

Centre Number	Candidate Number	Name
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CHEMISTRY

5070/02

Paper 2 Theory

May/June 2006

1 hour 30 minutes

Candidates answer on the Question Paper.
Additional Materials: Answer Booklet/Paper

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the work you hand in.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B

Answer any **three** questions.
Write your answers on any lined pages and/or separate answer paper.
You may use a calculator.
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	
Section A	
B8	
B9	
B10	
B11	
Total	

Section A

Answer **all** the questions in this section in the spaces provided.

The total mark for this section is 45.

A1 Choose from the following elements to answer the questions below.

aluminium

argon

iron

nickel

nitrogen

phosphorus

sodium

Each element can be used once, more than once or not at all.

Name an element which

(a) is used as a catalyst in the hydrogenation of alkenes,

..... [1]

(b) is manufactured by electrolysis,

..... [1]

(c) reacts with oxygen to give an acidic oxide,

..... [1]

(d) forms an ion that carries a negative charge,

..... [1]

(e) reacts with chlorine to form a solid that dissolves in water to give a coloured solution.

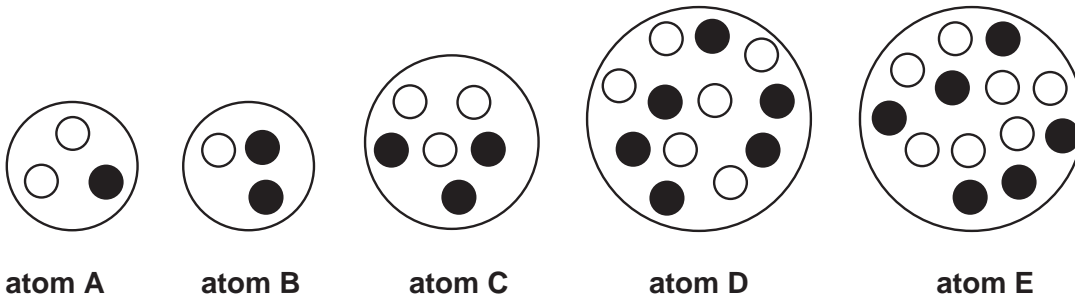
..... [1]

A2 The diagram shows the nuclei of five different atoms.

key

○ neutron

● proton



(a) Which atom has an atomic number of 3?

..... [1]

(b) Which atom has a mass number of 6?

..... [1]

(c) Which **two** atoms are isotopes of the same element?

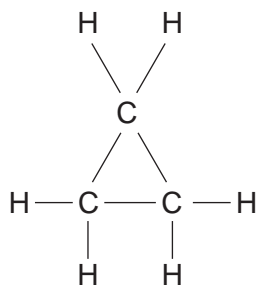
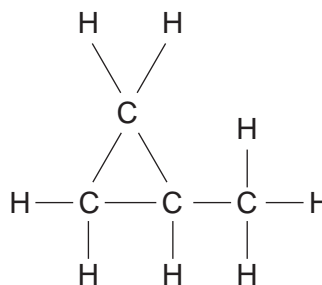
..... and [1]

(d) Complete the table below to show the number of sub-atomic particles in both an atom and an ion of potassium.

	potassium atom ${}^{39}_{19}\text{K}$	potassium ion ${}^{39}_{19}\text{K}^+$
number of protons		
number of electrons		
number of neutrons		

[2]

- A3** The structures shown below are of the first two members of an homologous series known as the cyclopropanes.

compound **D**compound **E**

Members of an homologous series have a general formula.

- (a) (i)** State **one other** characteristic of an homologous series.

..... [1]

- (ii)** Deduce the general formula for the cyclopropane homologous series.

..... [1]

- (b)** Cyclopropanes react in a similar way to alkanes such as methane.

- (i)** Write a chemical equation for the complete combustion of compound **D**.

..... [2]

- (ii)** Suggest the **type** of reaction by which compound **D** reacts with chlorine.

