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| Centre Number | Candidate Number | Name |
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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.

| For Examiner's Use |  |
|--------------------|--|
| 1                  |  |
| 2                  |  |
| 3                  |  |
| 4                  |  |
| 5                  |  |
| 6                  |  |
| <b>Total</b>       |  |

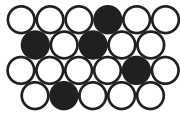
If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

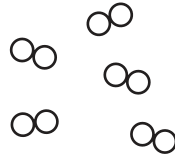
This document consists of **16** printed pages.



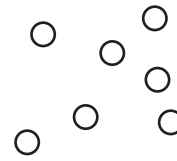
1 The diagram shows models of various structures,



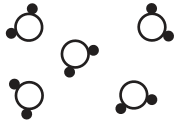
A



B



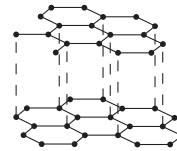
C



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]

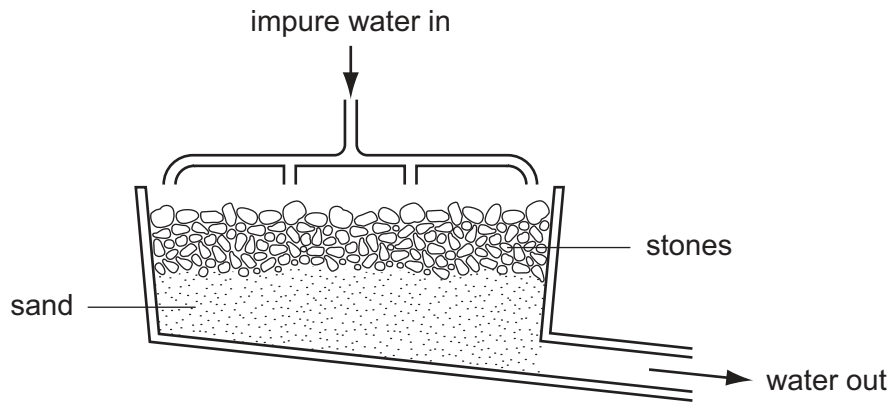
- (v) Complete the following equation for the reaction of hydrochloric acid with magnesium.



- (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.

..... [2]

(ii) Describe a chemical test for water.

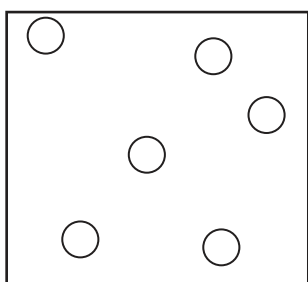
test .....

result .....

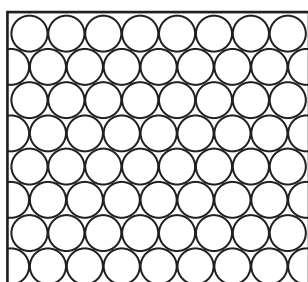
(iii) State **one** use of water in the home.

..... [1]

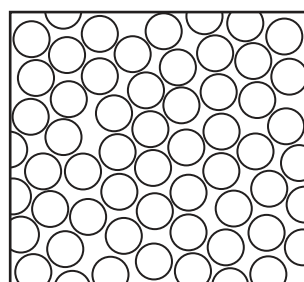
(d) The diagram shows the arrangement of particles in the three different states of water.



