

Centre Number	Index Number	Name
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Ordinary Level

**CHEMISTRY**

**5070/02**

Paper 2 Theory

October/November 2005

**1 hour 30 minutes**

Candidates answer on the Question Paper.  
Additional Materials: Answer Booklet/Paper

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.  
Write in blue or black pen.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

**Section A**

Answer **all** questions.  
Write your answers in the spaces provided on the Question Paper.

**Section B**

Answer any **three** questions.  
Write your answers on any lined pages and/or separate answer paper.

You may use a calculator.  
You may use a pencil for any diagrams, graphs, or rough working.  
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.  
A copy of the Periodic Table is printed on page 16.

For Examiner's Use	
<b>Section A</b>	
<b>B8</b>	
<b>B9</b>	
<b>B10</b>	
<b>B11</b>	
<b>Total</b>	

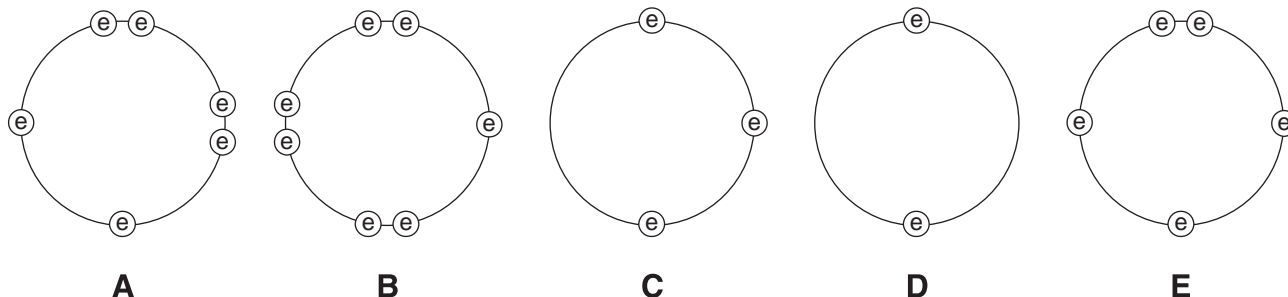
This document consists of **13** printed pages and **3** lined pages.



**Section A**

Answer **all** the questions in this section in the spaces provided.

- 1** These diagrams show the electron arrangement in the outer shells of five elements, **A** to **E**. All elements are from Period 3 of the Periodic Table.



- (a)** Put the letters **A** to **E** in the table to show which elements are metals and which are non-metals.

	metals	non-metals
elements		

[2]

- (b)** Which element is most likely to be in Group VI?

..... [1]

- (c)** Which element will form an ion of the type  $X^{2+}$  ?

..... [1]

- (d)** Which element has an atomic number of 15?

..... [1]

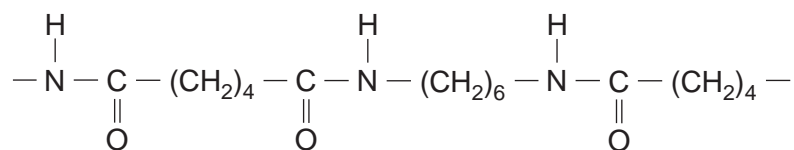
- (e)** Which two elements will form an ionic compound with a formula of the type  $YZ_2$ ?

..... [1]

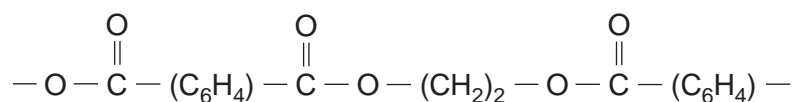
[Total: 6 marks]

- 2 These diagrams show sections of the polymer chain of two condensation polymers.

**Nylon**



**Terylene**



- (a) (i) Draw a circle around an amide linkage in the diagram. Label this **amide**.  
 (ii) Draw a circle around an ester linkage in the diagram. Label this **ester**. [2]
- (b) Name a type of naturally occurring polymer that has a similar linkage to nylon.  
 ..... [1]
- (c) The formulae of the two monomers used to make nylon are shown below.



Deduce the formulae of the two monomers that are used to make *Terylene*.

***Terylene* monomers**

[2]

- (d) Sea fishing nets used to be made from natural fibres. Many nets are now made from nylon. Suggest one **advantage**, other than strength, and one **disadvantage** of using nylon rather than natural fibres to make sea fishing nets.

advantage .....

disadvantage ..... [2]

[Total: 7 marks]

- 3 This table shows the soil pH ranges required by different crops for growth.

crop	pH range
peanut	5.0 – 6.5
millet	6.0 – 6.5
sunflower	6.0 – 7.5
paprika	7.0 – 8.5
mango	5.5 – 6.0

- (a) A farmer plants peanut and millet crops. Only the peanut crop grows well. Predict the pH of the soil.