..... [1]

- (c)** Name and draw the structure of an alkene that is an isomer of compound **D**.

name

structure

[2]

A4 This question is about calcium compounds.

(a) Write the equation for the thermal decomposition of calcium carbonate. One of the products of this reaction is calcium oxide.

..... [1]

(b) When water is added to calcium oxide, calcium hydroxide is formed.

(i) Write the equation for the reaction between water and calcium oxide.

..... [1]

(ii) Solid calcium hydroxide reacts slowly with carbon dioxide. Name the calcium containing product of this reaction.

..... [1]

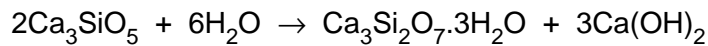
(c) State one large scale use of calcium hydroxide.

..... [1]

(d) Cement is made by heating calcium carbonate and clay together at a very high temperature.

One of the compounds produced is a form of calcium silicate, Ca_3SiO_5 .

In the presence of water a chemical reaction takes place that helps in the setting of cement.



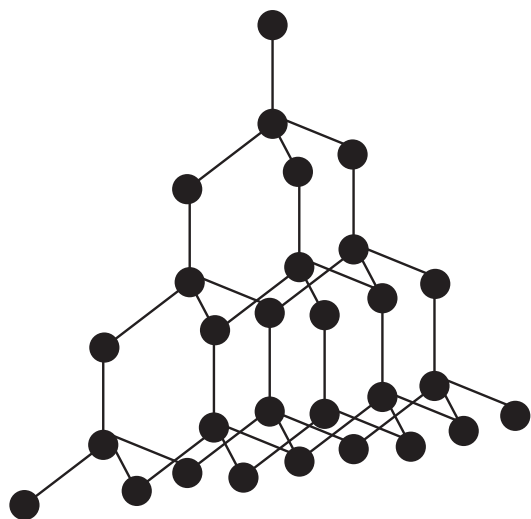
Calculate the mass of calcium hydroxide formed from 912 g of Ca_3SiO_5 .

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

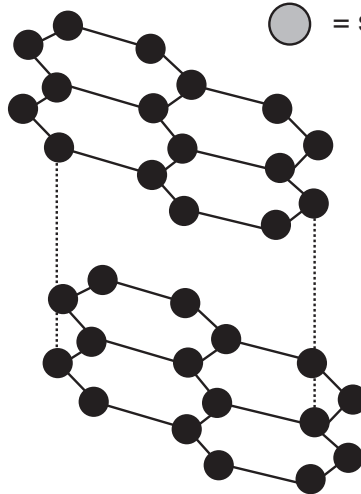
A5 The structures of diamond, graphite and silicon carbide are shown below.

