

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced Subsidiary GCE
CHEMISTRY
2811

Foundation Chemistry

Friday

17 JANUARY 2003

Morning

1 hour

Candidates answer on the question paper.

Additional materials:

Scientific calculator

Data Sheet for Chemistry

Candidate Name	Centre Number	Candidate Number										
	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> </tr> </table>						<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> <td style="width: 15px; height: 15px;"></td> </tr> </table>					

TIME 1 hour

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 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.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	12	
2	17	
3	14	
4	8	
5	9	
TOTAL	60	

This question paper consists of 10 printed pages and 2 blank pages.

Answer all the questions.

- 1 Gallium, atomic number 31, exists naturally as a mixture of its isotopes, ^{69}Ga and ^{71}Ga .

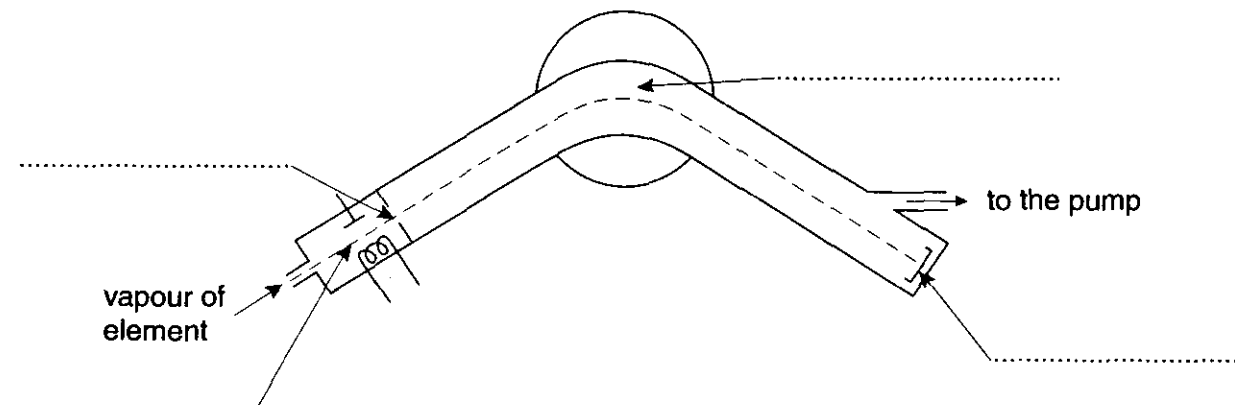
(a) Complete the table below to show the atomic structure of each isotope of gallium.

isotope	number of		
	protons	neutrons	electrons
^{69}Ga			
^{71}Ga			

[2]

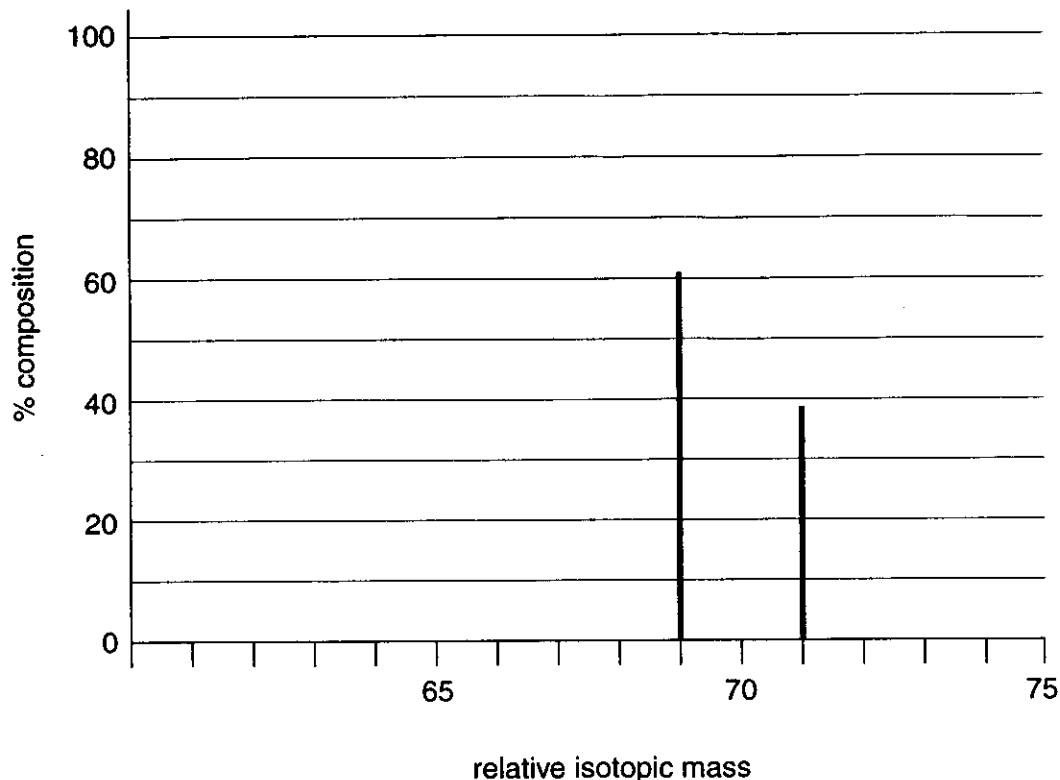
- (b) A mass spectrometer can be used to identify the isotopes in a sample of an element. The diagram below shows a mass spectrometer.

