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	

General Certificate of Education
Advanced Subsidiary Examination
June 2013

Chemistry CHM3X

Unit 3X AS Externally Marked Practical Assignment

Written Test

For submission by 15 May 2013

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	**Information**
• 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.	• The marks for questions are shown in brackets. • The maximum mark for this paper is 36. • You are expected to use a calculator where appropriate. • 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 .....

There are no questions printed on this page

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Section A

These questions are about the tasks, an investigation of baking powder.

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

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

1 (a) Use your results from **Task 1** to calculate the following masses:

the mass of sodium hydrogencarbonate in the crucible before heating

.....

.....

the mass of solid remaining in the crucible after the final heating.

.....

.....

(1 mark)

1 (b) Use your answers to Question **1 (a)** to calculate the percentage, by mass, of solid remaining after heating.
Give your answer to one decimal place.

.....

.....

(1 mark)

2 The equation for the thermal decomposition of sodium hydrogencarbonate is shown below.

$$2NaHCO_3(s) \longrightarrow Na_2CO_3(s) + CO_2(g) + H_2O(g)$$

Use this equation to calculate the percentage atom economy for the formation of sodium carbonate from sodium hydrogencarbonate.
Show your working.

.....

.....

.....

.....

(2 marks)

3 Calculate the difference between your answers to Questions **1 (b)** and **2**. Express this difference as a percentage of your answer to Question **2**.

Difference .....

Percentage .....

.....

(1 mark)

4 Assume that the maximum total error in using the balance to determine the mass of sodium hydrogencarbonate is ±0.01 g. This takes into account multiple measurements of mass.

Use your answer for the mass of sodium hydrogencarbonate before heating from Question **1 (a)** to calculate the percentage error in using the balance.

.....

.....

(1 mark)

5 A student carried out **Task 1** on a different pure sample of sodium hydrogencarbonate. In this case, the mass of solid in the crucible at the end of the experiment was 87.3% of the original mass.

Compare this percentage with your answer to Question **2** and suggest an experimental reason for this student's result.

.....

.....

(1 mark)

6 Use your results for **Task 2** to plot a graph of temperature (*y*-axis) against time on the grid on page 5.

Draw lines of best-fit for the points between 0 and 3 minutes and between 5 and 10 minutes.

Extrapolate both best-fit lines to the fourth minute.

(5 marks)

7 Use your graph to determine the temperature change at the fourth minute. Give your answer to the appropriate precision.

.....

(1 mark)

8 Use your answer to Question **7** to determine the heat energy change in **Task 2**.
Assume that the reaction mixture has a density of $1.00\,g\,cm^{-3}$, a volume of $30\,cm^3$ and a specific heat capacity of $4.18\,J\,K^{-1}\,g^{-1}$.
Show your working.

.....

.....

.....

.....

(3 marks)

9 The hydrochloric acid used in **Task 2** was in excess.

Calculate the amount, in moles, of sodium hydrogencarbonate used in **Task 2**.
Hence, determine the enthalpy of neutralisation per mole of sodium hydrogencarbonate.
(If you were unable to complete Question **8** you may assume that the heat energy change in **Task 2** is 1250 J. This is **not** the correct value.)
Show your working.

Amount of $NaHCO_3$ .....

.....

.....

Enthalpy of neutralisation .....

.....

.....

.....

(3 marks)

19

Section B

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

Baking powder

Baking powder contains sodium hydrogencarbonate and an acid or a mixture of acids. One acid that may be in baking powder is 2,3-dihydroxybutanedioic acid. This has the molecular formula $C_4H_6O_6$ and it is often referred to as tartaric acid.

10 Draw the structural formula of tartaric acid.

(1 mark)

11 Write an equation for the reaction of tartaric acid ($C_4H_6O_6$) with sodium hydrogencarbonate to form a salt, carbon dioxide and water.

.....

(1 mark)

12 Substances that contain carbonate or hydrogencarbonate ions can be used to confirm the presence of an acid.

Identify **one** other substance that could be used to confirm the presence of acid groups in tartaric acid.
State the observation you would make when this other substance is added to an aqueous solution of tartaric acid.

Substance .....

Observation .....

.....

.....

(2 marks)

13 It is known that tartaric acid contains alcohol and carboxylic acid functional groups only. A test can be used to show that tartaric acid contains secondary alcohol groups, **not** tertiary alcohol groups.

13 (a) Identify a reagent for this test and state the observation you would make for each type of alcohol.

Reagent .....

.....

Observation for secondary alcohol .....

.....

Observation for tertiary alcohol .....

.....

(3 marks)

13 (b) Suggest why this test **cannot** be used to distinguish between a primary alcohol and a secondary alcohol.

.....

.....

(1 mark)

14 Baking powder usually contains starch. Starch is added to absorb any water vapour that may come into contact with the baking powder when the container is opened.

Deduce a reason why this water vapour needs to be absorbed.

.....

.....

.....

.....

(1 mark)

15 Sodium hydrogencarbonate in baking powder forms carbon dioxide during the production of bread and cakes.

Suggest **one** advantage of having an acid in baking powder.

.....

.....

(1 mark)

16 Safety information indicates that tartaric acid and its salts can act as muscle toxins. These can cause paralysis and possible death.

Suggest **one** reason why the use of tartaric acid in baking powder is **not** a hazard to health.

.....

.....

(1 mark)

11

Turn over for the next question

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.

17 Read the following instructions that describe how to make up a standard solution of a solid in a volumetric flask.
Answer the questions which follow.

'Take a clean 250 cm^3 volumetric flask. Use the balance provided and a clean, dry container, to weigh out the amount of solid required. Tip the solid into a clean, dry 250 cm^3 beaker and add about 100 cm^3 of distilled water. Use a stirring rod to help the solid dissolve, carefully breaking up any lumps of solid with the rod. When the solid has dissolved, pour the solution into the flask using a filter funnel. Add water to the flask until the level rises to the graduation mark.'

17 (a) Suggest **three** further instructions that would improve the overall technique in this account.

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

(3 marks)

17 (b) In a series of titrations using the solution made up in Question **17 (a)**, a student obtained the following titres (all in cm^3).

Rough	1	2
25.7	25.20	25.35

State what this student must do in order to obtain an accurate average titre in this experiment.

.....

.....

.....

.....

(2 marks)

18 Barium chloride solution was added, dropwise, to magnesium sulfate solution until no more white precipitate was formed. The mixture was filtered.

Give the formulae of the **two** main ions in the filtrate.

.....

.....

(1 mark)

6

END OF QUESTIONS

There are no questions printed on this page

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