● = carbon atom

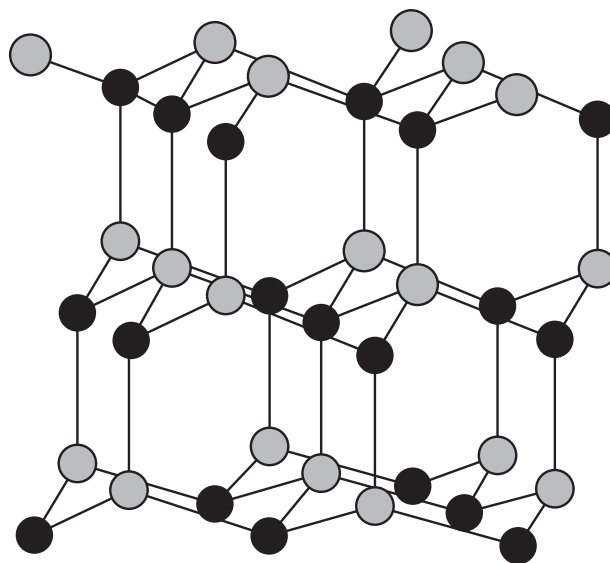
○ = silicon atom



diamond



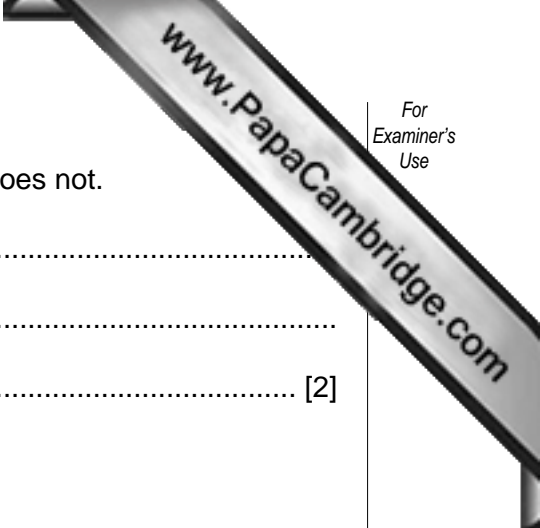
graphite



silicon carbide

(a) Suggest the formula for silicon carbide.

..... [1]



(b) Explain why graphite conducts electricity but silicon carbide does not.

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

(c) Silicon carbide has a very high melting point.

(i) Explain why silicon carbide has a very high melting point.

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

(ii) Suggest why the melting point of diamond is higher than that of silicon carbide.

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

(d) When a 1.20 g sample of **graphite** is completely burnt in oxygen, 4.40 g of carbon dioxide are produced. What mass of carbon dioxide is made when a 1.20 g sample of **diamond** is completely burnt in oxygen?

mass of carbon dioxide g [1]

A6 Lithium is in Group I of the Periodic Table.

Lithium reacts with water to form lithium hydroxide and hydrogen.

(a) Describe what you would observe when a small piece of lithium is dropped onto the surface of cold water.

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

(b) Write the equation for the reaction between lithium and water.

..... [1]

(c) When lithium reacts with water, lithium ions, Li⁺, are formed.



Explain why the formation of a lithium ion from a lithium atom is an example of oxidation.

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

(d) Rubidium, Rb, is another element in Group I.

Predict what you would observe when a small piece of rubidium is dropped onto cold water.

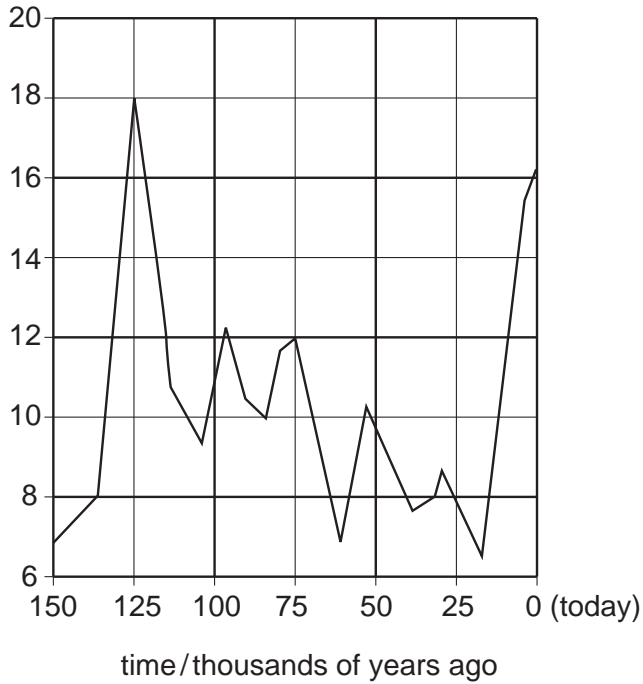
.....
.....
..... [2]

A7 Graph 1 shows how the average temperature at the Earth's surface may have changed over the last 150 thousand years.

Graph 2 shows how the percentage of carbon dioxide in the atmosphere may have changed over the last 150 thousand years.

