General Certificate of Education
Advanced Subsidiary Examination
June 2010

Chemistry CHM3X/TN

Unit 3X AS Externally Marked Practical Assignment

Teachers' Notes Confidential

To 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.

The investigation of a glass cleaner

Task 1 Measuring a temperature change

Materials

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

Reagent	Concentration	Volume	Note
Sodium hydroxide	approximately 1 mol dm^{-3} (0.95–1.05) This solution does not need to be accurately known.	75 cm^3	Labelled '**Glass cleaner**'
Hydrochloric acid	approximately 1 mol dm^{-3} (0.95–1.05) This solution does not need to be accurately known.	75 cm^3	Labelled '**Hydrochloric acid for Task 1**'

To avoid potentially serious problems for candidates with respiratory problems, and unpleasant working conditions on a warm day for all candidates, sodium hydroxide is used in place of ammonia for the glass cleaner solution.

General

Reagents of good analytical quality should be used and spare supplies of all solutions specified in these notes must be available.

Apparatus

Each candidate will require the following:

Number	Apparatus
1	50 cm^3 burette
1	funnel suitable for filling a burette
1	thermometer, measuring 0.2 ºC or better, covering the range 0 – 50 ºC (**not** digital)
1	stirrer
2	plastic cup (of a size suitable to fit into a 250 cm^3 beaker)
1	250 cm^3 beaker
1	25 cm^3 pipette
1	pipette filler
2	stand, clamp and boss
1	stop clock
1	wash bottle
	tissue for drying thermometer
	a plentiful supply of purified water (either distilled or de-ionised)
	eye protection

Teacher Result

A teacher must carry out Task 1, using the same stock solutions, in order to obtain a value for the temperature rise. A teacher result is required for **each** group of candidates. The teacher must complete the Teacher Results Sheets for Task 1, and determine an accurate value for the temperature rise using the method shown on page 6 of these notes. This value will be used by the examiner to assess the accuracy of the candidates' results. The teacher must **not** carry out Task 1 in the presence of the candidates.

In order to ensure that the appropriate Teacher Result can be matched with each candidate, teachers must ensure that all candidates complete all details on the Candidate Results Sheets for Task 1 and Task 2, including 'Teacher Group'.

The Teacher Results Sheets must be included with the scripts sent to the examiner.

Task 2 Observation Exercises

Materials

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

Reagent	Approximate Concentration	Volume	Note
Ammonium sulfate	0.5 mol dm^{-3}	10 cm^3	Labelled '**Solution A**'
Sodium hydroxide	0.5 mol dm^{-3}	10 cm^3	Labelled '**Sodium hydroxide**' Individual supply not required
Calcium chloride	0.5 mol dm^{-3}	10 cm^3	Labelled '**Calcium chloride**' Individual supply not required
Barium chloride	0.1 mol dm^{-3}	10 cm^3	Labelled '**Barium chloride**' Individual supply not required
Hydrochloric acid	1.0 mol dm^{-3}	5 cm^3	Labelled '**Hydrochloric acid for Task 2**' Individual supply not required
Silver nitrate	0.05 mol dm^{-3}	5 cm^3	Labelled '**Silver nitrate**' Individual supply not required
Nitric acid	1.0 mol dm^{-3}	5 cm^3	Labelled '**Nitric acid**' Individual supply not required

Notes Barium nitrate, of the same concentration, may be used in place of barium chloride. The sample should still be labelled 'barium chloride'.
Teachers should inform students of a suitable method for the safe disposal of silver nitrate residues.

General

Reagents of good analytical quality should be used and spare supplies of all solutions specified in these notes must be available.

Apparatus

Each candidate will require the following:

Number	Apparatus
4	test tube
7	dropping pipette
1	test tube rack
	a plentiful supply of purified water (either distilled or de-ionised)
	eye protection
2	piece of universal indicator paper
	Hot water is needed for part of Task 2. 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**.

