

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 (Core)

May/June 2005

**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.

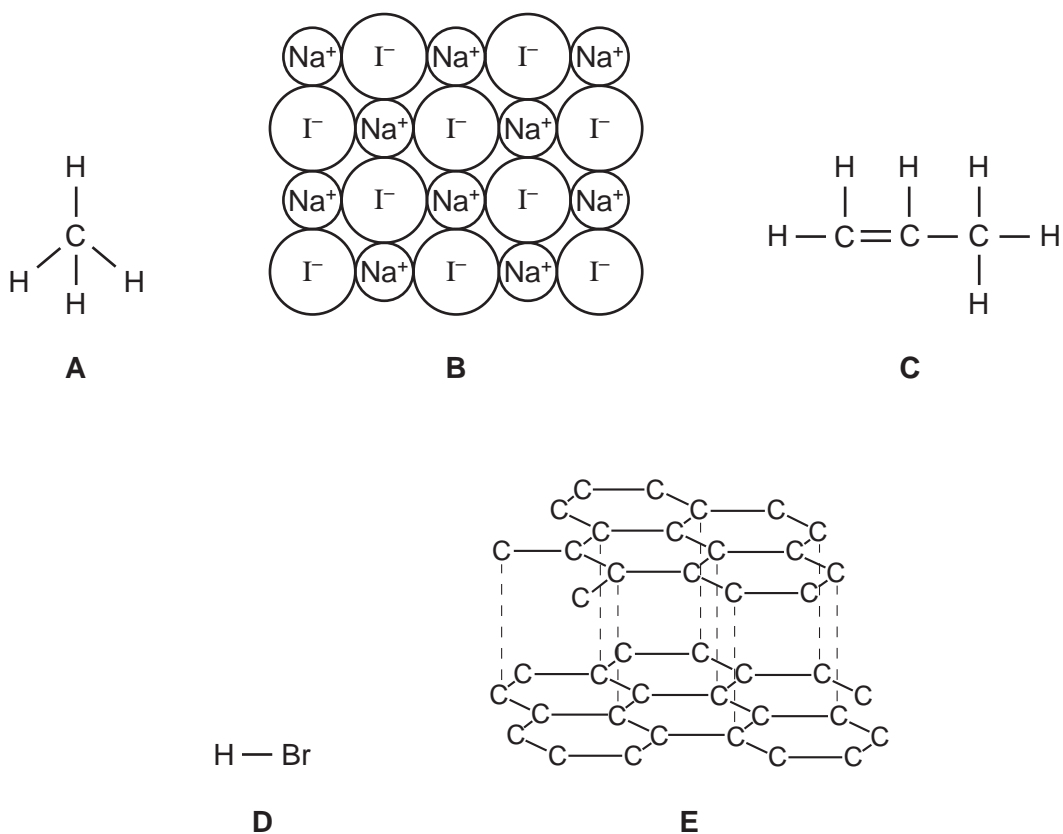
For Examiner's Use	
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<b>Total</b>	

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 structures of some substances are shown below.



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

- (i) Which structure is methane? ..... [1]
- (ii) Which two structures are giant structures? ..... and ..... [1]
- (iii) Which two structures are hydrocarbons? ..... and ..... [1]
- (iv) Which structure contains ions? ..... [1]
- (v) Which two structures have very high melting points?  
..... and ..... [1]

(b) Structure **E** is a form of carbon.

(i) What is the name of this structure?  
Put a ring around the correct answer.

carbide

graphite

lead

poly(hexene)

[1]

(ii) Name another form of carbon.

..... [1]

(c) Write the simplest formula for substance **B**.

..... [1]

(d) Is substance **D** an element or a compound?  
Explain your answer.

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

- 2 A student collected some water from a polluted river. The water contained soluble solids and insoluble clay and had a pH of 5.

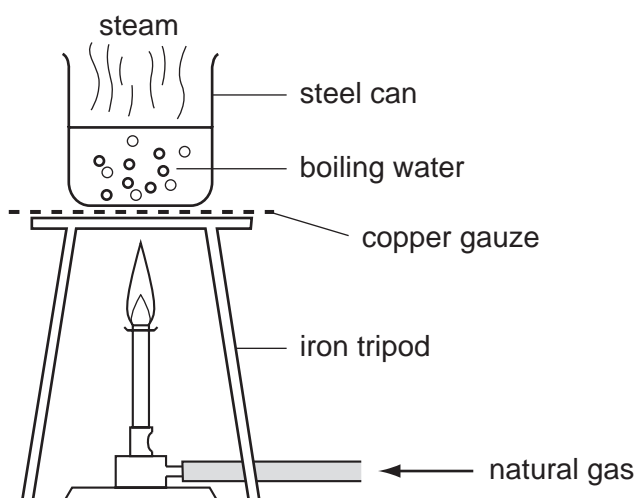
(a) How can the student separate the clay from the rest of the river water?

