

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	

This document consists of **14** printed pages and **2** lined pages.



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.

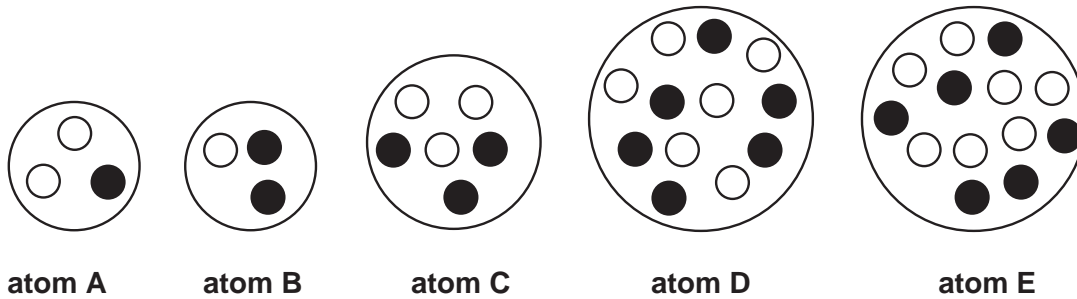
..... [1]

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?

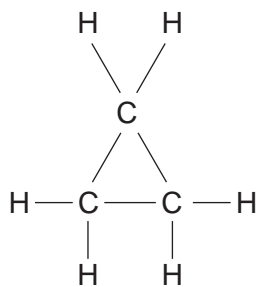
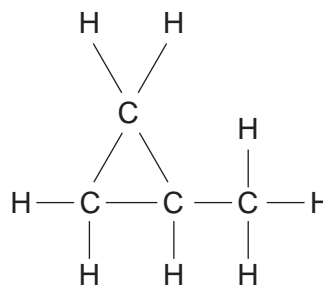
..... and [1]

(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]

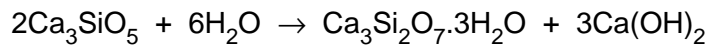
(c) State one large scale use of calcium hydroxide.

..... [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 .

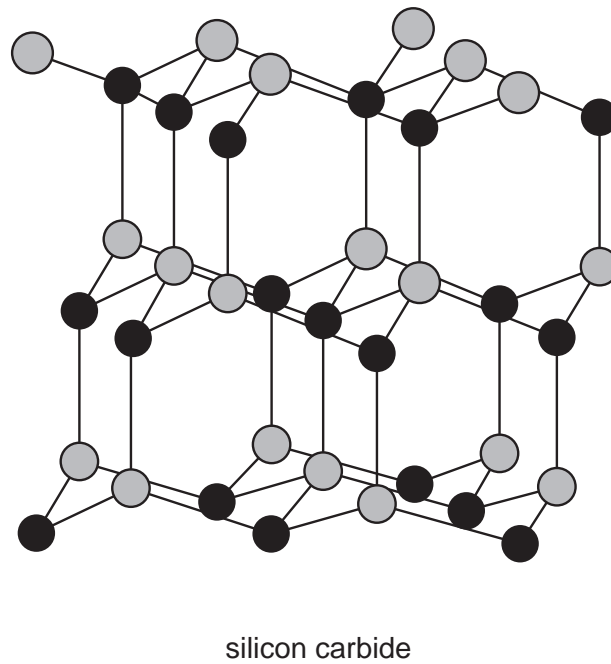
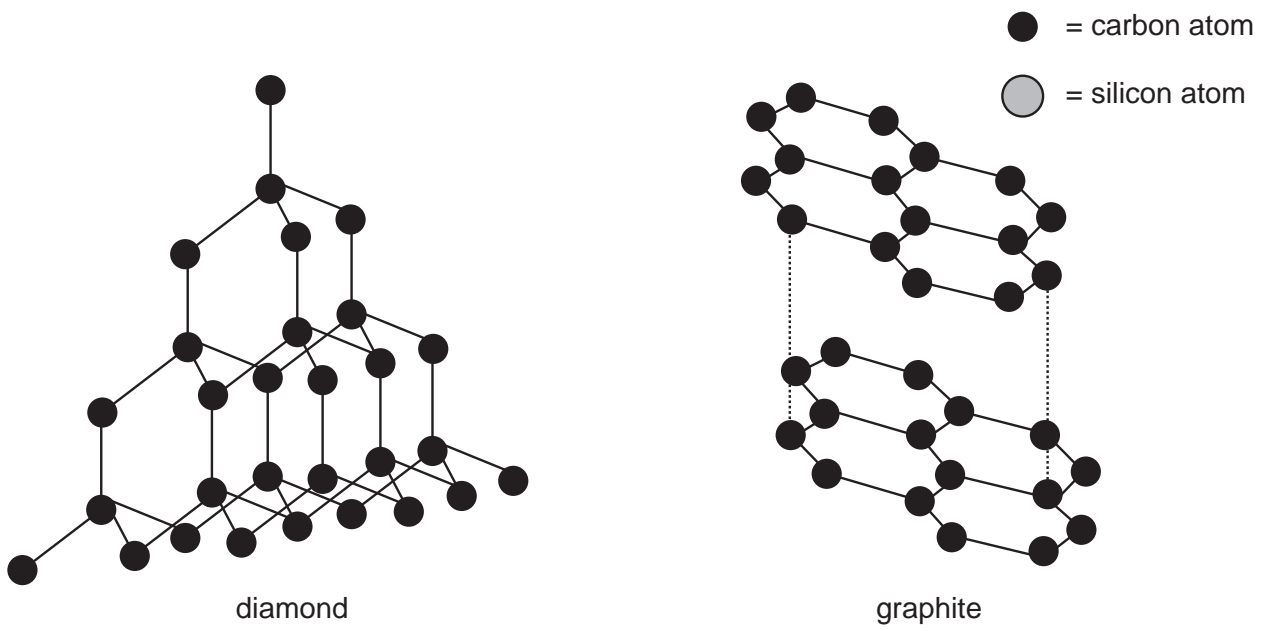
In the presence of water a chemical reaction takes place that helps in the setting of cement.



