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 2012

Chemistry CHM3X

Unit 3X AS Externally Marked Practical Assignment

Written Test

For submission by 15 May 2012

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 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 tasks, the investigation of a hand-warmer.

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**. Give your answer to the appropriate precision.

.....

(1 mark)

2 The concentration of the sodium hydroxide solution was 0.100 mol dm^{-3}.
Use your answer from Question **1** to calculate the concentration, in mol dm^{-3}, of the diluted hydrochloric acid used in **Task 1**.

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(2 marks)

3 Use your results from **Task 2** to plot a graph of temperature against time on the grid opposite. Draw a line of best fit for the points before the fourth minute.
Draw a line of best fit for the points after the fourth minute.
Extrapolate both lines to the fourth minute. *(4 marks)*

4 (a) Use your graph and the initial temperature of the hydrochloric acid that you have recorded on your Candidate Results Sheet for **Task 2** to determine an accurate value for the average temperature of the reagents at the fourth minute (**before** mixing).

.....

.....

(1 mark)

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

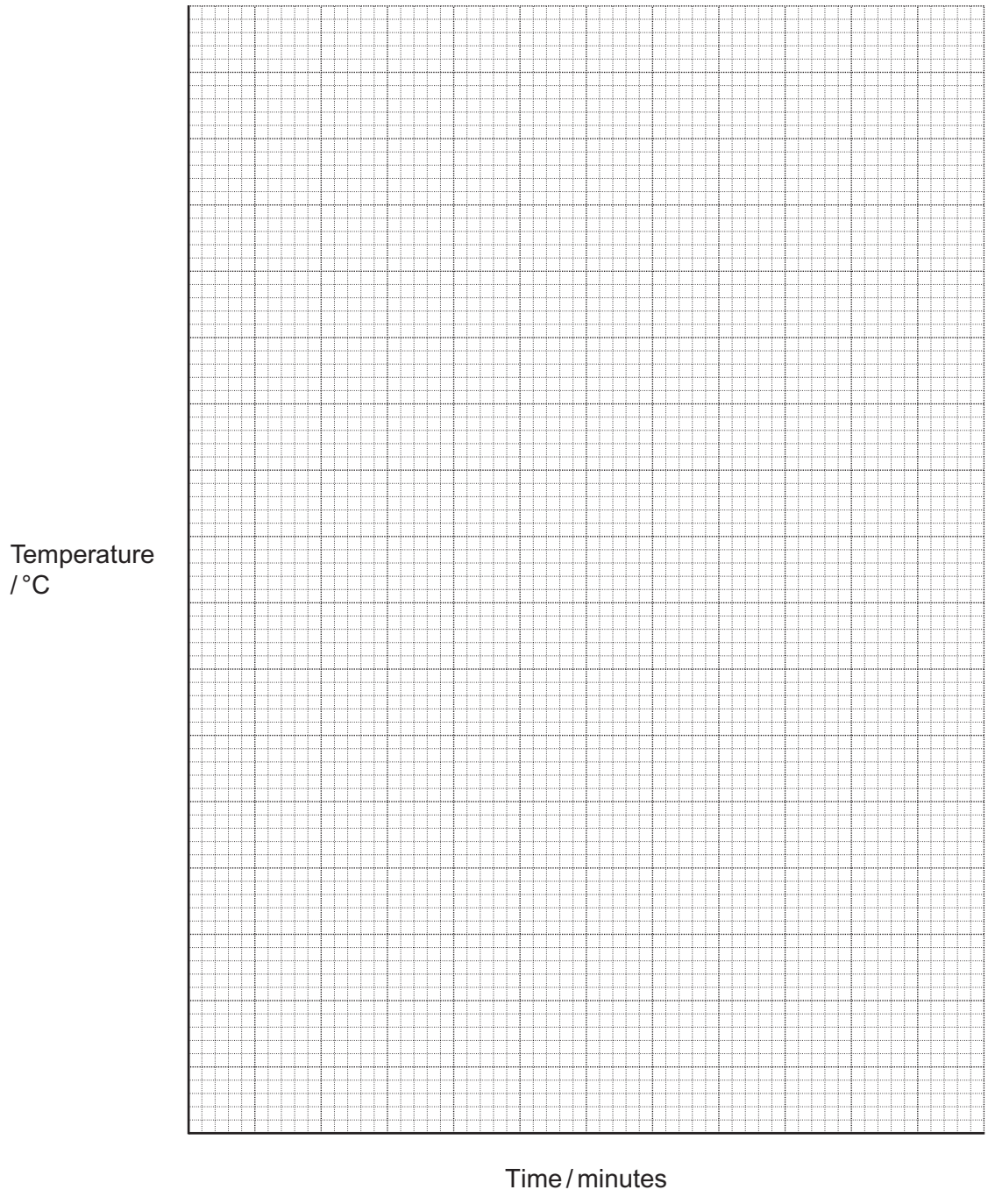
.....

(1 mark)

4 (c) Use your answers to parts **(a)** and **(b)** to determine an accurate value for the temperature rise at the fourth minute. Give your answer to the appropriate precision.

