

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.

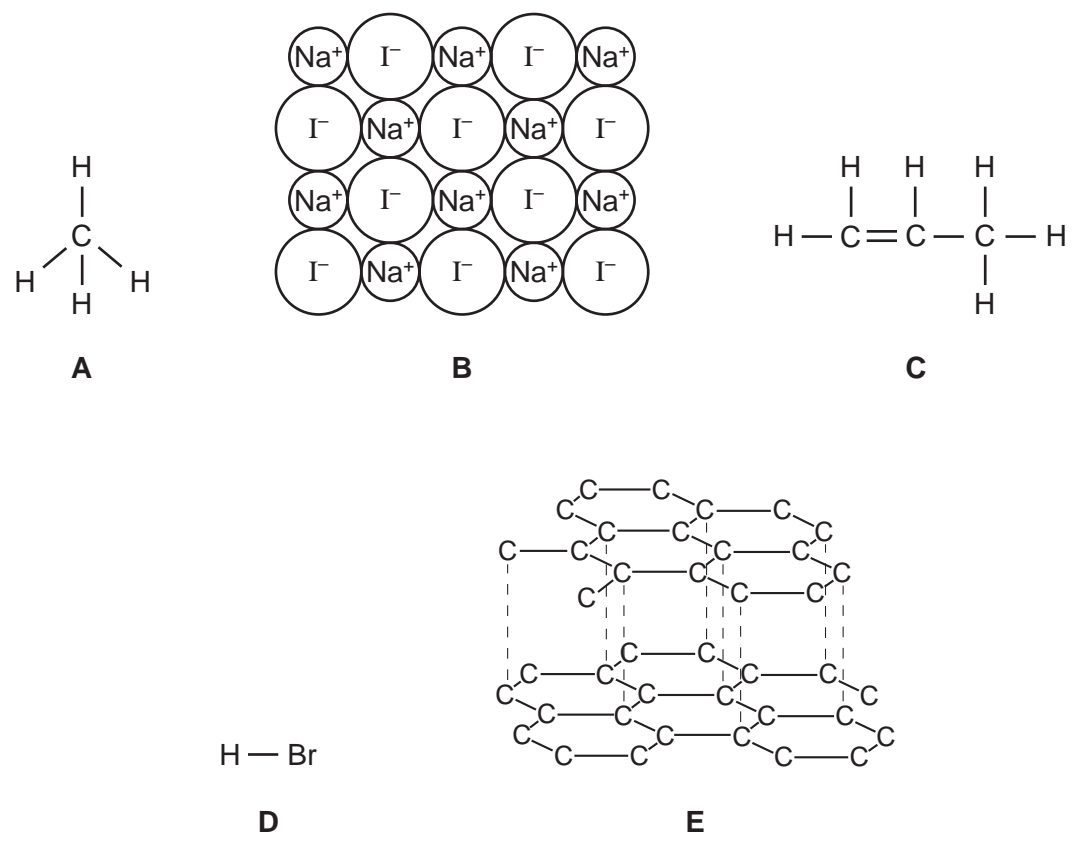
If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

For Examiner's Use

1	
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Total	

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]

3

(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.

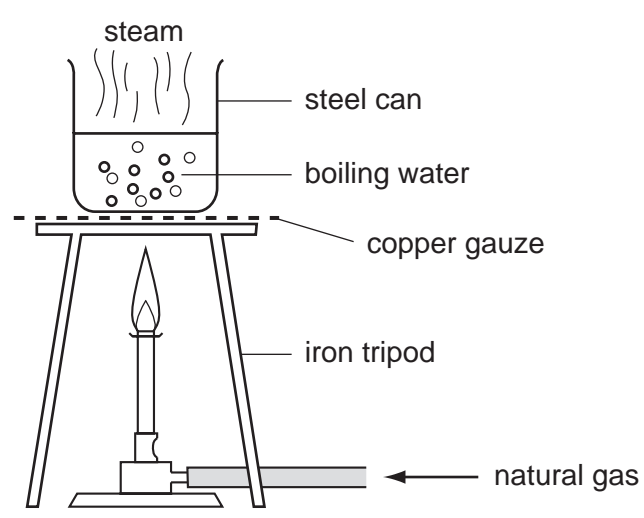
(a) How can the student separate the clay from the rest of the river water?

..... [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]

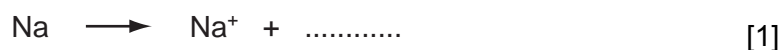
- (f) After the student boiled off the water, she analysed the white powder on the inside of the steel can.
The table shows her results.

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.