**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 → .....

(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]

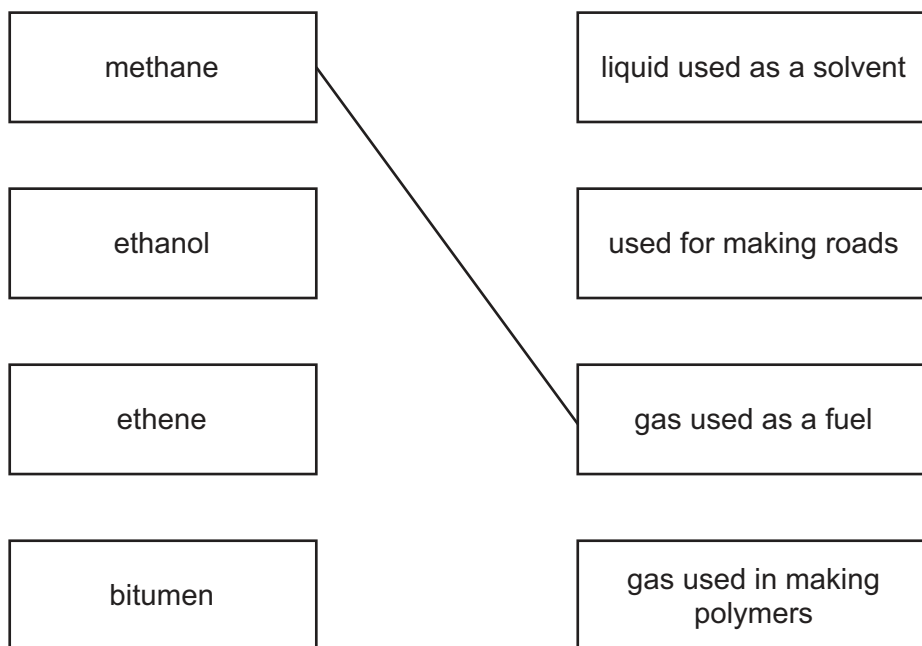
(ii) Draw the electronic structure of an atom of calcium.

[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.



[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**

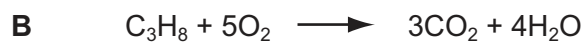
**ethane**

**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  $\text{C}_8\text{H}_{18}$  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

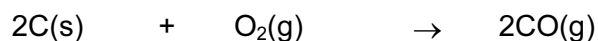
.....

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.

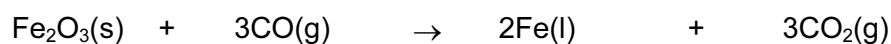
- (a) The coke burns in hot air. The equation for this reaction is



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.



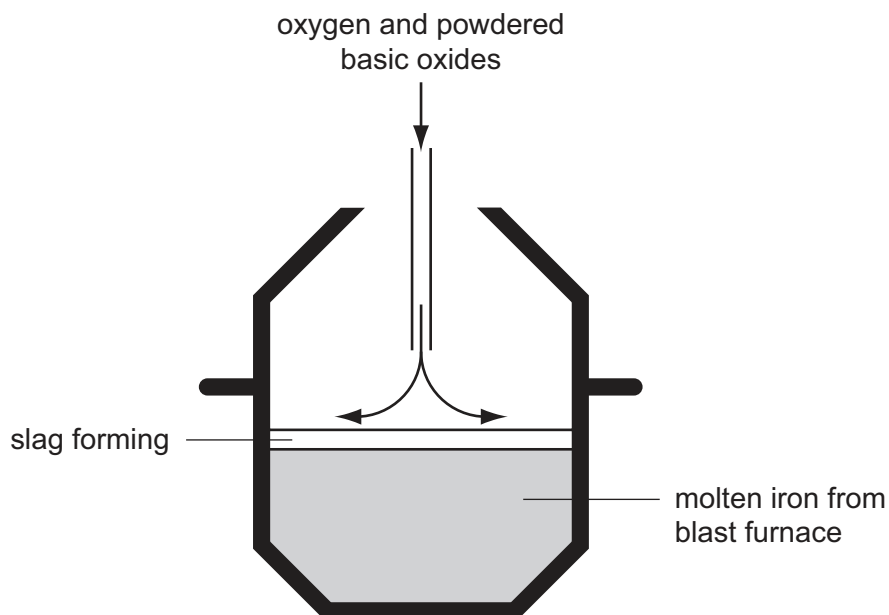
Use the equation to explain why the change of iron(III) oxide to iron is a reduction reaction.

