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Centre Number	Candidate Number	Name

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.

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Section A	
B8	
B9	
B10	
B11	
Total	

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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]

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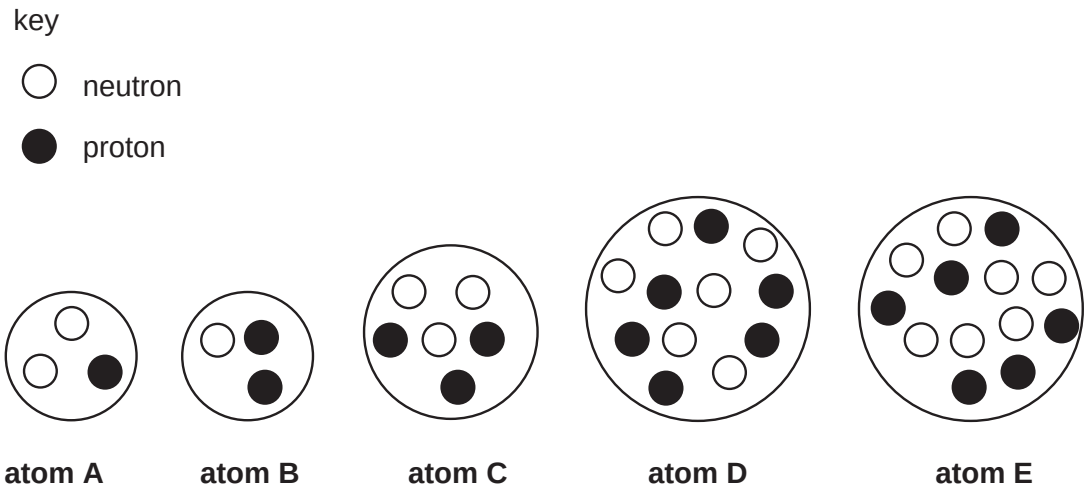
A2 The diagram shows the nuclei of five different atoms.



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

[2]

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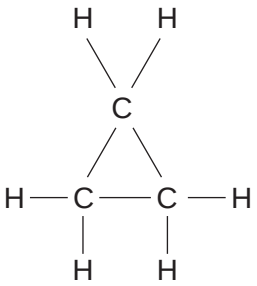
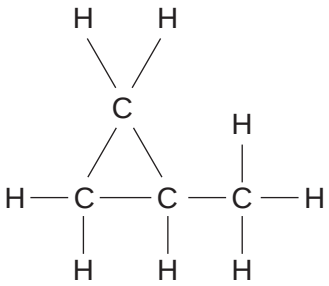
A3 The structures shown below are of the first two members of an homologous series known as the cyclopropanes.



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]

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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.

$$2Ca_3SiO_5 + 6H_2O \rightarrow Ca_3Si_2O_7.3H_2O + 3Ca(OH)_2$$

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

.....

.....

.....

.....

..... [3]

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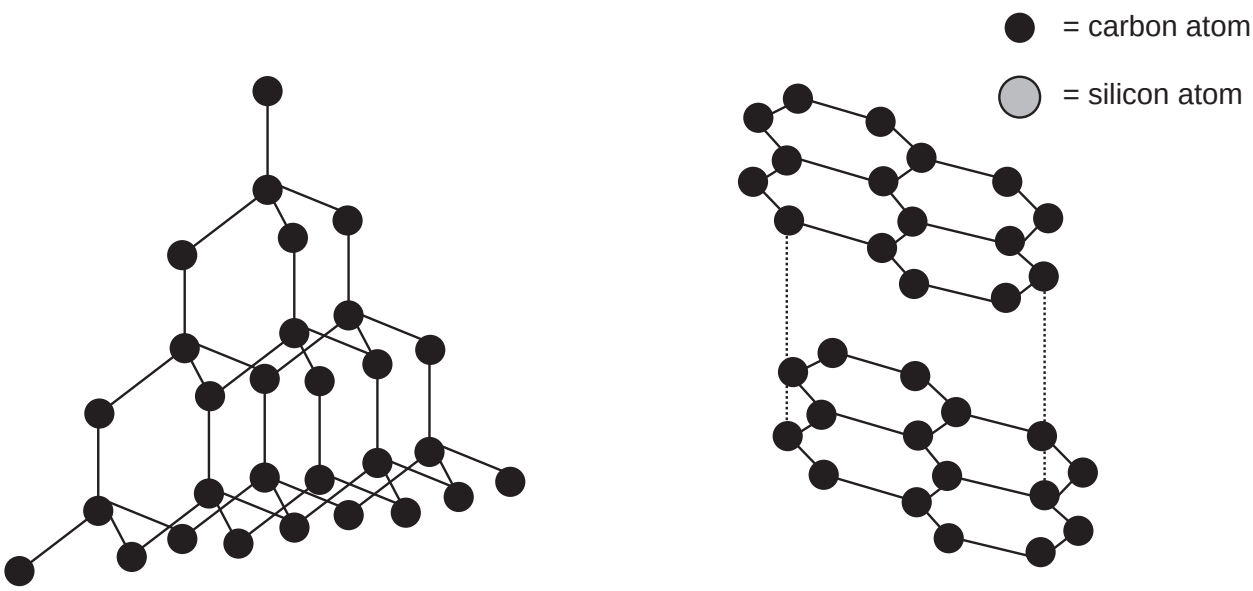
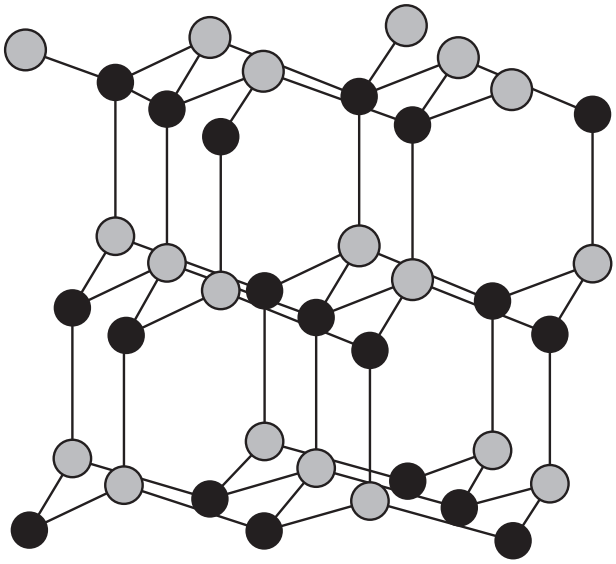
A5 The structures of diamond, graphite and silicon carbide are shown below.



diamond

graphite



silicon carbide

(a) Suggest the formula for silicon carbide.

..... [1]

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(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]

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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.

$$Li \rightarrow Li^+ + e^-$$

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]

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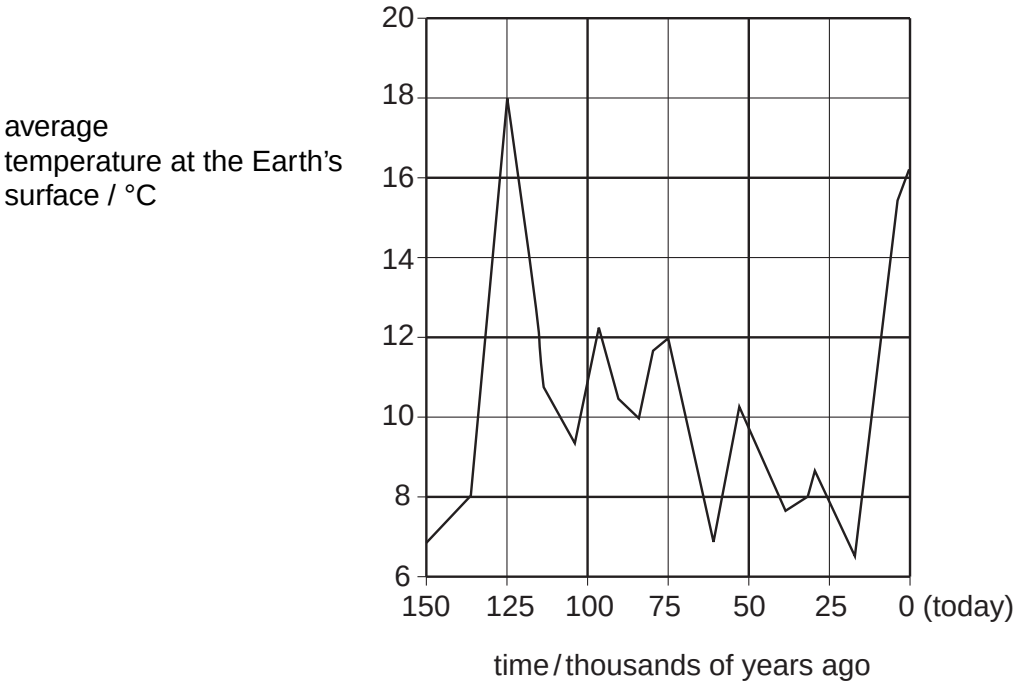
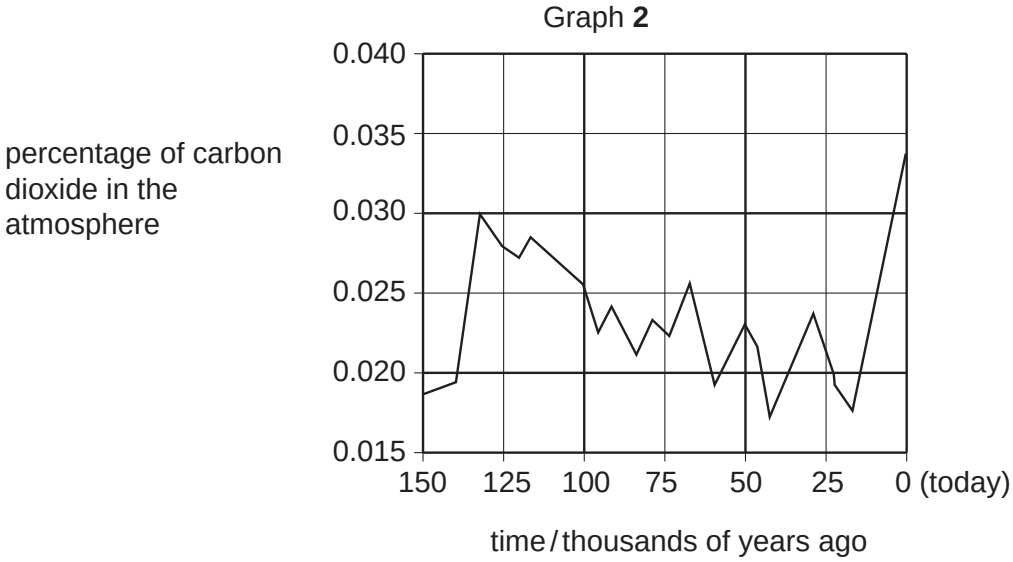
A7 Graph **1** shows how the average temperature at the Earth's surface may have changed over the last 150 thousand years.

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

Graph **1**



Graph **2**



(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]

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(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]

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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.

$$2H_2O(l) + O_2(aq) + 4I^-(aq) \rightarrow 4OH^-(aq) + 2I_2(aq)$$

When a 2000 cm^3 sample of river water was tested, 0.508 g of iodine was liberated.

Calculate the concentration, in mol/dm^3, 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.

$$H_2SO_4 + K_2CO_3 \rightarrow K_2SO_4 + CO_2 + H_2O$$

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]

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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]

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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.

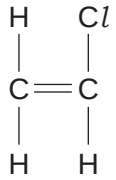
(a) Name the type of linkage joining the units in fats. [1]

(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	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	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	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	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	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

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

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

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