..... [1]

(b) The student uses litmus paper to show that the river water is acidic. What will be the result of this test?

..... [1]

(c) The student then boiled the river water to obtain the soluble solids. The diagram shows how she heated the water.



Which of the substances named in the diagram is

- (i) an alloy, ..... [1]  
 (ii) a compound which is liquid at room temperature, ..... [1]  
 (iii) an element, ..... [1]  
 (iv) a fuel? ..... [1]

(d) Name the main substance in natural gas.

..... [1]

(e) What is the normal temperature of boiling water?

..... [1]

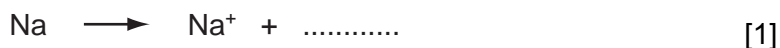
- (f) After the student boiled off the water, she analysed the white powder on the inside of the steel can.  
The table shows her results.

name of ion	formula of ion	mass of ion present /milligrams
calcium	$\text{Ca}^{2+}$	16
carbonate	$\text{CO}_3^{2-}$	35
chloride	$\text{Cl}^-$	8
nitrate	$\text{NO}_3^-$	4
sodium	$\text{Na}^+$	8
sulphate	$\text{SO}_4^{2-}$	6

- (i) Which positive ion had the greatest concentration in the sample of river water?

..... [1]

- (ii) Complete the following equation to show how a sodium ion is formed from a sodium atom.



- (g) Instead of using natural gas, the student could have used butane to heat the water.  
The formula of butane is  $\text{C}_4\text{H}_{10}$ .

- (i) What products are formed when butane burns in excess air?

..... [1]

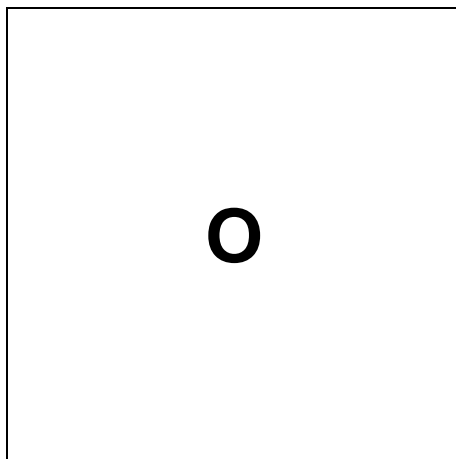
- (ii) Name the poisonous gas formed when butane undergoes incomplete combustion.

..... [1]

3 Ammonia is a gas which forms an alkaline solution when dissolved in water.

(a) Complete the diagram below to show the arrangement of the molecules in ammonia gas.

**O** represents a single molecule of ammonia.



[2]

(b) Which one of the following values is most likely to represent the pH of a dilute solution of ammonia?

Put a ring around the correct answer.

pH2

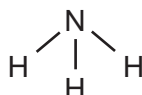
pH6

pH7

pH9

[1]

(c) The structure of the ammonia molecule is shown below.



(i) Write the simplest formula for ammonia.

[1]

(ii) Describe the type of bonding in a molecule of ammonia.

..... [1]

(iii) Ammonia is a gas at room temperature.  
Suggest why ammonia has a low boiling point.

..... [1]

(d) Many fertilisers contain ammonium sulphate.

- (i) Which acid must be added to ammonia solution to make ammonium sulphate?  
Put a ring around the correct answer.