..... [1]

- (b) Which other crop is most likely to grow well in the same soil?

..... [1]

- (c) The farmer adds calcium hydroxide,  $\text{Ca}(\text{OH})_2$ , and ammonium sulphate,  $(\text{NH}_4)_2\text{SO}_4$ , to the soil.

Explain the purpose of using each compound.

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

- (d) A reaction occurs between calcium hydroxide and ammonium sulphate.

- (i) Complete the equation for this reaction.



- (ii) Explain why the farmer should not have added these two compounds to the soil at the same time.

..... [3]

[Total: 8 marks]

- 4 This table shows some information about two homologous series; the alkanes and the acid chlorides.

alkanes	acid chlorides	
	formula	name
$C_2H_6$	ethanoyl chloride	$CH_3COCl$
$C_3H_8$		$C_2H_5COCl$
$C_4H_{10}$	butanoyl chloride	$C_3H_7COCl$
$C_5H_{12}$	pentanoyl chloride	$C_4H_9COCl$

Use the information in the table to answer the following questions.

- (a) Name the acid chloride with the highest boiling point.

..... [1]

- (b) Deduce the name of the acid chloride with the formula  $C_2H_5COCl$ .

..... [1]

- (c) The general formula for alkanes is  $C_xH_{(2x+2)}$ .  
Deduce the general formula for acid chlorides.

..... [1]

- (d) (i) Name the products of the complete combustion of an alkane.

.....

- (ii) Would you expect the products of complete combustion of the acid chlorides to be the same as in (i)? Explain your reasoning.

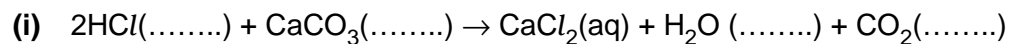
..... [2]

[Total: 5 marks]

- 5 An experiment was carried out to measure the rate of reaction between excess powdered calcium carbonate and dilute acids.

(a) In **Experiment 1**, 25 cm<sup>3</sup> of 1.5 mol/dm<sup>3</sup> hydrochloric acid was used.

Complete the equation for the reaction by filling in the missing state symbols.

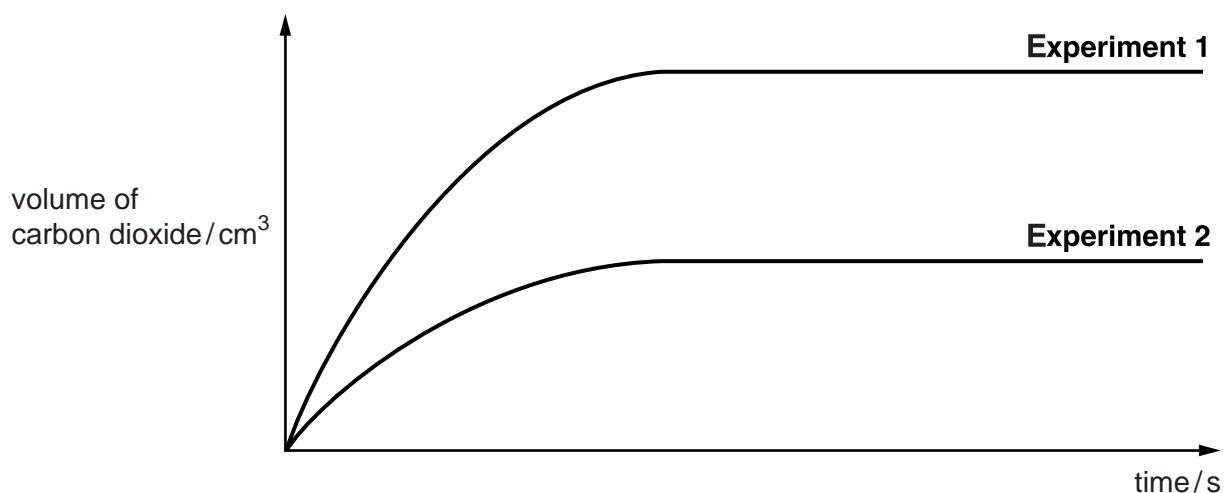


(ii) Calculate the total volume of carbon dioxide that is made from this reaction at r.t.p.

