OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE **2813/04**

CHEMISTRY

Alternative to Practical

MONDAY 12 MAY 2008 Afternoon

Time: 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials: Folder of Practical Evidence
Scientific calculator
Data Sheet for Chemistry (Inserted)

CUP/T34096

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- **You should refer to your Folder of Practical Evidence, as necessary.**

FOR EXAMINER'S USE		
Qu.	**Max**	**Mark**
1	**17**	
2	**6**	
3	**18**	
4	**19**	
TOTAL	**60**	

This document consists of **12** printed pages and a *Data Sheet for Chemistry*.

  Registered Charity Number: 1066969 **[Turn over**

Answer **all** the questions.

1 ***For this question you may find it helpful to refer to the acid-base titration in your folder.***

You are required to plan a titration that will enable you to determine the exact concentration of a sample of hydrochloric acid.

The concentration of the hydrochloric acid is approximately 0.1 mol dm^{-3}.

Sodium carbonate crystals, $Na_2CO_3.10H_2O$, are available and also the indicator bromothymol blue which is blue in alkaline solutions and yellow in acidic solutions.

Sodium carbonate reacts with hydrochloric acid as shown below.

$$Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$$

The apparatus necessary for the experiment is listed below:

three decimal place balance
weighing bottle
250 cm^3 beaker
50.0 cm^3 burette and stand
small funnel to fit the burette
250.0 cm^3 volumetric flask
25.0 cm^3 pipette and pipette filler
several 250 cm^3 conical flasks
white tile
wash bottle containing distilled (or de-ionised) water
glass rod

In order to do the titration a 0.0500 mol dm^{-3} solution of sodium carbonate must first be made.

(a) Calculate the mass of sodium carbonate crystals, $Na_2CO_3.10H_2O$, that would be required to make 250.0 cm^3 of a 0.0500 mol dm^{-3} solution.

mass of sodium carbonate, $Na_2CO_3.10H_2O$ = ... g [3]

(b) Describe carefully how you would make an accurate solution of sodium carbonate suitable for the experiment.

Start with your weighed sample and the apparatus listed opposite, including the volumetric flask.

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.....[4]

(c) Explain why a sodium carbonate solution with a concentration of 0.0500 mol dm^{-3} is likely to be suitable for titrating with 0.1 mol dm^{-3} hydrochloric acid.

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.....[2]

(d) It is thought that the pipette to be used for the experiment might be contaminated with some sodium hydroxide solution.

(i) Describe how you would clean this pipette.

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.....[1]

(ii) Describe how you would use the clean pipette to transfer 25.0 cm^3 of the sodium carbonate solution to a conical flask ready for the titration.

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.....[2]

(e) Assume that the burette has been filled with hydrochloric acid ready for the titration.

The indicator bromothymol blue is blue in alkaline solutions such as $Na_2CO_3(aq)$ and yellow in acidic solutions.

Describe how you would carry out a series of titrations to obtain a suitable accurate average value for the volume of hydrochloric acid required.

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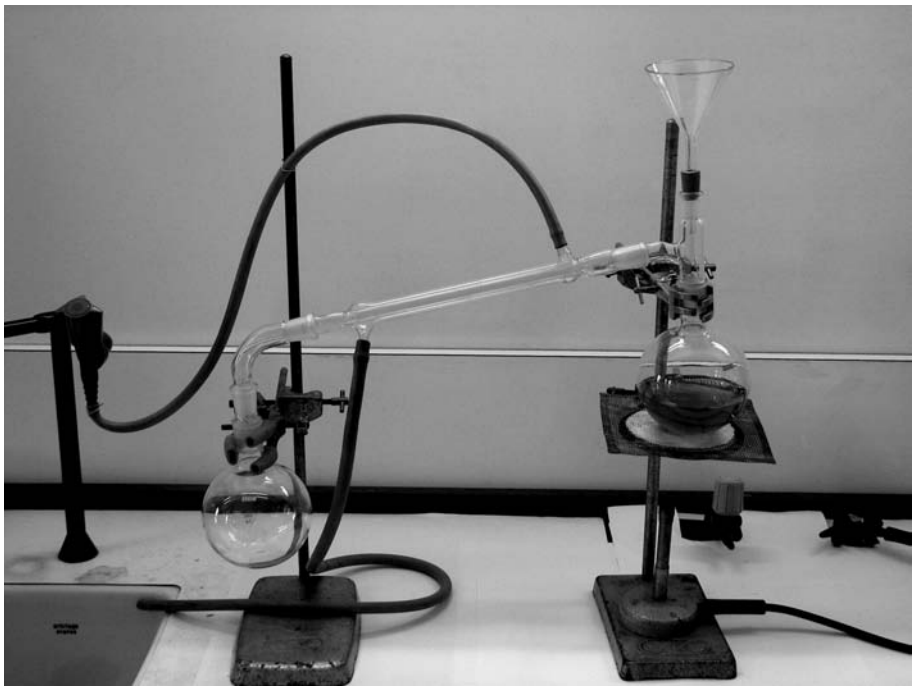
..... [5]

