General Certificate of Education
Advanced Subsidiary Examination
June 2011

Chemistry CHM3X/TN

Unit 3X AS Externally Marked Practical Assignment

Teachers' Notes Confidential

A copy should be given immediately to the teacher(s) responsible for GCE Chemistry

Open on receipt

Teachers' Notes

Confidential

These notes must be read in conjunction with *Instructions for the Administration of the Externally Marked Practical Assignment: GCE Chemistry* published on the AQA Website.

It is the responsibility of the centre to ensure that the investigations work with the materials provided to the candidates.

The investigation of a food preservative and of a moss killer

This practical assessment is in two parts.

Task 1 involves a titration of a solution of an acid with sodium hydroxide solution.

Task 2 involves a series of observation exercises on a solution of a salt.

Task 1

Materials

Each candidate should be provided with the following reagents in suitable closed containers.

Reagent	Concentration / mol dm^{-3}	Volume / cm^3	Note
Hydrochloric acid	between 0.100 and 0.110	200	Labelled '**Preservative solution for Task 1**'
Sodium hydroxide	between 0.090 and 0.100	175	Labelled '**Sodium hydroxide for Task 1**'
Phenolphthalein	standard indicator		Labelled '**Phenolphthalein'** Individual supply not required

Note Hydrochloric acid is used rather than an organic acid for safety and convenience.

Apparatus

In addition to access to general laboratory equipment, each candidate needs

Number	Apparatus
1	50 cm^3 burette and stand
1	funnel suitable for filling a burette
1	25 cm^3 pipette
1	pipette filler
1	250 cm^3 conical flask
1	dropping pipette
	a plentiful supply of purified water (either distilled or deionised)
	eye protection

Checking the burette reading

In part 5 of Task 1 candidates are instructed to have one of their final burette readings checked by their teacher. This is to ensure that a candidate does not lose several accuracy marks because of an incorrect reading. If the candidate has not read the burette reading correctly the teacher must tell the candidate the correct reading. There is no penalty for an incorrect reading. The centre is not required to inform AQA of an incorrect reading.

Task 2

Materials

Each candidate should be provided with the following reagent in a suitable closed container.

Reagent solution	Approximate Concentration / mol dm^{-3}	Volume / cm^3	Note
Barium nitrate	0.1	10	Labelled '**Solution A**'

Candidates will also require the following reagents. An individual supply is not required.

Sodium hydroxide	0.5	5	Labelled '**Sodium hydroxide for Task 2**'
Sulfuric acid	1.0	5	Labelled '**Sulfuric acid**'
Potassium chromate(VI)	0.2	5	Labelled '**Potassium chromate(VI)**'
Hydrochloric acid	1.0	10	Labelled '**Hydrochloric acid**'
Silver nitrate	0.05	5	Labelled '**Silver nitrate**'
Nitric acid	1.0	5	Labelled '**Nitric acid**'
Sodium carbonate	0.5	5	Labelled '**Sodium carbonate**'

Notes Teachers should inform candidates of a suitable method for the safe disposal of silver nitrate residues.

Apparatus

In addition to access to general laboratory equipment, each candidate needs

Number	Apparatus
5	test tube
8	dropping pipette
1	test tube rack
	a plentiful supply of purified water (either distilled or deionised)
	eye protection

Teacher Results

A teacher must carry out the tasks, using similar apparatus and samples of the same stock solutions/chemicals as the candidates, in order to obtain Teacher Results. This must **not** be done in the presence of candidates.

Teacher Results

- are required for both tasks
- are required for each group of candidates
- must be recorded on the Teacher Results Sheets
- are used to assess the accuracy of candidates' results
- must be included with the scripts sent to the examiner.

In order to ensure that each candidate can be matched to the appropriate Teacher Results, teachers must

- complete all details on each Teacher Results Sheet
- ensure that all candidates complete all details on the Candidate Results Sheets, clearly identifying their teaching group and/or teacher.

Managing the investigation

Centres with more than one teaching set

Centres may wish to divide their candidates into manageable groups and to conduct assessments at different times. This is acceptable provided that candidates in a later session are given a sodium hydroxide solution for Task 1 whose concentration is slightly different from that given to candidates in the earlier sessions.

Candidates with no results from the task

Candidates who have attempted the tasks must use their own results. A candidate absent for Task 1 or Task 2 should be given an opportunity to carry out the practical work before they sit the EMPA test. This may be with another group or at a different time. In exceptional circumstances, when such arrangements are not possible, the teacher may supply a candidate with data, such as the teacher's data. In this case candidates cannot be awarded marks for Task 1 and/or Task 2, but can still be awarded marks for the Written Test. The teacher must record the teacher's data on the Candidate Results Sheets for Task 1 and Task 2, which must be given to the candidate at the start of the Written Test.

