SAE/1 815/0854/1.

06/83

Centre Number	For Examiner's Use
Candidate Number	
Surname	
Signature	

UNIVERSITY OF LONDON

General Certificate of Education Examination

JUNE 1983 **ORDINARY LEVEL**

Chemistry 1

Two hours

In the spaces above write your Centre Number, Candidate Number, Surname and Signature.

This paper is arranged in two sections, A and B. Sections A and B carry equal marks and you are recommended to spend about one hour on each section.

Section A: You are advised to attempt ALL SIX questions; the mark awarded will be the total for your best FIVE answers.

Section B: Answer TWO questions. One objective of this section is to give you the opportunity to organize material and present ideas, including calculations and diagrams where appropriate, in a clear and logical form. Approximately one third of the marks in Section B will be awarded for these aspects of your answers.

In calculations, you are advised to show all the steps in your working, giving your answer at each stage.

USEFUL DATA. You may use the following figures in any question where you need them.

Avogadro constant, $L = 6 \times 10^{23}$ mol^{-1}

Relative atomic masses may be taken as:

Aluminium (Al)	27.0
Carbon (C)	12.0
Hydrogen (H)	1.0
Nitrogen (N)	14.0
Oxygen (O)	16.0
Sodium (Na)	23.0
Sulphur (S)	32.0

Turn over

PSE 82/2039 4/100/R41 000/R1000

Do not write in this margin

SECTION A

You are advised to attempt ALL SIX questions in this section; the mark awarded will be the total for your best FIVE answers. Write your answers in the spaces provided.

Useful data will be found on the front cover.

1. This question is concerned with the properties and uses of gases.

(*a*) Give the names of THREE gases which will CHANGE the colour of red or blue litmus but in DIFFERENT ways. For each gas, state the final colour of the litmus.

Gas 1: ..... Final colour of litmus.....

Gas 2: ..... Final colour of litmus.....

Gas 3: ..... Final colour of litmus.....

(*3 marks*)

(*b*) (i) Give the name of a gas which burns readily in air after a flame has been applied.

.....

(ii) Write an equation for the reaction taking place.

.....

(*2 marks*)

(*c*) (i) Give the name of a gas commonly used in fire extinguishers.

.....

(ii) Give TWO properties of this gas which make it suitable for this purpose.

.....

.....

(*3 marks*)

(*d*) (i) Give the name of a gas which reduces hot copper(II) oxide to copper.

.....

(ii) Write a balanced equation for the reaction taking place.

.....

(*2 marks*)

Do not write in this margin

2. *W*, *X*, *Y* and *Z* represent the symbols of four elements having atomic numbers of 7, 9, 12 and 13, respectively. (These letters are not the symbols of the elements concerned.)

(*a*) Give the electron configurations of the elements.

W .....*X* .....

Y .....*Z* .....

(*2 marks*)

(*b*) Use the symbols *W*, *X*, *Y* and *Z* to give

(i) the two elements most likely to be metals, ...

(ii) the element most likely to form an ion carrying a charge of 3+, ...

(iii) the element most likely to form an ion carrying a charge of 1−, ...

(iv) the element in Group VII (halogen group) of the Periodic Table.

.....

(*4 marks*)

(*c*) Use the symbols *W*, *X*, *Y* and *Z* to write down the most likely formula of

(i) the hydride of *W*, ...

(ii) the compound of *X* and *Y*, ...

(iii) the compound of *W* and *Z*. .....

(*3 marks*)

(*d*) Which of the compounds mentioned in (*c*) would you expect to be ionic?

