-1D

**TO BE OPENED ON WEDNESDAY, 30 APRIL 2025
BY TEACHERS/TECHNICIANS**

CHEMISTRY – A2 unit 5

Practical Examination

SETTING UP INSTRUCTIONS

Experimental Task

TESTS 1 and 2

CONFIDENTIAL

1410U501D
01

This document must be stored securely by the exams officer when not in use by the teacher/technician. This document must not be stored within the science department when not in use by the teacher/technician. Its contents should not be divulged except to those concerned with the preparation of the assessment.

Candidates should already have been given information about the main themes or topics to be assessed in Unit 5. This information can be found in the Instructions to Teachers/Exams Officers document which was received by centres in January 2025. It is also published on the WJEC GCE Chemistry webpage.

TEST 1

This practical examination is in two parts:

Part A – Determine the molar mass of ethanedioic acid and hence the value of x in $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$

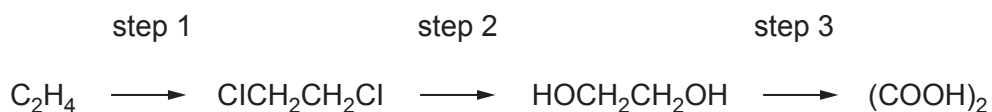
Ethanedioic acid is a common industrial cleaner, often used to remove corrosion from metal surfaces. It is usually bought in the form of a hydrated salt – $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$.

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 .

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.



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.

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.

Each candidate will need eye protection, gloves and the following apparatus:

- 1 × weighing bottle + lid containing approximately 2.0 g of $(\text{COOH})_2 \cdot 2\text{H}_2\text{O}$ (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
- 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 ideally a 3 decimal place weighing balance (although 2 is acceptable)

Chemicals

In addition to approximately 2.0 g of $(\text{COOH})_2 \cdot 2\text{H}_2\text{O}$ in the weighing bottle, each candidate will need:

- approximately 200 cm³ of approximately 0.15 mol dm⁻³ hydrochloric acid solution, HCl(aq) (irritant)
- approximately 200 cm³ of approximately 0.20 mol dm⁻³ sodium hydroxide solution, NaOH(aq) (irritant)
- phenolphthalein indicator (flammable)
- deionised water

The **exact concentration** of the hydrochloric acid, HCl(aq), **must be given to candidates**.

The concentration of the sodium hydroxide solution, NaOH(aq), **must NOT be given to candidates**.

Both concentrations must be recorded on the **Information from Centres** form (page 9).

Part B – Qualitative organic tests on the reaction mixture at each stage of the production of ethanedioic acid

Apparatus

Each candidate will need eye protection and the following apparatus:

- 4 × plastic dropping pipette
- 1 × test tube rack
- 1 × spatula

Chemicals

Each candidate will need:

- 1 × stoppered test tube labelled **1**, containing approximately 3 cm³ of 2-chloro-2-methylpropane
- 1 × stoppered test tube labelled **2**, containing approximately 3 cm³ of 2-chloro-2-methylpropane (the same as in tube **1**)
- 1 × stoppered test tube labelled **3**, containing approximately 3 cm³ of ethanoic acid

deionised water

- approximately 10 cm³ of 1 mol dm⁻³ nitric acid solution, HNO₃(aq) (corrosive)
- approximately 2 cm³ of 0.1 mol dm⁻³ silver nitrate solution, AgNO₃(aq) (irritant)
- approximately 5 cm³ of 1 mol dm⁻³ sodium hydroxide solution, NaOH(aq) (corrosive)
- approximately 1 g of solid sodium carbonate, Na₂CO₃(s) (irritant)
- approximately 2 cm³ of 0.002 mol dm⁻³ acidified potassium manganate(VII), KMnO₄/H⁺(aq) (irritant)

TEST 2

Only a very small number of centres will use **Test 2** and arrangements will already have been made well in advance of opening this document.

