GCE A LEVEL

1410U50-1D

S24-1410U50-1D

TO BE OPENED ON WEDNESDAY, 1 MAY 2024 BY TEACHERS / TECHNICIANS

CHEMISTRY – A2 unit 5

Practical Examination

SETTING UP INSTRUCTIONS

Experimental Task
TESTS 1 and 2

CONFIDENTIAL

1410U501D
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This document should 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 2024. It is also published on the WJEC GCE Chemistry webpage.

TEST 1

This practical examination is in two parts:

Part A – Thermometric titration of sodium hydroxide solution against hydrochloric acid of unknown concentration

Each candidate will carry out a “thermometric titration” to find the concentration of a hydrochloric acid solution and use their results to calculate the enthalpy change of neutralisation for this reaction.

Part B – Qualitative analysis of unknown metal ion solutions

Using two different acids to identify solutions containing calcium, lead(II) and sodium ions.

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

Part A – Thermometric titration of sodium hydroxide solution against hydrochloric acid of unknown concentration

Apparatus

Each candidate will need eye protection and the following apparatus:

1 × paper cup
1 × 250 cm^3 beaker
2 × 50 cm^3 burette
2 × small funnel
2 × burette stand
1 × 100 cm^3 beaker
1 × thermometer (±0.1°C or ±0.2°C)
1 × wash bottle (deionised water)

Chemicals

Each candidate will need:

approximately 300 cm^3 of approximately 1.0 mol dm^{-3} sodium hydroxide solution, NaOH(aq) (corrosive)
approximately 200 cm^3 of approximately 2.0 mol dm^{-3} hydrochloric acid solution, HCl(aq) (irritant)
deionised water

The **exact concentrations** of the NaOH and HCl solutions **must** be recorded by centre staff.

The exact concentration of the NaOH solution **only** must be given to candidates for their analysis.

They must **not** be given the concentration of the HCl solution.

Part B – Qualitative analysis of unknown metal ion solutions

Apparatus

Each candidate will need eye protection and the following apparatus:

3 × empty boiling tube
2 × boiling tube rack
2 × dropping pipette

sticky labels / marker pen

Chemicals

Each candidate will need the following solutions in three labelled boiling tubes:

approximately 10 cm^3 of 1 mol dm^{-3} sodium nitrate solution, $NaNO_3(aq)$ – labelled **X**
approximately 10 cm^3 of 1 mol dm^{-3} calcium nitrate solution, $Ca(NO_3)_2(aq)$ – labelled **Y**
approximately 10 cm^3 of 0.05 mol dm^{-3} lead(II) nitrate solution, $Pb(NO_3)_2(aq)$ – labelled **Z**

approximately 20 cm^3 of 1 mol dm^{-3} hydrochloric acid solution, HCl(aq)
approximately 20 cm^3 of 1 mol dm^{-3} sulfuric acid solution, $H_2SO_4(aq)$

Some of these solutions are classed as **irritant** or **corrosive** and lead(II) nitrate is **toxic**.

When the task has been completed **solutions containing lead(II) salts should be disposed of in accordance with CLEAPSS guidance**.

TEST 2

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

Test 2 involves the same apparatus and the following adaptations:

In **Part A** the concentration of the hydrochloric acid solution should be approximately 1.5 mol dm^{-3}

In **Part B** the unknown solutions should be assigned the following letters:

X lead(II) nitrate, $Pb(NO_3)_2$
Y sodium nitrate, $NaNO_3$
Z calcium nitrate, $Ca(NO_3)_2$

Part A – Thermometric titration of sodium hydroxide solution against hydrochloric acid of unknown concentration

Heater meals were originally developed for military use. They are ready-made self-heating meal packs. They can be activated in many ways – by pressing a button on the packaging, by unwrapping and shaking the pack, or by pouring the contents of one bag into another and waiting for a few minutes. All of these packs use exothermic chemical reactions. To make them as efficient as possible, companies need to know the exact concentrations of the reactants used and the amount of energy released.

In this practical, candidates will use a thermometric titration to find the concentration of a hydrochloric acid solution and use their results to calculate the enthalpy change of neutralisation for this reaction.

Procedure

- **Wear eye protection at all times**
- **Assume that all chemicals are corrosive**

1. Place the paper cup into the 250 cm^3 beaker for stability.

2. Carefully run exactly 50.0 cm^3 of sodium hydroxide solution from one of the burettes into the paper cup. **Do not completely empty the burette.**

3. Measure the temperature of the sodium hydroxide solution to the appropriate precision and record it in a table of your own design.

4. Carefully measure 10.0 cm^3 of hydrochloric acid solution from the other burette into a 100 cm^3 beaker.

5. Add the 10.0 cm^3 of acid to the paper cup and stir carefully with the thermometer. Record the highest temperature reached.

6. Carefully rinse out the paper cup and repeat the experiment four times using 50.0 cm^3 of sodium hydroxide solution with the following volumes of hydrochloric acid:

   20.0 cm^3
   30.0 cm^3
   40.0 cm^3
   50.0 cm^3

Part B – Qualitative analysis of unknown metal ion solutions

A student suggested that all acid-base reactions should release the same amount of energy per mole.

Another suggested that due to variations in **solubility** this may not necessarily be the case. She suggested testing the solubilities of certain metal salts to make a prediction.

Solutions **X**, **Y** and **Z** each contain calcium ions, lead(II) ions or sodium ions. Candidates will test each solution with hydrochloric acid and sulfuric acid to identify which solution contains which ions.

Procedure

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

1. Pour half of solution **X** into an empty boiling tube and label this tube **X**.
2. Repeat with solutions **Y** and **Z**, labelling them appropriately.
3. Use a dropping pipette to add approximately 5 cm^3 of hydrochloric acid solution to one of the samples of solution **X**.
4. Do not shake the tube but leave to settle.
5. Repeat with solutions **Y** and **Z**.
6. After 2–3 minutes record your observations.
7. Repeat steps 3–6 with the remaining samples of **X**, **Y** and **Z** using sulfuric acid instead of hydrochloric acid.
8. **Leave all tubes in their racks for safe disposal of the contents. Do not wash any solutions down the sink.**
9. Wash your hands thoroughly.

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.

Efficient use of time – award 1 mark if practical work is carried out efficiently

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

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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**.

Exact concentration of NaOH(aq)	mol dm^{-3}
Exact concentration of HCl(aq)	mol dm^{-3}

Volume of HCl(aq) added / cm^3	10.0	20.0	30.0	40.0	50.0
Temperature increase / °C					

Temperature increase ΔT at the point of intersection	°C

Name of Teacher: _____

Signature of Teacher: _____

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