Complete the diagram by adding the names of the processes that take place in each of the four labelled regions.



[4]

(c) A sample of gallium was analysed in a mass spectrometer to produce the mass spectrum below. The relative atomic mass of gallium can be calculated from this mass spectrum.



(i) Define the term *relative atomic mass*.

.....

.....

.....

..... [3]

(ii) Estimate the percentage composition of each isotope present in the sample.

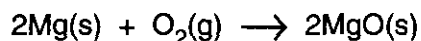
[1]

(iii) Calculate the relative atomic mass of this sample of gallium. Your answer should be given to three significant figures.

answer [2]

[Total : 12]

- 2 When magnesium is heated in air, it reacts with oxygen to form magnesium oxide.



- (a) Complete the electronic configuration of a magnesium atom.

1s² [1]

- (b) What is the oxidation state of magnesium in

(i) Mg [1]

(ii) MgO? [1]

- (c) When magnesium is heated in air, it also reacts with nitrogen to form solid magnesium nitride, Mg₃N₂.

(i) Construct an equation, with state symbols, for this reaction between magnesium and nitrogen.

..... [2]

(ii) Suggest why magnesium reacts with air to form much more MgO than Mg₃N₂.

.....

..... [1]

- (d) Magnesium oxide has an extremely high melting point which makes it suitable as a lining for furnaces.

Explain, in terms of its structure and bonding, why magnesium oxide has this property.

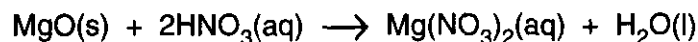
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.....

.....

..... [3]

- (e) When magnesium oxide is added to warm dilute nitric acid, a reaction takes place forming a solution of magnesium nitrate.



A student reacted 0.0500 mol MgO with 0.400 mol dm⁻³ nitric acid.

- (i) What would you see during this reaction?

.....
..... [1]

- (ii) Calculate the mass of MgO that reacted.

[2]

- (iii) Calculate the volume of 0.400 mol dm⁻³ HNO₃ required to react exactly with this amount of MgO.

[2]

- (f) The solution formed in this reaction contains ions.

- (i) Why does this solution conduct electricity?

.....
..... [1]

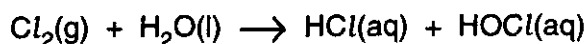
- (ii) State the formulae of **two** ions present in this solution.

..... [2]

[Total : 17]

3 This question is about chlorine and chlorine compounds.

(a) Chlorine reacts with water to form a solution.



(i) Why is chlorine added to water on a large scale?

..... [1]

(ii) Green universal indicator is added to this solution.

What colour changes would you see

immediately [1]

after some time? [1]

(b) Describe a simple test that you could carry out to show that chloride ions are present in a sample of sea water.

reagent

observation

equation

[3]

(c) Some dry-cleaning solvents include the chlorine compound *Perc*.

Perc has the following percentage composition by mass: Cl, 85.6%; C, 14.4%.

The relative molecular mass of *Perc* is 166.

(i) Calculate the molecular formula of *Perc*.

[3]

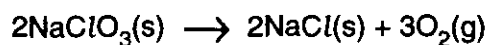
(ii) Suggest why *Perc* would not react in the test in (b).

.....

..... [1]

- (d) Sodium chlorate, NaClO_3 , is a chlorine compound used as a weed killer.

When heated, NaClO_3 releases oxygen gas.



Calculate the volume of O_2 that can be formed at room temperature and pressure by heating 4.26 g of NaClO_3 .

1 mol of gas molecules occupies 24.0 dm^3 at room temperature and pressure.

[4]

[Total : 14]

- 4 The first six successive ionisation energies of an element **D** are shown in Table 4.1 below.

Table 4.1

element	ionisation energy / kJ mol ⁻¹					
	1st	2nd	3rd	4th	5th	6th
D	1086	2353	4621	6223	37832	47278

- (a) Define the term *first ionisation energy*.

.....
.....
.....
..... [3]

- (b) Write an equation, with state symbols, to represent the **third** ionisation energy of element **D**.

..... [2]

- (c) Use Table 4.1 to deduce which group of the Periodic Table contains element **D**. Explain your answer.

group

explanation

.....
..... [3]

[Total : 8]

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