[4]

(b) A further experiment using hydrochloric acid, **Experiment 2**, was carried out.

The results of **Experiments 1** and **2** are shown on the graph.



Suggest the **concentration** and **volume** of acid used for **Experiment 2**.

concentration ..... mol/dm<sup>3</sup>

volume ..... cm<sup>3</sup>

[2]

(c) **Experiment 3** was carried out using 25 cm<sup>3</sup> of 1.5 mol/dm<sup>3</sup> sulphuric acid. The initial rate of reaction for **Experiment 3** was faster than for the other experiments but the reaction stopped suddenly after only a small amount of gas had been given off.

(i) Name the salt formed in **Experiment 3**.

.....

(ii) Explain why the reaction stops suddenly.

.....

(iii) Explain why the initial rate of reaction was faster than for the other experiments.

.....

[4]

[Total: 10 marks]

- 6 The table below shows some information about two copper ores, tenorite and cuprite. Both contain copper oxide.

ore	formula of copper oxide in ore	oxidation number of copper	percentage of copper by mass
tenorite		+2	80.0%
cuprite	Cu <sub>2</sub> O		

- (a) (i) What is the formula of the copper compound in tenorite?

.....

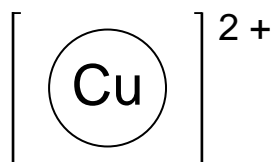
- (ii) What is the oxidation number of copper in cuprite, Cu<sub>2</sub>O?

.....

- (iii) Calculate the percentage of copper by mass in Cu<sub>2</sub>O.

[5]

- (b) Another ore of copper contains copper(II) sulphide. Complete the dot and cross diagram below for copper(II) sulphide showing outer electrons only.



copper ion

sulphide ion

[2]

[Total: 7 marks]



- 7 An oil refinery uses two different processes, **Process 1** and **Process 2**, to crack naphtha. The table below shows some information about the percentage yields of products from each process.

product	yield / %	
	Process 1	Process 2
hydrogen	1	1
methane	18	14
ethene	32	20
propene	13	15
C <sub>4</sub> hydrocarbons	9	10
C <sub>5</sub> to C <sub>8</sub> hydrocarbons	27	40

The refinery sells ethene and C<sub>5</sub> to C<sub>8</sub> hydrocarbons. Ethene is used to make addition polymers, and C<sub>5</sub> to C<sub>8</sub> hydrocarbons are added to petrol. Use the information given to explain why the refinery must use **both** processes to meet the high demand for both ethene and C<sub>5</sub> to C<sub>8</sub> hydrocarbons.