Teacher Result

A teacher must carry out Task 2, using the same stock solutions. A teacher set of observations is required for **each** group of candidates. The teacher's observations, along with the Teacher Group, must be recorded in the space provided on the Teacher Results Sheet for Task 2. These observations will be used by the examiner to assess the accuracy of the candidates' results. The teacher must **not** carry out Task 2 in the presence of the candidates.

In order to ensure that the appropriate Teacher Result can be matched with each candidate, teachers must ensure that all candidates complete all details on the Candidate Results Sheets for Task 1 and Task 2, including 'Teacher Group'.

The Teacher Results Sheets must be included with the scripts sent to the examiner.

Managing the tasks

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.

One week before sitting Task 1 of the EMPA you may inform your candidates:

The aim of this task is to investigate the compound present in a glass cleaner by means of the determination of the enthalpy change of neutralisation and a series of observation exercises.

There should be no further discussion of this topic.

Teacher Results Sheet for Task 1

Centre Number | | | | | |

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

Results

Initial temperature of the hydrochloric acid ..... ºC

Temperature rise, $T_2 - T_1$, (see **Q4** on page 6) ..... ºC

Time / minutes	0	1	2	3	4	5	6	7	8	9	10
Temperature / ºC											

This sheet may be photocopied

Teacher Results Sheet for Task 1

Centre Number | | | | | |

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

1 Use your graph to determine an accurate value for the temperature of the glass cleaner at the fourth minute **before** mixing.

Temperature before mixing ..... °C

2 Use your answer from Question **1** and the temperature of the hydrochloric acid recorded on your Teacher Results Sheet for Task 1 to calculate the average value for the temperature of the two solutions before mixing (T_1).

Average temperature of the two solutions before mixing, T_1 = ... °C

3 Use your graph to determine an accurate value for the temperature of the reaction mixture at the fourth minute (T_2).

Temperature at the fourth minute, T_2 = ... °C

4 Determine an accurate value for the temperature rise at the fourth minute ($T_2 - T_1$). Record your value to the appropriate precision.

Temperature rise, $T_2 - T_1$ = ... °C

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 solution A in each of the following tests	**Observations with Solution A**
Test 1 with sodium hydroxide solution (a) Place about 10 drops of **A** in a labelled test tube. Add 10 drops of sodium hydroxide solution, and shake the mixture. **Keep this mixture for use in part (b).** (b) Half fill a 250 cm^3 beaker with the hot water provided. Stand the test tube containing the mixture from part (a) in the beaker. Test the vapour above the mouth of the test tube with damp universal indicator paper.	
Test 2 with calcium chloride solution Place about 10 drops of **A** in a test tube. Add about 10 drops of calcium chloride and shake the mixture. Allow the mixture to stand for a few minutes at room temperature. **While you are waiting, begin the tests below.**	
Test 3 with barium chloride solution and hydrochloric acid Place about 10 drops of **A** in a labelled test tube. Add 10 drops of dilute hydrochloric acid, followed by 10 drops of barium chloride solution. Shake the mixture.	
Test 4 with silver nitrate solution and nitric acid Place about 10 drops of **A** in a labelled test tube. Add 10 drops of dilute nitric acid, followed by 10 drops of silver nitrate solution. Shake the mixture.	

This sheet may be photocopied

Turn over ▶

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use
Total Task 1

General Certificate of Education
Advanced Subsidiary Examination
June 2010

Chemistry CHM3X/PM1

Unit 3X AS Externally Marked Practical Assignment
Task Sheet 1

To be completed before Task Sheet 2.

For submission by 15 May 2010

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

The investigation of a glass cleaner

Aqueous ammonia is the main constituent in industrial glass cleaners. After use, safe disposal of the glass cleaner involves the neutralisation of the unreacted ammonia. The neutralisation process is exothermic.

This practical assessment is in two parts, Task 1 and Task 2.

In Task 1 you will measure a temperature change in order to determine the enthalpy change when the main constituent in the glass cleaner is neutralised.

In Task 2 you will complete a series of observation exercises on a solution obtained by neutralising the glass cleaner. The results of these exercises will allow you to identify the salt produced by this neutralisation.

Task 1 Measurement of the temperature change

Wear eye protection at all times.
For the purpose of this task assume that all of the solutions are toxic and corrosive.

