Centre Number	Candidate Number	Name

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

CHEMISTRY **9701/02**

Paper 2 Structured Questions AS Core

May/June 2003

1 hour

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	
1	
2	
3	
4	
5	
6	
7	
TOTAL	

This document consists of **9** printed pages and **3** blank pages.

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UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

[Turn over

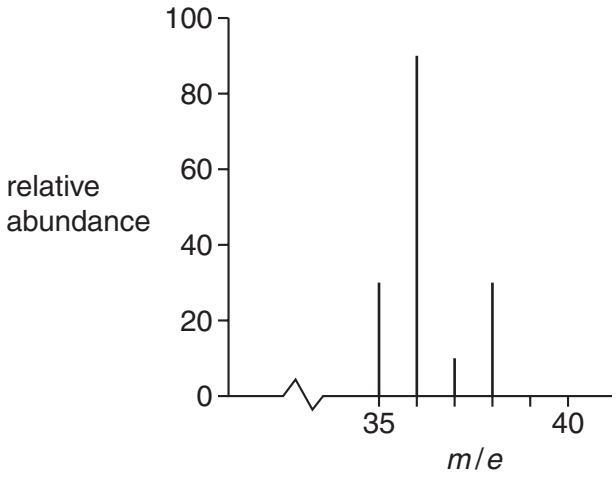
1 **(a)** Define *an isotope* in terms of its sub-atomic particles.

.....

.....

[1]

(b) In a mass spectrometer some hydrogen chloride molecules will split into atoms. The mass spectrum of HC*l* is given. Chlorine has two isotopes. The hydrogen involved here is the isotope $^{1}_{1}H$ only.



(i) What particle is responsible for the peak at mass 35? .....

(ii) What particle is responsible for the peak at mass 38? .....

[2]

(c) Use the relative heights of the peaks to determine the proportions of the two isotopes of chlorine. Explain simply how you obtained your answer.

[2]

(d) Use your answer to **(c)** to explain why chlorine has a relative atomic mass of 35.5.

[1]

[Total : 6]

2 This question is about the physical chemistry of gases, with particular emphasis on the inert gas argon. Argon exists in the atmosphere as single atoms.

(a) State **two** of the assumptions of the kinetic theory as applied to an inert gas.

(i) .....

.....

(ii) .....

.....

[2]

(b) How many atoms of argon are present in **one** mole of the gas?

.....[1]

(c) You are to calculate the percentage of the volume occupied by the atoms themselves in one mole of argon at room temperature and pressure.

(i) Use the *Data Booklet* to calculate the volume of one atom of argon.
[volume = $\frac{4}{3}\pi r^3$ $\pi = 3.14$]

(ii) Use your answer to **(c)(i)** to calculate the volume of one mole of argon atoms.

(iii) State the volume occupied by one mole of argon (assume it to behave as an ideal gas) at room temperature and pressure.

.....

(iv) What percentage of this volume is occupied by the atoms themselves?

(v) Explain how your answer to **(c)(iv)** justifies one of your assumptions in **(a)**.

.....

.....

[5]

[Turn over

(d) Argon is used to fill electric light bulbs. These have a fine filament of a metal wire, usually tungsten, which glows white hot from its electrical resistance to the current.

Suggest why argon, rather than air, is used to fill electric light bulbs.

.....

.....

.....

.....[2]

[Total : 10]

3 In the Haber Process, ammonia is synthesised from its elements.

(a) Write an equation for the Haber process and state whether it is endo- or exo-thermic.

.....[2]

(b) What are the **three** usual operating conditions of the Haber Process?

.....

.....

.....[2]

(c) Explain the considerations which lead to the temperature you have stated in **(b)** being used.

.....

.....

.....

.....[2]

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(d) Under certain conditions the equilibrium pressures of the three gases are

nitrogen 44.8 atm,
hydrogen 105.6 atm,
ammonia 37.2 atm.

(i) Write an expression for the equilibrium constant, K_p, for the Haber Process.

(ii) Calculate K_p from these data, giving the units.

[4]

(e) One of the uses of ammonia is to form nitrates which are used as efficient inorganic fertilisers. The uncontrolled use of these fertilisers has led to environmental problems. Briefly describe and explain these problems.

.....

.....

.....

.....

.....