- (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]

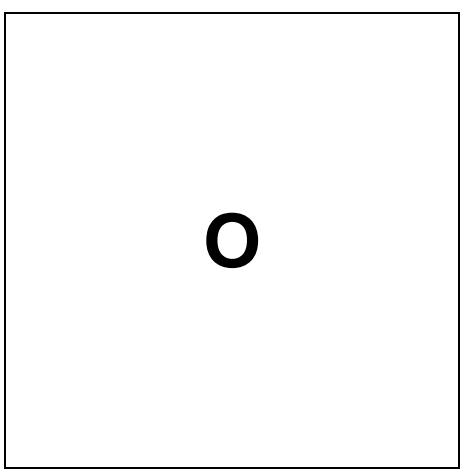
- (ii) Name the poisonous gas formed when butane undergoes incomplete combustion.

..... [1]

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

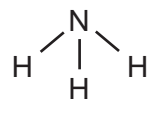
pH6

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.

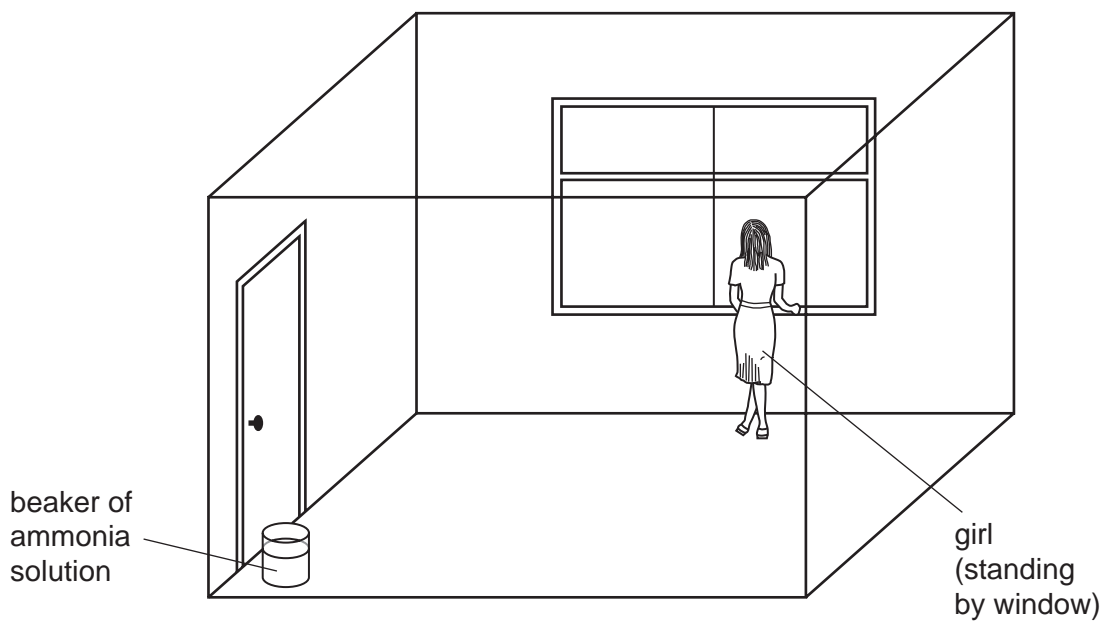
- HCl
 - HNO_3
 - H_3PO_4
 - H_2SO_4
- [1]

(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.

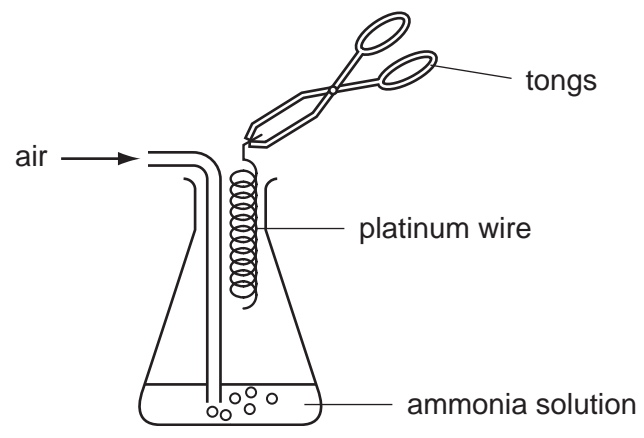


At first, the girl by the closed window cannot smell the ammonia.
 After 30 seconds she smells the ammonia.
 Use the kinetic particle theory to explain these facts.

.....

[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, NO₂.

(i) Where does the oxygen come from in this reaction?
 [1]

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

$$2\text{NO} + \text{O}_2 \rightleftharpoons \dots\text{NO}_2$$
 [1]

(iii) What is the meaning of the symbol \rightleftharpoons ?
 [1]

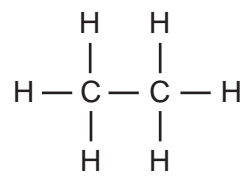
(iv) The platinum wire acts as a catalyst in the reaction. As the reaction takes place, the wire begins to glow red hot. What does this show about the reaction?
 [1]

4 Poly(ethene) is a plastic which is made by polymerizing ethene, C₂H₄.

(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.