Candidates **must not** be given information about an EMPA assessment until one week before **Task 1.**

One week before **Task 1**, teachers should give their candidates the following information.

The aim of **Task 1** is to identify the organic acid present in a food preservative by titration of a solution of the preservative with sodium hydroxide.

The aim of **Task 2** is to identify the metal ion in the salt of an organic acid used as a moss killer by a series of observation exercises.

The main areas of the specification in the Written Test include Section 3.1.2 (Amount of Substance) and Section 3.2.6 (Group 2, the Alkaline Earth Metals).

There **must** be no further discussion and candidates **must not** be given any further resources to prepare for the assessment.

Teacher Results Sheet for Task 1

Centre Number | | | | | |

Teacher Name ..... Teacher Group .....

Results

Record your titration results in the table below.

Final burette reading / cm^3				
Initial burette reading / cm^3				
Volume of hydrochloric acid used / cm^3				
Tick the titres to be used in calculating the average titre				

Average titre / cm^3	

This sheet may be photocopied

Teacher Results Sheet for Task 2

Centre Number | | | | | |

Teacher Name ..... Teacher Group .....

Results

Record your observations in the table below.

Use a separate sample of the salt solution A in each of the following tests	**Observations with solution A**
Test 1 Sodium hydroxide solution Place about 10 drops of **A** in a test tube. Add 10 drops of sodium hydroxide solution and shake the mixture.	
Test 2 Sulfuric acid Place about 10 drops of **A** in a test tube. Add 10 drops of sulfuric acid and shake the mixture.	
Test 3 (a) Potassium chromate(VI) solution Place about 10 drops of **A** in a test tube. Add 10 drops of potassium chromate(VI) solution and shake the mixture. **Keep this mixture for use in part (b).**	
Test 3 (b) Hydrochloric acid To the mixture from part (a) add hydrochloric acid, with shaking, until there is no further change.	
Test 4 Silver nitrate and nitric acid Place about 10 drops of **A** in a test tube. Add 10 drops of nitric acid, followed by 10 drops of silver nitrate solution. Shake the mixture.	
Test 5 Sodium carbonate solution Place about 10 drops of **A** in a test tube. Add 10 drops of sodium carbonate solution and shake the mixture.	

This sheet may be photocopied

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use
Total Task 1

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Chemistry CHM3X/PM1

Unit CHM3X AS Externally Marked Practical Assignment
Task Sheet 1

To be completed before Task Sheet 2

For submission by 15 May 2011

For this paper you must have:
- a ruler
- a calculator.

The investigation of a food preservative and of a moss killer

Organic acids are used to preserve food.

The salts of these acids are used to prevent the growth of moss on building materials stored outdoors.

This practical assessment is in two parts.

The aim of Task 1 is to identify the organic acid present in a food preservative by titration of a solution of the preservative with a 0.100 mol dm^{-3} solution of sodium hydroxide.

The aim of Task 2 is to identify the metal ion in the salt of an organic acid used as a moss killer by a series of observation exercises.

Task 1 Titration

Wear eye protection at all times.
Assume that all of the solutions are toxic and corrosive.

Procedure

1. Rinse the burette with the preservative solution provided. Set up the burette and use a funnel to fill it with the preservative solution. Record the initial burette reading in a table of your own design on the Candidate Results Sheet for Task 1.

2. Use a pipette filler to rinse the pipette with the sodium hydroxide solution provided. Use this pipette to transfer 25.0 cm^3 of the sodium hydroxide solution to a 250 cm^3 conical flask.

3. Add 3 or 4 drops of phenolphthalein indicator to the conical flask.

4. Add the preservative solution from the burette until the mixture in the conical flask just turns colourless. Record your final burette reading in your table.

5. Rinse the conical flask with distilled or deionised water. Repeat the titration until you obtain **two** titres that are within 0.10 cm^3 of each other. You should do no more than five titrations.

   Have one of your final burette readings checked by your teacher.

6. Calculate and record the average titre on the Candidate Results Sheet for Task 1. Indicate clearly the titres that you used in calculating this average titre.

You are not required to carry out any further calculations on the Candidate Results Sheet for Task 1. You will use your results to identify the organic acid in **Section A** of the Written Test.