Procedure

Read all of the instructions before designing a table for your temperature readings.

1. Rinse a burette with the hydrochloric acid provided. Set up the burette and, using a funnel, fill it with the hydrochloric acid provided.

2. Using the burette, transfer 25.0 cm^3 of the hydrochloric acid to a clean, dry plastic cup.

3. Measure the temperature of the hydrochloric acid in the cup to one decimal place.
   Record your result in the space provided on the Candidate Results Sheet for Task 1.

4. Wash the thermometer with distilled or de-ionised water and dry the thermometer.

5. Using a pipette filler, rinse a pipette with the glass cleaner provided. Using this pipette and the filler, transfer 25.0 cm^3 of the glass cleaner to a second clean, dry plastic cup.

6. Place the plastic cup containing the glass cleaner in a beaker to provide support and additional insulation. Mount the thermometer in the cup using a clamp and stand. The bulb of the thermometer must be fully immersed in the solution. Place a stirrer in the cup.

7. Stir the glass cleaner in the cup and measure the temperature to one decimal place. Record your result in a table of your own design on the Candidate Results Sheet for Task 1.
   Every minute for a further three minutes stir the solution, measure the temperature and record each result in your table.

8. At the fourth minute add the 25.0 cm^3 of hydrochloric acid from the plastic cup. Stir the mixture but do not record the temperature.

9. Continue to stir the mixture, and measure the temperature at the fifth minute, and then every subsequent minute for a further five minutes. Record each temperature in your table on the Candidate Results Sheet for Task 1.

Candidate Results Sheet for Task 1

Teacher Group .....

Results

Temperature of the hydrochloric acid / ºC	

Record your results from the enthalpy change experiment in a table of your own design in the space below.

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use
Total Task 2

General Certificate of Education
Advanced Subsidiary Examination
June 2010

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 2010

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

Turn over ▶

Task 2 Observation Exercise

Investigation of a salt produced by neutralising the glass cleaner

You are provided with an aqueous solution, labelled **A**, obtained by neutralising the glass cleaner with an acid.

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

Record what you **observe** 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 part of the task.

Wear eye protection at all times.
For the purpose of this task assume that all solutions are toxic and corrosive.

Test 1 Test with sodium hydroxide solution

(a) Place about 10 drops of **A** in a test tube. Add 10 drops of sodium hydroxide solution, and shake the mixture. **Keep this mixture for use in part (b).**

(b) Half fill a 250 cm^3 beaker with the hot water provided. Stand the test tube containing the mixture from part (a) in the beaker. Test the vapour above the mouth of the test tube with damp universal indicator paper.

Test 2 Test with calcium chloride solution

Place about 10 drops of **A** in a test tube. Add 10 drops of calcium chloride solution. Shake the mixture. Allow the mixture to stand for a few minutes at room temperature.
While you are waiting, begin the tests below.

Test 3 Test with barium chloride solution and hydrochloric acid

Place about 10 drops of **A** in a test tube. Add 10 drops of dilute hydrochloric acid, followed by 10 drops of barium chloride solution. Shake the mixture.

Test 4 Test with silver nitrate solution and nitric acid

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

Candidate Results Sheet Task 2

Results

Record your observations in a table of your own design in the space below.

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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	

General Certificate of Education
Advanced Subsidiary Examination
June 2010

Chemistry CHM3X

Unit 3X AS Externally Marked Practical Assignment

Written Test

For submission by 15 May 2010

For this paper you must have:
- 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.

Time allowed
- 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 spaces 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.
- The Periodic Table / Data Sheet is provided as an insert.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use accurate scientific terminology.

