OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

CHEMISTRY 2813/04

Alternative to Practical

Thursday **18 MAY 2006** Morning 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Data Sheet for Chemistry
Candidate's Folder of Practical Evidence
Scientific calculator

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks 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.
- You may use the *Data Sheet for Chemistry*.
- 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	14	
2	11	
3	17	
4	18	
TOTAL	60	

This question paper consists of 13 printed pages and 3 blank pages.

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[Turn over

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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 was asked to carry out an acid-base titration with the aim of finding the concentration of a solution of sodium hydroxide, NaOH. A sample of propanoic acid, CH_3CH_2COOH, which is a liquid at room temperature, was provided.

The equation for the reaction is given below.

$$CH_3CH_2COOH(aq) + NaOH(aq) \longrightarrow CH_3CH_2COONa(aq) + H_2O(l)$$

(a) The student weighed out 1.85 g of CH_3CH_2COOH and prepared 250.0 cm^3 of solution for use in the titration.

Describe how the student would have prepared this solution using the weighed sample.

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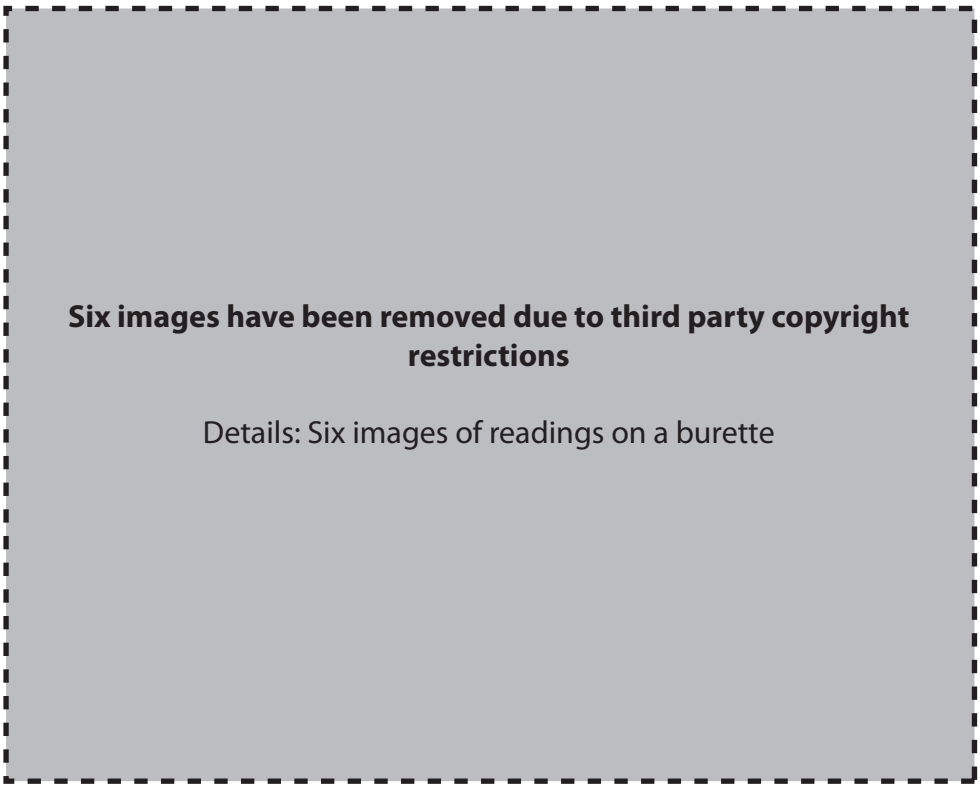
.....[3]

(b) The student carried out the titration using a burette, measuring to an accuracy of 0.05 cm ^{3}.

- The burette was filled with the aqueous NaOH.
- The student carried out a rough titration using a 25.00 cm ^{3} sample of the aqueous propanoic acid measured using a pipette.
- The student carried out further titrations using 25.00 cm ^{3} samples of the aqueous propanoic acid and the readings are shown below.
  (In each diagram the initial burette reading is vertically above the final reading.)

titration 1 titration 2 titration 3

initial reading



final reading

Record the student's results in an appropriate format below. Calculate the accurate average titre.

Student's results

average titre = ... cm^3 [6]

(c) Calculate the concentration, in mol dm^{-3}, of the propanoic acid solution. Show your working.
M_r: CH_3CH_2COOH, 74.0

answer = ... mol dm^{-3} [2]

(d) Calculate the number of moles of propanoic acid in a pipetted sample. Show your working.

answer = ... mol [1]

(e) Calculate the concentration, in mol dm^{-3}, of the sodium hydroxide solution. Show your working.

answer = ... mol dm^{-3} [2]

[Total: 14]

2 The apparatus shown below can be used to determine the relative molecular mass of a volatile organic liquid.

A diagram has been removed due to third party copyright restrictions

Details: A diagram of the apparatus used to determine the relative molecular mass of a volatile organic liquid. The diagram shows a hot water bath at 90 degrees with a flask in it which is connected to a graduated syringe

The experiment is carried out as follows:

- The organic liquid is weighed in a small tube.
- The bung of the conical flask is removed and the small tube is inserted into the flask. The bung is replaced.
- The organic liquid vapourises and the volume of the vapour is measured in the 100 cm^3 graduated syringe.

(a) The boiling points of three organic compounds are shown below.

For each compound, state, with a reason , whether this method would be suitable for the determination of its relative molecular mass.

compound	boiling point / °C
1,2-dibromoethane	13
1-chloropropane	47
1-iodobutane	130.5

1,2-dibromoethane .....

