TAYLOR'S COLLEGE

Wisdom • Integrity • Excellence

| Class | Student Number | Name |
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**CAMBRIDGE A LEVEL PROGRAMME**

# A2 TRIAL EXAMINATION MARCH/APRIL 2010

**(January & March 2009 Intakes)**

**Wednesday** **7 April 2010** **8.30 am – 9.45 am**

## CHEMISTRY 9701/52

**PAPER 5 Planning, analysis and evaluation** 1 hour 15 minutes

Candidates answer on the Question Paper

**READ THESE INSTRUCTIONS FIRST**

Write your name, class and student number in the spaces at the top of this page.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples , paper clips , highlighters, glue or correction fluid

Answer **all** questions.
You are advised to show all working in calculations.
Use of a Data Booklet is unnecessary.

At the end of the examination , fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| Total | |

This document consists of **9** printed pages



[Turn over

1. In this planning exercise, you are expected to use scientific language and correct terminology for the quality of your written communication.

When hydrated sodium carbonate is heated, the water of crystallisation is lost and the solid becomes anhydrous.

You are to devise an experimental method for determining the formula of hydrated sodium carbonate, $Na_2CO_3.x\ H_2O$. You will need to find the value of 'x'; the number of moles of water of crystallisation in one mole of hydrated sodium carbonate.

The method must involve heating of crystals of hydrated sodium carbonate.

The normal apparatus to be found in a school chemistry laboratory is available.

a) Outline, by a series of numbered steps, the apparatus to be used and the detailed practical method which give full instructions about how to obtain accurate results and ensure the reliability of results.

Your plan should also include the following:

- the measurements to be taken
- specimen results recorded in an appropriate form
- at least one source of error and the action you will take to minimise it
- one thing that you may do to improve the precision of the experiment
- a specimen calculation to show how the number of moles of water of crystallisation would be calculated
- details of the potential hazards and the relevant safety precautions

[10]

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**[Turn Over**

b) The value of 'x' may also be determined by using a method involving titration.

i) Write a balanced chemical equation for the suggested reaction

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ii) Suggest the name of a suitable indicator and the quantities of chemicals you would use in the titration experiment.

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iii) Show by means of calculations how you decided these quantities.

[5]

[Total:15]

**[Turn Over**

2 An acid, HA, reacts with potassium hydroxide as shown by the following equation.

$$HA(aq) + KOH(aq) \rightarrow KA(aq) + H_2O(l)$$

Using a measuring cylinder, a student measured out 50 $cm^3$ of a 0.950 mol $dm^{-3}$ solution of the acid.

Using a second measuring cylinder, the student measured out 50 $cm^3$ of a 1.00 mol $dm^{-3}$ solution of potassium hydroxide and transferred it to a plastic cup. This cup was placed in a beaker to provide insulation and support.

Using a thermometer, the student recorded the temperature of the liquid in the cup every minute, stirring the liquid before reading the temperature.

At the fourth minute, the student added the 50 $cm^3$ of acid, but did not record the temperature. The student stirred the mixture thoroughly, then recorded the temperature at the fifth minute.

