Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

General Certificate of Education
June 2009
Advanced Subsidiary Examination

CHEMISTRY   **CHM3T/P09/test**
Investigative Skills Assignment (ISA)
Written test

For submission by 15 May 2009

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

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 composition of antacid tablets.

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

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

1 Record the average titre from your Candidate Results Sheet.
(If your teacher has given you a result to use, you should record this value here, and use it in the questions below.)

Average titre ....

(1 mark)

2 The equation for the reaction between sodium hydrogencarbonate and hydrochloric acid is shown below.

$$NaHCO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$$

The concentration of the hydrochloric acid used was $0.100 \, mol \, dm^{-3}$.
Use your answer from question 1 to calculate the concentration, in $mol \, dm^{-3}$, of sodium hydrogencarbonate in the antacid solution.

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(2 marks)

3 Use data from the Periodic Table to calculate the relative formula mass of sodium hydrogencarbonate.

....

(1 mark)

4 Use your answers from question 2 and question 3 to determine the concentration, in $g \, dm^{-3}$, of sodium hydrogencarbonate in the antacid solution.

....

....

(1 mark)

5 The antacid solution was prepared by dissolving 20.0 g of the tablets in water and making up to 1.00 dm^3 of solution. Use your answer from question 4 to calculate the percentage by mass of sodium hydrogencarbonate in the tablets.

....

....

(1 mark)

6 The maximum total error in using the burette is $\pm 0.15 \, \text{cm}^3$. This error takes into account multiple measurements. Use the average titre from question 1 to calculate the percentage error in using the burette.

....

....

(1 mark)

7 Sucrose is used in antacid tablets to improve their taste. Suggest **one** reason why the presence of sucrose in the antacid tablet does not affect the titration with hydrochloric acid.

....

....

(1 mark)

8

Turn over ▶

There are no questions printed on this page

SECTION B

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

INTRODUCTION

In **Section A** you determined the percentage by mass of sodium hydrogencarbonate in antacid tablets. Some antacid tablets contain sodium hydrogencarbonate, sucrose and citric acid.

8   Analysis of a pure sample of citric acid showed that it contained 37.50% of carbon and 4.17% of hydrogen by mass, the remainder being oxygen. Use these data to show that the empirical formula of the acid is $C_6H_8O_7$

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(3 marks)

9   When the antacid tablet is added to water, sodium hydrogencarbonate and citric acid react together to form a gas. Identify this gas.

....

(1 mark)

10   A weighed portion of this antacid was added to water. The gas formed was collected and its volume measured.

   (a)   Draw a diagram to show how this experiment could have been carried out to collect and measure the volume of the gas.

(2 marks)

Turn over ▶

(b) The experiment was repeated with further weighed portions of the same antacid.

The results are shown below.

Experiment	1	2	3	4	5
Mass of antacid/g	2.60	1.17	0.88	2.31	1.80
Volume of gas collected/cm^3	168	86	57	149	116

(i) On the graph paper included, plot a graph of mass of antacid (*x*-axis) against volume of gas collected.

(3 marks)

(ii) Draw a line of best fit on the graph, ignoring any anomalous points.

(1 mark)

(iii) Use the graph to determine the volume of gas which would have been collected using 2.00 g of antacid.

Volume of gas collected..

(1 mark)

11 Suggest **one** reason why the presence of sodium hydrogencarbonate in the stomach may cause a person to suffer some extra discomfort for a short time.

....

(1 mark)

12 Explain why the value for the M_r of citric acid does not need to be an exact value to deduce the molecular formula of citric acid from its empirical formula.

....

....

(2 marks)

