General Certificate of Education
Advanced Level Examination
June 2013

Chemistry CHM6X/TN

Unit 6X A2 Externally Marked Practical Assignment

Teachers' Notes Confidential

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

Estimated entries must be submitted to AQA in order for centres to receive hard copies of the materials to be used by candidates

Teachers' Notes

Confidential

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

An Investigation of Bordeaux Mixture

Task 1 Back titration of Bordeaux mixture

Candidates will add a sample of Bordeaux mixture to a known amount of hydrochloric acid. The calcium hydroxide in the mixture will neutralise some of this acid. The amount of hydrochloric acid remaining is then determined by a back titration with sodium hydroxide solution. Because of the difficulty in ensuring homogeneity of Bordeaux mixture and, hence, consistency of titres, centres should make up individual candidate samples of Bordeaux mixture as follows.

*Weigh out accurately (to two decimal places) between 0.70 g and 0.80 g of calcium hydroxide into a suitable container. Label this container as 'Bordeaux mixture for Task 1' and write on the container a mass value for calcium hydroxide which is **twice** the precise mass it actually contains. Add approximately 0.75 g of copper(II) sulfate-5-water **powder**, stopper and shake the container.

It is strongly recommended that centres purchase a fresh sample of calcium hydroxide and that it is not opened until shortly before the EMPA.

Task 1 Materials

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

Reagents	Concentration / mol dm^{-3}	Quantity	Note
Bordeaux mixture	Solid prepared as described above*		Labelled **'Bordeaux mixture for Task 1'** with the precise mass of the $Ca(OH)_2$ doubled (to two decimal places)
Hydrochloric acid	2.00	40 cm^3	Labelled **'Hydrochloric acid'**
Sodium hydroxide solution	0.100	200 cm^3	Labelled **'Sodium hydroxide solution'**
Methyl orange indicator	Standard laboratory reagent		Labelled **'Methyl orange'** Individual supplies are not required

General

It is the responsibility of the centre to ensure that the investigation works with the materials provided to the candidates **before** candidates carry out the task.

Spare supplies of all substances specified in these notes must be available.

Task 1 Apparatus

Each candidate will require the following:

Number	Apparatus
1	100 cm^3 beaker
1	25 cm^3 pipette
1	pipette filler
1	stirring rod
1	filter funnel with stem that fits into a 250 cm^3 volumetric flask
1	filter funnel with stem that fits into a burette
1	filter paper
1	250 cm^3 volumetric flask with stopper
	a plentiful supply of distilled or deionised water
1	50 cm^3 burette and stand
1	250 cm^3 conical flask
	eye protection

The teacher should advise candidates of the filtering process involving the use of a fluted filter paper mounted in a funnel. The following website may be helpful
http://www.chem-ilp.net/labTechniques/FlutedFilterPaper.htm

Teachers may prefer to show their candidates how to prepare and use a fluted filter paper.

Checking the burette reading

After step 11 of Task 1, candidates are instructed to ask their teacher to check one of their final burette readings. If a candidate does not read the burette 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 Some reactions of Bordeaux mixture

In this task, the candidate will perform a series of tests starting from a sample of Bordeaux mixture. Observations at various points in the task will be recorded.

To ensure that consistency of results is possible, the teacher should demonstrate to the candidates the quantity of solid implied by 'a spatula-load'. The amount on the spatula should be approximately 0.5 g. This should be demonstrated in advance of the task.

Task 2 Materials

Each candidate should be provided with the following reagents in suitable closed containers. An individual supply is **not** required apart from the Bordeaux mixture. Note that the composition of the Bordeaux mixture used for Task 2 is different to that used for Task 1. This is to make the observations in Task 2 more obvious to the candidate.

*For Task 2, the Bordeaux mixture must be made up by mixing $Ca(OH)_2$ and $CuSO_4.5H_2O$ powder in an approximate ratio of 1:2 by mass.

Reagents	Concentration / mol dm^{-3}	Quantity	Note
Bordeaux mixture*	Solid	approx 3 g	Labelled **'Bordeaux mixture for Task 2'** Individual supply required
Dilute nitric acid	2	15 cm^3	Labelled **'Dilute nitric acid'**
Dilute sulfuric acid	1	15 cm^3	Labelled **'Dilute sulfuric acid'**
Dilute ammonia solution	2	5 cm^3	Labelled **'Dilute ammonia solution'**
Potassium iodide solution	1	5 cm^3	Labelled **'Potassium iodide solution'** Make up shortly in advance of the task
Fehling's solution B	35 g of potassium sodium tartrate and 12 g of NaOH per 100 cm^3 of water	2 cm^3	Labelled **'Solution X'**
Glucose solution	0.1	1 cm^3	Labelled **'Solution Y'**

General

It is the responsibility of the centre to ensure that the investigation works with the materials provided to the candidates **before** candidates carry out the task.