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.



(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.

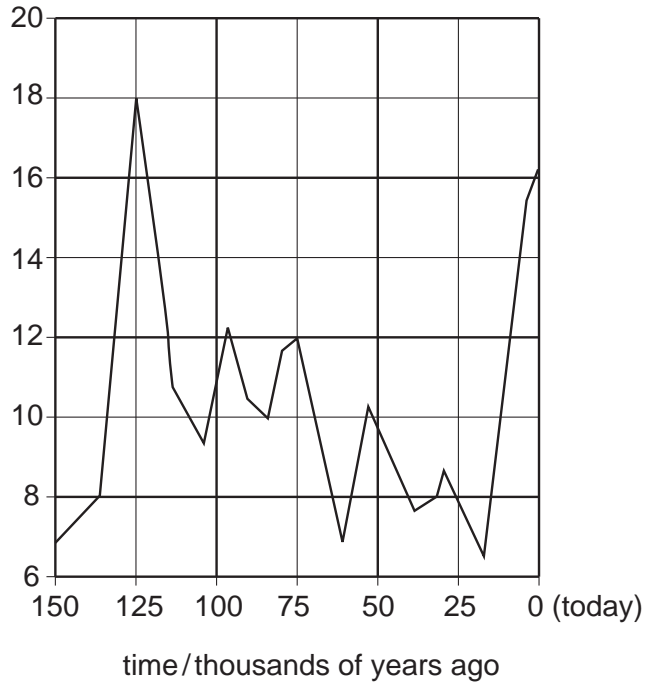
.....
.....
..... [2]

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.

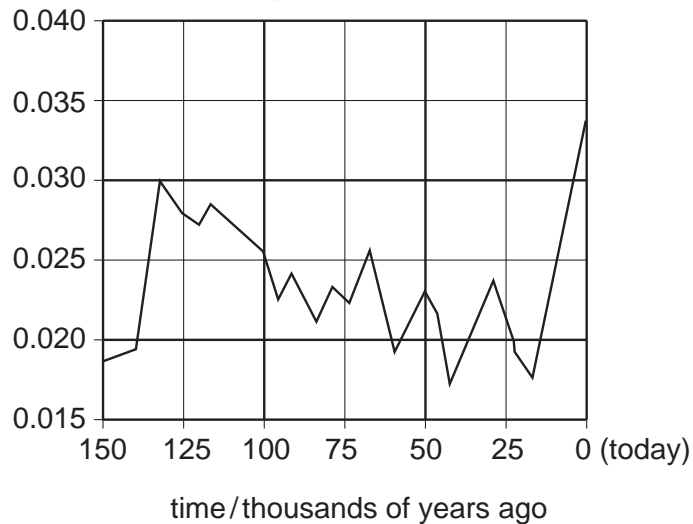
Graph 1

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.

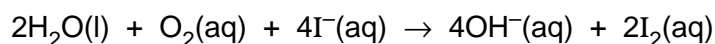
(a) Give one source of phosphates in water. [1]

(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]

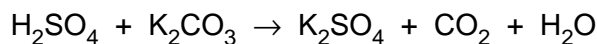
B9 Fertilisers are soluble salts containing one or more of the essential elements required for plant growth.

(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. [1]

(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]

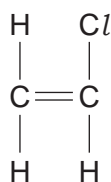
(ii) Write an ionic equation for this reaction. [1]

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]

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DATA SHEET
The Periodic Table of the Elements

		Group																																																																																																												
I	II	III	IV	V	VI	VII	O																																																																																																							
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10	18 Ar Argon 18	19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	58 Pr Praseodymium 58	59 Ce Cerium 59	60 Nd Neodymium 60	61 Pm Promethium 61	62 Sm Samarium 62	63 Eu Europium 63	64 Gd Gadolinium 64	65 Tb Terbium 65	66 Dy Dysprosium 66	67 Ho Holmium 67	68 Er Erbium 68	69 Tm Thulium 69	70 Yb Ytterbium 70	71 Lu Lutetium 71	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	104 Rf Rutherfordium 104	105 Db Dubnium 105	106 Sg Seaborgium 106	107 Bh Bohrium 107	108 Hs Hassium 108	109 Mt Meitnerium 109	110 Ds Darmstadtium 110	111 Rg Roentgenium 111	112 Cn Copernicium 112	113 Nh Nihonium 113	114 Fl Flerovium 114	115 Mc Moscovium 115	116 Lv Livermorium 116	117 Ts Tennessine 117	118 Og Oganesson 118

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

Key

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

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