Centre Number	Candidate Number	Name

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.

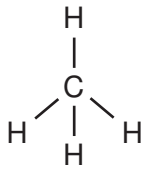
Answer **all** questions.
The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is printed on page 16.

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.

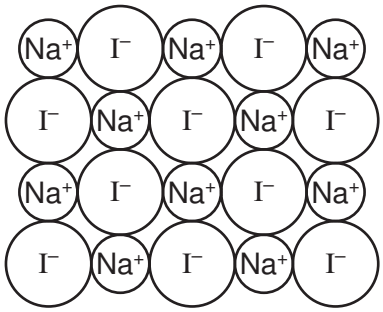
Stick your personal label here, if provided.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
Total	

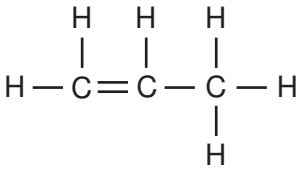
1 The structures of some substances are shown below.



A



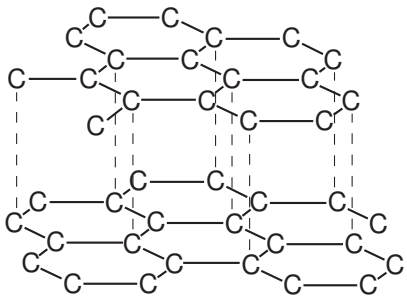
B



C

H — Br

D



E

(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.

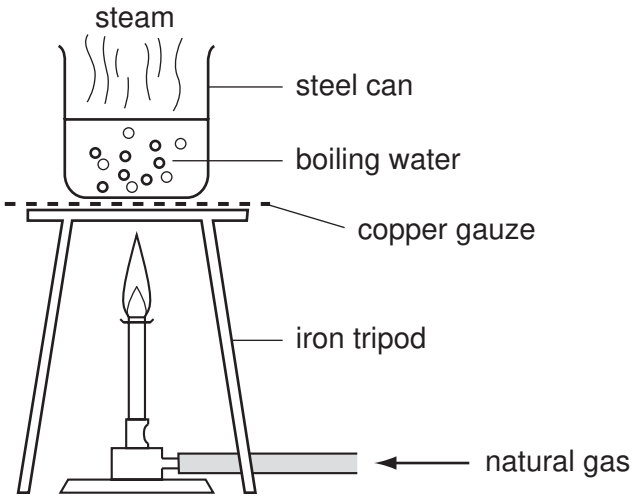
(a) How can the student separate the clay from the rest of the river water?

..... [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	Ca^{2+}	16
carbonate	CO_3^{2-}	35
chloride	Cl^-	8
nitrate	NO_3^-	4
sodium	Na^+	8
sulphate	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.

$$Na \longrightarrow Na^+ + ...$$ [1]

(g) Instead of using natural gas, the student could have used butane to heat the water.
The formula of butane is C_4H_{10}.

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

..... [1]

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

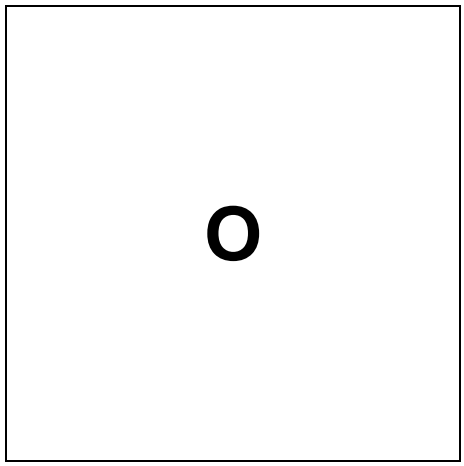
..... [1]

[Turn over

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.

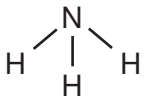


[2]

(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_3 H_3PO_4 H_2SO_4 [1]