Turn over ▶

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use
Total Task 2

General Certificate of Education
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Chemistry CHM3X/PM2

Unit 3X AS Externally Marked Practical Assignment
Task Sheet 2

To be completed before the EMPA Written Test

For submission by 15 May 2011

For this paper you must have:
- a ruler
- a calculator.

Task 2 Observation Exercises

Investigation of the metal ion in a moss killer

You are provided with an aqueous solution of the salt of an organic acid in a moss killer, labelled **A**.

Use a separate sample of solution **A** in each of the following tests.

Record your observations in a table of your own design on the Candidate Results Sheet for Task 2.

Where no visible change is observed, write 'no visible change'.

You are **not** required to identify solution **A** or any of the reaction products in this task.

Wear eye protection at all times.
Assume that all solutions are toxic and corrosive.

Procedure

Test 1 Test with sodium hydroxide solution
Place about 10 drops of **A** in a test tube.
Add 10 drops of sodium hydroxide solution and shake the mixture.

Test 2 Test with sulfuric acid
Place about 10 drops of **A** in a test tube.
Add 10 drops of sulfuric acid and shake the mixture**.**

Test 3 Test with potassium chromate(VI) solution and hydrochloric acid
(a) Place about 10 drops of **A** in a test tube.
Add 10 drops of potassium chromate(VI) solution and shake the mixture.
Keep this mixture for use in part (b).

(b) To the mixture from part (a) add hydrochloric acid, with shaking, until there is no further change.

Test 4 Test with silver nitrate solution and nitric acid
Place about 10 drops of **A** in a test tube.
Add 10 drops of nitric acid, followed by 10 drops of silver nitrate solution.
Shake the mixture.

Test 5 Test with sodium carbonate solution
Place about 10 drops of **A** in a test tube.
Add 10 drops of sodium carbonate solution and shake the mixture.

Centre Number						Candidate Number				
Surname						Other Names				

Notice to Candidate. The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you or if you cheat in any other way, you may be disqualified.

Candidate Declaration. I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate Signature		Date	

For Examiner's Use Total EMPA mark	
Examiner's Initials	
Section	Mark
Task 1	
Task 2	
Section A	
Section B	
Section C	
TOTAL EMPA MARK	

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Chemistry CHM3X

Unit 3X AS Externally Marked Practical Assignment

For submission by 15 May 2011

For this paper you must have:	**Time allowed**
• the Periodic Table/Data Sheet provided as an insert (enclosed) • your Task Sheets 1 and 2, including your own Candidate Results Sheets • a ruler with millimetre measurements • a calculator.	• 1 hour 20 minutes
Instructions • Use black ink or black ball-point pen. • Fill in the boxes at the top of this page. • Answer **all** questions. • You must answer the questions in the space provided. Do not write outside the box around each page or on blank pages. • Do all rough work in this book. Cross through any work you do not want to be marked.	**Information** • The marks for questions are shown in brackets. • The maximum mark for this paper is 36. • You will be marked on your ability to: – organise information clearly – use scientific terminology accurately.

Details of additional assistance (if any). Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page.

Yes ☐ No ☐

Teacher Declaration:

I confirm that the candidate has met the requirements of the practical skills verification (PSV) in accordance with the instructions and criteria in section 3.8 of the specification.

Practical Skills Verification	**Yes** ☐

Signature of teacher ..... Date .....

Section A

These questions are about the investigation of a food preservative and of a moss killer.

You should use your Task Sheets 1 and 2, including your own Candidate Results Sheets to answer them.

Answer **all** questions in the spaces provided.

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1 Record the average titre from your Candidate Results Sheet for Task 1.

2 The unknown acid in the preservative can be represented as HA.
Write an equation for the reaction between HA and sodium hydroxide.

3 The concentration of the sodium hydroxide solution used was 0.100 mol dm^{-3}.
Calculate the amount, in moles, of NaOH in 25.0 cm^3 of this sodium hydroxide solution.

4 Use your answers from Questions **1**, **2** and **3** to calculate the concentration, in mol dm^{-3}, of the unknown acid in the preservative.
Give your answer to the appropriate precision.

5 The preservative solution was prepared by dissolving 8.00 g of the acid supplied by a manufacturer and making up to 1.00 dm^3 of solution with water.

Use your answer from Question **4** to calculate the M_r of the acid. Assume that the solution is made from a pure sample of the acid.
Give your answer to one decimal place.

(If you could not complete the calculation in Question **4**, assume that the concentration of the acid is 0.106 mol dm^{-3}. This is not the correct value.)

