Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use Total for EMPA

General Certificate of Education
June 2009
Advanced Subsidiary Examination

Chemistry CHM3X

Unit 3X Externally Marked Practical Assignment Written Test

For submission by 15 May 2009

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

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

You may use 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.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- The Periodic Table/Data Sheet is provided as an insert.

Information
- The maximum mark for this paper is 36.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in all answers.

SECTION A

These questions are about how the type of magnesium carbonate present in a sample can be identified. 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.

Show **all** your working.

1 In Task 1, you tested a neutral solution produced by adding hydrochloric acid to the mineral. State **one** observation which suggests that magnesium ions were present.

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(1 mark)

2 State **one** observation which suggests that barium ions were **not** present. Explain your answer.

Observation .....

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Explanation .....

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(2 marks)

3 Use your concordant results from Task 2 to determine a mean titre.

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(1 mark)

4 The sodium hydroxide solution used in Task 2 had a concentration of $0.100\,\text{mol}\,\text{dm}^{-3}$. Use your answer from Question **3** to calculate the amount, in moles, of sodium hydroxide used in the titration.

.....

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(1 mark)

5 In Task 2, the 25.0 cm^3 portion of the mineral solution was obtained by adding 0.520 g of the mineral to 25.0 cm^3 of 0.500 mol dm^{-3} hydrochloric acid. To ensure that all of the magnesium carbonate in the mineral reacted, this amount of hydrochloric acid was an excess.

Calculate the amount, in moles, of hydrochloric acid in 25.0 cm^3 of 0.500 mol dm^{-3} hydrochloric acid.

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(1 mark)

6 Use your answers from Question **4** and from Question **5** to calculate the amount, in moles, of hydrochloric acid which reacted with 0.520 g of the mineral.

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.....

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(1 mark)

7 The equation for the reaction between magnesium carbonate and hydrochloric acid is shown below.

$$MgCO_3 + 2HCl \longrightarrow MgCl_2 + CO_2 + H_2O$$

Use your answer from Question **6** to calculate the amount, in moles, of magnesium carbonate which reacted.

.....

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(1 mark)

8 Use your answer from Question **7** to calculate the M_r of the magnesium carbonate in the mineral. Give your answer to the appropriate precision.

.....

.....

(2 marks)

9 The formula of the magnesium carbonate can be represented as $MgCO_3.xH_2O$

Use your answer from Question **8** to calculate the value of x

.....

.....

.....

(1 mark)

11

SECTION B

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

Show **all** your working.

Introduction

Magnesium carbonate, $MgCO_3$, can occur as the anhydrous compound, or as hydrates with 2, 3 or 5 molecules of water of crystallisation. All types of magnesium carbonate can be decomposed to form magnesium oxide, an important starting material for many processes. This decomposition reaction can be used to identify the type of magnesium carbonate present in a mineral.

A chemist was asked to identify the type of magnesium carbonate present in a mineral imported from France. The chemist weighed a clean dry crucible, and transferred 0.25 g of the magnesium carbonate mineral to the crucible. The crucible was then heated for a few minutes. The crucible was then allowed to cool, and the crucible and its contents were reweighed. This process was repeated until the crucible and its contents had reached constant mass. The mass of the crucible and its contents was then recorded.

The experiment was repeated using different masses of the magnesium carbonate mineral.

For each experiment the chemist recorded the original mass of the mineral and the mass of magnesium oxide left after heating to constant mass. The chemist's results are shown in the table below.

Experiment	1	2	3	4	5	6
Mass of mineral / g	1.60	1.17	0.74	1.31	1.80	1.34
Mass of magnesium oxide / g	0.54	0.39	0.24	0.44	0.61	0.49

10 Plot a graph of the mass of the mineral (*x*-axis) against the mass of magnesium oxide on the grid provided on page 5.

Draw a straight line of best fit on your graph. *(4 marks)*

11 Use the graph to determine the mass of the mineral which would have formed 0.50 g of magnesium oxide.

Mass of the mineral ..... *(1 mark)*

12 Calculate the amount, in moles, of MgO present in 0.50 g of magnesium oxide.

.....

.....

(1 mark)

13 Use your answers from Question **11** and from Question **12** to calculate the M_r of the magnesium carbonate present in the mineral.

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(1 mark)

14 Use your answer from Question **13** to confirm that this mineral is $MgCO_3.2H_2O$

(If you could not complete the calculation in Question **13**, you should assume that the experimental M_r value is 122.0 This is not the correct answer.)

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(1 mark)

15 Explain why it was **not** necessary to use a more precise balance in this experiment.

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(1 mark)

16 Consider your graph and comment on the results obtained by the chemist. Identify any anomalous results.

Comment .....

.....

Anomalous results .....

.....

(2 marks)

17 Explain why it was necessary for the chemist to heat the crucible and its contents to constant mass.

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(1 mark)

18 Suggest **one** reason in each case why

18 (a) small amounts of the mineral, such as 0.10 g, should **not** be used in this experiment

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(1 mark)

18 (b) large amounts of the mineral, such as 50 g, should **not** be used in this experiment.

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(1 mark)

19 Analysis of a different hydrated magnesium carbonate showed that it contained 39.05 % by mass of water. Determine the formula of this hydrated magnesium carbonate.

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(2 marks)

20 Magnesium oxide is produced by the thermal decomposition of magnesium carbonate and by the thermal decomposition of magnesium hydroxide. The equations for the reactions taking place are shown below.

Reaction 1 $MgCO_3 \longrightarrow MgO + CO_2$
Reaction 2 $Mg(OH)_2 \longrightarrow MgO + H_2O$

Show that Reaction 2 has the greater atom economy for the production of magnesium oxide.

.....

.....

(2 marks)

21 Apart from cost, suggest **one** advantage of using magnesium hydroxide rather than magnesium carbonate to reduce acidity in the stomach.

.....

.....

(1 mark)

19

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.

Show **all** your working.

22 In an experiment to determine the rate of a reaction, the volume of gas produced in the reaction was measured at regular intervals for several minutes.

22 (a) State **one** experimental condition that must be kept constant during the experiment.

.....

.....

(1 mark)

22 (b) Describe how the initial rate of this reaction can be determined from a graph of volume of gas produced against time.

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(1 mark)

23 Both strontium carbonate and strontium sulfate are white solids which are insoluble in water. Strontium carbonate reacts with hydrochloric acid to produce a solution of strontium chloride. Strontium sulfate does not react with hydrochloric acid.

Describe how you would obtain strontium sulfate from a mixture of strontium carbonate and strontium sulfate.

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(2 marks)

24 In an investigation of the chemical properties of alcohols, a mixture of ethanol and acidified potassium dichromate(VI) is heated in a conical flask in a water bath.

24 (a) Explain why a water bath is used to heat the mixture.

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(1 mark)

24 (b) Describe the colour change which would be observed.

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(1 mark)

6

END OF QUESTIONS

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