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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.

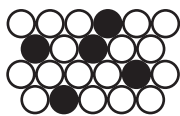
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If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

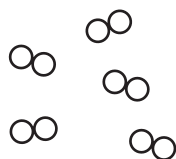
Stick your personal label here, if provided.

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

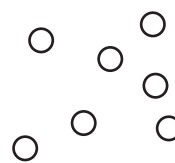
1 The diagram shows models of various structures,



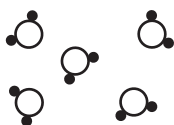
A



B



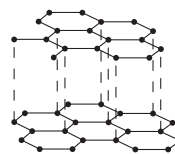
C



D



E



F

(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]

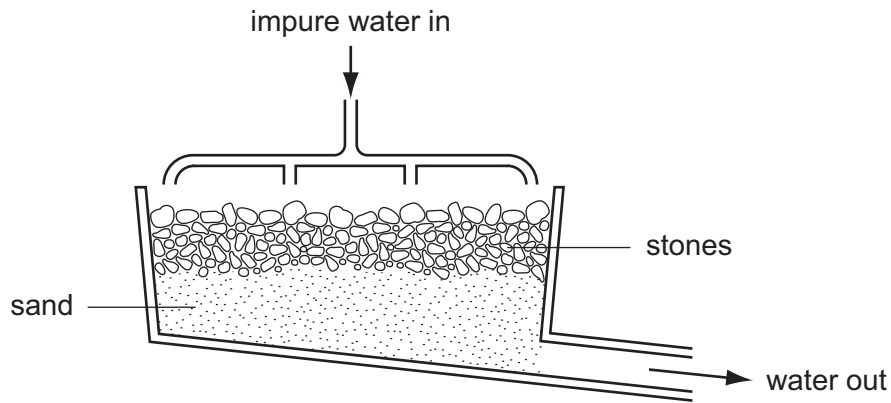
- (v) Complete the following equation for the reaction of hydrochloric acid with magnesium.



- (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.

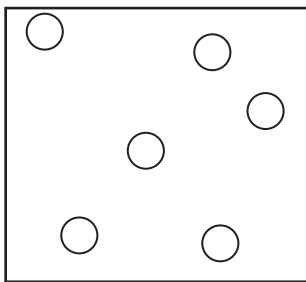
test [1]

result [1]

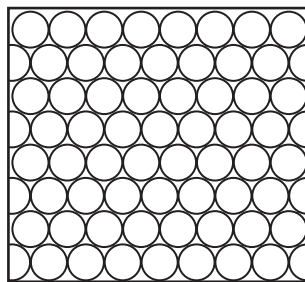
(iii) State **one** use of water in the home.

..... [1]

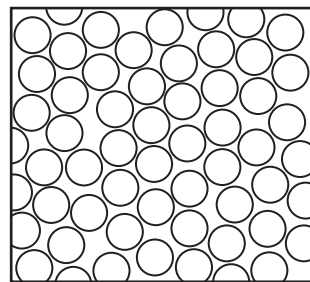
(d) The diagram shows the arrangement of particles in the three different states of water.



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]

(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.

methane	liquid used as a solvent
ethanol	used for making roads
ethene	gas used as a fuel
bitumen	gas used in making polymers

[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

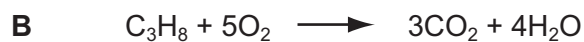
ethane

ethanol

methane

[1]

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



(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

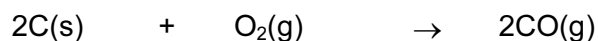
.....

change in chlorine atom

..... [2]

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

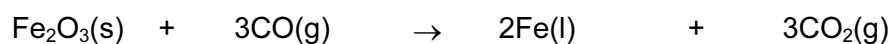
(a) The coke burns in hot air. The equation for this reaction is



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.



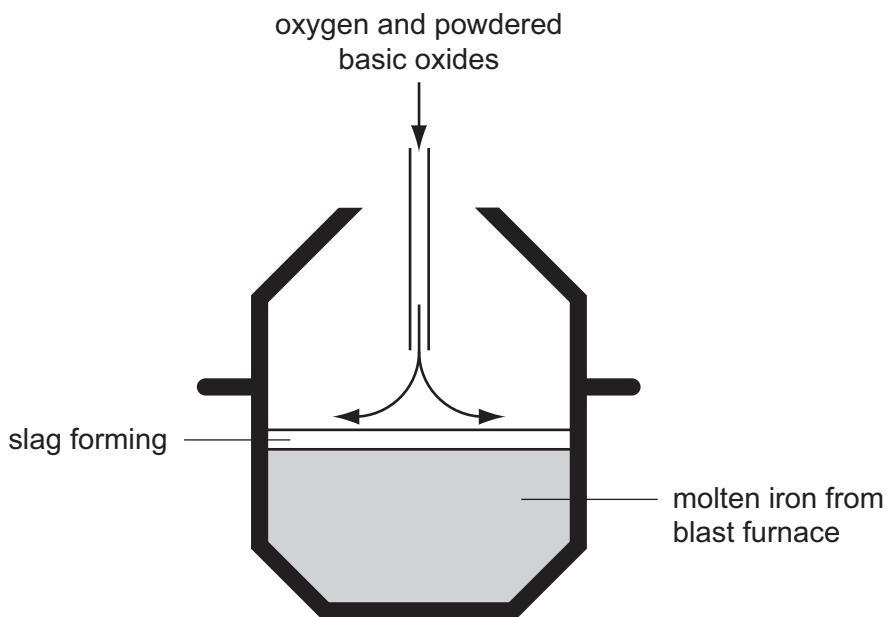
Use the equation to explain why the change of iron(III) oxide to iron is a reduction reaction.

..... [1]

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



- (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?

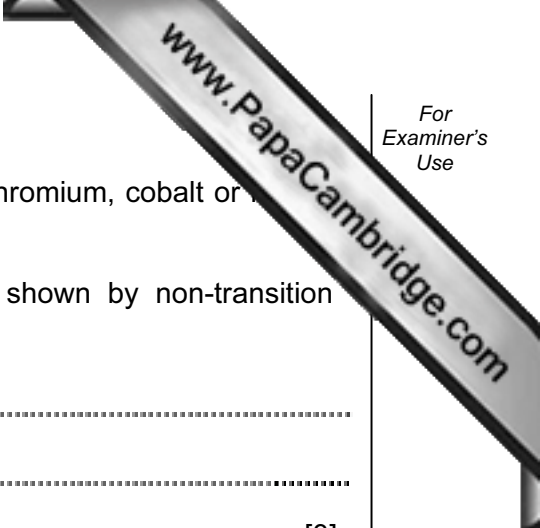
..... [1]

- (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 nickel. 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																																																																																																								
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	11 B Boron 5	13 Al Aluminium 13	15 P Phosphorus 15	17 S Sulphur 16	18 Ar Argon 18	23 Na Sodium 11	24 Mg Magnesium 12	27 Fe Iron 26	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 Ca Calcium 20	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 Ce Cerium 58	59 Pr Praseodymium 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	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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	226 Ra Radium 88	227 Ac Actinium 89	232 Th Thorium 90	238 U Uranium 92

*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.).