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

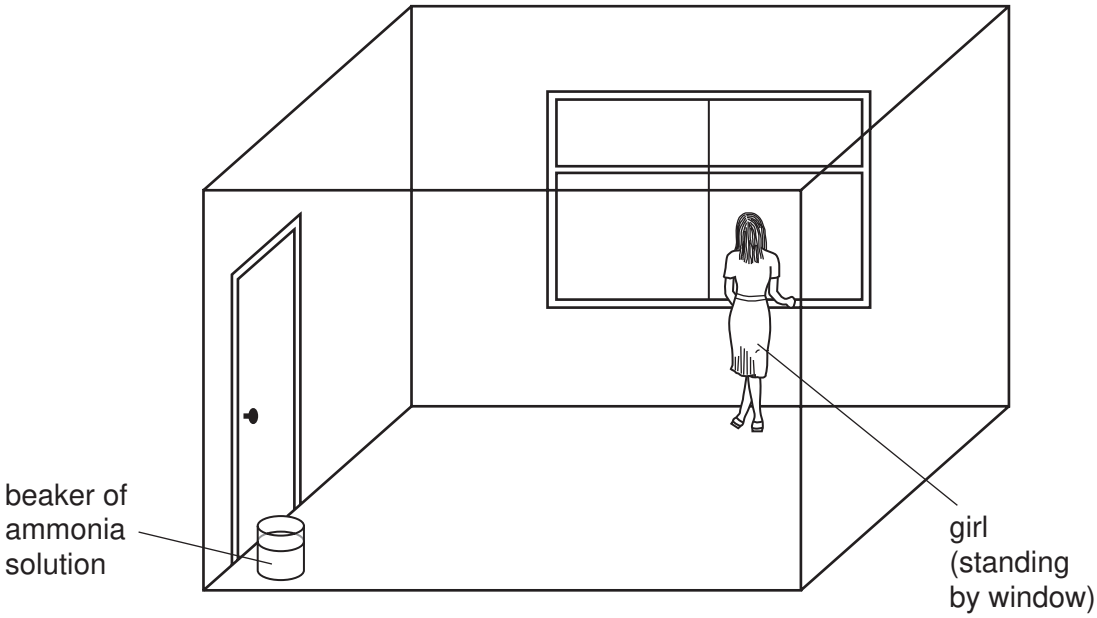
air hydrogen nitrogen soil sodium water

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.

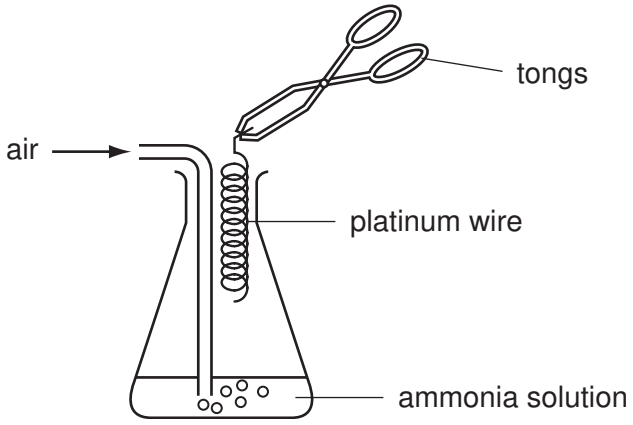
.....

.....

.....

..... [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_2.

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

.....

[1]

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

$$2NO + O_2 \rightleftharpoons .....NO_2$$

[1]

(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?

.....

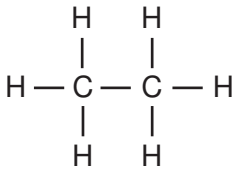
[1]

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, $C_{10}H_{22}$.

$$C_{10}H_{22} \longrightarrow C_2H_4 + \text{.....}$$ [1]

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

(i) Complete the equation for this reaction.

$$C_2H_6 \longrightarrow C_2H_4 + \text{.....}$$

[1]

(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]

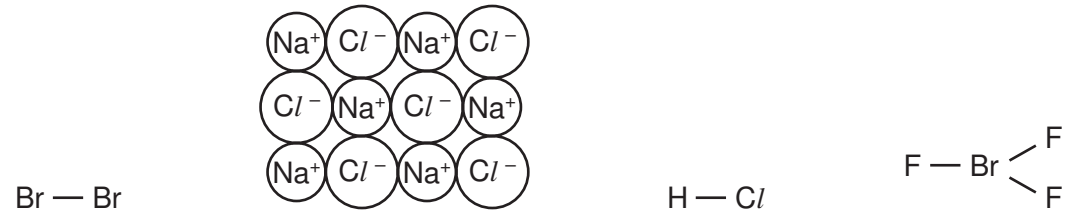
(d) (i) Draw a diagram to show the electronic structure of a chlorine molecule. Show only the outer electrons.

[2]

(ii) State a use of chlorine.

..... [1]

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



A **B** **C** **D**

(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]

[Turn over

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

$$Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2$$

(i) Write a word equation for this reaction.

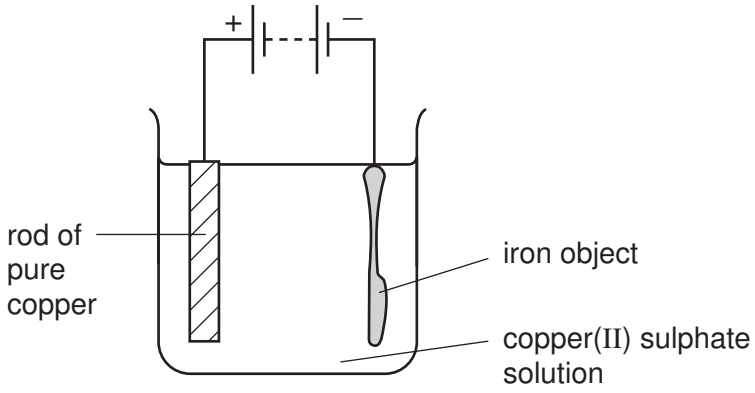
[2]

(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	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 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.).