Section A

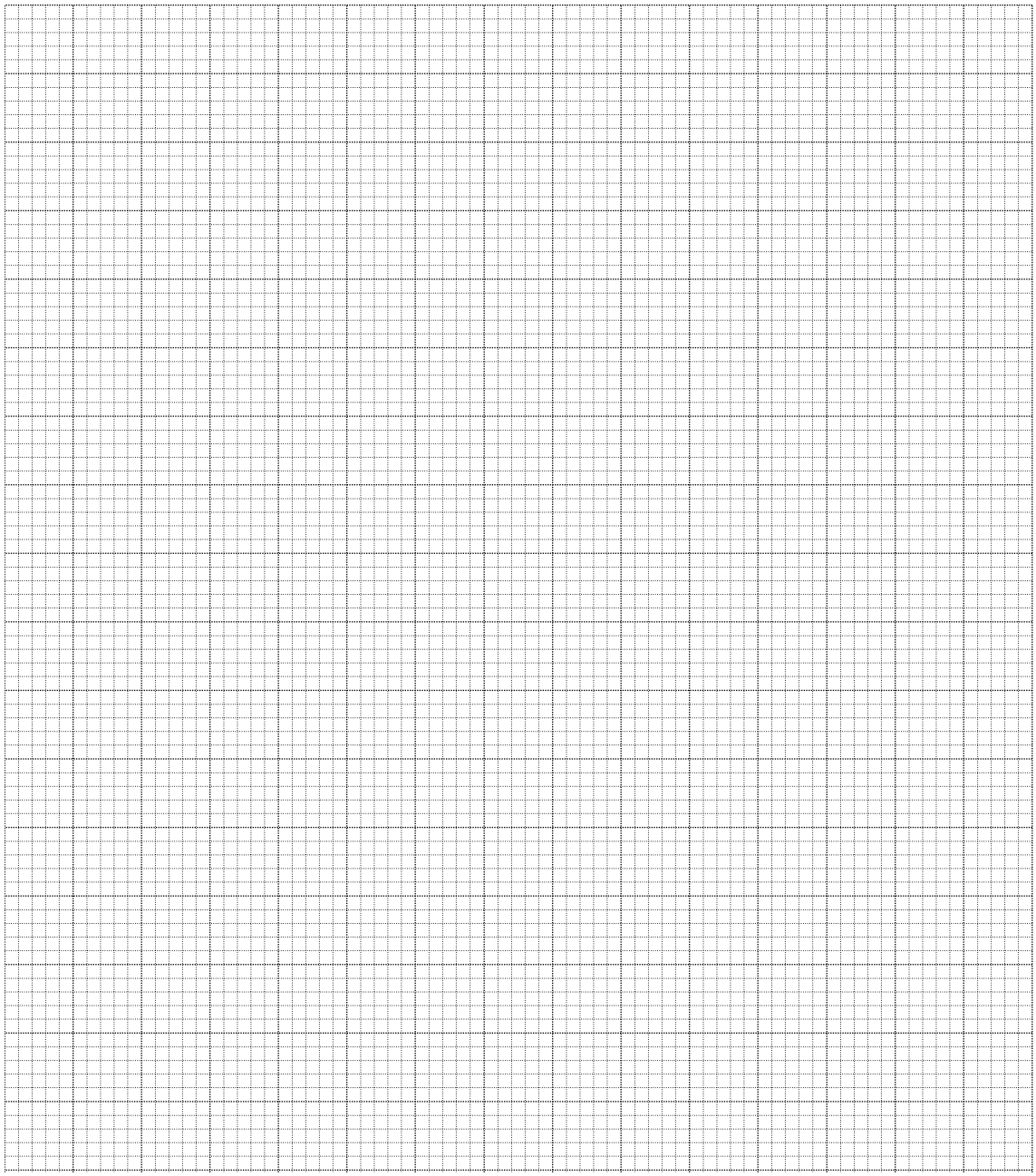
These questions are about the task, the investigation of a glass cleaner.

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

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

---

1 Using your results recorded on the Candidate Results Sheet for Task 1, plot a graph of **temperature** (*y*-axis) against **time** on the graph paper below. Draw a line of best fit for the points before the fourth minute. Draw a second line of best fit for the points after the fourth minute. Extrapolate both lines to the fourth minute.



2 Use your graph to determine an accurate value for the temperature of the glass cleaner at the fourth minute **before** mixing.

