Surname			Other Names		
Centre Number			Candidate Number		
Candidate Signature					

General Certificate of Education
June 2009
Advanced Subsidiary Examination

CHEMISTRY   **CHM3T/Q09/test**
Investigative Skills Assignment (ISA)
Written test

AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

For submission by 15 May 2009

For this paper you must have
- the task sheet and your Candidate Results Sheet
- a ruler with millimetre measurements.

You may use a calculator.

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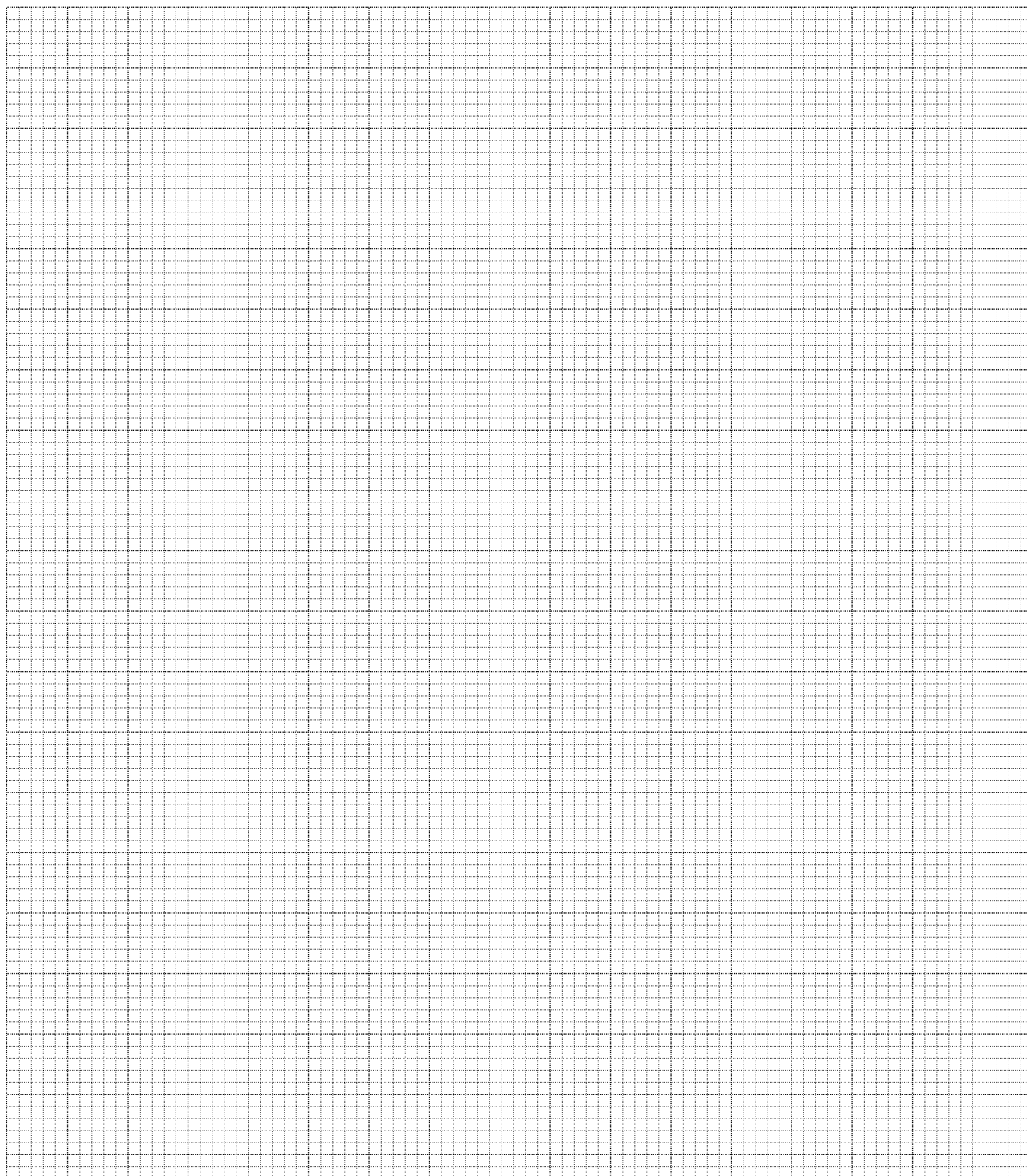
2 Use your graph to determine an accurate value for the temperature of the sodium hydroxide solution at the fourth minute **before** mixing.

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 $25.0\,cm^3$ of a $1.00\,mol\,dm^{-3}$ solution.

....

(1 mark)

8 Use your answers from Question 6 and Question 7 to calculate the molar enthalpy change, in $kJ\,mol^{-1}$, 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 $-58.2\,kJ\,mol^{-1}$. 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 $-50.1\,kJ\,mol^{-1}$. 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.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

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

....

....
(2 marks)

25

Turn over ▶

SECTION B

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

INTRODUCTION

In **Section A** you determined the enthalpy of neutralisation of an unknown acid from a storage tank.

The chemical company's records refer to the following acids

  hydrochloric acid   nitric acid
  hydrobromic acid   sulfuric acid
  hydriodic acid

A waste tank was thought to contain a mixture of two of these acids. A chemist performed test-tube reactions on separate samples from the waste tank. The results of these tests are shown below.

Test	Reagent	Observations
A	Barium chloride solution	White precipitate
B	Silver nitrate solution	White precipitate

17 Use the result from Test **A** to identify an acid in the company's records which must be **present** in the waste tank.

....

(1 mark)

18 Use the results from Test **A** and Test **B** to identify an acid in the company's records which must be **absent** from the waste tank.

....

(1 mark)

19 The chemist suspected that the waste tank contained hydrochloric acid. State how the precipitate formed in Test **B** could be tested to confirm the presence of hydrochloric acid in the waste tank. State what you would observe.

  Test ....

   ....

  Observation ....

   ....

(2 marks)

20 Suggest one reason why carbonate ions could not be present in the waste tank.

....

(1 mark)

END OF QUESTIONS