Spare supplies of all substances specified in these notes must be available.

Task 2 Apparatus

Each candidate will require the following:

Number	Apparatus
6	plastic graduated pipette
1	small spatula
1	test tube
3	boiling tube
1	bung/stopper for boiling tube
1	test-tube rack that can hold test tubes and boiling tubes
1	25 or 50 cm^3 measuring cylinder
1	100 cm^3 beaker
1	100 or 250 cm^3 conical flask to support the filter funnel
1	stirring rod
1	250 cm^3 beaker
	a plentiful supply of distilled or deionised water
	hot water is needed for part of the task. Centres are advised to use an **electric kettle** to provide a convenient and quick supply of hot water. Alternatively, each candidate will need a **tripod**, **gauze** and **Bunsen burner**. It is important that the water is hot.
1	filter funnel
1	filter paper

Risk assessment and risk management

Risk assessment and risk management are the responsibility of the centre.

Notes from CLEAPSS

Technicians/teachers should follow safety data sheets provided by the supplier for handling reagents. The worldwide regulations covering the labelling of reagents by suppliers are currently being changed. Details about these changes can be found in leaflet GL101, which is available on the CLEAPSS Website. You will need to have a CLEAPSS login.

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.

Centres with more than one teaching set

Centres may wish to divide their candidates into manageable groups and to conduct the task at different times.

Assessment Advisers

If you have any queries about the practical work for the EMPA, please contact your Assessment Adviser. Contact details for your Assessment Adviser can be obtained by e-mailing your centre name and number to chemistry-gce@aqa.org.uk

Information to be given to candidates

Candidates **must not** be given information about an EMPA assessment until one week before Task 1. One week before Task 1, candidates should be given the following information.

The aim of these tasks is to investigate a sample of Bordeaux mixture by acid-base titration and by observing a series of chemical tests on the sample.

The main areas of the specification in the Written Test include Section 3.1.2 (Amount of Substance), Section 3.4.5 (Compounds Containing the Carbonyl Group), Section 3.4.11 (Structure Determination – Chromatography), Section 3.5.3 (Redox Equilibria), Section 3.5.4 (Transition Metals) and Section 3.5.5 (Reactions of Inorganic Compounds in Aqueous Solution).

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

A completed copy of this sheet must be included with the scripts sent to the examiner.

Centre Number | | | | | |

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

Results

Record your titration results in the table below.

Mass of Bordeaux mixture (on container)……g

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

Average titre / cm^3	

This sheet may be photocopied

Turn over ▶

Teacher Results Sheet for Task 2

A completed copy of this sheet must be included with the scripts sent to the examiner.

Centre Number | | | | | |

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

Results

Record your observations in the table below.

Test 1: Bordeaux mixture + H_2O	
Test 2: Bordeaux mixture + HNO_3	
Test 3: Bordeaux mixture + H_2SO_4 Filtrate Solid in filter paper	
Test 4: Filtrate + NH_3	
Test 5: Filtrate + KI	
Test 6: Filtrate + solution **X** + solution **Y**	

This sheet may be photocopied

An investigation of a fungicide

Fungus, in the form of mildew, is a common disease affecting the health and productivity of plants. For over a hundred years, gardeners have used a fungicide called Bordeaux mixture to control this disease. It was first used extensively in French vineyards where vines can be severely affected by mildew.

Bordeaux mixture is made by mixing powdered calcium hydroxide ($Ca(OH)_2$) and powdered copper(II) sulfate-5-water ($CuSO_4.5H_2O$). The copper salt gives the mixture a pale blue colour.

In this part of the investigation, you will add a sample of Bordeaux mixture to a known amount (an excess) of hydrochloric acid. The calcium hydroxide in the mixture will neutralise some of the acid. The amount of unreacted hydrochloric acid can then be determined by titration with sodium hydroxide solution. This technique is called a back titration.

Task 1 Back titration of Bordeaux mixture

Procedure

- **Wear eye protection at all times.**
- **Assume that all solids and solutions are toxic and corrosive.**
- **Read all of the following instructions and then design a table on the Candidate Results Sheet for Task 1 to record your results.**

1 You are provided with a sample of Bordeaux mixture. The precise mass of this mixture is written on the container. Record this mass on your Candidate Results Sheet for Task 1.

2 Transfer all of the Bordeaux mixture into a clean 100 cm^3 beaker. Rinse any remaining solid into the beaker with distilled or deionised water.