.....

(1 mark)



5 Use your answer from Question **4 (c)** to calculate the heat energy given out during your 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}.
Assume that all of the heat energy given out is used to heat the reaction mixture.
Show your working.

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(3 marks)

6 In your experiment 25.0 cm^3 of 1.00 mol dm^{-3} hydrochloric acid were neutralised by 25.0 cm^3 of 1.00 mol dm^{-3} sodium hydroxide solution.
Use your answer to Question **5** to calculate a value, in kJ mol^{-1}, for the enthalpy change of neutralisation of hydrochloric acid by sodium hydroxide.
(If you could not complete the calculation in Question **5** assume that the heat energy given out was 1560 J. This is **not** the correct answer.)
Show your working.

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(3 marks)

16

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Section B

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

Introduction

Another student carried out **Tasks 1** and **2** and calculated that the value for the enthalpy change of neutralisation was −51.2 kJ mol^{-1}.

The design of a possible hand-warmer using hydrochloric acid and sodium hydroxide was discussed. It was proposed that 500 cm^3 of hydrochloric acid should be used in a flexible, sealed plastic container with a breakable tube of solid sodium hydroxide also in the container. On breaking the tube, the sodium hydroxide would be released, react with the acid and produce heat. A 40 °C temperature rise was thought to be suitable.

7 Calculate the heat energy, in J, required to raise the temperature of the reaction mixture by 40 °C. 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}.
Assume that all of the heat energy given out is used to heat the reaction mixture.

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(2 marks)

8 Use your answer from Question **7** and the value for the enthalpy change of neutralisation of −51.2 kJ mol^{-1} to calculate the minimum amount, in moles, and hence the minimum mass of sodium hydroxide required in the breakable tube.
(If you could not complete the calculation in Question **7** assume that the heat energy required was 77 400 J. This is **not** the correct answer).

Show your working.

Moles of NaOH.....

.....

Mass of NaOH.....

.....

(3 marks)

9 Use the amount, in moles, of sodium hydroxide from Question **8** to calculate the minimum concentration, in mol dm^{-3}, of hydrochloric acid required in the 500 cm^3 of solution used in the sealed container.

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(1 mark)

10 Suggest **one** possible risk to a person who uses a hand-warmer containing sodium hydroxide and hydrochloric acid.

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(1 mark)

11 A commercial hand-warmer uses powdered iron sealed in a plastic container.
A valve allows air to enter the container, and oxygen in the air reacts slowly with the iron to form solid iron(III) oxide. The heat released warms the container.

11 (a) Write an equation for this reaction between iron and oxygen to form iron(III) oxide.

.....

(1 mark)

11 (b) One version of an iron-oxygen hand-warmer advertises that it is designed to stay warm for up to four hours.
Other than by increasing the amount of iron in the container, state **one** change to the iron in the hand-warmer that would increase this time.
Explain why this change to the iron might **not** be an advantage.

Change to the iron .....

.....

Explanation .....

.....

.....

(3 marks)

Turn over ▶

12 Another type of hand-warmer uses sodium thiosulfate. Sodium thiosulfate is very soluble in water at 80 °C but is much less soluble at room temperature.
When a hot, concentrated solution of sodium thiosulfate is cooled it does not immediately crystallise. The sodium thiosulfate stays dissolved as a stable 'super-saturated' solution until crystallisation is triggered.
Heat energy is then released when the sodium thiosulfate crystallises.

12 (a) This type of hand-warmer is re-usable.
Suggest **one** environmental advantage that a sodium thiosulfate hand-warmer has over the other two types.

.....

(1 mark)

12 (b) Describe the **two** steps that you would take to make the sodium thiosulfate hand-warmer ready for re-use.

Step 1 .....

.....

Step 2 .....

.....

(2 marks)

14

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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13 The following instructions are from an experimental procedure for the preparation of cyclohexene from cyclohexanol and concentrated phosphoric acid.
Read these instructions and answer the questions that follow.

1 Place 25 cm^3 of cyclohexanol into a round-bottomed flask with some porous pot to act as anti-bumping granules. Add 10 cm^3 of concentrated phosphoric acid carefully while shaking the flask. Cool the flask under the tap if it gets too hot. Make sure the reagents are thoroughly mixed.

2 Set up an apparatus for simple distillation using this flask.

3 Warm the flask, gently at first, for about 15 minutes. Then increase the heating so that cyclohexene begins to distil over. Collect the fraction that distils below 95 °C.

13 (a) State the purpose of the anti-bumping granules.

.....

.....

(1 mark)

13 (b) Name the part of the distillation apparatus where cyclohexene vapour is changed back into a liquid.
Draw a simple diagram of this part of the apparatus.

Name .....

Diagram

(2 marks)

14 Some alcohols can be oxidised by an acidified solution of potassium dichromate(VI). Aldehydes can be oxidised by Tollens' reagent or by Fehling's solution.

An unknown pure liquid **A** contains only a single alcohol.
Outline a simple procedure to allow you to determine whether **A** is a primary, a secondary or a tertiary alcohol.

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(3 marks)

6

END OF QUESTIONS

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