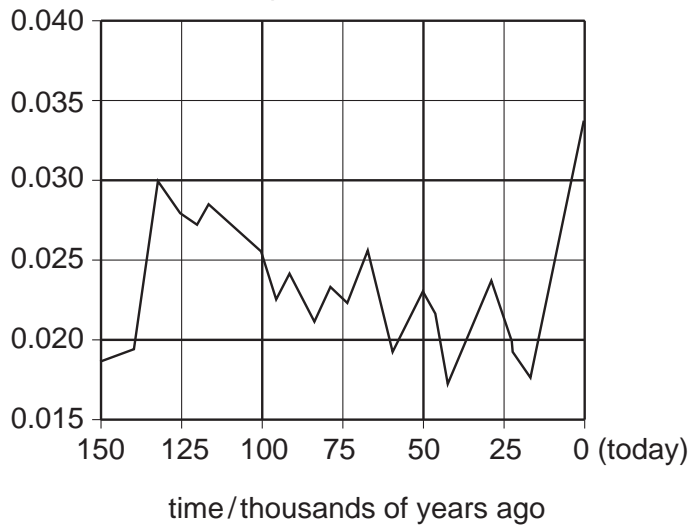
Graph 1

average
temperature at the Earth's
surface / °C



Graph 2

percentage of carbon
dioxide in the
atmosphere



(a) Carbon dioxide is a greenhouse gas. Scientists think that an increase in the greenhouse gases will result in global warming.

(i) Explain how graphs 1 and 2 support this statement.

.....

..... [1]

(ii) Describe **two** consequences of global warming.

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

(b) Draw a 'dot and cross' diagram for carbon dioxide. Show the outer shell electrons only.

[2]

(c) Chlorofluorocarbons, CFCs, are also greenhouse gases.

(i) Name **one** other greenhouse gas found in the atmosphere.

..... [1]

(ii) State the origin of this greenhouse gas, named in part (i).

.....[1]

(iii) Describe how the presence of CFCs in the upper atmosphere increases the amount of ultra-violet light reaching the Earth's surface.

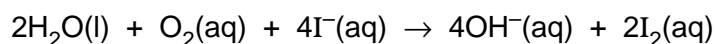
.....
.....
..... [2]

Section B

Answer **three** questions from this section.
The total mark for this section is 30.

B8 River water contains many substances including minerals, dissolved oxygen, organic material, nitrates and phosphates.

- (a) Give one source of phosphates in water. [1]
- (b) Excess dissolved phosphates in river water cause *eutrophication*. Describe the process of eutrophication. [3]
- (c) (i) Describe a chemical test to show the presence of the nitrate ion. [2]
(ii) Suggest why it might be difficult to test for the presence of the nitrate ion in a sample of river water. [1]
- (d) The concentration of dissolved oxygen in river water can be determined by a series of reactions that is summarised by the equation below.



When a 2000 cm³ sample of river water was tested, 0.508 g of iodine was liberated.

Calculate the concentration, in mol/dm³, of dissolved oxygen in the river water sample. [3]

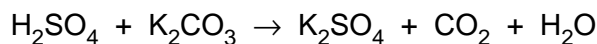
B9 Fertilisers are soluble salts containing one or more of the essential elements required for plant growth.

- (a) Ammonium chloride can be prepared by the reaction between aqueous ammonia and hydrochloric acid.

Write an **ionic** equation for this reaction. [1]

- (b) State suitable reagents and outline the experimental procedure by which a pure sample of the fertiliser potassium chloride could be prepared in the laboratory. [4]

- (c) Potassium sulphate can be prepared by the reaction between dilute sulphuric acid and potassium carbonate.



Calculate the mass of potassium sulphate that can be prepared from 3.45 g of potassium carbonate. [3]

- (d) Give electronic structures, including the charges, of the ions present in potassium chloride. [2]

B10 Brass is an alloy containing zinc and copper.