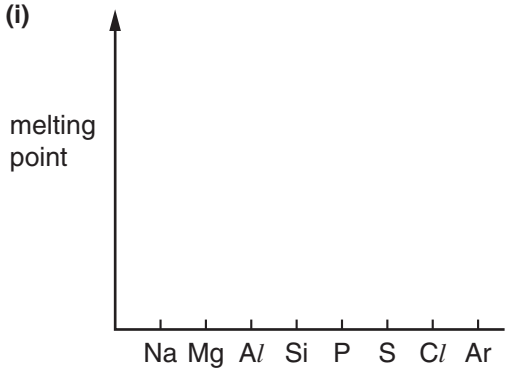
.....[3]

[Total : 13]

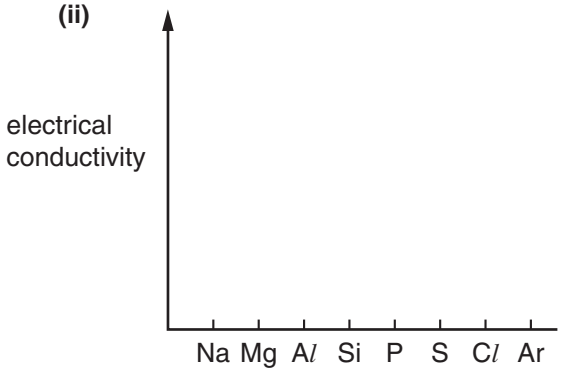
[Turn over

4 **(a)** The use of the *Data Booklet* is relevant to this question. Complete these sketches for elements of the third period (sodium to argon) to show how each property changes along the period.

(i)



(ii)



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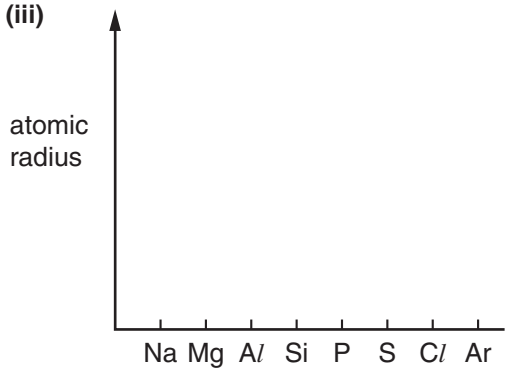
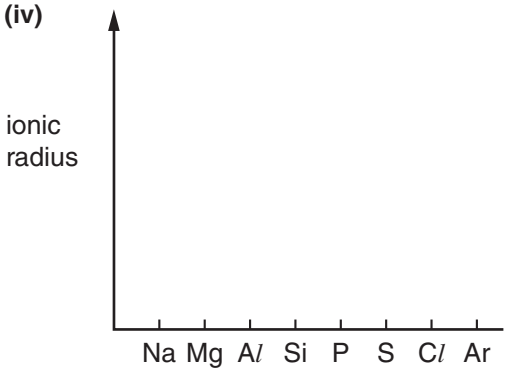


(iv)



[6]

(b) **(i)** In the boxes below, write the formulae of **one** of the oxides of each of these five elements.

sodium	magnesium	aluminium	phosphorus	sulphur

(ii) Write an equation for sodium oxide reacting with water.

.....

(iii) Write an equation for your chosen oxide of sulphur reacting with an alkali.

.....[3]

[Total : 9]

5 **(a)** Draw a section of poly(propene), showing three repeat units.

[1]

(b) To what homologous series does poly(propene) belong?

.....[1]

(c) When a rupture (hernia) or a deep wound, e.g. as a result of a sports accident, is repaired by surgery, a mesh is inserted below the muscle tissue so that on healing the wound is less likely to reopen and the repair is stronger.

Poly(propene) is the recommended material for the mesh.

(i) Suggest **two** reasons why poly(propene) is used rather than a natural fibre such as cotton.

.....

.....

.....

(ii) Members of the homologous series you have given in **(b)** are considered to have two different kinds of reactions. Explain why neither of them can take place in a poly(propene) mesh inserted in living body tissues.

.....

.....

.....

.....[4]

[Total : 6]

6 A compound, **A**, has the following composition by mass.

C, 66.7%; H, 11.1%; O, 22.2%.

It has an M_r of 72.

(a) Calculate the molecular formula of **A**.

[2]

(b) **A** reacts with 2,4-dinitrophenylhydrazine but not with Fehling's or Tollens' reagents.

(i) State what you would see when **A** reacts with the 2,4-dinitrophenylhydrazine reagent.

.....

(ii) State what functional group is present in **A**. .....

(iii) Identify **A** either by name or by its structural formula.

.....[3]

(c) **A** can be reduced to compound **B**.

For this reaction

(i) state a suitable reducing agent, ...

(ii) name the functional group in **B** (two words are required),

.....

(iii) give the structural formula of **B.**

[3]

[Total : 8]

7 **(a)** **(i)** This question is about esters; esters occur naturally and are widely used.
In the boxes below, draw the structural formulae of any **three** different esters that have the molecular formula $C_5H_{10}O_2$.

(ii) Write an equation for the hydrolysis of **one** of these esters by hot, aqueous sodium hydroxide.

.....[4]

(b) State **two** general physical properties of esters.

(i) .....

(ii) .....[2]

(c) State **two** commercial uses of esters.

(i) .....

(ii) .....[2]

[Total : 8]

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