UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*6335113340*

**CHEMISTRY** **0620/02**

Paper 2 **May/June 2008**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may need to use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES

Answer **all** questions.
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 | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| Total | |

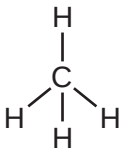
This document consists of **16** printed pages.



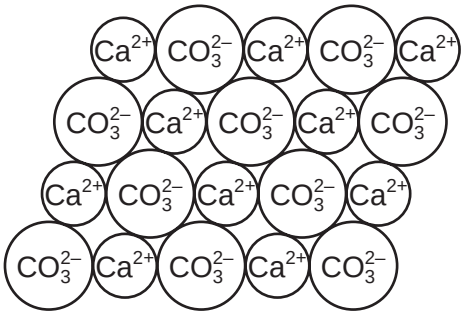

UNIVERSITY of CAMBRIDGE International Examinations

For Examiner's Use

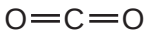
**1** The diagram shows the structures of some substances containing carbon.



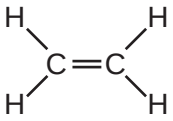
**A**



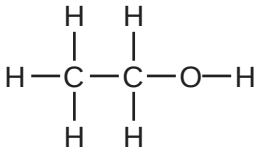
**B**



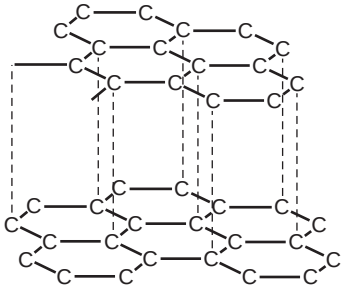
**C**



**D**



**E**



**F**

**(a)** Answer these questions using the letters **A, B, C, D, E** or **F**.

**(i)** Which one of these structures is ionic? ..... [1]

**(ii)** Which one of these structures represents ethanol? ..... [1]

**(iii)** Which one of these structures represents a gas which turns limewater milky? ..... [1]

**(iv)** Which one of these structures is an unsaturated hydrocarbon? ..... [1]

**(b)** Describe a chemical test for an unsaturated hydrocarbon.

test .....

result ..... [2]

**(c)** State the chemical name of structure **B**.

.....

[1]

*For Examiner's Use*

**(d)** Structure **F** has several uses. Which one of the following is a correct use of structure **F**? Tick **one** box.

| | |
|---|---|
| for cutting metals | ☐ |
| as a lubricant | ☐ |
| for filling balloons | ☐ |
| as an insulator | ☐ |

[1]

**(e)** The structures **A** to **E** are compounds. What do you understand by the term *compound*?

.....

.....

[1]

**(f)** State the type of bonding in structure **A**.

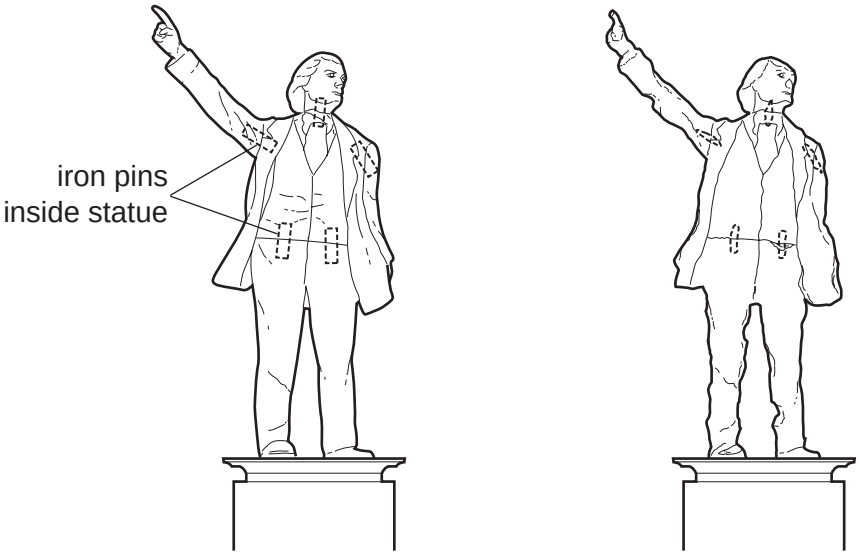
.....

[1]

[Total: 10]

**2** The diagram shows a statue in a park in an industrial town. The statue is made from limestone.

*For Examiner's Use*




statue when first erected

the same statue after 20 years

**(a)** State the name of the chemical present in limestone.

.....

[1]

**(b)** Use ideas about the chemistry of atmospheric pollutants to suggest how and why the statue changes over 20 years.

.....

.....