- (a) Explain why the physical properties of brass are different from those of zinc and copper.
- (b) A sample of powdered brass is added to excess dilute nitric acid.

The mixture is heated gently until all the brass reacts.

The resulting solution, **A**, contains aqueous copper(II) ions and aqueous zinc ions.

- (i) Suggest the colour of solution **A**. [1]
- (ii) Describe and explain, with the aid of equations, what happens when aqueous sodium hydroxide is slowly added to solution **A**. [5]
- (c) Another sample of powdered brass is added to excess dilute hydrochloric acid.

The mixture is heated and an aqueous solution of a compound **B** together with a solid **C** are formed.

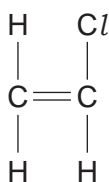
- (i) Name both **B** and **C**. [2]
- (ii) Write an ionic equation for this reaction. [1]

B11 Macromolecules are large molecules built up from many small units.

Proteins and fats are natural macromolecules.

Poly(chloroethene) and poly(ethene) are synthetic macromolecules.

- (a) Name the type of linkage joining the units in fats. [1]
- (b) Proteins can be hydrolysed into monomers by boiling with concentrated hydrochloric acid.
- (i) Name the monomers produced in this hydrolysis. [1]
- (ii) Suggest why clothes made from nylon are damaged by concentrated hydrochloric acid. [1]
- (c) Poly(chloroethene) is made from the monomer chloroethene. The structure of chloroethene is shown below.



- (i) Draw the structure of poly(chloroethene). [1]
- (ii) Explain why poly(chloroethene) has a low melting point. [1]
- (iii) Describe what you would observe when bromine reacts with chloroethene and state what type of reaction takes place.
- Explain why bromine will **not** readily react with poly(chloroethene). [3]
- (d) State and explain why plastics such as poly(ethene) may cause problems of pollution. [2]

A series of horizontal dotted lines for writing, spanning the width of the page.

DATA SHEET
The Periodic Table of the Elements

		Group															
		I	II	III	IV	V	VI	VII	VIII	IX	X						
7 Li Lithium	9 Be Beryllium	<table border="1" style="margin: auto;"> <tr> <td style="width: 20px; height: 20px;">1</td> <td style="width: 20px; height: 20px;">H Hydrogen</td> </tr> </table>										1	H Hydrogen				
1	H Hydrogen																
23 Na Sodium	24 Mg Magnesium																
39 K Potassium	40 Ca Calcium	11 B Boron	12 C Carbon	13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulphur	17 Cl Chlorine	18 Ar Argon								
85 Rb Rubidium	88 Sr Strontium	55 Mn Manganese	56 Fe Iron	59 Co Cobalt	64 Cu Copper	65 Zn Zinc	70 Ga Gallium	73 Ge Germanium	75 As Arsenic	79 Se Selenium	80 Br Bromine	84 Kr Krypton					
133 Cs Caesium	137 Ba Barium	91 Ti Titanium	92 V Vanadium	93 Nb Niobium	94 Zr Zirconium	96 Cr Chromium	101 Ru Ruthenium	103 Rh Rhodium	106 Pd Palladium	108 Ag Silver	112 Cd Cadmium	115 In Indium	119 Sn Tin	122 Sb Antimony	127 I Iodine	128 Te Tellurium	131 Xe Xenon
226 Fr Francium	227 Ra Radium	140 Ce Cerium	141 Pr Praseodymium	144 Nd Neodymium	145 Pm Promethium	150 Sm Samarium	152 Eu Europium	157 Gd Gadolinium	162 Dy Dysprosium	165 Ho Holmium	167 Er Erbium	169 Tm Thulium	173 Yb Ytterbium	175 Lu Lutetium			
232 Th Thorium	238 U Uranium	89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium	

8-71 Lanthanoid series
0-103 Actinoid series

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.).