.....

1-chloropropane .....

....

1-iodobutane.....

....[3]

(b) In a similar experiment, 0.10 g of a hydrocarbon was vapourised. Its volume, measured in the syringe, was 33.5 cm^3 when corrected to room temperature and pressure (r.t.p.).

(At r.t.p., 1 mol of gas has a volume of 24.0 dm^3)

Calculate the relative molecular mass of the hydrocarbon and suggest its possible molecular formula.

[3]

(c) In this question one mark is available for the organisation and clarity of your answer.

Discuss the **significant** errors in both the procedure and in the measurements made.

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.....[4]

Quality of Written Communication [1]

[Total: 11]

3 A teacher provided the following instructions for her students so that they could prepare a sample of 1-bromobutane C_4H_9Br, (boiling point 102 °C).

Reagents

- Concentrated sulphuric acid ..... 
- Sodium bromide ..... minimal hazard
- Butan-1-ol, C_4H_9OH .....  

Procedure

1 Transfer 5 g of crushed sodium bromide to a 100 cm^3 round bottomed flask; add 10 cm^3 of distilled water and 5 cm^3 of butan-1-ol (boiling point 117 °C). Swirl the flask gently to dissolve the sodium bromide.

2 Carefully add 6 cm^3 of concentrated sulphuric acid to the mixture in the flask. The sulphuric acid will react with the sodium bromide to form hydrogen bromide. If the contents of the flask become too hot then cool the flask in cold water.

3 Fit a water-cooled condenser and boil the contents of the flask for 30 minutes.

4 Allow the apparatus to cool and arrange it for distillation.

5 Heat the flask gently and allow the mixture to distil over into a small conical flask. Collect the fraction boiling between 95 °C and 125 °C.

6 Add sodium hydrogencarbonate solution to the distillate and shake the mixture until no more gas is given off. Two layers of liquid will form in the conical flask.

7 Separate the two layers of liquid and collect the impure 1-bromobutane. Wash it with water. Separate the water layer before drying the 1-bromobutane with anhydrous sodium carbonate.

8 Re-distil and collect the fraction boiling between 101 °C and 103 °C.

For Examiner's Use

(a) What hazards are illustrated by the two symbols shown below?

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[2]

(b) In stage 4, the instructions state that the apparatus used should be arranged for distillation.

Draw a diagram to show how you would set up the apparatus for distillation.

[3]

(c) In stage 5, suggest what impurities might be present within the fraction collected.

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(d) In stage 6, a gas is given off. Name the gas and explain why it is formed.

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.....[2]

(e) In stage 7, the two layers of liquid have to be separated from each other.

The 1-bromobutane is contained in the lower layer.

Suggest how the two layers might be separated.

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.....[2]

(f) An equation for the reaction is shown below:

$$C_4H_9OH + HBr \longrightarrow C_4H_9Br + H_2O$$

Calculate the mass of 1-bromobutane that would be formed from 3.7 g of butan-1-ol, assuming a 40% yield.

[3]

(g) During the experiment the laboratory technician whispered to the teacher that he thought that he had provided the students with sodium chloride rather than sodium bromide.

Suggest how the students could use a chemical test to find out whether their product was 1-bromobutane rather than 1-chlorobutane.

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[Total: 17]

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[Turn over

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

(a) You are asked to plan an experiment to determine the enthalpy change per mole of magnesium for the reaction 4.1 shown below:

$$Mg(s) + ZnSO_4(aq) \longrightarrow Zn(s) + MgSO_4(aq) \qquad \textbf{reaction 4.1}$$

You are supplied with $100\,cm^3$ of sulphuric acid which has a concentration of $0.50\,mol\,dm^{-3}$.

Also available are samples of magnesium ribbon and pieces of zinc metal (granulated zinc).

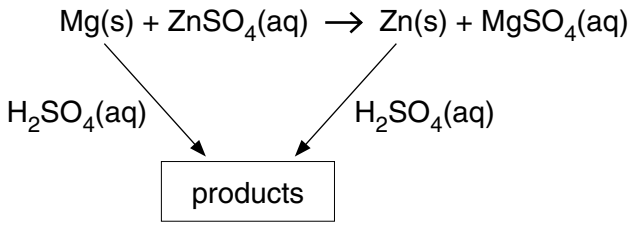
Since no zinc sulphate is readily available, the enthalpy change of reaction 4.1 is to be determined indirectly by reacting Mg and Zn separately with sulphuric acid.

$$Mg(s) + H_2SO_4(aq) \longrightarrow MgSO_4(aq) + H_2(g)$$

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

Hess's Law can then be used to determine the enthalpy change of reaction 4.1.

The relevant enthalpy cycle is shown below.



You can use any ordinary laboratory equipment.

Calculate the quantities of reagents you would use and, in each case, give a reason for your choice.

[5]

(b) List the apparatus that would be needed to make the **measurements** in your experiment.

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.....[3]

(c) Explain how you would use your results to calculate a value for the enthalpy change per mole of magnesium for the reaction 4.1.

$$Mg(s) + ZnSO_4(aq) \longrightarrow Zn(s) + MgSO_4(aq)$$ **reaction 4.1**

[5]

(d) Suggest **two** modifications that you might make to the experiment to obtain a more accurate result. Justify your answers.

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Turn over for Question 4(e)

(e) The experiments that you have planned in **(a)** and **(b)** are to be repeated using the same volumes of 0.50 mol dm^{-3} hydrochloric acid in place of the sulphuric acid.

Explain what differences, if any, it would make to the results.

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.....[3]

[Total: 18]

END OF QUESTION PAPER

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