OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE **2813/04**

CHEMISTRY

Alternative to Practical

TUESDAY 15 MAY 2007 Afternoon

Time: 1 hour 30 minutes

Additional materials: Scientific calculator
Data Sheet for Chemistry (Inserted)
Candidate's Folder of Practical Evidence

CUP/T39887

Candidate Name

Centre Number

Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- 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	16	
2	13	
3	11	
4	20	
TOTAL	60	

This document consists of **11** printed pages, **1** blank page and a *Data Sheet for Chemistry*.

[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.***

A student plans to titrate a solution of sodium hydroxide with hydrochloric acid.

The hydrochloric acid available has a concentration of 0.500 mol dm^{-3} but this is too concentrated for the titration and must be diluted to 0.0500 mol dm^{-3}.

The student decides to make 250.0 cm^3 of this diluted solution in a volumetric flask.

(a) Calculate what volume of the 0.500 mol dm^{-3} hydrochloric acid the student would need to mix with water to make 250.0 cm^3 of a 0.0500 mol dm^{-3} solution.

volume needed = ... cm^3 [1]

(b) What apparatus should be used to measure this volume of hydrochloric acid?

..... [1]

(c) The diluted hydrochloric acid is to be placed in a burette ready for the titration.

Describe how the student should prepare the burette ready to begin the titration.

.....

.....

.....

..... [2]

(d) The student has been told that, in order to measure volumes accurately for a titration, he must read all volumes from the bottom of the meniscus of the solution.

However, a friend tells him that he prefers to read the volume from the top of the meniscus and that it will make no difference to the volume measured.

State, with a reason, whether his friend would obtain the correct volume of solution in each of the following.

If the volume would not be correct, state whether the volume would be less or more.

(i) 25.0 cm^3 of a solution measured using a 25.0 cm^3 pipette.

.....

..... [2]

(ii) 25.0 cm^3 of a solution measured using a burette.

.....

..... [2]

(e) When the student carries out each titration he measures the volume of hydrochloric acid with a burette. The burette has an accuracy of 0.05 cm^3.

In each case 25.0 cm^3 of sodium hydroxide is used.

He records the burette readings in a table as shown below.

titration	trial	1	2	3
final volume	26	24.6	28.65	25.2
initial volume	0	0.14	4.55	1.15
volume used	26	24.46	24.1	24.05

There are several errors in the way in which these results have been recorded.

Use the table below to set out the results correctly.

titration	trial	1	2	3
final volume				
initial volume				
volume used				

[3]

(f) What should the student conclude to be the average volume of hydrochloric acid required for the titration? Give your answer appropriate for the accuracy of the burette used.

average volume of hydrochloric acid = ... units = ... [3]

(g) During the titration some drops of hydrochloric acid drip down the inside of the conical flask. To make sure that these drips go into the sodium hydroxide solution the student washes the inside of the flask with distilled (de-ionised) water.

His friend tells him that he should not do this because it will dilute the sodium hydroxide and lead to an error in the titration result.

Explain why his friend is wrong.

.....

.....

.....

..... [2]

[Total: 16]

2 ***In your folder find the organic preparation that you have carried out.***

During your preparation you will have started with at least one organic reactant and made an organic product. One, or more, additional reactants will also have been required.

(a) Each of these chemicals may be toxic and require care when handled.

From the following list choose **one** other hazard that applies to the chemicals.

State '**none**' if there is a minimal hazard.

corrosive

irritant or **harmful**

flammable

oxidising

name of organic reactant .....

hazard .....

name of one other reactant .....

hazard .....

name of organic product .....

hazard ..... [3]

(b) The ester, ethyl ethanoate, $CH_3COOCH_2CH_3$, can be prepared by mixing together ethanol, CH_3CH_2OH, and ethanoic acid, CH_3COOH, and then cautiously adding concentrated sulphuric acid. After allowing the reaction to take place the ester is distilled off. The sulphuric acid acts as a catalyst for the reaction.

The equation for the reaction is shown in **equation 2.1** below.

$$CH_3CH_2OH + CH_3COOH \rightarrow CH_3COOCH_2CH_3 + H_2O \qquad \textbf{equation 2.1}$$

The ethyl ethanoate formed is immiscible (forms a separate layer) when added to water.

(i) The ethyl ethanoate that is distilled contains acidic impurities.

Identify **two** other impurities.

impurity 1 .....

impurity 2 ..... [2]

(ii) Acidic impurities can be removed by shaking the distillate with sodium carbonate solution.

Describe **two** things you would **see** if sodium carbonate solution is shaken with the impure sample of ethyl ethanoate.