[Total: 17]

2 Propanone can be prepared in the laboratory by reacting propan-2-ol with a suitable solution of an oxidising agent and distilling the propanone into a suitable container.

A student plans to do this and sets up the apparatus as shown below.



Look carefully at the apparatus. There are several faults with the way in which the apparatus is set up.

Identify **three** faults and give a reason why the apparatus would be unsuitable to use if these faults were not corrected.

fault 1 .....

reason .....

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.....[2]

fault 2 .....

reason .....

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.....[2]

fault 3 .....

reason .....

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.....[2]

[Total: 6]

3 ***For this question you may find it helpful to refer to enthalpy experiments in your folder.***

In part **(a)** one mark is available for the quality of use and organisation of scientific terms.

The enthalpy change obtained by dissolving hydrated copper sulphate crystals, $CuSO_4.5H_2O$, in water is to be determined.

The apparatus available is:

- a polystyrene cup
- a two decimal place balance
- a thermometer.

(a) Describe how you would carry out this experiment.

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Quality of Written Communication [1]

(b) Explain how you would use results from your experiment in **(a)** to calculate a value for ΔH for dissolving 1 mol of $CuSO_4.5H_2O$ in water.

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.....[3]

(c) The enthalpy change of reaction when 1 mol of hydrated copper sulphate crystals, $CuSO_4.5H_2O$, is dissolved in water is shown in **equation 3.1** below.

$$CuSO_4.5H_2O(s) + (aq) \longrightarrow CuSO_4(aq) \quad \Delta H = +11.3\,kJ\,mol^{-1} \qquad \textbf{equation 3.1}$$

A student dissolved 5.00 g of $CuSO_4.5H_2O$ in water to obtain 40.0 g of solution.

(i) Calculate the number of moles of $CuSO_4.5H_2O$ used.

number of moles of $CuSO_4.5H_2O$ = ...[2]

(ii) The original temperature of the water was 18.0 °C.

The specific heat capacity of the solution formed is $4.18\,J\,g^{-1}\,K^{-1}$.

Using $\Delta H = +11.3\,kJ\,mol^{-1}$, calculate the temperature that could be obtained.

Give your answer to three significant figures.

temperature obtained = ... °C [4]

(d) In practice, the temperature change measured is unlikely to be the same as that calculated.

Suggest **one** reason why this might be so.

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.....[1]

(e) The enthalpy changes of reaction when 1 mol of hydrated copper sulphate crystals and 1 mol of anhydrous copper sulphate are separately dissolved in water are shown below.

$$CuSO_4.5H_2O(s) + (aq) \rightarrow CuSO_4(aq) \quad \Delta H = +11.3\,kJ\,mol^{-1} \quad \textbf{equation 3.1}$$

$$CuSO_4(s) + (aq) \rightarrow CuSO_4(aq) \quad \Delta H = -67.2\,kJ\,mol^{-1} \quad \textbf{equation 3.2}$$

Use **equation 3.1**, **equation 3.2** and Hess' law to calculate the enthalpy change for the following reaction.