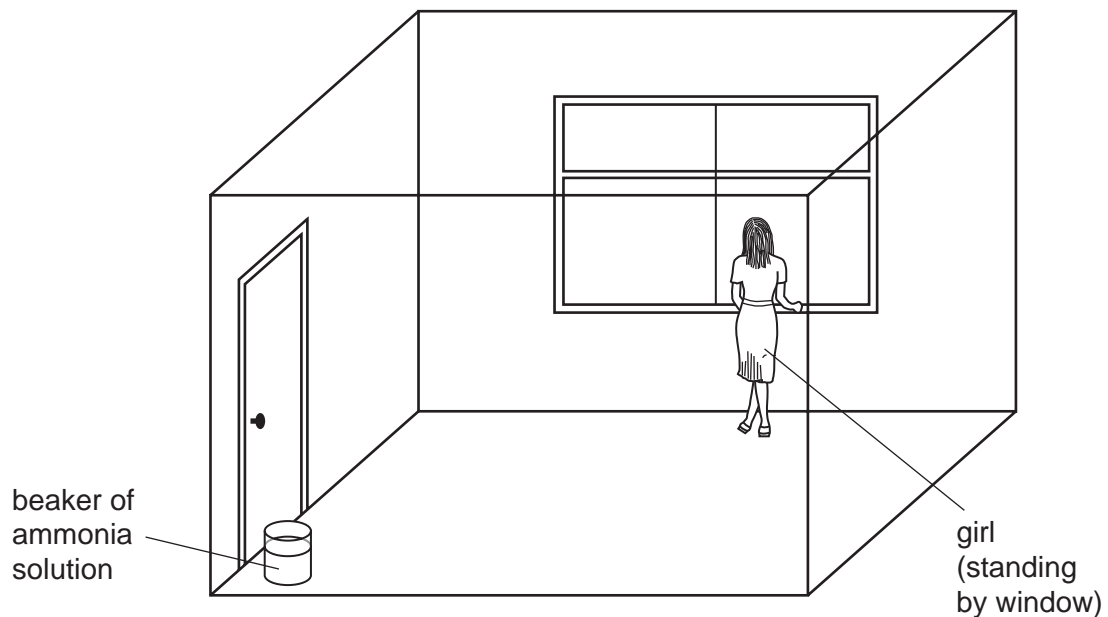
HCl                      HNO<sub>3</sub>                      H<sub>3</sub>PO<sub>4</sub>                      H<sub>2</sub>SO<sub>4</sub>                      [1]

- (ii) Fill in the missing words in the following sentence using two of the words from the list.

air                      hydrogen                      nitrogen                      soil                      sodium                      water

Fertilisers are needed in agriculture to replace the .....,  
phosphorus and other elements which are removed from the .....  
when crops are grown. [2]

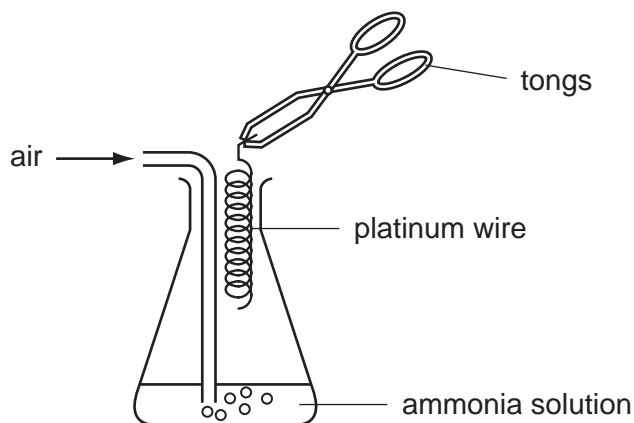
- (e) A solution of ammonia has a strong smell.  
A beaker of ammonia solution is put in the corner of a room which is free of draughts.



At first, the girl by the closed window cannot smell the ammonia.  
After 30 seconds she smells the ammonia.  
Use the kinetic particle theory to explain these facts.

.....  
.....  
.....  
..... [3]

- (f) The diagram shows the apparatus used for oxidising ammonia in the laboratory.

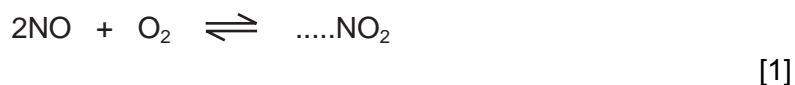


First, nitrogen(II) oxide, NO, is produced. This then reacts with oxygen to form nitrogen(IV) oxide, NO<sub>2</sub>.

- (i) Where does the oxygen come from in this reaction?

..... [1]

- (ii) Balance the equation for the reaction of nitrogen(II) oxide with oxygen.



- (iii) What is the meaning of the symbol  $\rightleftharpoons$  ?

..... [1]

- (iv) The platinum wire acts as a catalyst in the reaction. As the reaction takes place, the wire begins to glow red hot. What does this show about the reaction?

..... [1]

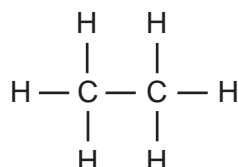


4 Poly(ethene) is a plastic which is made by polymerizing ethene,  $C_2H_4$ .

(a) Which one of the following best describes the ethene molecules in this reaction?  
Put a ring around the correct answer.

alcohols      alkanes      monomers      polymers      products      [1]

(b) The structure of ethane is shown below.



Explain, by referring to its bonding, why ethane cannot be polymerized.

..... [1]

(c) Draw the structure of ethene, showing all atoms and bonds.

[1]

(d) Ethene is obtained by cracking alkanes.

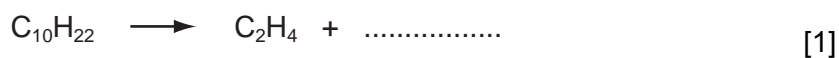
(i) Explain the meaning of the term *cracking*.

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

(ii) What condition is needed to crack alkanes?

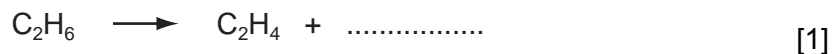
..... [1]

(iii) Complete the equation for cracking decane,  $C_{10}H_{22}$ .



(e) Some oil companies 'crack' the ethane produced when petroleum is distilled.

(i) Complete the equation for this reaction.



(ii) Describe the process of fractional distillation which is used to separate the different fractions in petroleum.

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

(iii) State a use for the following petroleum fractions.

petrol fraction .....

lubricating fraction ..... [2]

5 The halogens are a group of diatomic non-metals showing a trend in colour, state and reactivity.

(a) In this description, what is the meaning of

(i) diatomic, ..... [1]

(ii) state? ..... [1]

(b) The table gives some information about some of the halogens.

element	melting point /°C	boiling point /°C	colour	state at room temperature
chlorine	-101	-35	green	
bromine	-7	+59		
iodine	+114		grey-black	

(i) Complete the last column in the table to show the state of each of the halogens at room temperature. [2]

(ii) State the colour of bromine.

..... [1]

(iii) Suggest a value for the boiling point of iodine.

..... [1]

(c) Complete the word equation for the reaction of chlorine with potassium iodide.

chlorine + potassium iodide → ..... + .....  
..... [2]

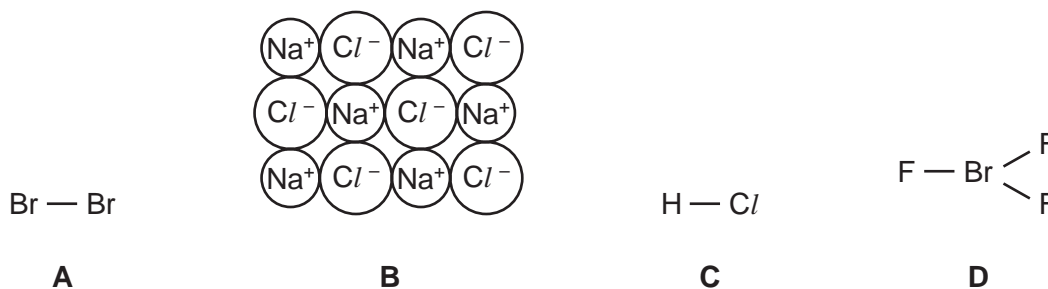
- (d) (i) Draw a diagram to show the electronic structure of a chlorine molecule.  
Show only the outer electrons.

[2]

- (ii) State a use of chlorine.

[1]

- (e) The structures of some substances containing halogens are shown below.



- (i) Which one of these structures, **A**, **B**, **C** or **D**, shows an element?

[1]

- (ii) Which one of these structures forms hydrochloric acid when dissolved in water?

[1]

- (iii) Complete the following sentence.

Structure **B** conducts electricity when it is molten because .....

[2]

(f) Astatine, At, is below iodine in Group VII of the Periodic Table.

(i) In which Period of the Periodic Table is astatine?

..... [1]

(ii) How many protons does astatine have in its nucleus?

..... [1]

(iii) Astatine has many isotopes.  
What do you understand by the term *isotopes*?

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

(iv) The most common isotope of astatine has a nucleon number (mass number) of 210.  
Calculate the number of neutrons in this isotope of astatine.

..... [1]

- 6 The electroplating of iron with chromium involves four stages.
1. The iron object is cleaned with sulphuric acid, then washed with water.
  2. The iron is plated with copper.
  3. It is then plated with nickel to prevent corrosion.
  4. It is then plated with chromium.