.....

..... [2]

(c) In a preparation of ethyl ethanoate, 9.20 g of ethanol is reacted with 15.0 g of ethanoic acid. 7.04 g of ethyl ethanoate is obtained.

Refer to **equation 2.1** to answer the following questions.

(i) Deduce, by calculation, whether the ethanol or the ethanoic acid is present in excess.

[3]

(ii) Calculate the percentage yield of ethyl ethanoate.

percentage yield = ... % [3]

[Total: 13]

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

A student plans to determine the enthalpy change for the reaction of zinc and sulphuric acid. The equation for this reaction is shown below.

$$Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(aq) + H_2(g)$$

She decides to use 0.10 mol (6.54 g) of zinc metal foil (an excess) and to react this with 50 cm^3 of a 1.0 mol dm^{-3} solution of sulphuric acid.

She pours the sulphuric acid into a beaker and, using a thermometer accurate to 1 °C, measures the initial temperature of the acid as 17 °C.

She then adds the zinc, stirs the mixture carefully, and finds that the highest temperature reached is 22 °C.

(a) Show that 50 cm^3 of 1.0 mol dm^{-3} sulphuric acid contains 0.050 mol of sulphuric acid.

[1]

(b) Describe **two** different observations that would be seen if zinc powder had been used instead of zinc foil.

.....

.....

..... [2]

(c) The student then considered some modifications to her experiment to obtain a more reliable result.

For each of the following modifications, **explain** whether you think the change proposed might affect the final recorded temperature.

(i) Use of 10.0 g of zinc foil instead of 6.54 g of zinc foil.

.....

.....

..... [2]

(ii) Use of 50 cm^3 of 2.0 mol dm^{-3} sulphuric acid instead of 50 cm^3 of 1.0 mol dm^{-3} sulphuric acid.

.....

.....

..... [2]

(iii) Use of 100 cm^3 of 0.5 mol dm^{-3} sulphuric acid instead of 50 cm^3 of 1.0 mol dm^{-3} sulphuric acid.

.....

.....

..... [2]

(d) A more accurate result may be obtained by using a more accurate balance and measuring the volume of sulphuric acid more accurately.

State **two** other modifications to the apparatus that the student might use to obtain a more accurate result for the enthalpy change.

modification 1 .....

.....

modification 2 .....

..... [2]

[Total: 11]

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

Magnesium carbonate reacts with hydrochloric acid to form a solution of magnesium chloride and carbon dioxide gas.

$$MgCO_3(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + CO_2(g) + H_2O(l)$$

(a) Use the equation above to calculate the mass of magnesium carbonate which will produce 72 cm^3 of carbon dioxide at room temperature and pressure, r.t.p.

At r.t.p. 1 mol of carbon dioxide occupies 24 dm^3.

mass of magnesium carbonate = ... g [3]

(b) You are supplied with 50 cm^3 of 1 mol dm^{-3} hydrochloric acid. This is a sufficient excess to make sure that all the magnesium carbonate, calculated in part **(a)**, reacts.

You are required to plan an experiment to time how long it takes to collect 72 cm^3 of carbon dioxide from the reaction of magnesium carbonate with excess hydrochloric acid.

(i) List the apparatus required for the necessary measurements.

Include, where appropriate, the size and accuracy of the apparatus.

[4]

(ii) Describe how you would carry out the experiment.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

Quality of Written Communication [1]

(c) One of the difficulties with the experiment is that gas may be lost when the magnesium carbonate is added to the acid.

The experiment is carried out in a conical flask.

Draw a diagram of the apparatus to show how the reagents could be mixed without the need to remove the bung from the flask.

You only need to draw the arrangement in the conical flask, ***not*** *the rest of the apparatus.*

[2]

TURN OVER FOR PART (d)

(d) Magnesium carbonate also reacts with nitric acid, HNO_3.

(i) Name the products of this reaction.

..... [1]

(ii) Write a balanced equation for the reaction of magnesium carbonate and nitric acid.

..... [1]

(iii) The experiment in part **(b)** is repeated with the same mass of magnesium carbonate and the same volume and concentration of nitric acid in place of the hydrochloric acid.

Both nitric acid and hydrochloric acid are strong acids.

Suggest, with reasons, how using nitric acid affects:

- the time taken for the reaction to finish;
- the total volume of carbon dioxide evolved.

time taken .....

.....

.....

total volume of carbon dioxide .....

.....

..... [4]

[Total: 20]

END OF QUESTION PAPER

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

PLEASE DO NOT WRITE ON THIS PAGE