3 Use your answer from Question **2** and the temperature of the hydrochloric acid recorded on your Candidate Results Sheet for Task 1 to calculate the average value for the temperature of the two solutions before mixing (T_1).

4 Use your graph to determine an accurate value for the temperature of the reaction mixture at the fourth minute (T_2).

5 Determine an accurate value for the temperature rise at the fourth minute ($T_2 - T_1$). Record your value to the appropriate precision.

6 Use your answer from Question **5** to calculate the heat given out during this experiment. Assume that the reaction mixture has a density of 1.00 g cm^{-3} and a specific heat capacity of 4.18 J K^{-1} g^{-1}. Show your working.

7 The hydrochloric acid, HCl used in Task 1 had a concentration of 1.00 mol dm^{-3}. Calculate the amount, in moles, of HCl present in 25.0 cm^3 of this acid.

8 Use your answers from Questions **6** and **7** to calculate the enthalpy change, in kJ mol^{-1}, for the reaction between one mole of HCl and the glass cleaner.

9 Assume that the maximum total error in using the thermometer is ± 0.2 ºC. This error takes into account multiple measurements. Use your answer from Question **5** to calculate the percentage error in your value for the temperature rise.

10 Consider your graph. State whether your lines of best fit are good enough for you to extrapolate with confidence. Explain your answer.

11 Explain why the experiment should be repeated several times in order to determine an accurate value for the enthalpy change.

12 Apart from experimental errors and apparatus errors, suggest **one** reason why your value for the enthalpy change using the glass cleaner might differ from a data book value for the enthalpy change of neutralisation of ammonia.

13 Use your observations from Task 2 to identify the ammonium salt in the solution labelled **A**.

14 State **one** observation which enabled you to identify the negative ion in **A**.

15 State **one** observation which suggests that **A** does not contain carbonate ions. Explain your answer.

16 Barium chloride is toxic. Suggest **one** safety precaution you would take to minimise this hazard.

Section B

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

Introduction

Ammonium salts such as ammonium nitrate are used in fertilisers. The ammonium nitrate content of a fertiliser can be determined by heating a sample of the fertiliser with an excess of sodium hydroxide solution. An equation for this reaction is shown below.

$$NH_4NO_3 + NaOH \longrightarrow NH_3 + NaNO_3 + H_2O$$

Heating ensures that all of the ammonia produced is given off as a gas. The unreacted sodium hydroxide remaining in the solution can be determined by a titration with standard hydrochloric acid.

17 Explain why it is necessary to remove all of the ammonia before titrating the unreacted sodium hydroxide.

18 Suggest why it is important to test samples from more than one batch of the fertiliser.

19 Ammonium nitrate decomposes when heated to form water and one other product. Write an equation for this reaction.

20 The table below shows some information about three salts that could be used in fertilisers.

Salt	Nitrogen content by mass / %	Price per tonne / £
Ammonium chloride	26.2	134
Ammonium nitrate	35.0	175
Ammonium sulfate	21.2	111

20 (a) Use the data in the table to determine the salt that offers the best value for money, based on nitrogen content. Show your working.

20 (b) Ammonium nitrate is very soluble in water. Suggest **one** disadvantage of its high solubility when ammonium nitrate is used in a fertiliser.

21 A saturated solution of ammonia contains 300 g of ammonia in 1.00 dm^3 of solution. Calculate the concentration, in mol dm^{-3}, of ammonia in this solution.

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.

---

22 In an experiment to determine the concentration of a solution of sodium hydroxide, 25.0 cm^3 of 0.100 mol dm^{-3} hydrochloric acid were transferred to a conical flask. An indicator was added to the flask. The solution of sodium hydroxide was then added to the flask from a burette.

22 (a) State a suitable amount of indicator solution that should be added to the flask.

22 (b) State why it is important to fill the space below the tap in the burette with alkali before beginning the titration.

23 An equation for the decomposition of hydrogen peroxide is shown below.

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

State the measurements you would take in order to investigate the rate of this reaction.

24 Ethanol can be oxidised slowly to ethanal. State how a sample of ethanol could be tested to confirm the presence of ethanal. State what you would observe.

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED