Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CHEMISTRY **0620/02**

Paper 2

May/June 2004

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 on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is printed on page 16.

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

For Examiner's Use	
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3	
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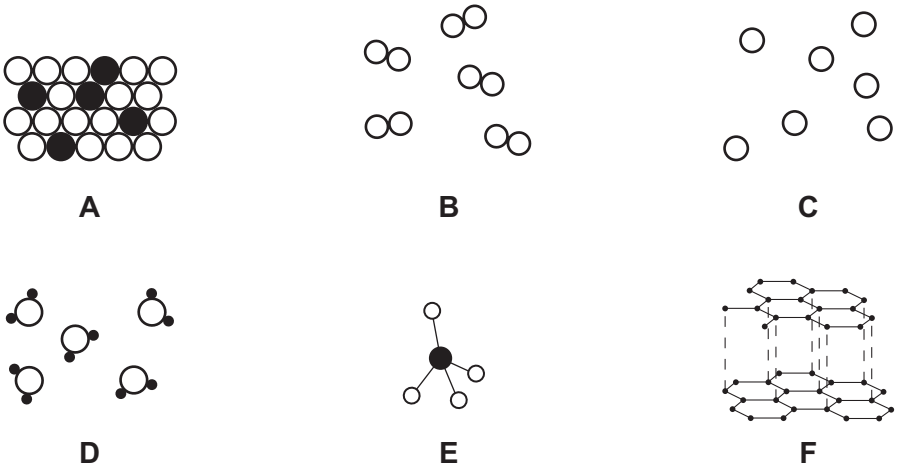
6	
Total	

This document consists of **16** printed pages.

1 The diagram shows models of various structures,



(a) Which **three** of the structures **A** to **F** represent elements? Give a reason for your answer.

structures .....

reason ..... [2]

(b) Which one of the structures **A** to **F** represents a gas containing single atoms?

..... [1]

(c) **(i)** Which one of the structures **A** to **F** represents a gas containing diatomic molecules?

.....

(ii) State the name of a gas which has diatomic molecules.

..... [2]

(d) **(i)** Which one of the structures **A** to **F** represents graphite?

.....

(ii) State **one** use of graphite.

..... [2]

(e) Structure **D** represents a compound.

(i) State what is meant by the term *compound*.

.....

.....

(ii) Which one of the following substances is structure **E** most likely to represent?

Put a ring around the correct answer.

ammonia **hydrogen chloride** **methane** **water** [2]

(f) Hydrogen chloride is a compound.

(i) Draw a diagram to show how the electrons are arranged in a molecule of hydrogen chloride.

Show only the outer electrons.

show hydrogen electrons as •
show chlorine electrons as x

..... [2]

(ii) State the name of the type of bonding present in hydrogen chloride.

..... [1]

(iii) Hydrogen chloride dissolves in water to form an acidic solution (hydrochloric acid). Describe how you would use litmus paper to show that this solution is acidic.

.....

..... [2]

(iv) Which one of the following values is most likely to represent the pH of a dilute solution of hydrochloric acid?

Put a ring around the correct answer.

pH 2 **pH7** **pH10** **pH14** [1]

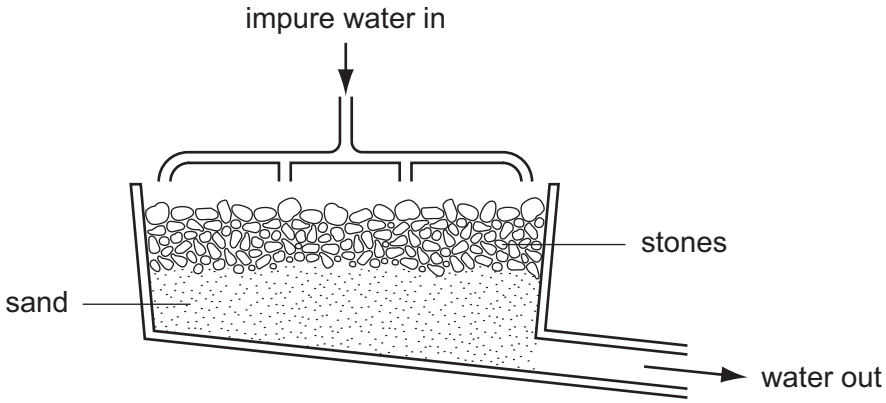
(v) Complete the following equation for the reaction of hydrochloric acid and magnesium.

$Mg(s) + \ldots\ldots HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$ [1]

(vi) Name the salt formed in this reaction.

..... [1]

2 Two of the stages in water purification are filtration and chlorination.
The diagram below shows a filter tank.



(a) Explain how this filter helps purify the water.

.....

.....

..... [2]

(b) **(i)** Why is chlorine added during water purification?

.....

(ii) After chlorination, the water is acidic. A small amount of slaked lime is added to the acidic water. Explain why slaked lime is added.

.....

(iii) What is the chemical name for slaked lime?

.....

(iv) State **one** other use of slaked lime.

..... [4]

(c) **(i)** State the boiling point of pure water.

.....

[1]

(ii) Describe a chemical test for water.

test .....

[1]

result .....

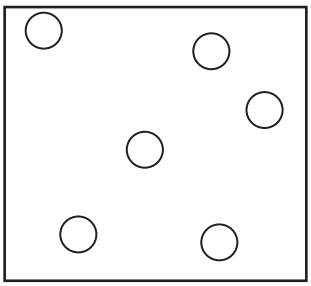
[1]

(iii) State **one** use of water in the home.

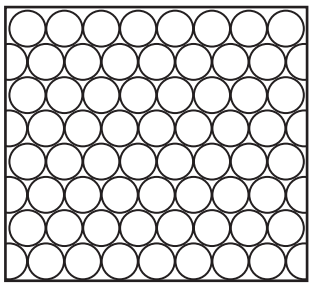
.....

[1]

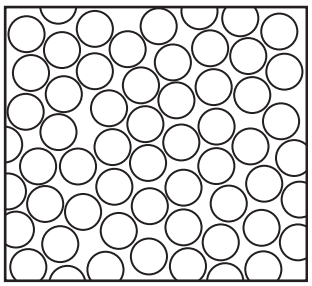
(d) The diagram shows the arrangement of particles in the three different states of water.



A



B



C

Which of these diagrams, **A**, **B** or **C**, shows water in a solid state?

.....

[1]

(e) Steam reacts with ethene in the presence of a catalyst. Complete the word equation for this reaction.

ethene + steam → .....

[1]

(f) Potassium reacts violently with water. Complete the word equation for this reaction.

potassium + water → ..... + ...

.....

[2]

3 When lumps of calcium carbonate react with hydrochloric acid, carbon dioxide is released.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

(a) Describe a practical method for investigating this reaction, which would enable you to calculate the rate of reaction.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) What effect will the following have on the rate of the reaction?

(i) increasing the temperature

.....

(ii) adding water to the acid

.....

(iii) using powdered calcium carbonate instead of lumps

..... [3]

(c) Describe a test for calcium ions.

result .....

test .....

..... [3]

(d) Calcium can be obtained by the electrolysis of molten calcium chloride.

(i) Suggest why calcium must be extracted by electrolysis rather than by reduction with carbon.

.....

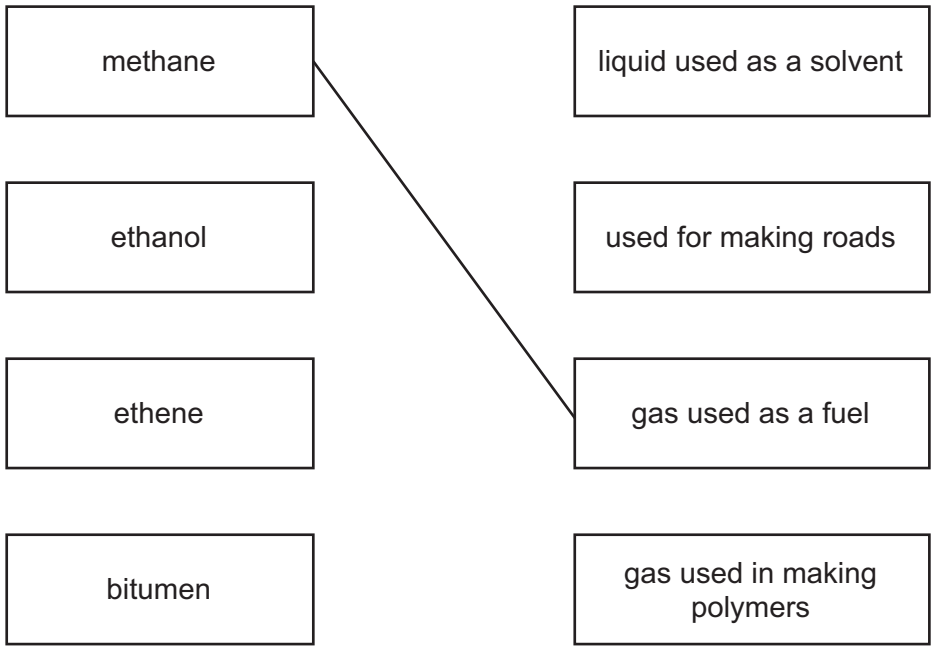
[1]

(ii) Draw the electronic structure of an atom of calcium.

[2]

4 Organic substances have many uses.

(a) Match the substances in the boxes on the left with the descriptions in the boxes on the right. The first one has been done for you.



[3]

(b) Which one of the following would be least likely to be obtained from the fractional distillation of petroleum? Put a ring around the correct answer.

bitumen **ethane** **ethanol** **methane** [1]

(c) Some reactions of organic compounds are shown below.

A $n\ CH_2{=}CH_2 \longrightarrow -(-CH_2-CH_2-)-_n$

B $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

C $C_6H_{12}O_6 \longrightarrow 2CO_2 + 2C_2H_5OH$
glucose

D $C_8H_{18} \longrightarrow C_6H_{14} + C_2H_4$

(i) Which **one** of the reactions, **A**, **B**, **C** or **D**, shows fermentation?

.....

(ii) Which **one** of the reactions, **A**, **B**, **C** or **D**, shows polymerization?

.....

(iii) Which **one** of the reactions, **A**, **B**, **C** or **D**, shows combustion?

.....

(iv) Which **one** of the reactions, **A**, **B**, **C** or **D**, shows cracking?

..... [4]

(d) The hydrocarbon C_8H_{18} is an alkane.

(i) What is meant by the term *hydrocarbon*?

.....

(ii) Explain why this hydrocarbon is an alkane.

..... [2]

5 Look at the list of five elements below.

argon
bromine
chlorine
iodine
potassium

(a) Put these five elements in order of increasing proton number.

.....

[1]

(b) Put these five elements in order of increasing relative atomic mass.

.....

[1]

(c) The orders of proton number and relative atomic mass for these five elements are different. Which **one** of the following is the most likely explanation for this?

Tick **one** box.

The proton number of a particular element may vary. ☐

The presence of neutrons. ☐

The atoms easily gain or lose electrons. ☐

The number of protons must always equal the number of neutrons. ☐

[1]

(d) Which of the five elements in the list are in the same group of the Periodic Table?

.....

[1]

(e) **(i)** From the list, choose **one** element which has one electron in its outer shell.

.....

[1]

(ii) From the list, choose **one** element which has a full outer shell of electrons.

.....

[1]

(f) Which **two** of the following statements about argon are correct?

Tick **two** boxes.

Argon is a noble gas. ☐

Argon reacts readily with potassium. ☐

Argon is used to fill weather balloons. ☐

Argon is used in light bulbs. ☐

[2]

(g) Potassium chloride can be made by reacting potassium with chlorine. The bonding in potassium chloride is ionic.

What does this information tell you about

(i) the boiling point of potassium chloride,

.....

[1]

(ii) the electrical conductivity of molten potassium chloride?

.....

[1]

(h) Describe the change in the electronic structure of potassium and chlorine atoms when they combine to make potassium chloride.

change in potassium atom

.....

change in chlorine atom

.....

[2]

6 Iron is extracted from its ore in a blast furnace using carbon (coke) as a reducing age as a source of heat.

(a) The coke burns in hot air. The equation for this reaction is

$2C(s) + O_2(g) \rightarrow 2CO(g)$

State the name of the gas produced in this reaction.

.....

[1]

(b) Near the top of the blast furnace, the iron(III) oxide in the iron ore gets reduced to iron.

$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(l) + 3CO_2(g)$

Use the equation to explain why the change of iron(III) oxide to iron is a reduction reaction.

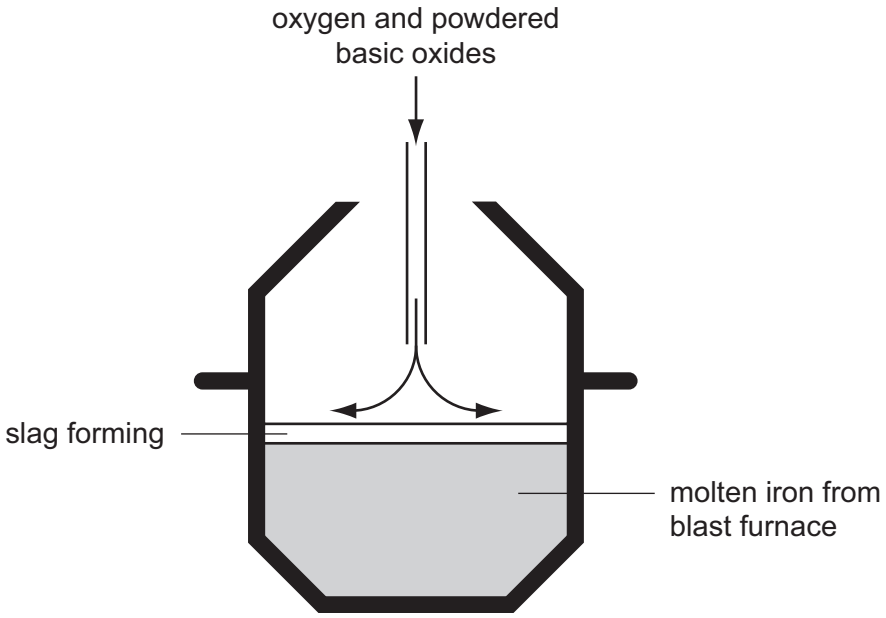
.....

[1]

(c) In the hottest regions of the furnace, iron(III) oxide is reduced by carbon.
Complete the equation for this reaction.

$Fe_2O_3(s) + \ldots\ldots C(s) \rightarrow \ldots\ldots Fe(l) + 3CO(g)$ [2]

(d) The iron from the blast furnace contains up to 10% by mass of impurities. The impurities are carbon, silicon and phosphorus. The diagram below shows one method of making steel from iron.



A mixture of oxygen and basic oxides is blown onto the surface of the molten iron.

(i) What is the purpose of blowing oxygen onto the molten iron?

.....

[1]

(ii) A large amount of energy is released in the process of steelmaking.
What name is given to chemical reactions which release energy?

.....

[1]

(iii) The basic oxides react with the impurities in the iron and form a slag. What information in the diagram suggests that the slag is less dense than the molten iron?

.....

[1]

(iv) Which one of the following is a basic oxide?
Put a ring around the correct answer.

calcium oxide **carbon dioxide** **sulphur dioxide** **water** [1]

(v) Why is steel rather than iron used for constructing buildings and bridges?

.....

[1]

(e) Special steels contain added elements such as vanadium, chromium, cobalt or [illegible]. These are all transition metals.

State three properties of transition metals which are **not** shown by non-transition metals.

1. .....

2. .....

3. ..... [3]

(f) What is the name given to metals which are mixtures of more than one metal?

..... [1]

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 Lawr 10

*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.).