13 Apart from misreading the gas volume, suggest **two** reasons why the volumes of gas collected may be lower than the volumes of gas produced.
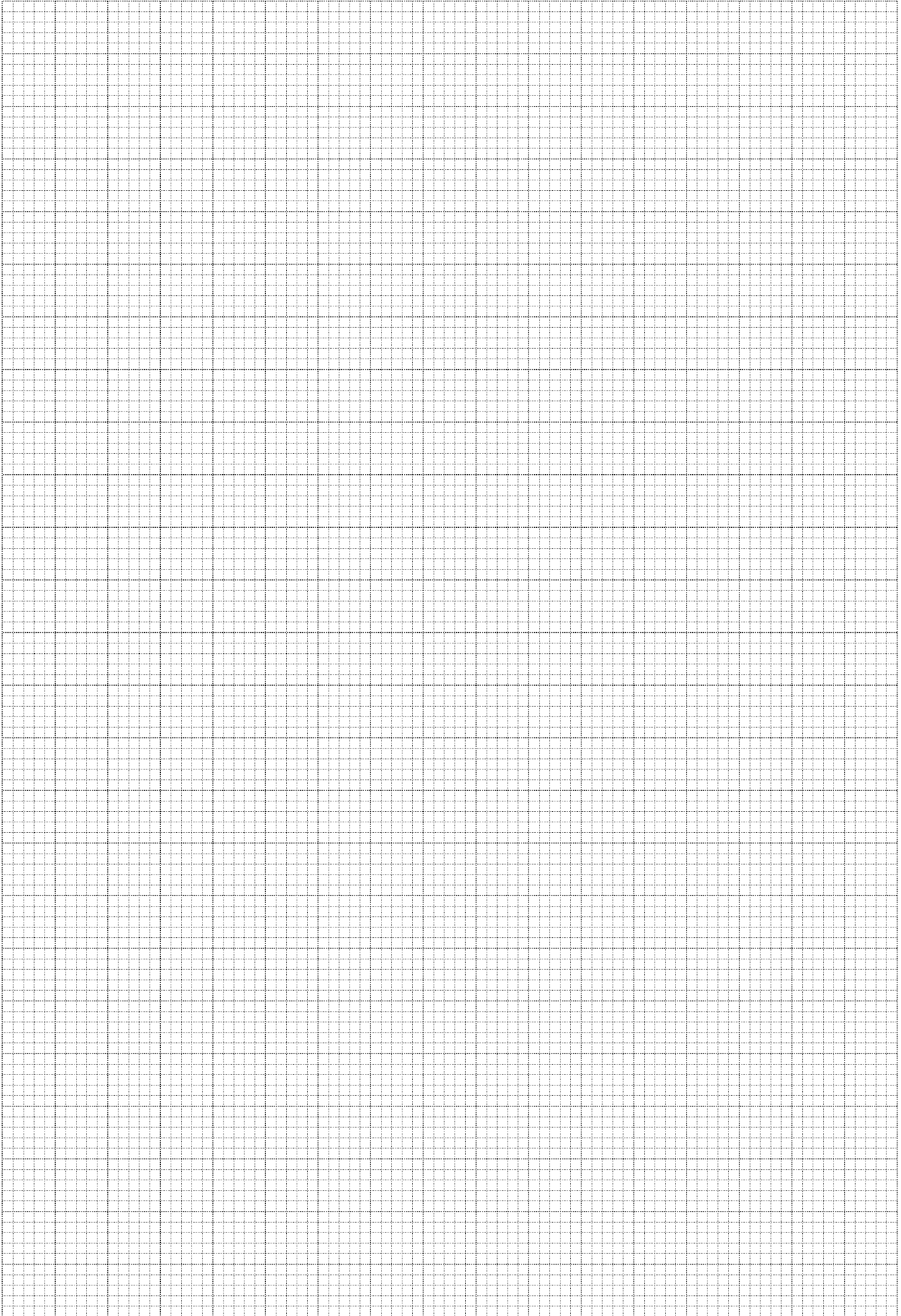
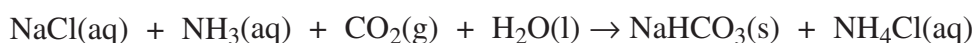Reason 1 ....

....

Reason 2 ....

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(2 marks)

14 Explain why it is important to record the temperature and pressure when measuring the volume of a gas.

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(1 mark)

15 Suggest why, in an analysis of an antacid, it is important to test samples from more than one bottle of the antacid.

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(1 mark)

16 In the industrial production of sodium hydrogencarbonate, ammonia and carbon dioxide are bubbled through a saturated solution of sodium chloride. The equation for this reaction, and some solubility data, are shown below.

$$NaCl(aq) + NH_3(aq) + CO_2(g) + H_2O(l) \rightarrow NaHCO_3(s) + NH_4Cl(aq)$$

Compound	Solubility in water at $20\,°C\,/\,g\,dm^{-3}$
sodium chloride	360
sodium hydrogencarbonate	96
ammonium chloride	370

(a) Suggest **one** reason why sodium hydrogencarbonate precipitates from the reaction mixture at this temperature.

...
(1 mark)

(b) Explain how this reaction could be used to remove carbon dioxide from the gases formed when fossil fuels are burned.

....

....
(1 mark)

17 The thermal decomposition of sodium hydrogencarbonate produces sodium carbonate. The other products are water and carbon dioxide. Write an equation for this thermal decomposition.

....

(1 mark)

18 Sodium carbonate is produced on an industrial scale by a multi-step process. The equation which summarises the reactions taking place is shown below.

$$CaCO_3 + 2NaCl \rightarrow CaCl_2 + Na_2CO_3$$
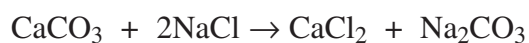
Calculate the percentage atom economy for the production of sodium carbonate by this reaction.

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(1 mark)

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22

END OF QUESTIONS