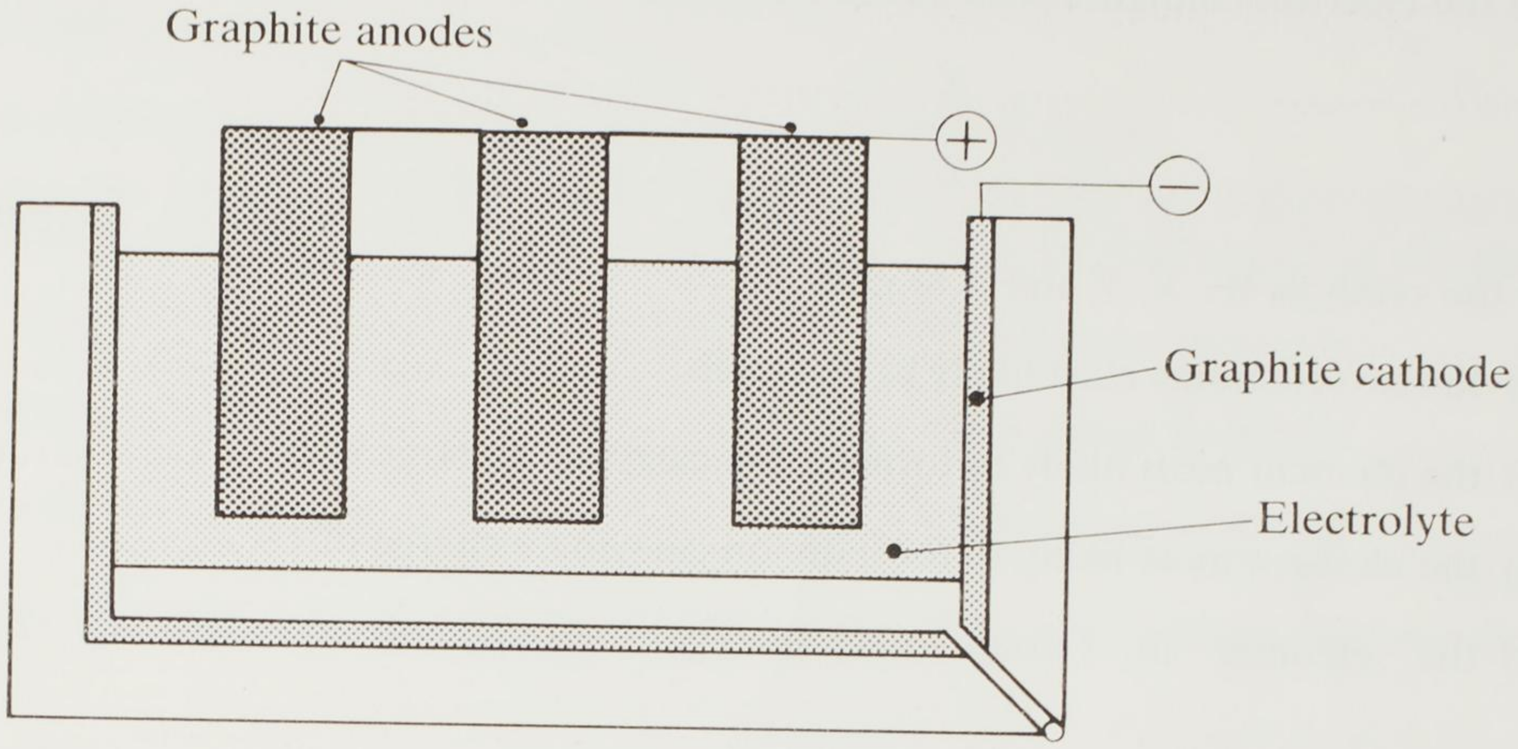
.....

.....

(*1 mark*)

Do not write in this margin

3. The diagram below shows the cell in which aluminium is obtained from purified aluminium oxide by electrolysis.



(*a*) Aluminium oxide cannot be electrolyzed directly. State what must be done to enable it to be electrolyzed.

.....

(*1 mark*)

(*b*) (i) Give the name of the substance produced at the *anode*.

.....

(ii) Write an equation to show the reaction taking place at the *cathode*.

.....

(*2 marks*)

(*c*) The equation for the overall reaction in the cell is

$$2Al_2O_3 \rightarrow 4Al + 3O_2$$

If 1 tonne of aluminium is required, what is the minimum number tonnes of aluminium oxide that is needed to produce it?

.....

.....

.....

.....

(*3 marks*)

(*d*) (i) If a piece of aluminium is placed in warm dilute hydrochloric acid, the reaction is slow at the start before becoming rapid. If the aluminium is rubbed with sandpaper before it is placed in the acid, the reaction is rapid from the start. Suggest an explanation for this.

.....

.....

.....

.....

(ii) Write an IONIC equation for the reaction of aluminium with dilute hydrochloric acid.

.....

(3 marks)

(*e*) Both copper and aluminium are good conductors of electricity, but aluminium is preferred to copper for use in overhead cables. Suggest a reason for this.

.....

.....

(1 mark)

4. (*a*) (i) Give the name of an oxide which reacts with water.

.....

(ii) Write an equation to show the reaction of this oxide with water.

.....

(*2 marks*)

(*b*) Complete the following table of information about three oxides.

Element	Name of oxide	Formula of oxide	Acidic, basic or neutral
Carbon			Neutral
Magnesium	Magnesium oxide		
Hydrogen			Neutral

(*3 marks*)

(*c*) (i) Give the name of a metal which reacts with both acids and alkalis.

.....

(ii) Write an equation to show the reaction of this metal with EITHER dilute sulphuric acid OR with aqueous sodium hydroxide.

.....

(*2 marks*)

(*d*) Aluminium powder reacts, on heating, with chromium(III) oxide to liberate the metal chromium.

$$2Al + Cr_2O_3 \rightarrow Al_2O_3 + 2Cr$$

(i) What conclusion can be drawn about the relative degree of reactivity of the two metals aluminium and chromium?

.....

.....

(ii) Give the name of ONE other metal which you would expect to be released from its oxide by heating with aluminium powder.

.....

(iii) In industry certain metals are extracted from their oxides by heating with carbon in the form of coke. Give the name of ONE such metal.

.....

(*3 marks*)

Do not write in this margin

5. (*a*) If 32.0 g of oxygen contains L molecules of oxygen gas, O_2, write down, in terms of L, **the number of**

(i) sulphur atoms, S, in 32.0 g of sulphur,

.....

(ii) sulphur dioxide molecules, SO_2, in 32.0 g of sulphur dioxide,

.....

