Centre Number	Index Number	Name

# 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.

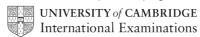
At the end of the examination, fasten all your work securely together.

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 Exami	ner's Use
Section A	
В8	
В9	
B10	
B11	
Total	

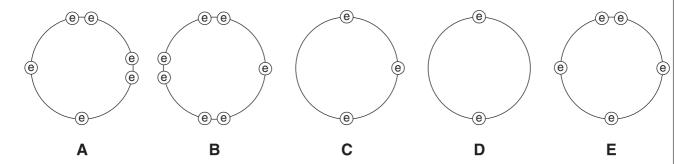
This document consists of 13 printed pages and 3 lined pages.



## **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		

1)	
_	
_	

(b)	Which element is most likely to be in Group VI?	<u>-</u> ,
		. [1]
(c)	Which element will form an ion of the type X <sup>2+</sup> ?	
(d)	Which element has an atomic number of 15?	. [1]
(u)	which element has an atomic number of 10:	. [1]
(e)	Which two elements will form an ionic compound with a formula of the type YZ <sub>2</sub> ?	

[Total: 6 marks]

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

- (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.

**Nylon monomers**  $HOOC(CH_2)_4COOH$   $H_2N(CH_2)_6NH_2$ 

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)		rmer plants peanut and millet crops. Only the peanut crop grows well. dict the pH of the soil.
(b)		ich other crop is most likely to grow well in the same soil?
(c)		farmer adds calcium hydroxide, $Ca(OH)_2$ , and ammonium sulphate, $(NH_4)_2SO_4$ , to
(-)	the	soil.
		[3]
(d)	A re	eaction occurs between calcium hydroxide and ammonium sulphate.
	(i)	Complete the equation for this reaction.
		$Ca(OH)_2 + (NH_4)_2 SO_4 \ \rightarrow \dots \\ + \ 2H_2 O$
	(ii)	Explain why the farmer should not have added these two compounds to the soil at the same time.
		[3]
		[Tatal: 0 mayles]

[Total: 8 marks]

[Total: 5 marks]

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

alkanes	acid chlorides	
formula	name	formula
C <sub>2</sub> H <sub>6</sub>	ethanoyl chloride	CH <sub>3</sub> COC <i>l</i>
C <sub>3</sub> H <sub>8</sub>		C <sub>2</sub> H <sub>5</sub> COC <i>l</i>
C <sub>4</sub> H <sub>10</sub>	butanoyl chloride	C₃H <sub>7</sub> COC <i>l</i>
C <sub>5</sub> H <sub>12</sub>	pentanoyl chloride	C <sub>4</sub> H <sub>9</sub> COC <i>l</i>

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

(a)	Nar	ne the acid chloride with the highest boiling point.	
			[1]
(b)	Dec	duce the name of the acid chloride with the formula $\mathrm{C_2H_5COC}{\it l}$ .	
			[1]
(c)	The Dec	general formula for alkanes is $C_xH_{(2x+2)}$ . duce 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 the same as in (i)? Explain your reasoning.	be
			[2]

- 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.

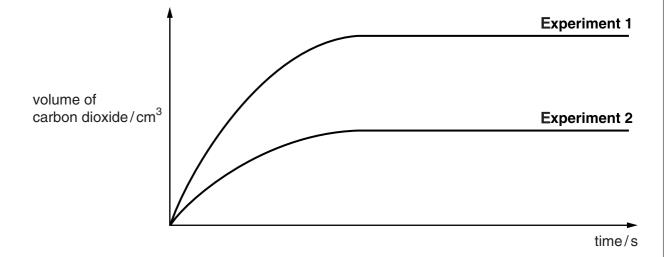
(i) 
$$2HCl(....) + CaCO_3(...) \rightarrow CaCl_2(aq) + H_2O(...) + CO_2(...)$$

(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]

•		<b>eriment 3</b> was carried out using 25 cm <sup>3</sup> of 1.5 mol/dm <sup>3</sup> sulphuric acid. initial rate of reaction for <b>Experiment 3</b> was faster than for the other experiments the reaction stopped suddenly after only a small amount of gas had been given off.
(	(i)	Name the salt formed in <b>Experiment 3.</b>
(	ii)	Explain why the reaction stops suddenly.
(i	ii)	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.

