

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

For Teacher's Use Total ISA mark
-------------------------------------

General Certificate of Education  
June 2009  
Advanced Subsidiary Examination



**CHEMISTRY**  
**Investigative Skills Assignment (ISA)**  
**Written test**

**CHM3T/Q09/test**

For submission by 15 May 2009

<p><b>For this paper you must have</b></p> <ul style="list-style-type: none"> <li>the task sheet and your Candidate Results Sheet</li> <li>a ruler with millimetre measurements.</li> </ul> <p>You may use a calculator.</p>
--

For Teacher's Use	
	Mark
<b>Task</b>	
<b>Section A</b>	
<b>Section B</b>	
<b>TOTAL ISA MARK</b>	

**Time allowed:** 1 hour

**Instructions**

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

**Information**

- The maximum mark for this test is 30.
- 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.

Signature of Teacher marking this ISA..... Date.....

**SECTION A**

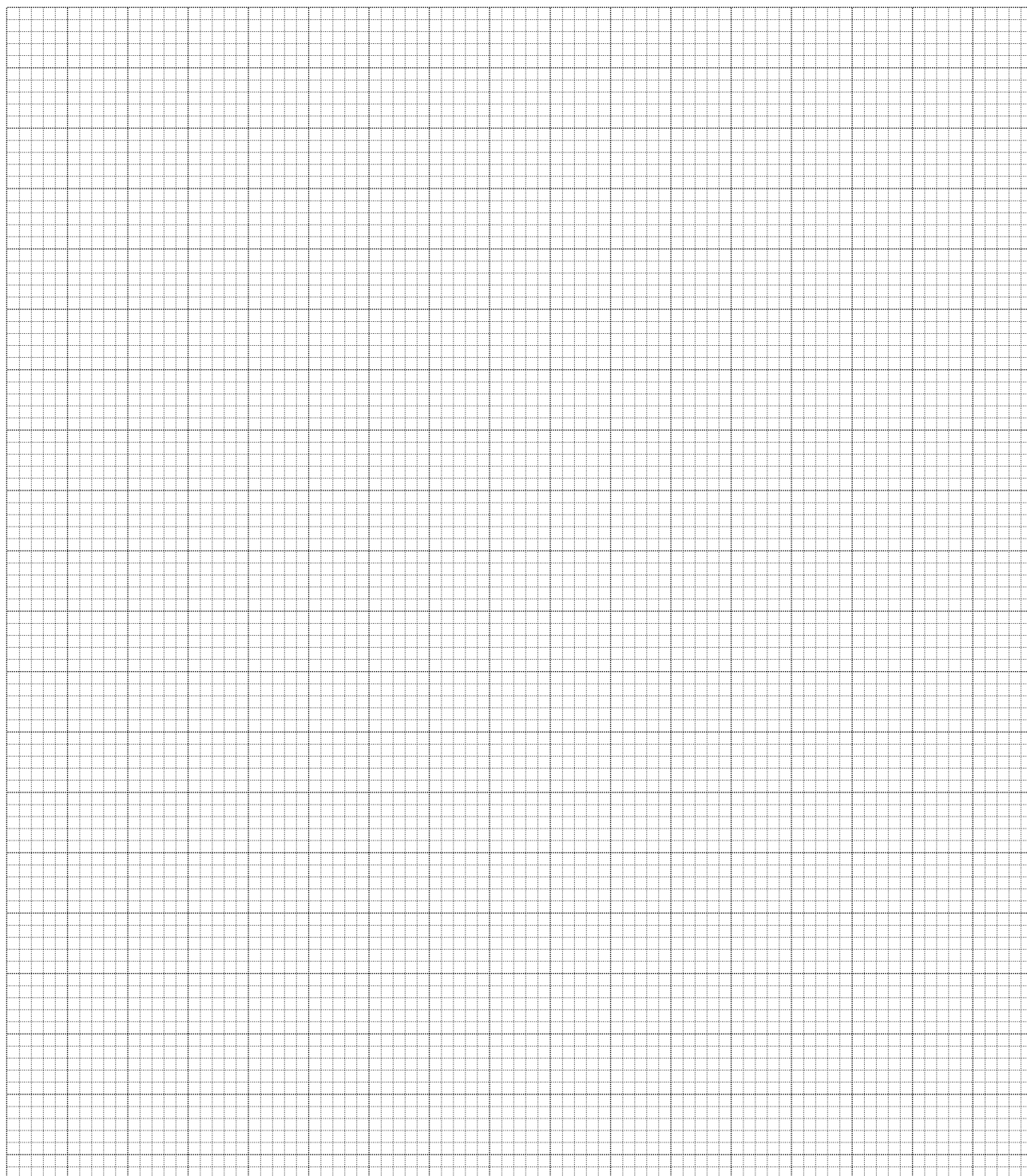
These questions are about the task, the investigation of an unknown acid.