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

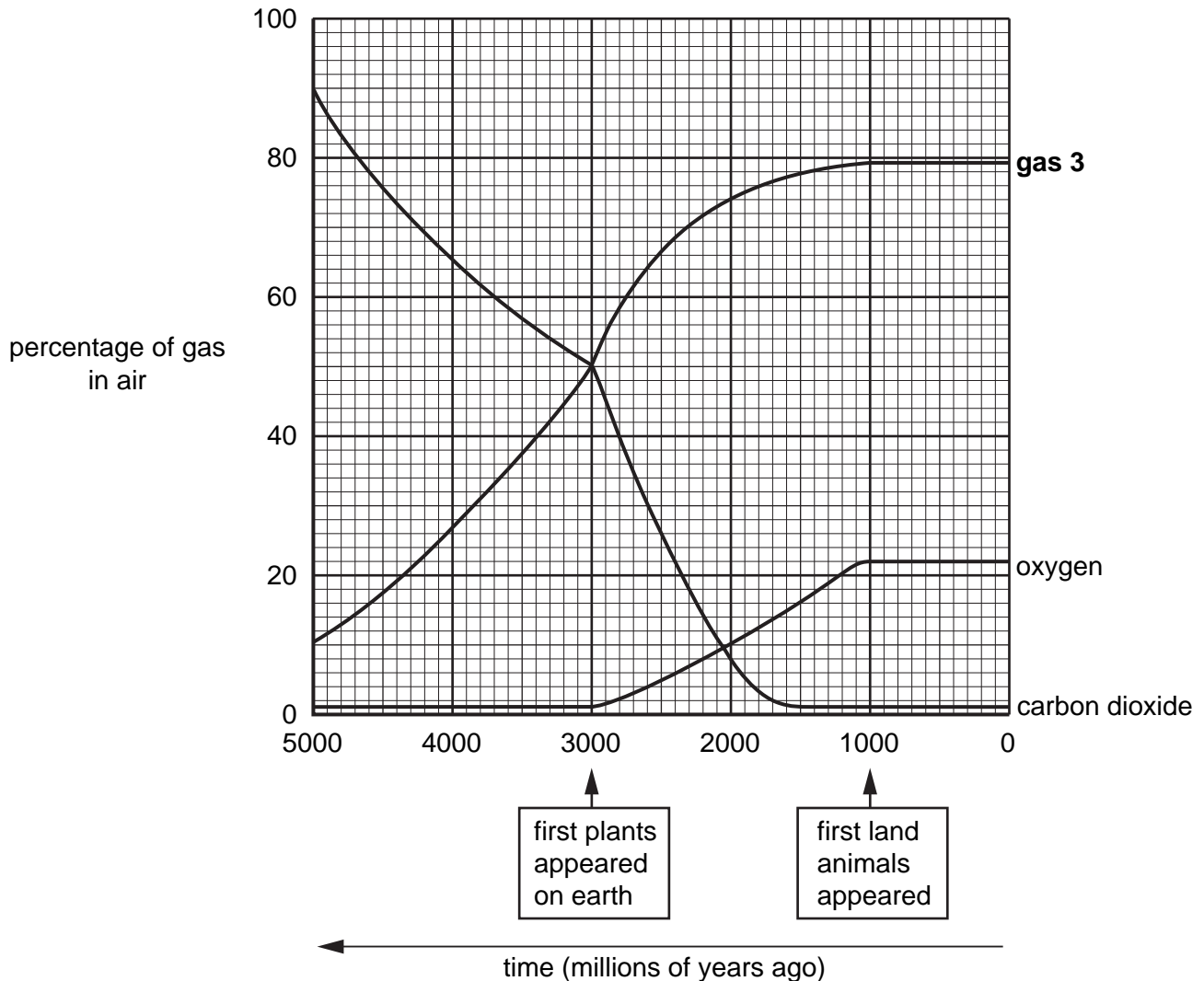
[Total: 2 marks]

## Section B

Answer **three** questions from this section.

Write your answers on any lined pages provided and/or a separate answer paper.

- B8** This graph shows how the percentage of three of the gases in the Earth's atmosphere has changed over five thousand million years.



Use information from the graph to answer the following questions.

- (a) (i) How long have the percentages of all gases in the atmosphere remained unchanged? [3]  
 (ii) Name **gas 3**. Give a reason for your answer. [3]
- (b) (i) Describe how the percentages of carbon dioxide and oxygen have changed. [5]  
 (ii) Suggest an explanation for the changes that have taken place in carbon dioxide and oxygen percentages, identifying the processes involved and giving equations for any reactions. [5]
- (c) Oxygen is separated from air by fractional distillation. Outline how this separation takes place. [2]

[Total: 10 marks]

**B9** Chlorine, bromine and iodine are elements in Group VII of the Periodic Table.

- (a) Describe how you would carry out a series of experiments to show the trend in reactivity of these three elements, using the reagents shown below.

aqueous chlorine  
aqueous bromine  
aqueous iodine

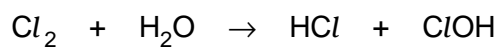
aqueous potassium chloride  
aqueous potassium bromide  
aqueous potassium iodide

Your answer should include details of

- which of the reagents you would use in each experiment,
- a table showing the observations you would expect to see,
- the equations for any reactions.

[7]

- (b) Chlorine reacts with water to make a solution that can be used as a bleach. The equation is shown below.



Use oxidation numbers to show that chlorine is both oxidised and reduced in this reaction. [3]

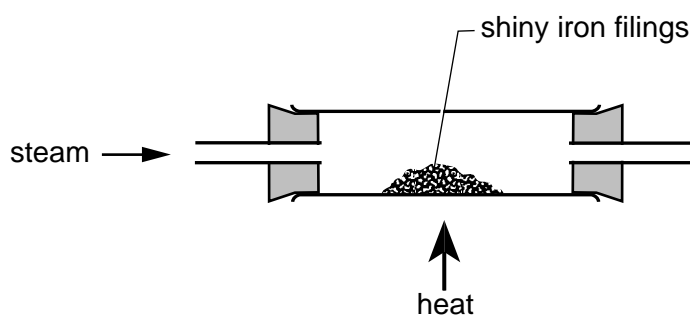
[Total:10 marks]

**B10** A student carried out an electrolysis of dilute sulphuric acid and collected the gases formed.

- (a) Draw a labelled diagram to show the apparatus used. [2]
- (b) (i) Give the formulae of all the ions present in the solution.  
 (ii) Write half equations for the reactions at the anode and cathode. Use the half equations to construct an overall equation for the reaction and give tests for any gases evolved.  
 (iii) Use your equations to explain how the composition of the solution changes after the electrolysis has been running for some time. [6]
- (c) Describe another method for making hydrogen from dilute sulphuric acid. Your answer should include names of the reagents you use and an equation for the reaction. [2]

[Total: 10 marks]

**B11** The diagram below shows an experiment in which steam was passed over hot iron filings. The products of the reaction are iron oxide,  $\text{Fe}_3\text{O}_4$ , and a gas which burns with a blue flame.