.....

(iii) sulphate ions, SO_4^{2-}, in 32.0 g of sulphate ions.

.....

.....

(5 marks)

(*b*) A crystal of urea, $CO(NH_2)_2$, has a mass of 0.6 g.

(i) Calculate the relative molecular mass of urea.

.....

.....

(ii) How many moles of urea molecules are present in the 0.6 g crystal?

.....

.....

(iii) L is known as the Avogadro constant and it has a numerical value of 6.0×10^{23}. How many molecules of urea are present in the crystal?

.....

.....

.....

(5 marks)

6. (*a*) Complete the following table.

Class of compound	Named example	Structural formula of named example
Alkene		
Alcohol		
Carboxylic acid		

(3 marks)

(*b*) Alkenes can undergo *addition polymerization*.

(i) Explain what is meant by the words in italics.

.....

.....

.....

(ii) Write an equation to illustrate this process, using an appropriate substance.

.....

.....

(iii) State the conditions necessary for the reaction to take place.

.....

.....

(iv) State ONE important difference in physical property between the alkene and its addition polymer.

.....

.....

(4 marks)

(*c*) The reversible reaction between an alcohol and a carboxylic acid produces an equilibrium mixture containing an ester and water.

(i) Write an equation to illustrate such a reaction, using appropriate substances.

.....

.....

(ii) How might the reaction be made to reach equilibrium more quickly?

.....

(iii) How might the proportion of ester in the equilibrium mixture be increased?

.....

(3 marks)

SECTION B

Answer TWO questions in this section. Where appropriate, equations and diagrams should be given to clarify your answers.

This page may be detached. Write your answers on the lined paper which follows this section.

Useful data will be found on the front cover.

7. The following is a list of elements and compounds to be used in your answer to this question:

sodium chloride, magnesium, carbon (diamond).

(*a*) For each example show, with the aid of a diagram, the structure of the solid. Describe the bonding that is present, making clear the nature of the particles in the solid lattice and of the forces holding them together.

(*b*) For each example, give ONE physical property of the substance and explain how it is related to the structure and bonding that you have described in (*a*) above.

(*c*) Solid carbon dioxide has physical properties which are different from those of the three substances mentioned above. Explain this by referring to the structure of solid carbon dioxide.

(25 marks)

---

8. Describe in detail a simple laboratory experiment to show that each of the following statements is correct.

(*a*) Ammonia is *very* soluble in water and gives an alkaline solution.

(*b*) Chlorophyll is usually associated with an orange-coloured pigment in green plants.

(*c*) The reaction of sodium hydroxide with hydrochloric acid is exothermic.

(*d*) Copper(II) sulphate crystals give off water on heating, and this reaction is readily reversed.

For each experiment you should state clearly the conditions, any observations you would make during the experiment and, where appropriate, give a diagram of the apparatus you would use.

(25 marks)

---

9. The following are descriptions of the behaviour of three substances *A*, *C* and *E*.

(*a*) A white solid *A* gave a lilac flame test. When heated with excess dilute hydrochloric acid, the solid reacted to give *sulphur dioxide* and a colourless solution. When the colourless solution was evaporated to dryness, a white solid *B* remained.

(*b*) A black powder *C* dissolved in dilute nitric acid, without producing a gas, to form a blue solution *D*. When this solution was heated, water vapour was evolved and a blue solid remained. On stronger heating, the blue solid changed into a black powder and a mixture of *nitrogen dioxide* and oxygen was evolved.

(*c*) When metal *E* was heated in dry hydrogen chloride, *hydrogen* gas was evolved and a white solid *F* remained. When the same metal *E* was heated in dry chlorine, a dark red solid *G* was formed. *F* and *G* were dissolved separately in water and sodium hydroxide solution was added to each solution; *F* gave a green precipitate and *G* gave a brown precipitate.

Identify the substances *A*, *B*, *C*, *D*, *E*, *F* and *G* and give equations for all the reactions described.

Describe a test you would use to identify each of the three gases in italics in the descriptions above.

(25 marks)

---

10. Large quantities of ammonia and nitric acid are produced from atmospheric nitrogen for conversion into nitrogenous fertilizers.

(*a*) Describe how ammonia and nitric acid are manufactured, emphasizing chemical principles rather than technical details.

(*b*) Explain why nitrogen compounds are added to cultivated land.

(*c*) In terms of nitrogen content show, by calculation, which is the better fertilizer, sodium nitrate or ammonium sulphate.

(25 marks)

---

not write in
is margin

Question.....

Write on both sides of the paper.

Do not write in
this margin

o not write in
this margin

Question.....

Write on both sides of the paper.

Do not write
this margin

not write in
is margin

Question.....

Write on both sides of the paper.

Do not write in
this margin

Do not write in this margin

Question.....

Write on both sides of the paper.

Do not write in this margin

not write in
his margin

Question.....

Write on both sides of the paper.

Do not write i
this margin

o not write in
this margin

Question.....

Do not write
this margin

Do not write in this margin

Question.....

Do not write in this margin