Test 2 involves the same apparatus and the following adaptations:

In **Part A** the mass of (COOH)₂·2H₂O should be increased to approximately 2.5 g

In **Part B** the test tube labelled **1** should contain cyclohexene and the test tube labelled **2** should contain 2-chloro-2-methylpropane

Part A – Determine the molar mass of ethanedioic acid and hence the value of x in $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$

Candidates will standardise a solution of sodium hydroxide by titrating against hydrochloric acid of known concentration. They will then make up a solution of ethanedioic acid and titrate this against the standardised sodium hydroxide solution. From their results they 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**

Standardising sodium hydroxide solution using hydrochloric acid of known concentration

1. Draw an appropriate table 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).
7. Calculate the mean titre. Show clearly which values you have selected to carry out the calculation.

Making up a solution of ethanedioic acid

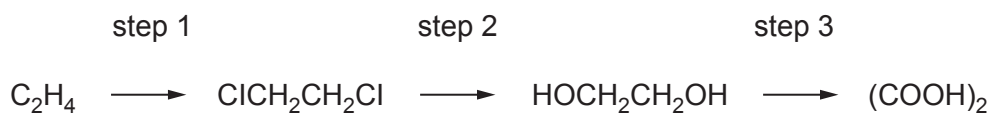
8. Weigh the weighing bottle containing $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$ and record the mass.
9. Transfer the contents to the beaker and reweigh the bottle and lid.
10. Record the mass and calculate the exact mass of $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$ transferred to the beaker.
11. 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.
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.

Titrating ethanedioic acid with standardised sodium hydroxide

15. Draw an appropriate table to record the results of your titration.
16. Repeat steps 2–6 (on page 5) using the ethanedioic acid solution in place of hydrochloric acid.
17. Calculate the mean titre. Show clearly which values you have selected to carry out the calculation.

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.



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.

Candidates will carry out the tests below and record their observations. For each of the tests, if there is no apparent change, they should write 'no observable change'.

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 cm³ of sodium hydroxide.
2. Replace the stopper, shake gently and allow to stand for a few minutes.
3. Add approximately 8 cm³ of nitric acid and again shake gently.
4. Add a few drops of silver nitrate solution.

Test tube 3

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

Do not replace the stopper in this tube.

TEACHERS/TECHNICIANS

A staff member **must** carry out the experiment to ensure that the solutions give the expected results for both parts. Please contact WJEC if there are any issues.

Subject Officer	Jonathan Owen	029 2240 4252	science@wjec.co.uk
Support Officer	Eira Morgan	029 2240 4252	science@wjec.co.uk

The teacher must carry out **Part A** using the exact same solutions as the candidates and the results must be recorded on the **Information from Centres** form. Please ensure that this form is given to the exams officer to be **forwarded to the examiner** with the completed examination papers.

Candidate results in **Part A** will be compared with the teacher results. **When more than one batch of solutions is prepared it is vital that teacher results are recorded for each batch.** Which candidates used which batch must be clearly recorded for the examiner. This may require completion of multiple copies of the **Information from Centres** form.

TEACHER-AWARDED MARKS

A mark of 0 or 1 must be awarded by the teacher for two aspects relating to the practical work carried out by each candidate. These should be recorded as work proceeds and added to the front of the candidates' booklets at the end of the session.

Working safely – 1 mark to be awarded unless intervention is required to ensure safety

Making up a solution – 1 mark to be awarded for correctly making a solution of ethanedioic acid from the sample provided

Centres should prepare a suitable volume of a back-up ethanedioic acid solution in case of candidates making significant errors in the preparation of their own solution. The exact mass of solid dissolved must be recorded and given to any candidate needing this solution. Any candidates needing this solution must not be awarded the above mark.

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CHEMISTRY – A2 unit 5**Practical Examination****Experimental Task****Information from Centres**

Centre Number _____ Test/Group _____

Please record the Teacher Results here.

Complete additional copies of this form if different groups of candidates use different batches of solutions.

Please also ensure that **Teacher-awarded marks** are recorded on the **front cover of all candidates' booklets**.

Mass of $(\text{COOH})_2 \cdot 2\text{H}_2\text{O}$ in solution = ... gConcentration of HCl = ... mol dm^{-3} Concentration of NaOH = ... mol dm^{-3} Mean titre (NaOH with HCl) = ... cm^3 Mean titre (NaOH with $(\text{COOH})_2$) = ... cm^3

Name of Teacher: _____

Signature of Teacher: _____

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