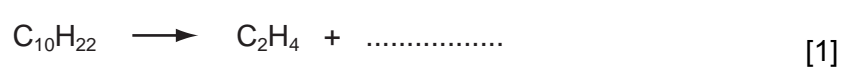
(i) Explain the meaning of the term *cracking*.

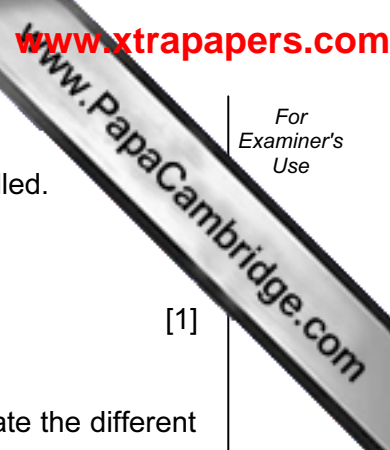
.....
..... [1]

(ii) What condition is needed to crack alkanes?

..... [1]

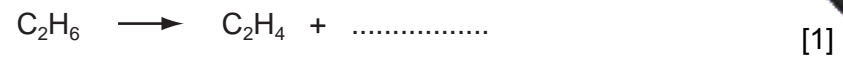
(iii) Complete the equation for cracking decane, C₁₀H₂₂.





(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]

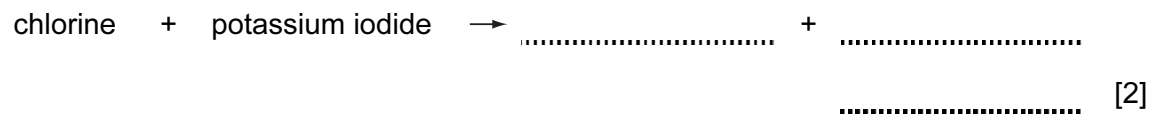
(ii) State the colour of bromine.

..... [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.



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

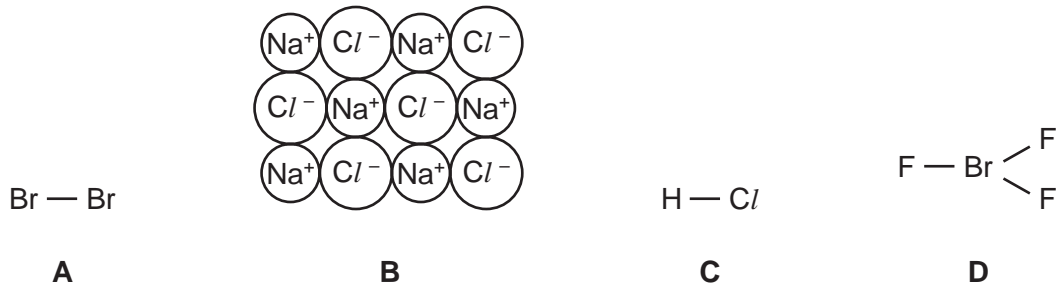
[2]

(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.

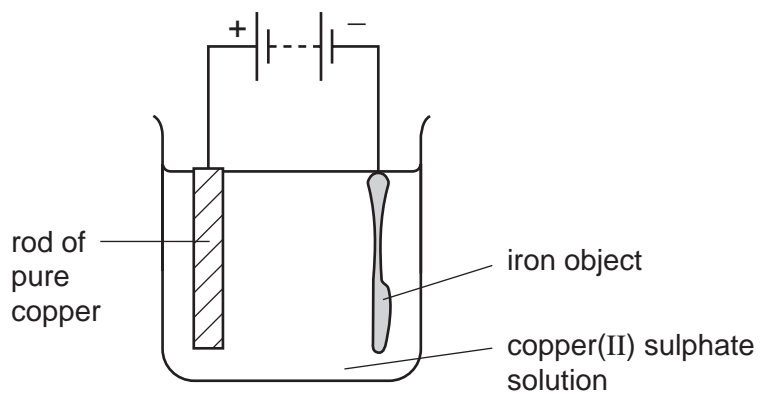
[2]

(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 H Hydrogen											2 He Helium						
3 Li Lithium	4 Be Beryllium											10 Ne Neon					
11 Na Sodium	12 Mg Magnesium											18 Ar Argon					
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Caesium	56 Ba Barium	57 La Lanthanum	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89 Ac Actinium															

140 Ce Cerium	141 Pr Praseodymium	144 Nd Neodymium	150 Sm Samarium	152 Eu Europium	157 Gd Gadolinium	162 Dy Dysprosium	165 Ho Holmium	167 Er Erbium	169 Tm Thulium	173 Yb Ytterbium	175 Lu Lutetium
90 Th Thorium	91 Pa Protactinium	92 U Uranium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

*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.).