You should use the Task Sheet and your own Candidate Results Sheet to answer them.

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

- 1** Plot a graph of **temperature** (y-axis) against **time** on the grid 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.

(5 marks)



- 2 Use your graph to determine an accurate value for the temperature of the sodium hydroxide solution at the fourth minute **before** mixing.

Temperature before mixing ..... °C  
(1 mark)

- 3 Use your answer from Question 2 and the temperature of the unknown acid recorded on your Candidate Results Sheet to calculate the average value for the temperature of the sodium hydroxide and unknown acid solutions before mixing.

Average temperature before mixing ..... °C  
(1 mark)

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

Temperature ..... °C  
(1 mark)

- 5 Use your answers from Question 3 and Question 4 to determine an accurate value for the temperature rise at the fourth minute.

Temperature rise ..... °C  
(1 mark)

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

.....  
.....  
.....  
.....  
.....  
.....  
(2 marks)

Turn over ►

7 Calculate the amount, in moles, of the acid present in 25.0 cm<sup>3</sup> of a 1.00 mol dm<sup>-3</sup> solution.

.....  
(1 mark)

8 Use your answers from Question 6 and Question 7 to calculate the molar enthalpy change, in kJ mol<sup>-1</sup>, for the reaction between the acid and sodium hydroxide.

.....  
.....  
.....  
(1 mark)

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

.....  
.....  
(1 mark)

10 State **one** potential hazard in this experiment and **one** safety precaution you would take to minimise this hazard.

.....  
.....  
(1 mark)

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

.....  
.....  
.....  
(2 marks)

- 12 For the neutralisation of the acid in the storage tank, a data book value for the molar enthalpy change is  $-58.2 \text{ kJ mol}^{-1}$ . Calculate the difference between your value from question 8 and this data book value. Express this difference as a percentage of the data book value.

(If you could not complete the calculation in question 8, you should assume that the experimental enthalpy change is  $-50.1 \text{ kJ mol}^{-1}$ . This is not the correct value.)

Difference .....

Percentage .....

.....  
(2 marks)

- 13 Identify the main source of error in this experiment. Suggest **one** improvement to minimise this main source of error.

Source of error .....

Improvement .....

.....  
(2 marks)

- 14 Explain why the experiment should be repeated several times in order to determine an accurate value for the enthalpy of neutralisation.

.....  
.....  
(1 mark)

- 15 When acid spillages occur, calcium carbonate is often used to neutralise the acid. Apart from cost, suggest **one** reason why the use of calcium carbonate is more appropriate than using sodium hydroxide.

.....  
.....  
(1 mark)

- 16 The equation for the reaction between hydrochloric acid and calcium carbonate is shown below.



The storage tank contained  $1000 \text{ dm}^3$  of  $0.97 \text{ mol dm}^{-3}$  hydrochloric acid. Calculate the mass, in kg, of calcium carbonate ( $M_r = 100.1$ ) needed to react with all of the acid.

.....  
.....  
(2 marks)

Turn over ►