- (a) Write an equation, including state symbols, for the reaction and describe what you would see as the iron reacts with the steam. [3]
- (b) Describe how the observations would be different if the experiment was repeated using each of the following two metals in place of the iron filings.  
 (i) magnesium  
 (ii) copper [3]
- (c) (i) Both copper and aluminium are good conductors of electricity. Explain why overhead cables are usually made from aluminium and not copper.  
 (ii) Draw a diagram to show the structure and bonding of aluminium metal. Use your diagram to explain why aluminium conducts electricity so well. [4]

[Total: 10 marks]

A series of horizontal dotted lines for writing.

Dotted lines for writing.



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

		Group																																																																																													
I	II	III	IV	V	VI	VII	0					0																																																																																			
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>N</b> Nitrogen 7	15 <b>P</b> Phosphorus 15	16 <b>O</b> Oxygen 8	17 <b>Cl</b> Chlorine 17	18 <b>Ar</b> Argon 18	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10	21 <b>Sc</b> Scandium 21	22 <b>Ti</b> Titanium 22	23 <b>V</b> Vanadium 23	24 <b>Cr</b> Chromium 24	25 <b>Mn</b> Manganese 25	26 <b>Fe</b> Iron 26	27 <b>Co</b> Cobalt 27	28 <b>Ni</b> Nickel 28	29 <b>Cu</b> Copper 29	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36	37 <b>Rb</b> Rubidium 37	38 <b>Sr</b> Strontium 38	39 <b>Y</b> Yttrium 39	40 <b>Zr</b> Zirconium 40	41 <b>Nb</b> Niobium 41	42 <b>Mo</b> Molybdenum 42	43 <b>Tc</b> Technetium 43	44 <b>Ru</b> Ruthenium 44	45 <b>Rh</b> Rhodium 45	46 <b>Pd</b> Palladium 46	47 <b>Ag</b> Silver 47	48 <b>Cd</b> Cadmium 48	49 <b>In</b> Indium 49	50 <b>Sn</b> Tin 50	51 <b>Sb</b> Antimony 51	52 <b>Te</b> Tellurium 52	53 <b>I</b> Iodine 53	54 <b>Xe</b> Xenon 54	55 <b>Cs</b> Caesium 55	56 <b>Ba</b> Barium 56	57 <b>La</b> Lanthanum 57	58 <b>Ce</b> Cerium 58	59 <b>Pr</b> Praseodymium 59	60 <b>Nd</b> Neodymium 60	61 <b>Pm</b> Promethium 61	62 <b>Sm</b> Samarium 62	63 <b>Eu</b> Europium 63	64 <b>Gd</b> Gadolinium 64	65 <b>Tb</b> Terbium 65	66 <b>Dy</b> Dysprosium 66	67 <b>Ho</b> Holmium 67	68 <b>Er</b> Erbium 68	69 <b>Tm</b> Thulium 69	70 <b>Yb</b> Ytterbium 70	71 <b>Lu</b> Lutetium 71	72 <b>Hf</b> Hafnium 72	73 <b>Ta</b> Tantalum 73	74 <b>W</b> Tungsten 74	75 <b>Re</b> Rhenium 75	76 <b>Os</b> Osmium 76	77 <b>Ir</b> Iridium 77	78 <b>Pt</b> Platinum 78	79 <b>Au</b> Gold 79	80 <b>Hg</b> Mercury 80	81 <b>Tl</b> Thallium 81	82 <b>Pb</b> Lead 82	83 <b>Bi</b> Bismuth 83	84 <b>Po</b> Polonium 84	85 <b>At</b> Astatine 85	86 <b>Rn</b> Radon 86	87 <b>Fr</b> Francium 87	88 <b>Ra</b> Radium 88	89 <b>Ac</b> Actinium 89	90 <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
	<b>X</b>	X = atomic symbol
b		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.).