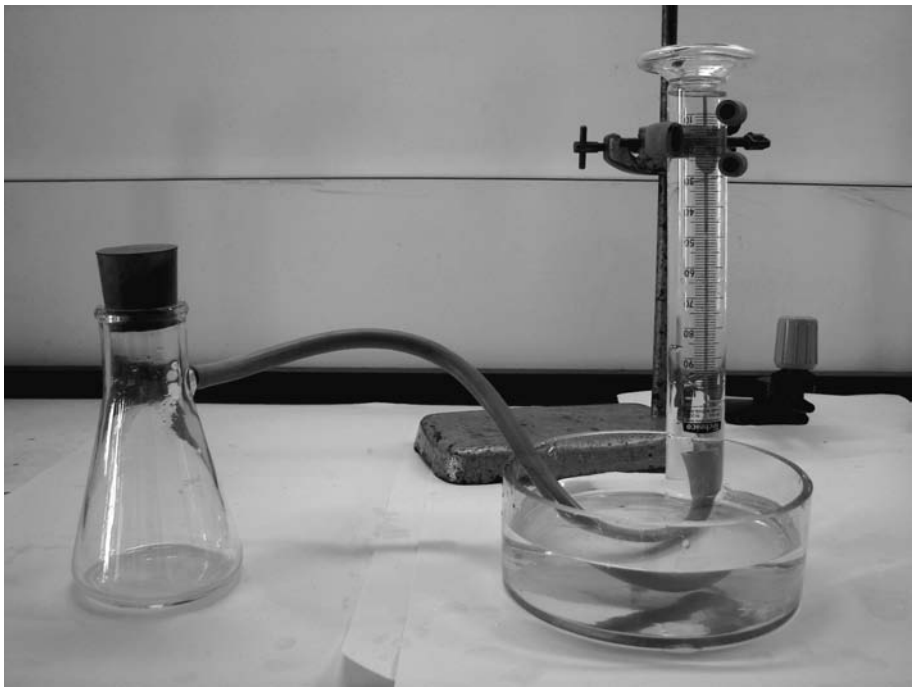
$$CuSO_4.5H_2O(s) \rightarrow CuSO_4(s) + 5H_2O(l)$$

ΔH = ... $kJ\,mol^{-1}$ [2]

[Total: 18]

4 Magnesium reacts with hydrochloric acid to form hydrogen gas.

The apparatus shown below was set up to measure the volume of hydrogen formed.



Method

- A two decimal place balance is used to measure out 0.06 g of magnesium.
- 25 cm^3 of 1 mol dm^{-3} hydrochloric acid is placed in the conical flask. This is an excess of hydrochloric acid.
- The magnesium is added to the acid in the flask and the bung is quickly replaced.
- The volume of hydrogen given off during the reaction is measured in a 100 cm^3 measuring cylinder.

(a) (i) Write the equation for the reaction that takes place between magnesium and hydrochloric acid. Include state symbols in your answer.

.....[2]

(ii) Show by calculation that 60 cm^3 of $H_2(g)$ should be collected at room temperature and pressure, r.t.p.

At r.t.p., 1 mol of $H_2(g)$ occupies 24.0 dm^3.

volume of $H_2(g)$ = ... cm^3 [2]

(b) Why is it necessary to use an excess of hydrochloric acid?

.....[1]

(c) After the reaction had finished, a student decided that he would test the solution in the conical flask to show a chloride had been formed.

He added aqueous silver nitrate to the solution and a white precipitate was produced.

Explain why this test does **not** prove conclusively that the product of the reaction is a chloride.

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.....[2]

(d) When the experiment was completed, the student was surprised to find that the actual volume in the measuring cylinder was different from what he had expected in **(a)(ii)**.

A friend suggested that the poor result could be explained by one or more of the following reasons.

1 The bung of the conical flask had **not** been replaced quickly enough after the addition of the magnesium.

2 The surface of the magnesium used was contaminated by a coating of magnesium oxide.

3 The gas collected might have been above room temperature.

4 The gas collected in the measuring cylinder included some air from the apparatus.

Consider each of the suggestions above.

State with a reason the effect, if any, that each suggestion would have on the volume of gas collected.

suggestion 1.....

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suggestion 2.....

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suggestion 3.....

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suggestion 4.....

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.....[8]

(e) Another reason for unexpected results could be the accuracy of the equipment used.

Consider the likely errors in weighing out the magnesium using the two decimal place balance and in measuring the volume of hydrogen using a 100 cm^3 measuring cylinder.

weighing out the magnesium

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measuring the volume of hydrogen

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.....[4]

[Total: 19]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE