



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CHEMISTRY

0620/02

Paper 2

May/June 2007

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, Candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may need to use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the periodic table is printed on page 16.

At the end of the examination, fasten all your work securely together.

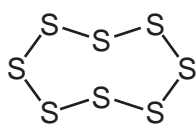
The number of marks is given in brackets [] at the end of each question or part question.

| For Examiner's Use | |
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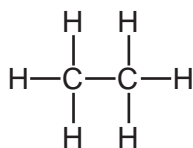
This document consists of **15** printed pages and **1** blank page.



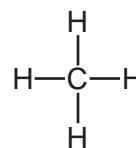
1 The structures of some elements and compounds are shown below.



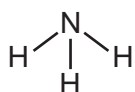
A



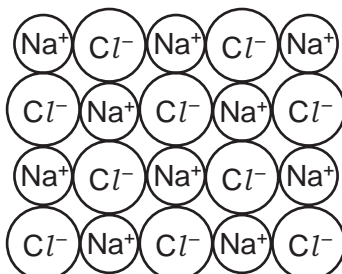
B



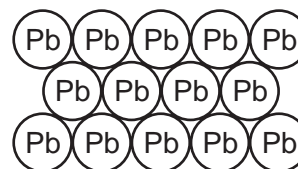
C



D



E



F

(a) Answer these questions using the letters **A** to **F**.

- (i) Which structure is ethane? [1]
- (ii) Which structure contains ions? [1]
- (iii) Which structure is a gas that turns moist red litmus paper blue? [1]
- (iv) Which structure is sodium chloride? [1]
- (v) Which structure is the main constituent of natural gas? [1]
- (vi) Which **two** structures are organic compounds? [1]
- (vii) Which **two** structures are elements? [1]

(b) Structure **F** is lead.

(i) What is the source of the small amount of lead present in the air?

..... [1]

(ii) State an adverse effect of lead on health.

..... [1]

(c) Structure **A** is sulphur. Explain why burning fossil fuels containing sulphur is harmful to the environment.

.....
..... [2]

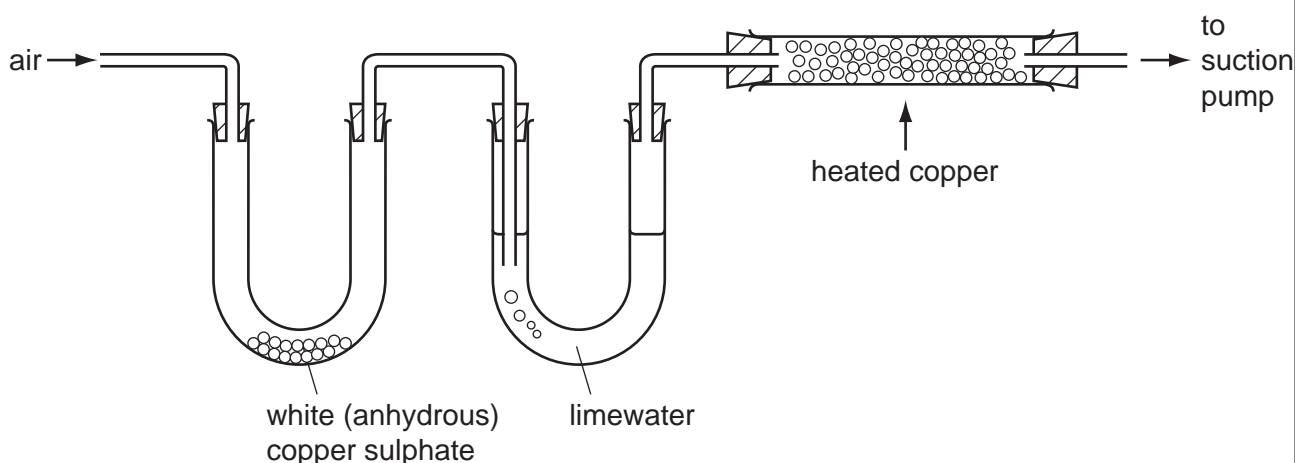
[Total: 11]

2 Clean air contains a number of different gases.

(a) State the names of the **two** gases which make up most of the air.

..... [2]

(b) A sample of air is drawn through the apparatus shown below.



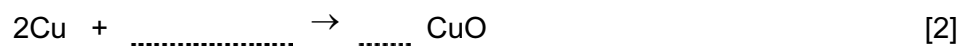
(i) When the air is drawn through the apparatus, the lime water turns milky. Which gas turns lime water milky?

..... [1]

(ii) The white (anhydrous) copper sulphate turns blue. State the name of the substance which turns white copper sulphate blue.

..... [1]

(iii) Oxygen is removed from the air by passing it over heated copper. Complete the equation for this reaction.



(c) Pure air contains about 1% argon.

(i) In which Period of the Periodic Table is argon?

..... [1]

(ii) State the **name** of the Group of elements to which argon belongs.

..... [1]

(iii) Draw the electronic structure of argon.

[1]

(iv) Why is argon used in lamps?

..... [1]

(v) An isotope of argon has a mass number of 40.
Calculate the number of neutrons in this isotope of argon.

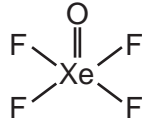
..... [1]

(d) A small amount of xenon is present in the air.
A few compounds of xenon have been made in recent years.

Calculate the relative molecular mass of xenon difluoride, XeF₂.

[1]

(e) The structure of another compound of xenon is shown below.



(i) Write the simplest formula for this compound of xenon.

..... [1]

(ii) Describe the type of bonding in this compound.

..... [1]

[Total: 14]

- 3 Hydrogen is a fuel which can be obtained from water by electrolysis.
Petrol is a fuel obtained by the fractional distillation of petroleum.

(a) (i) Complete the equation for the burning of hydrogen.



(ii) Suggest why hydrogen is a renewable source of energy.

..... [1]

(iii) When hydrogen is burnt, heat is given off. State the name of the type of reaction which gives off heat.

..... [1]

(b) Petrol is a mixture of alkanes.
One of the alkanes in petrol is octane, C_8H_{18} .

What products are formed when octane is completely burnt in air?

..... [2]

(c) Petrol is only one of the fractions obtained from the fractional distillation of petroleum. State the name of two **other** fractions obtained from the distillation of petroleum. Give a use for each of these fractions.

fraction

use

fraction

use [4]

(d) More petrol can be made by cracking less useful petroleum fractions.

(i) What do you understand by the term *cracking*?

..... [1]

(ii) State **two** conditions needed for cracking.

..... [2]

(iii) Alkenes can be formed by cracking. The simplest alkene is ethene.
Draw a diagram to show the structure of ethene.
Show all atoms and bonds.

[1]

[Total: 13]

4 Catalysts are often used in industry.

(a) (i) What do you understand by the term *catalyst*?

..... [1]

(ii) Which type of metals often act as catalysts?

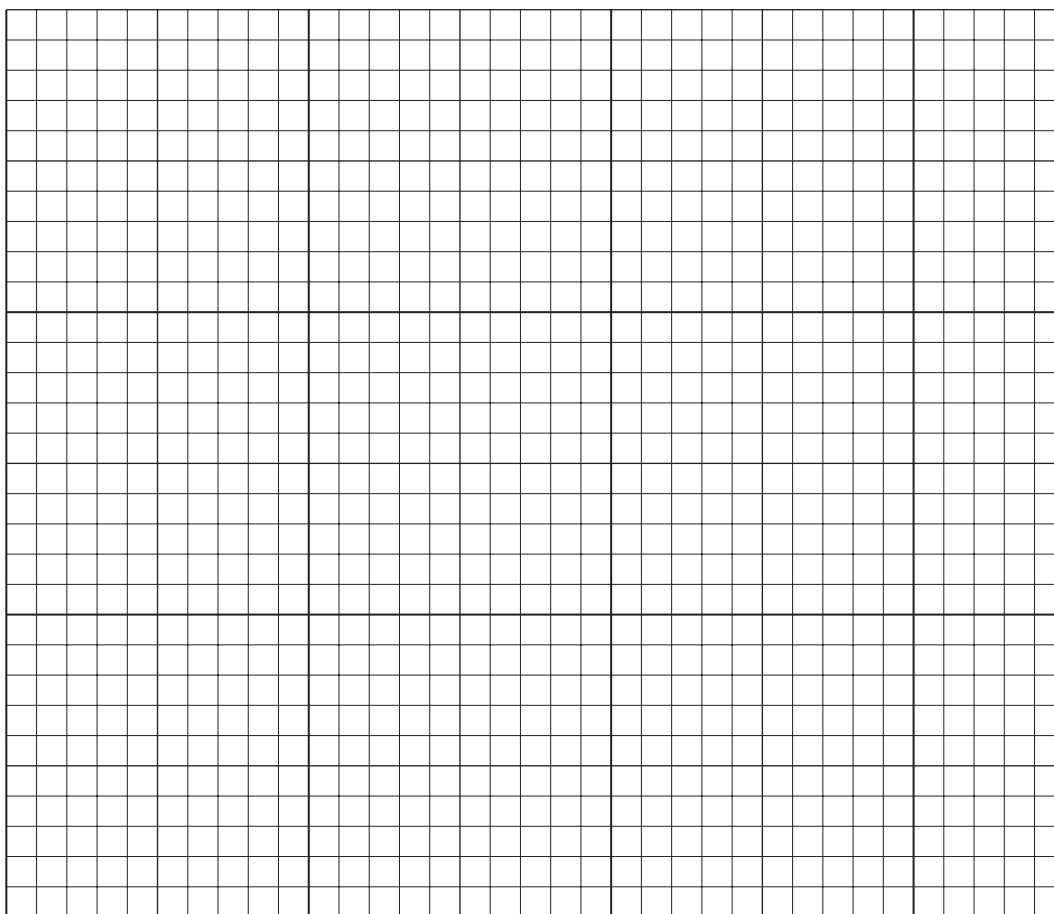
..... [1]

(b) A student measured the volume of hydrogen gas produced when a few large pieces of zinc reacted with hydrochloric acid of concentration 2.0 mol/dm^3 . The hydrochloric acid was in excess.

The results are given in the table.

| | | | | | | | |
|------------------------------------|---|----|----|----|-----|-----|-----|
| time / minutes | 0 | 10 | 20 | 30 | 40 | 50 | 60 |
| volume of hydrogen / cm^3 | 0 | 27 | 54 | 81 | 100 | 110 | 110 |

(i) Plot a graph of volume of hydrogen against time on the axes below. Label the axes.



[4]

(ii) Copper ions catalyse the reaction between zinc and hydrochloric acid.
On the axes above, sketch the line you would expect for the catalysed reaction.
Label this line **C**. [2]

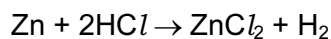
(iii) Explain why no more hydrogen is given off after 50 minutes.
..... [1]

(c) What would happen to the speed of the reaction if

(i) small pieces of zinc were used instead of large pieces,
..... [1]

(ii) the concentration of hydrochloric acid was 1.0 mol/dm^3 ?
..... [1]

(d) The equation for this reaction is



(i) State the name of the salt formed in this reaction.
..... [1]

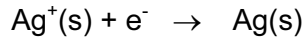
(ii) Describe a test for hydrogen.

test
result [2]

[Total: 14]

5 Some sunglasses are made from glass which darkens in bright sunlight. The glass contains tiny crystals of silver chloride and copper(I) chloride.

(a) In bright sunlight, in the presence of copper(I) chloride, the silver chloride breaks down to solid silver which darkens the glass.



State the name of the particle with the symbol e⁻.

..... [1]

(b) Silver is a metal. State **two** physical properties which are characteristic of all metals.

.....
..... [2]

(c) In bright sunlight, the copper(I) chloride in the sunglasses is converted to copper(II) chloride.

What do the roman numerals (I) and (II) show in these copper compounds?
Tick one box.

the number of atoms of copper in the copper compounds

the number of neutrons in the copper compounds

whether the copper is in the solid, liquid or gaseous state

the oxidation state of the copper in the copper compounds

[1]

(d) Describe a test for aqueous copper(II) ions.

test

result

..... [3]

(e) Give a common use of copper.

..... [1]

[Total: 8]

6 The halogens are a group of elements showing trends in colour, state and reaction with other halide ions.

(a) Complete the word equation for the reaction of chlorine with aqueous potassium bromide.

chlorine + potassium bromide → + [2]

(b) Explain why an aqueous solution of iodine does not react with potassium chloride.

..... [1]

(c) The table shows the properties of some halogens.

| halogen | state at room temperature | colour | boiling point / °C | density of solid / g cm ⁻³ |
|----------|---------------------------|-----------|--------------------|---------------------------------------|
| fluorine | gas | yellow | | 1.51 |
| chlorine | | green | -35 | 1.56 |
| bromine | liquid | red-brown | 59 | |
| iodine | solid | | 184 | 4.93 |

(i) Complete the missing spaces in the table. [2]

(ii) Suggest values for

the boiling point of fluorine,

the density of bromine. [2]

(d) How many electrons does an atom of fluorine have

(i) in total,

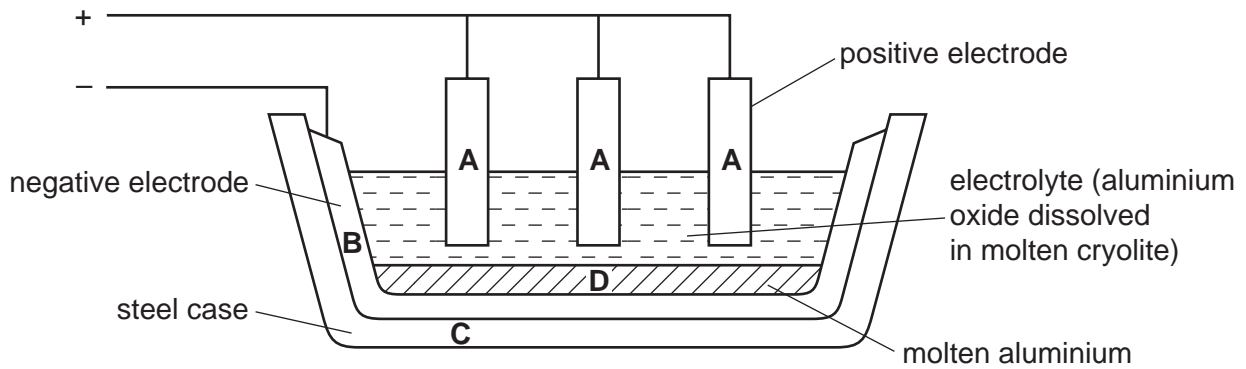
(ii) in its outer shell? [2]

(e) State a use for chlorine.

..... [1]

[Total: 10]

7 Aluminium is extracted by the electrolysis of aluminium oxide dissolved in cryolite.



(a) What information in the diagram shows that aluminium is more dense than the electrolyte? [1]

.....

(b) What form of carbon is used for the electrodes in this electrolysis? [1]

.....

(c) Which letter in the diagram, A, B, C or D, represents the anode? [1]

.....

(d) Suggest why electrolysis is used to extract aluminium rather than reduction using carbon. [1]

.....

(e) Oxygen gas is released at the anode.

(i) Where does this oxygen come from? [1]

.....

(ii) The oxygen reacts with the carbon anode to form carbon dioxide. What is the formula of carbon dioxide? [1]

.....

(iii) Why does the anode decrease in size during electrolysis? [1]

.....

- (f) Each electrolysis cell makes 212 kg of aluminium per day from 400 kg of aluminium oxide.
Calculate how much aluminium can be made from 1 tonne (1000 kg) of aluminium oxide.

[1]

- (g) Complete the following sentences about the electrolysis of aluminium oxide using words from the following list.

atoms gaseous molten solid ions molecules

Aluminium oxide conducts electricity when it is because it
contains which are free to move.

[2]

[Total: 10]

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DATA SHEET
The Periodic Table of the Elements

| | | Group | | | | | | | | | | | | |
|-----------------------------------|------------------------------------|------------------------------------|--|-------------------------------------|--------------------------------------|-------------------------------------|------------------------------------|--------------------------------------|--------------------------------------|-----------------------------------|------------------------------------|------------------------------------|-------------------------------------|------------------------------------|
| I | II | III | IV | V | VI | VII | 0 | | | | | 0 | | |
| | | 1 H Hydrogen 1 | | | | | | | | | | | 4 He Helium 2 | |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | | | | | | | | | | | 20 Ne Neon 10 | | |
| 23 Na Sodium 11 | 24 Mg Magnesium 12 | 5 B Boron 5 | 11 Al Aluminium 13 | 12 C Carbon 6 | 14 N Nitrogen 7 | 16 O Oxygen 8 | 19 F Fluorine 9 | 35.5 Cl Chlorine 17 | 40 Ar Argon 18 | | | | | |
| 39 K Potassium 19 | 40 Ca Calcium 20 | 27 Al Aluminium 13 | 28 Si Silicon 14 | 70 Ga Gallium 31 | 73 Ge Germanium 32 | 75 As Arsenic 33 | 79 Se Selenium 34 | 80 Br Bromine 35 | 84 Kr Krypton 36 | | | | | |
| 85 Rb Rubidium 37 | 88 Sr Strontium 38 | 56 Fe Iron 26 | 55 Mn Manganese 25 | 59 Co Cobalt 27 | 59 Ni Nickel 28 | 64 Cu Copper 29 | 65 Zn Zinc 30 | 112 Cd Cadmium 48 | 115 In Indium 49 | 119 Sn Tin 50 | 122 Sb Antimony 51 | 127 I Iodine 53 | 131 Xe Xenon 54 | |
| 133 Cs Caesium 55 | 137 Ba Barium 56 | 91 Zr Zirconium 40 | 93 Nb Niobium 41 | 96 Mo Molybdenum 42 | 101 Ru Ruthenium 44 | 106 Pd Palladium 46 | 108 Ag Silver 47 | 201 Hg Mercury 80 | 204 Tl Thallium 81 | 207 Pb Lead 82 | 209 Bi Bismuth 83 | 210 Po Polonium 84 | 222 Rn Radon 86 | |
| 226 Ra Radium 88 | 227 Ac Actinium 89 | 140 Ce Cerium 58 | 141 Pr Praseodymium 59 | 144 Nd Neodymium 60 | 146 Pm Promethium 61 | 150 Sm Samarium 62 | 152 Eu Europium 63 | 157 Gd Gadolinium 64 | 162 Dy Dysprosium 66 | 165 Ho Holmium 67 | 167 Er Erbium 68 | 169 Tm Thulium 69 | 173 Yb Ytterbium 70 | 175 Lu Lutetium 71 |
| | | 232 Th Thorium 90 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 | 238 U Uranium 92 |

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

| | |
|---|----------|
| a | X |
| b | |

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).