.....

.....

.....

[4]

**(c)** Parts of the statue are joined together with iron pins. After 30 years, the arm falls off the statue.
Suggest why the arm falls off.

.....

[1]

**(d)** Iron has several isotopes.

**(i)** What do you understand by the term *isotopes*?

.....

[1]

**(ii)** The table shows the number of subatomic particles in an atom of iron.

| type of particle | number of particles | relative charge on the particle |
|---|---|---|
| electron | 26 | |
| neutron | 30 | |
| proton | 26 | |

Complete the table to show the relative charge on each particle. [3]

**(iii)** State the number of nucleons in this isotope of iron.

.....

[1]

**(e)** Some isotopes are radioactive. State one industrial use of radioactive isotopes.

.....

[1]

**(f)** Iron reacts with very dilute nitric acid.

$$Fe + 2HNO_3 \longrightarrow Fe(NO_3)_2 + H_2$$

Write a word equation for this reaction.

[1]

[Total: 13]

**3** The table shows the concentration of some ions present in seawater.

| name of ion | formula of ion | concentration of ion in g / $dm^3$ |
|---|---|---|
| bromide | $Br^-$ | 0.07 |
| calcium | $Ca^{2+}$ | 0.4 |
| chloride | $Cl^-$ | 19.1 |
| magnesium | $Mg^{2+}$ | 1.2 |
| potassium | $K^+$ | 0.3 |
| sodium | $Na^+$ | 10.6 |
| | $SO_4^{2-}$ | 0.8 |

**(a)** Which negative ion has the highest concentration in seawater?

..... [1]

**(b)** State the name of the ion with the formula $SO_4^{2-}$.

..... [1]

**(c)** Which two ions in the table are formed from Group I elements?

..... and ..... [1]

**(d)** When seawater is evaporated a number of different compounds are formed.
State the name of the compound which is present in the greatest quantity.

..... [1]

**(e)** State the names of two ions in the table which move to the cathode when seawater is electrolysed.

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

*For Examiner's Use*

**(f)** When concentrated seawater is electrolysed, chlorine is formed at one of the electrodes.

**(i)** To which Period in the Periodic Table does chlorine belong?

..... [1]

**(ii)** Draw the electronic structure of a chlorine molecule. Show only the outer electrons.

[2]

**(g)** Drinking water can be obtained by purifying seawater.
Explain why distillation rather than filtration is used to purify seawater for drinking.

.....

..... [2]

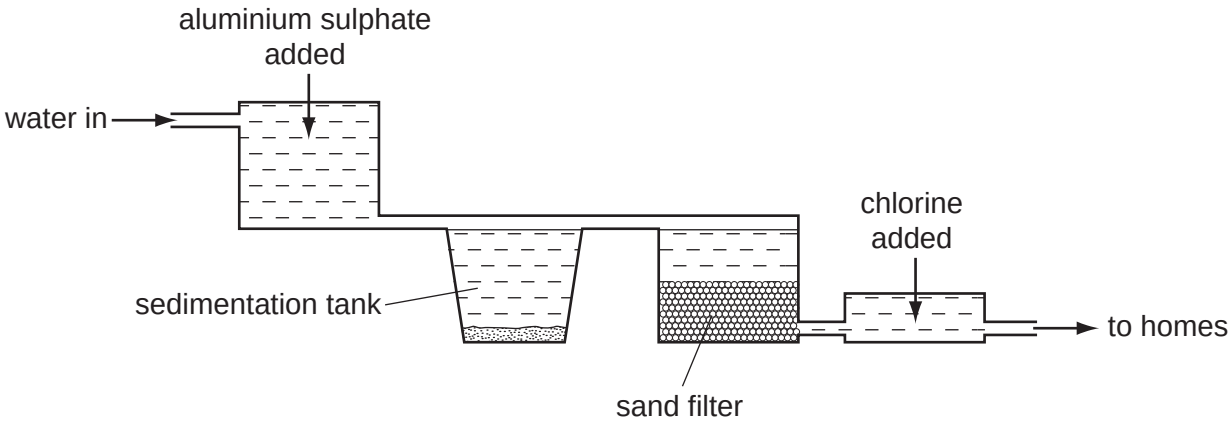
[Total: 11]





**[Turn over**

**4** The diagram shows a water treatment works.




**(a)** State one use of water in industry.

.....

[1]

**(b)** Explain how the sand filter helps purify the water.

.....

.....

[2]

**(c)** The aluminium ions in aluminium sulphate cause clay particles to clump together. Describe a test for aluminium ions.

test .....

result .....

.....

[3]

**(d)** Why is chlorine added to the water?

.....