6 The acid HA can be represented by the formula $C_nH_{2n+1}COOH$, where n is a whole number. Use your answer from Question **5** and data from the Periodic Table to suggest a value for n.

7 The maximum total errors for the pipette and the burette are shown below. These errors take into account multiple measurements.

pipette ± 0.05 cm^3
burette ± 0.15 cm^3

Estimate the maximum percentage error in using each of these pieces of apparatus.
Use the average titre from Question **1** to calculate the percentage error in using the burette. Show your working.

Turn over ▶

8 A solution of barium hydroxide is often used for the titration of organic acids. A suitable indicator for the titration is thymol blue. Thymol blue is yellow in acid and blue in alkali. In a titration a solution of an organic acid was added from a burette to a conical flask containing 25.0 cm^3 of a barium hydroxide solution and a few drops of thymol blue.

8 (a) Describe in full the colour change at the end-point of this titration.

8 (b) Thymol blue is an acid. State how the average titre would change if a few cm^3, rather than a few drops, of the indicator were used by mistake in this titration.

8 (c) Barium hydroxide is toxic. Suggest **one** safety precaution you would take to minimise this hazard when wiping up a spillage of barium hydroxide solution.

8 (d) Suggest **one** reason why a 250 cm^3 conical flask is preferred to a 250 cm^3 beaker for a titration.

8 (e) Suggest **one** reason why repeating a titration can improve its reliability.

9 Solubility data for barium hydroxide and calcium hydroxide are given in the table below.

Compound	Solubility at 20 °C / g dm^{-3}
barium hydroxide	38.9
calcium hydroxide	1.73

9 (a) Use the data given in the table to calculate the concentration, in mol dm^{-3}, of a saturated solution of calcium hydroxide (M_r = 74.1) at 20 °C.

9 (b) Suggest **one** reason why calcium hydroxide solution is **not** used in the titration of a 0.200 mol dm^{-3} solution of an acid.

10 Use your observations from Task 2 to identify the metal ion in the solution labelled **A**. State **one** observation that helped you to identify this metal ion.

11 The manufacturer of the salt used in the moss killer claims that there are no magnesium ions present in the salt.
Deduce whether or not you can use your observations from Task 2 to confirm this claim.
State **one** observation that supports your deduction. Explain your answer.

Section B

Answer **all** questions in the spaces provided.

Introduction

In an experiment to determine its solubility in water, solid barium hydroxide was added to 100 cm^3 of water until there was an excess of the solid. The mixture was filtered and an excess of sulfuric acid was added to the filtrate. The barium sulfate produced was obtained from the reaction mixture, washed with cold water and dried. The mass of barium sulfate was then recorded.

12 Explain why the mixture was filtered before the addition of sulfuric acid.

13 State how the barium sulfate produced was obtained from the reaction mixture.

14 Explain why the barium sulfate was washed before it was dried.

15 Write an equation for the reaction between barium hydroxide and sulfuric acid.

16 In an experiment, 4.25 g of barium sulfate were formed when an excess of sulfuric acid was added to 100 cm^3 of a saturated solution of barium hydroxide.

16 (a) Use data from the Periodic Table to calculate the M_r of barium sulfate.
Give your answer to one decimal place.

16 (b) Calculate the amount, in moles, of $BaSO_4$ in 4.25 g of barium sulfate.

16 (c) Use your answer from part (**b**) to calculate the mass of barium hydroxide (M_r = 171.3) present in 1 dm^3 of saturated solution. Show your working.

17 Barium sulfate is taken by mouth by patients so that an outline of a human digestive system can be viewed using X-rays. Explain why patients do **not** suffer any adverse effects from barium sulfate when it is known that solutions containing barium ions are toxic.

Section C

These questions test your understanding of the skills and techniques you have acquired during your AS course.

Answer **all** questions in the spaces provided.

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18 A sample of an alcohol was thought to be contaminated with an alkene. Give a reagent that could be used to confirm the presence of an alkene. State what you would observe.

19 A chemist was asked to prepare a standard solution of sodium carbonate.
The chemist dissolved an accurately known mass of sodium carbonate in a small amount of water in a conical flask. The chemist then poured the solution into a 250 cm^3 graduated flask and made the solution up to the mark. Suggest **one** improvement to the chemist's procedure.

20 The presence of halide ions in solution can be detected by adding silver nitrate solution and dilute nitric acid.

20 (a) State the purpose of the nitric acid in this test.

20 (b) Explain how the addition of an ammonia solution can be used to confirm that a precipitate is silver bromide.