..... [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 main 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                           | VIII                         | IX                             | X                              |                             |                                 |                              |                                |                             |                              |                             |                            |                           |                                 |                              |                               |                             |                             |                               |                            |                               |                            |                           |                            |                              |                             |
| 7   | 3                         | <b>Li</b><br>Lithium<br>4   | <b>Be</b><br>Beryllium<br>4     | <table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;"><b>H</b><br/>Hydrogen<br/>1</td> </tr> </table> |   |                              |                               |                               |                              |                                |                                |                             |                                 | 1                            | <b>H</b><br>Hydrogen<br>1      | 11                          | 5                            | <b>B</b><br>Boron<br>5      | <b>C</b><br>Carbon<br>6    | <b>N</b><br>Nitrogen<br>7 | <b>O</b><br>Oxygen<br>8         | <b>F</b><br>Fluorine<br>9    | <b>Ne</b><br>Neon<br>10       |                             |                             |                               |                            |                               |                            |                           |                            |                              |                             |
| 1   | <b>H</b><br>Hydrogen<br>1 |                             |                                 |   |   |                              |                               |                               |                              |                                |                                |                             |                                 |                              |                                |                             |                              |                             |                            |                           |                                 |                              |                               |                             |                             |                               |                            |                               |                            |                           |                            |                              |                             |
| 23  | 11                        | <b>Na</b><br>Sodium<br>11   | <b>Mg</b><br>Magnesium<br>12    | <b>Al</b><br>Aluminium<br>13  | <b>Si</b><br>Silicon<br>14  | <b>P</b><br>Phosphorus<br>15 | <b>S</b><br>Sulphur<br>16     | <b>Cl</b><br>Chlorine<br>17   | <b>Ar</b><br>Argon<br>18     |                                |                                |                             |                                 |                              |                                |                             |                              |                             |                            |                           |                                 |                              |                               |                             |                             |                               |                            |                               |                            |                           |                            |                              |                             |
| 39  | 19                        | <b>K</b><br>Potassium<br>19 | <b>Ca</b><br>Calcium<br>20      | <b>Sc</b><br>Scandium<br>21   | <b>Ti</b><br>Titanium<br>22   | <b>V</b><br>Vanadium<br>23   | <b>Cr</b><br>Chromium<br>24   | <b>Mn</b><br>Manganese<br>25  | <b>Fe</b><br>Iron<br>26      | <b>Co</b><br>Cobalt<br>27      | <b>Ni</b><br>Nickel<br>28      | <b>Cu</b><br>Copper<br>29   | <b>Zn</b><br>Zinc<br>30         | <b>Ga</b><br>Gallium<br>31   | <b>Ge</b><br>Germanium<br>32   | <b>As</b><br>Arsenic<br>33  | <b>Se</b><br>Selenium<br>34  | <b>Br</b><br>Bromine<br>35  | <b>Kr</b><br>Krypton<br>36 |                           |                                 |                              |                               |                             |                             |                               |                            |                               |                            |                           |                            |                              |                             |