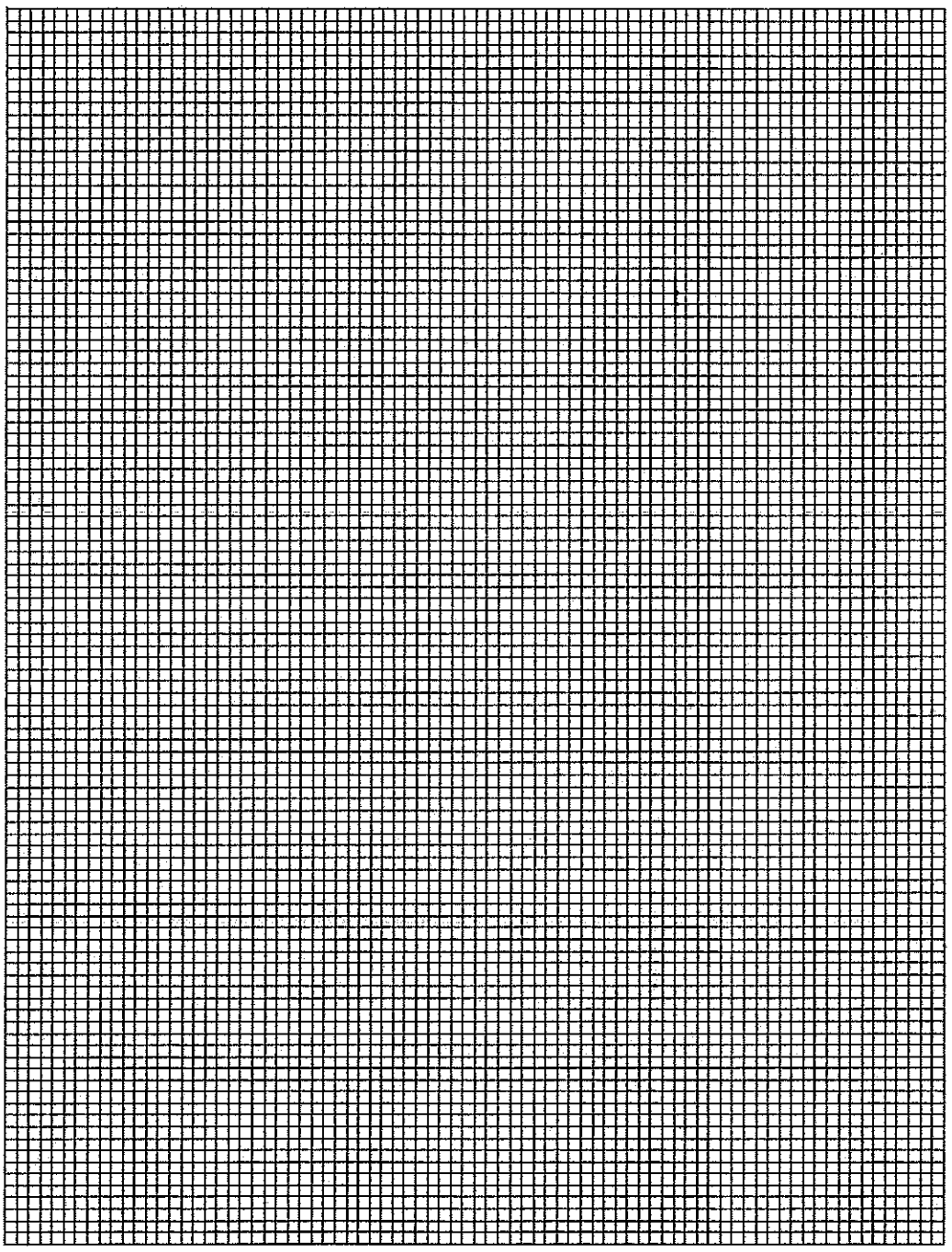
The student continued stirring and recording the temperature every minute for five more minutes.

The student's results are shown below.

| Time (minutes) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 18.9 | 18.8 | 18.9 | - | 24.5 | 24.2 | 24.3 | 23.6 | 23.3 | 23.0 |

(a) Plot a graph of temperature against time on the graph below. Draw a straight line 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. Use the lines to determine the temperature rise at the fourth minute.

Temperature rise at the fourth minute ..... °C.



[5]

(b) Use this temperature rise to calculate the heat given out during this experiment. Assume that the solution has a density of 1.00 g $cm^{-3}$ and a specific heat capacity of 4.18 $J K^{-1} g^{-1}$.

.....[1]

(c) Calculate the number of moles of HA present in the 50 $cm^3$ of 0.950 mol $dm^{-3}$ solution.
Hence, calculate the standard enthalpy change of neutralisation for the acid.

.....[2]

(d) For the measuring cylinder and the thermometer, the maximum total errors are shown below. These errors take into account multiple measurements.

50 $cm^3$ measuring cylinder ± 1.0 $cm^3$

Thermometer ± 0.1 °C

Estimate the maximum percentage error in using these pieces of apparatus and, hence, estimate their combined error.

The temperature rise from your graph should be used to estimate the percentage error in using the thermometer.

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(e) From your graph, identify any anomalous results.

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(f) By making reference to the experimental method, identify the main source of error in this experiment. Suggest one improvement to minimise this main source of error.

Source of error .....

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Improvement .....

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.....[2]

(g) Besides apparatus error, identify one other source of error in this experiment and suggest one improvement to minimize this other source of error.

Source of error .....

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Improvement .....

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.....[2]

[Total: 15]