Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

CHEMISTRY **9701/02**

Paper 2 Structured Questions AS Core

May/June 2004

1 hour 15 minutes

Candidates answer on the Question Paper.
Data Booklet.

READ THESE INSTRUCTIONS FIRST

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

Answer **all** questions.
The number of marks is given in brackets [ ] at the end of each question or part question.
You may lose marks if you do not show your working or if you do not use appropriate units.
A Data Booklet is provided.

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

For Examiner's Use	
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TOTAL	

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SP (SC) S52970/3

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International Examinations

[Turn over

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1 **(a)** State **two** assumptions of ideal gas behaviour.

(i) ....

....

(ii) ....

....[2]

Use of the *Data Booklet* is relevant in (b) and (c).

(b) The ideal gas equation is $pV = nRT$. Explain as fully as you can the meaning of the following terms, and give the units for each to correspond with the value of R given in the *Data Booklet*.

(i) p ....

....

(ii) V ....

....

(iii) T ....

....[6]

(c) **(i)** When an evacuated glass bulb of volume 63.8 cm^3 is filled with a gas at 24 °C and 99.5 kPa, the mass increases by 0.103 g. Deduce whether the gas is ammonia, nitrogen or argon.

(ii) Explain why ammonia is the most likely of these three gases to deviate from ideal gas behaviour.

....

....

....

....

....[5]

[Total : 13]

2 Compounds of phosphorus have many uses in everyday life, e.g. fertilisers, matches and in water softeners.

(a) State the full electronic configuration of phosphorus.

....[1]

(b) Phosphoric acid, H_3PO_4, is used in the manufacture of phosphate fertilisers.

Deduce the oxidation number of phosphorus in H_3PO_4.

....[1]

(c) The salt sodium phosphate, Na_3PO_4, is a water-softening agent.

(i) Write the equation for the complete neutralisation of phosphoric acid with aqueous sodium hydroxide.

....

Sodium phosphate was prepared from $50.0\,cm^3$ of $0.500\,mol\,dm^{-3}$ H_3PO_4 and an excess of aqueous sodium hydroxide.

(ii) How many moles of H_3PO_4 were used?

(iii) Use your equation in **(c)(i)** to calculate how many moles of sodium hydroxide are required.

[3]

(d) Phosphorus sulphide, P_4S_3, is used in small amounts in the tip of a match. On striking a match, this compound burns.

(i) Construct an equation for this reaction.

....

(ii) Both oxides formed in **(i)** dissolve in water to give acidic solutions. Construct an equation for the reaction of each oxide with water.

....

....[4]

[Total : 9]

3 Ammonia, NH_3, is a colourless, pungent-smelling gas which has been known to man from the beginning of recorded time. It is given off from urine such as that on a wet nappy from a baby.

The nitrogen-containing substance in urine is urea, $CO(NH_2)_2$, and this decomposes by hydrolysis into ammonia and another colourless gas.

(a) Construct an equation for the hydrolysis of aqueous urea.

....[2]

Ammonia was named after the shrine of Jupiter Ammon which was near the Egyptian-Libyan border. In ancient times ammonia was obtained by distilling camel dung.

(b) Now ammonia is synthesised from its elements in the Haber Process.

(i) Write an equation for this process.

....

(ii) State the **three** usual operating conditions of the Haber Process.

....

....

....

(iii) State **two** modern commercial uses of ammonia.

....

....[4]

(c) $1.20\,dm^3$ of ammonia gas were dissolved in water to form $200\,cm^3$ of aqueous alkali at room temperature and pressure.

(i) Use the *Data Booklet* to calculate how many moles of $NH_3(g)$ were dissolved.

(ii) Write the equation for the neutralisation of aqueous ammonia by dilute sulphuric acid.

....

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(iii) Calculate the volume of $0.50\,mol\,dm^{-3}$ sulphuric acid that is required to neutralise the $200\,cm^3$ of aqueous ammonia.

[3]

(d) In the boxes below, draw diagrams to show the shapes of an ammonia molecule and an ammonium ion. Clearly show the bond angles on your diagrams.

ammonia	ammonium ion

[4]

(e) Ammonia does not burn in air but will burn in pure oxygen.

(i) Balance the equation for this reaction:

$$\ldots\ldots\ NH_3(g) + \ldots\ldots\ O_2(g) \longrightarrow \ldots\ldots\ N_2(g) + \ldots\ldots\ H_2O(g)$$

(ii) Use oxidation numbers to explain why this is a redox reaction.

....

....

....[3]

[Total : 16]

4 Esters are compounds which provide the flavour of many fruits and the perfumes of many flowers.

(a) The ester $CH_3(CH_2)_2CO_2CH_3$ contributes to the aroma of apples.

(i) State the reagents and conditions needed for the hydrolysis of this ester.

....

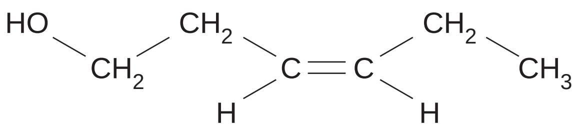
(ii) Write the equation for the hydrolysis of this ester.

....

(iii) Apart from their use as perfumes and food flavourings, state **one** major commercial use of esters.

....[3]

(b) Leaf alcohol is a stereoisomer that can form when insects such as caterpillars eat green leaves.



(i) Draw the other stereo-isomer of leaf alcohol.

(ii) Draw the structure for the ester formed when leaf alcohol reacts with ethanoic acid. Show **all** the bonds in the ester group.

[3]

(c) **(i)** Deduce the relative molecular mass, M_r, for leaf alcohol.

(ii) Leaf alcohol was reacted to form a product with an M_r value 18 units less.

Suggest a structure for this product and deduce the type of reaction that took place.

structure of product.

type of reaction ....[3]

(d) Describe a simple chemical test to distinguish between leaf alcohol and your product in **(c)(ii)**.

test ....

observation ....[2]

[Total : 11]

5 A number of organic compounds containing the halogens fluorine and/or chlorine are commercially important because of their chemical inertness.

(a) Name **three** such compounds, and for each state a use where its inertness is important.

(i) ....

....

(ii) ....

....

(iii) ....

....[6]

(b) Under certain conditions in the upper atmosphere, some of these compounds break down.

(i) Explain how this happens and what effects this has, in chemical terms.

....

....

....

....

(ii) Suggest alternative compounds, which do not contain a halogen, for **two** of the uses you have given in **(a)**.

....

....[5]

[Total : 11]

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