| 85  | 37                        | <b>Rb</b><br>Rubidium<br>37 | <b>Sr</b><br>Strontium<br>38    | <b>Y</b><br>Yttrium<br>39   | <b>Zr</b><br>Zirconium<br>40  | <b>Nb</b><br>Niobium<br>41   | <b>Mo</b><br>Molybdenum<br>42 | <b>Tc</b><br>Technetium<br>43 | <b>Ru</b><br>Ruthenium<br>44 | <b>Rh</b><br>Rhodium<br>45     | <b>Pd</b><br>Palladium<br>46   | <b>Ag</b><br>Silver<br>47   | <b>Cd</b><br>Cadmium<br>48      | <b>In</b><br>Indium<br>49    | <b>Sn</b><br>Tin<br>50         | <b>Sb</b><br>Antimony<br>51 | <b>Te</b><br>Tellurium<br>52 | <b>I</b><br>Iodine<br>53    | <b>Xe</b><br>Xenon<br>54   |                           |                                 |                              |                               |                             |                             |                               |                            |                               |                            |                           |                            |                              |                             |
| 133 | 55                        | <b>Cs</b><br>Caesium<br>55  | <b>Ba</b><br>Barium<br>56       | <b>La</b><br>Lanthanum<br>57  | <b>Hf</b><br>Hafnium<br>72  | <b>Ta</b><br>Tantalum<br>73  | <b>W</b><br>Tungsten<br>74    | <b>Re</b><br>Rhenium<br>75    | <b>Os</b><br>Osmium<br>76    | <b>Ir</b><br>Iridium<br>77     | <b>Pt</b><br>Platinum<br>78    | <b>Au</b><br>Gold<br>79     | <b>Hg</b><br>Mercury<br>80      | <b>Tl</b><br>Thallium<br>81  | <b>Pb</b><br>Lead<br>82        | <b>Bi</b><br>Bismuth<br>83  | <b>Po</b><br>Polonium<br>84  | <b>At</b><br>Astatine<br>85 | <b>Rn</b><br>Radon<br>86   |                           |                                 |                              |                               |                             |                             |                               |                            |                               |                            |                           |                            |                              |                             |
| 226 | 87                        | <b>Fr</b><br>Francium<br>87 | <b>Ra</b><br>Radium<br>88       | <b>Ac</b><br>Actinium<br>89   | <table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="text-align: center;">a</td> <td style="text-align: center;"><b>X</b></td> <td style="text-align: center;">b</td> </tr> </table> |                              |                               |                               |                              |                                |                                |                             |                                 |                              | a                              | <b>X</b>                    | b                            | 140                         | 58                         | <b>Ce</b><br>Cerium<br>58 | <b>Pr</b><br>Praseodymium<br>59 | <b>Nd</b><br>Neodymium<br>60 | <b>Pm</b><br>Promethium<br>61 | <b>Sm</b><br>Samarium<br>62 | <b>Eu</b><br>Europium<br>63 | <b>Gd</b><br>Gadolinium<br>64 | <b>Tb</b><br>Terbium<br>65 | <b>Dy</b><br>Dysprosium<br>66 | <b>Ho</b><br>Holmium<br>67 | <b>Er</b><br>Erbium<br>68 | <b>Tm</b><br>Thulium<br>69 | <b>Yb</b><br>Ytterbium<br>70 | <b>Lu</b><br>Lutetium<br>71 |
| a   | <b>X</b>                  | b                           |                                 |   |   |                              |                               |                               |                              |                                |                                |                             |                                 |                              |                                |                             |                              |                             |                            |                           |                                 |                              |                               |                             |                             |                               |                            |                               |                            |                           |                            |                              |                             |
| 232 | 90                        | <b>Th</b><br>Thorium<br>90  | <b>Pa</b><br>Protactinium<br>91 | <b>U</b><br>Uranium<br>92   | <b>Np</b><br>Neptunium<br>93  | <b>Pu</b><br>Plutonium<br>94 | <b>Am</b><br>Americium<br>95  | <b>Cm</b><br>Curium<br>96     | <b>Bk</b><br>Berkelium<br>97 | <b>Cf</b><br>Californium<br>98 | <b>Es</b><br>Einsteinium<br>99 | <b>Fm</b><br>Fermium<br>100 | <b>Md</b><br>Mendelevium<br>101 | <b>No</b><br>Nobelium<br>102 | <b>Lr</b><br>Lawrencium<br>103 |                             |                              |                             |                            |                           |                                 |                              |                               |                             |                             |                               |                            |                               |                            |                           |                            |                              |                             |

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

**Key**

|   |          |   |
|---|----------|---|
| a | <b>X</b> | b |
|---|----------|---|

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

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