3 Use a pipette filler to rinse the pipette with the hydrochloric acid provided. Use this pipette to transfer 25.0 cm^3 of hydrochloric acid into the 100 cm^3 beaker.

4 Stir the contents of the beaker until the solid dissolves. A small amount of white solid may remain undissolved.

5 Set up a filter funnel and fluted filter paper resting in a clean 250 cm^3 volumetric flask. Pour the contents of the beaker, and washings from the stirrer and beaker, into the funnel. Allow the filtrate to collect in the flask. Pour a little more distilled or deionised water through the filter paper to wash it.

6 Make up the liquid in the volumetric flask to the graduation mark with distilled or deionised water. Put a stopper in the flask and invert the flask several times to make sure that the contents are fully mixed.

7 Rinse a burette with the sodium hydroxide solution provided. Set up the burette and use another filter funnel to fill it with the sodium hydroxide solution. Record the initial burette reading.

8 Rinse the pipette thoroughly with distilled or deionised water. Use the pipette filler to rinse the pipette with the solution from the volumetric flask. Use this pipette to transfer 25.0 cm^3 of this solution to a 250 cm^3 conical flask.

9 Add 3 or 4 drops of methyl orange indicator to the solution in the conical flask. The solution will turn red.

10 Add sodium hydroxide solution from the burette until the mixture in the conical flask just turns orange. (It will turn yellow if you add too much sodium hydroxide.) Record your final burette reading in your table.

11 Rinse the conical flask with distilled or deionised water. Repeat the titration until you obtain **two** concordant titres. In this experiment, titres are concordant if they are within 0.20 cm^3 of each other.
You should do no more than five titrations.

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

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

You are **not** expected to carry out any further work in Task 1.
You will use your results in Section A of the Written Test.

An investigation of a fungicide

Task 2 Some reactions of Bordeaux mixture

In this task, you will perform a series of tests starting from a sample of Bordeaux mixture.
You will record your observations for each test.

Procedure

- **Wear eye protection at all times.**
- **Assume that all solids and solutions are toxic and corrosive.**
- **Design a table on the Candidate Results Sheet for Task 2 in which you can record your observations for Tests 1 to 6.**

Test 1

- Place about 3 cm^3 of distilled or deionised water in a boiling tube.
- Add a spatula-load (as demonstrated by your teacher) of Bordeaux mixture.
- Stopper the tube and shake the contents for about 1 minute.
- Record what you observe after shaking.

Test 2

- Use a measuring cylinder to pour about 15 cm^3 of dilute nitric acid into a 100 cm^3 beaker.
- Add a spatula-load of the Bordeaux mixture to the acid in the beaker.
- Stir the contents of the beaker for about 1 minute.
- Record what you observe after stirring.

Test 3

- Wash out the beaker thoroughly with distilled or deionised water.
- Use a measuring cylinder to pour about 15 cm^3 of dilute sulfuric acid into the beaker.
- Add two spatula-loads of the Bordeaux mixture to the acid in the beaker.
- Stir the contents of the beaker for about 1 minute.
- Separate the reaction products by filtering the contents of this beaker into a conical flask.
- Wash the filter paper with a little distilled or deionised water.
- Record the appearance of the filtrate and the solid in the filter paper.
- Do **not** discard this filtrate.

Use separate portions of this filtrate in Tests 4, 5 and 6.

Test 4

- Place about 2 cm^3 of the filtrate into a clean test tube.
- Add dilute ammonia solution **dropwise** with shaking until there is no further change.
- Record what you observe.

Test 5

- Place about 2 cm^3 of the filtrate into a clean boiling tube.
- Add about 5 cm^3 of potassium iodide solution, shake and allow the mixture to stand until you have completed **Test 6**.
- Record what you observe.

Test 6

- Place about 2 cm^3 of the filtrate into a clean boiling tube.
- Add about 2 cm^3 of solution **X** and about 1 cm^3 of solution **Y** and swirl to mix.
- Place the boiling tube in a beaker of water that has just been boiled. Leave for 2 minutes.
- Record what you observe.

You are **not** expected to do any further work in Task 2.
You will use your results in Section A of the Written Test.

Section A

These questions are about the tasks, an investigation of a fungicide.

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

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

1 Record your average titre from **Task 1** to the appropriate precision.

2 The concentration of hydrochloric acid used in step 3 of **Task 1** was 2.00 mol dm^{-3}.

Calculate the amount, in moles, of hydrochloric acid used in this step.

3 The concentration of the sodium hydroxide solution used in **Task 1** was 0.100 mol dm^{-3}.

3 (a) Use your answer to Question **1** to calculate the amount, in moles, of sodium hydroxide used in the average titre.