[1]

**(e)** Chlorine is in Group VII of the Periodic Table.
When chlorine reacts with a solution of potassium bromide, the solution turns a reddish – brown colour.

*For Examiner's Use*

**(i)** Write a word equation for this reaction.

[2]

**(ii)** Explain why iodine does not react with a solution of potassium bromide.

..... [1]

**(f)** When chlorine reacts with sodium to form sodium chloride, energy is released.

**(i)** State the name given to a reaction which releases energy.

..... [1]

**(ii)** What type of bonding is present in sodium chloride?

..... [1]

**(iii)** Explain what happens in terms of electron transfer when a sodium atom reacts with a chlorine atom.

.....

..... [2]

[Total: 14]

*For Examiner's Use*

**5** Pure dry crystals of magnesium sulphate can be made by reacting excess magnesium powder with dilute sulphuric acid.

**(a)** During the reaction, bubbles of a colourless gas are given off.
State the name of this gas.

.....

[1]

**(b)** **(i)** Why is excess magnesium used?

.....

[1]

**(ii)** How is the excess magnesium removed from the reaction mixture?

.....

[1]

**(c)** Describe how you can obtain pure dry crystals of magnesium sulphate from a solution of magnesium sulphate.

.....

.....

[2]

**(d)** **(i)** Describe one other reaction that makes magnesium sulphate.

.....

.....

[1]

**(ii)** Write a word equation for the reaction you suggested in part **(d)(i)**.

[1]

**(iii)** Magnesium sulphate can be used as a medicine. Explain why the chemicals used in medicines need to be as pure as possible.

.....

.....

[1]

**(e)** A student repeats the experiment using excess sulphuric acid.
She obtains 24 g of magnesium sulphate from 4.8 g of magnesium.
How much magnesium sulphate can the student obtain from 1.2 g of magnesium?

*For Examiner's Use*

[1]

**(f)** A sample of 20 g of impure magnesium sulphate contains 19.5 g of magnesium sulphate.
Calculate the percentage purity of the magnesium sulphate.

[1]

[Total: 10]

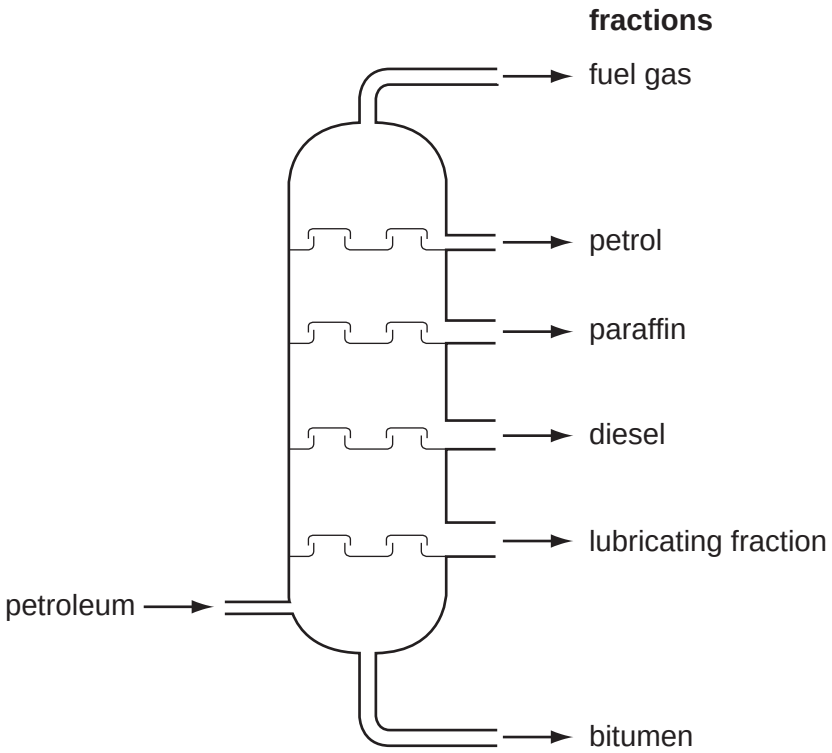




**[Turn over**

For Examiner's Use

**6** Petroleum is separated into useful fractions by distillation.




**(a) (i)** What do you understand by the term *fraction*?

.....

..... [1]

**(ii)** Which fraction has the lowest boiling point?

..... [1]

**(iii)** Describe how distillation is used to separate these fractions.

.....

.....

..... [2]

**(iv)** State a use for

the paraffin fraction, .....

the bitumen fraction. ..... [2]

For Examiner's Use

**(b)** Ethene can be made by cracking certain hydrocarbon fractions.

**(i)** Explain what is meant by the term *cracking*.

.....

..... [1]

**(ii)** Complete the equation for the cracking of tetradecane, $C_{14}H_{30}$.

$$C_{14}H_{30} \longrightarrow \text{.....} + C_2H_4 \quad [1]$$

**(c)** Ethanol is formed when steam reacts with ethene at high pressure and temperature. A catalyst of phosphoric acid is used.

$$\text{ethene} + \text{steam} \rightleftharpoons \text{ethanol}$$

**(i)** What is the function of the catalyst?

..... [1]

**(ii)** What is the meaning of the symbol $\rightleftharpoons$?

..... [1]

**(iii)** Ethanol is also formed when yeast grows in sugar solution.
What is this process called?
Put a ring around the correct answer.

**addition** **combustion** **fermentation** **neutralisation** [1]

**(iv)** Phosphoric acid is a typical acid. State what you would observe when a solution of phosphoric acid is added to

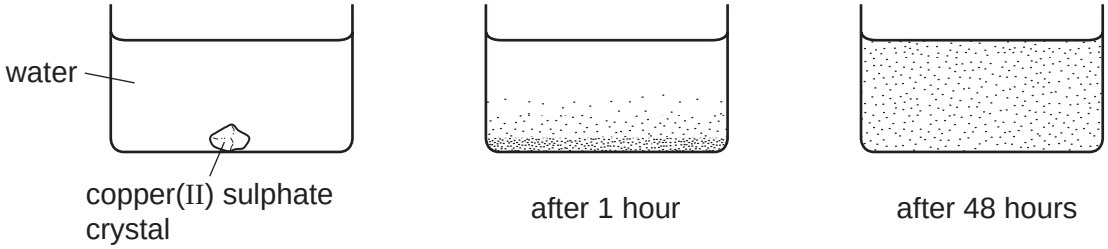
blue litmus, .....

a solution of sodium carbonate. ..... [2]

[Total: 13]

*For Examiner's Use*

**7** A student placed a crystal of copper(II) sulphate in a beaker of water.
After one hour the crystal had completely disappeared and a dense blue colour was observed in the water at the bottom of the beaker. After 48 hours the blue colour had spread throughout the water.




**(a)** Use the kinetic particle theory to explain these observations.

.....

.....

.....

..... [2]

**(b)** Describe the arrangement and motion of the particles in the copper(II) sulphate crystal.

arrangement .....

motion ..... [2]

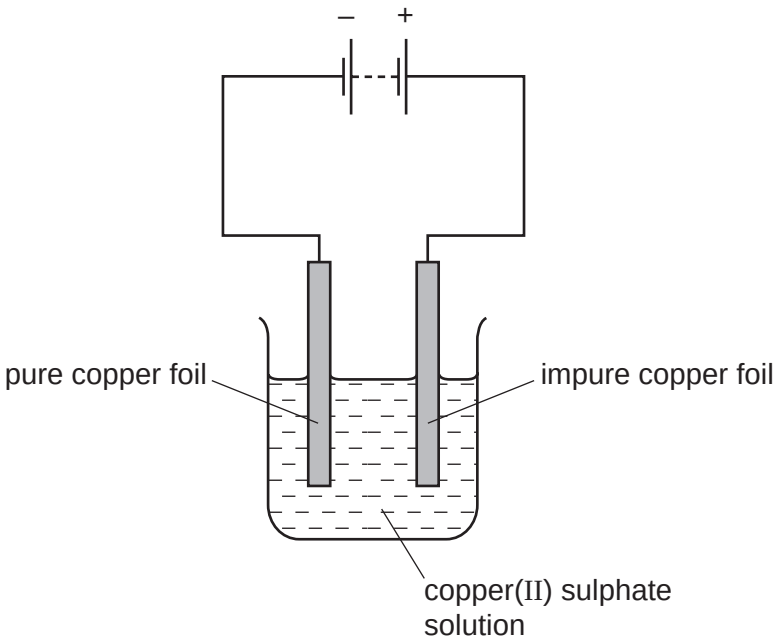
**(c)** Copper ions can be separated from other metal ions by paper chromatography. Draw a labelled diagram of the apparatus for paper chromatography.

In your diagram include

- the solvent,
- the spot where the solution containing copper ions is placed.

[2]

**(d)** Copper can be purified by electrolysis.




**(i)** Choose a word from the list below which describes the pure copper foil.
Put a ring around the correct answer.

**anion** **anode** **cathode** **cation** **electrolyte** [1]

**(ii)** Describe what happens during this electrolysis to

the pure copper foil, .....

the impure copper foil. ..... [2]

[Total: 9]

# 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 Radius 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 X b — 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.).