(a) The equation for stage 1 is



(i) Write a word equation for this reaction.

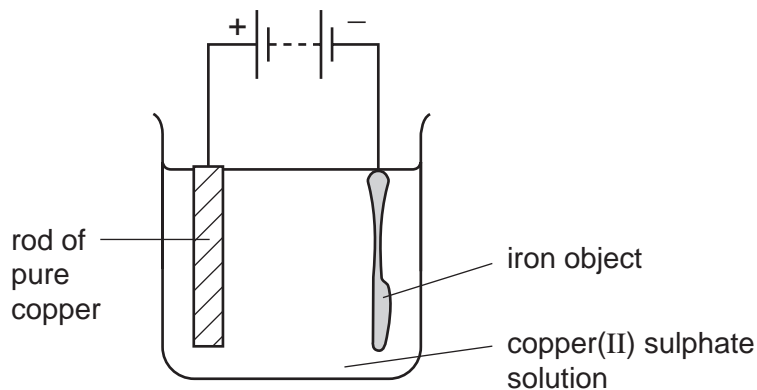
[2]

(ii) Describe a test for the gas given off in this reaction.

test .....

result ..... [2]

(b) The diagram shows how iron is electroplated with copper.



(i) Choose a word from the list below which describes the iron object.  
Put a ring around the correct answer.

anion                  anode                  cathode                  cation                  [1]

(ii) What is the purpose of the copper(II) sulphate solution?

..... [1]

(iii) Describe what happens during the electroplating to

the iron object, .....

the rod of pure copper. .... [2]

(iv) Describe a test for copper(II) ions.

test .....

result .....

..... [3]

(c) Suggest why chromium is used to electroplate articles.

..... [1]

(d) The information below shows the reactivity of chromium, copper and iron with warm hydrochloric acid.

chromium – few bubbles of gas produced every second

copper – no bubbles of gas produced

iron – many bubbles of gas produced every second

Put these three metals in order of their reactivity with hydrochloric acid.

Most reactive →


Least reactive →

[1]

**DATA SHEET**  
**The Periodic Table of the Elements**

		Group																																																	
I	II	III	IV	V	VI	VII	O																																												
		1 <b>H</b> Hydrogen 1										4 <b>He</b> Helium 2																																							
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4											20 <b>Ne</b> Neon 10																																							
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9					35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18																																							
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulphur 16	35.5 <b>Cl</b> Chlorine 17					79 <b>Se</b> Selenium 34	84 <b>Kr</b> Krypton 36																																							
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35					128 <b>Te</b> Tellurium 52	131 <b>Xe</b> Xenon 54																																							
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53					209 <b>Po</b> Polonium 84	86 <b>Rn</b> Radon 86																																							
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	65 <b>Zn</b> Zinc 30	64 <b>Cu</b> Copper 29	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	108 <b>Ag</b> Silver 47	106 <b>Pd</b> Palladium 46	103 <b>Rh</b> Rhodium 45	100 <b>Ru</b> Ruthenium 44	101 <b>Ru</b> Ruthenium 44	197 <b>Au</b> Gold 79	195 <b>Pt</b> Platinum 78	192 <b>Ir</b> Iridium 77	190 <b>Os</b> Osmium 76	186 <b>Re</b> Rhenium 75	184 <b>W</b> Tungsten 74	181 <b>Ta</b> Tantalum 73	93 <b>Nb</b> Niobium 41	91 <b>Zr</b> Zirconium 40	89 <b>Y</b> Yttrium 39	45 <b>Sc</b> Scandium 21	48 <b>Ti</b> Titanium 22	52 <b>Cr</b> Chromium 24	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	59 <b>Co</b> Cobalt 27	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Po</b> Polonium 84	81 <b>Th</b> Thorium 90	90 <b>Th</b> Thorium 90	232 <b>Th</b> Thorium 90	91 <b>Pa</b> Protactinium 91	92 <b>U</b> Uranium 92	93 <b>Np</b> Neptunium 93	94 <b>Pu</b> Plutonium 94	95 <b>Am</b> Americium 95	96 <b>Cm</b> Curium 96	97 <b>Bk</b> Berkelium 97	98 <b>Cf</b> Californium 98	99 <b>Es</b> Einsteinium 99	100 <b>Fm</b> Fermium 100	101 <b>Md</b> Mendelevium 101	102 <b>No</b> Nobelium 102	103 <b>Lr</b> Lawrencium 103

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

**Key**

a	<b>X</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.).