3 (b) Use your answers from Questions **2** and **3 (a)** to deduce the amount, in moles, of hydrochloric acid that reacted with the Bordeaux mixture in the beaker in step 4 of **Task 1**.
Show your working.

4 Calcium hydroxide ($Ca(OH)_2$) is a base that can be neutralised by hydrochloric acid.

4 (a) Write an equation for this reaction of calcium hydroxide with hydrochloric acid.

4 (b) Use your answer from Question **3 (b)** to calculate the mass of calcium hydroxide in the Bordeaux mixture that you used in **Task 1**. Give this mass to three significant figures.
Show your working.

(If you have been unable to complete Question **3 (b)**, assume that the amount of hydrochloric acid that reacted was 0.0212 mol. This is **not** the correct answer.)

4 (c) Calculate the percentage, by mass, of calcium hydroxide in your sample of Bordeaux mixture.

5 Write an equation for the reaction between calcium hydroxide and copper(II) sulfate in **Test 1** of **Task 2**.

6 Identify the species responsible for the colour of the solution in **Test 2** of **Task 2**.

7 Give the formula of the solid in the filter paper in **Test 3** of **Task 2**.

8 State **one** reason why your observations suggest that the filtrate in **Test 3** of **Task 2** contains a transition metal ion.

9 In **Test 4** of **Task 2**, suggest why there was no visible change when the first few drops of dilute ammonia solution were added to the filtrate.

10 The reaction in **Test 5** of **Task 2** is a redox reaction. Identify the product formed by oxidation in this reaction.

11 The solution formed by mixing the filtrate and solution **X** in **Test 6** of **Task 2** is called Fehling's solution. Use your observations of the reaction that occurs when solution **Y** is added to deduce the organic functional group present.

12 The active ingredient in the fungicide is the copper(II) ion. Use your observations from **Test 1** of **Task 2** to suggest why Bordeaux mixture is more effective as the fungicide on vine leaves when it rains rather than just using copper(II) sulfate.

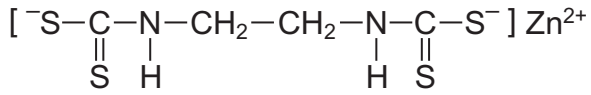
13 Despite its toxicity, Bordeaux mixture has been used for over a hundred years as an effective treatment for mildew in vineyards.

Suggest **one** environmental problem that could result from this prolonged use of Bordeaux mixture.

Section B

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

14 Because of the toxic nature of the copper(II) ion, a wide range of alternative anti-fungal drugs has been developed for use in agriculture. One example is Zineb.



Zineb

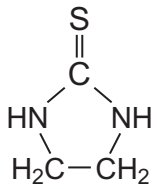
14 (a) The negative ion in Zineb could act as a bidentate ligand.

On the structure above, draw a ring around each of **two** atoms that could provide the lone pairs of electrons when this ion acts as a bidentate ligand.

14 (b) Calculate the M_r of Zineb. Give your answer to the appropriate precision.

14 (c) Name the functional group formed at each end of the negative ion when all the sulfur atoms in the structure of Zineb are replaced by oxygen atoms.

15 Zineb has been investigated for harmful effects. Generally, Zineb has been found to be safe to use in agriculture. It is only slightly soluble in water and is sprayed onto plants. A breakdown product of Zineb is ethylene thiourea (ETU), which is very soluble in water. The structure of ETU is shown below.



Determine the percentage, by mass, of sulfur in ETU (M_r = 102.1).

16 Chromatography is a technique used to show the presence of a small amount of ETU in Zineb.

Outline how this technique is used to separate and identify ETU from a sample of Zineb powder.

Section C

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

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

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17 An experiment was carried out to measure the e.m.f. of this cell.

$$Al(s) \mid Al^{3+}(aq) \parallel H^{+}(aq) \mid H_2(g) \mid Pt(s)$$

17 (a) The aluminium used as the electrode is rubbed with sandpaper prior to use.

Suggest the reason for this.

17 (b) Draw a labelled diagram of a suitable apparatus for the right-hand electrode in this cell. You do **not** need to include the salt bridge or the external electrical circuit.

17 (c) A simple salt bridge can be prepared by dipping a piece of filter paper into potassium carbonate solution. Explain why such a salt bridge would **not** be suitable for use in this cell.

18 Ammonia and methylamine were dissolved in separate samples of water. The two solutions had equal molar concentrations.

State **one** simple method, other than smell, of distinguishing these solutions. State what you would observe.

END OF QUESTIONS