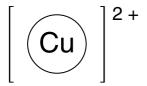
ore	formula of copper oxide in ore	oxidation number of copper	percentage of copper by mass
tenorite		+2	80.0%
cuprite	Cu <sub>2</sub> O		

(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 / %			
product	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		

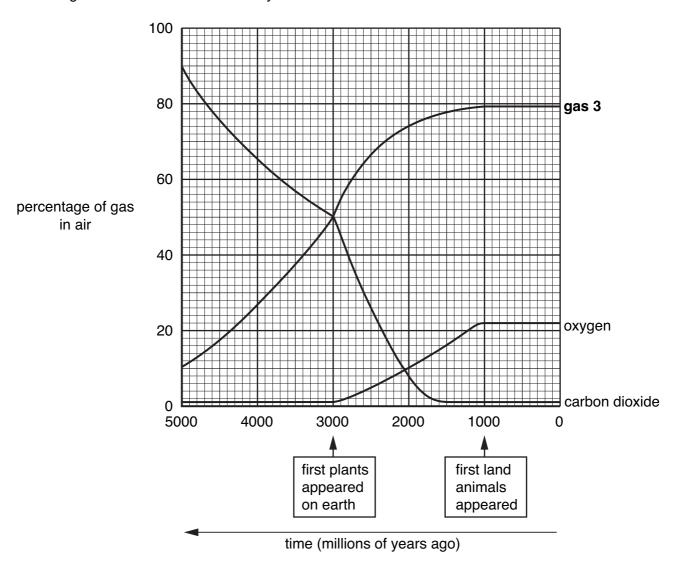
he refinery sells ethene and $C_5$ to $C_8$ hydrocarbons. thene is used to make addition polymers, and $C_5$ to $C_8$ hydrocarbons are added to petrol. se the information given to explain why the refinery must use <b>both</b> processes to meet the gh demand for both ethene and $C_5$ to $C_8$ hydrocarbons.
[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?
  - (ii) Name gas 3. Give a reason for your answer.

[3]

- (b) (i) Describe how the percentages of carbon dioxide and oxygen have changed.
  - (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 potassium chloride aqueous bromine aqueous potassium bromide aqueous iodine 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.

$$\text{Cl}_2 + \text{H}_2\text{O} \rightarrow \text{HC}l + \text{C}l\text{OH}$$

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]

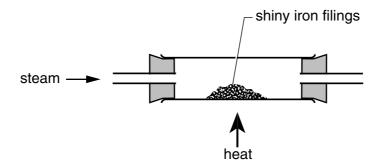
- **(b) (i)** Give the formulae of all the ions present in the solution.
  - (ii) Write half equations for the reactions at the anode and cathode. Use the half equations to construct an overall equation for the reaction and give tests for any gases evolved.
  - (iii) Use your equations to explain how 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,  $Fe_3O_4$ , 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]

15

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

DATA SHEET
The Periodic Table of the Elements

			. <b>o</b> =	O <b>0</b> 5	. <b>.</b>	4 <b>7</b> oo	- <b>0</b> g	<b>C</b> no	
		0	4 <b>He</b> lium	20 <b>Ne</b> Neon	40 <b>Ar</b> Argon 18	84 <b>Kr</b> Krypton 36	131 <b>Xe</b> Xenon 54	Radon 86	
		IIA		19 <b>T</b> Fluorine	35.5 <b>C1</b> Chlorine	80 <b>Br</b> Bromine 35	127 <b>I</b> lodine 53	At Astatine 85	
		IN		16 Oxygen 8	32 <b>S</b> Sulphur 16	79 Selenium 34	128 <b>Te</b> Tellurium 52	<b>Po</b> Polonium 84	
		^		14 Nitrogen 7	31 <b>P</b> Phosphorus 15	75 <b>AS</b> Arsenic 33	122 <b>Sb</b> Antimony 51	209 <b>Bi</b> Bismuth 83	
		Ν		12 <b>C</b> Carbon 6	28 <b>Si</b> Silicon	73 <b>Ge</b> Germanium	119 <b>Sn</b> Tin	207 <b>Pb</b> Lead 82	
		Ш		11 <b>B</b> Boron 5	27 <b>A1</b> Aluminium 13	70 <b>Ga</b> Gallium 31	115 In Indium	204 <b>T1</b> Thallium	
5						65 <b>Zn</b> Zinc 30	112 <b>Cd</b> Cadmium 48	201 <b>Hg</b> Mercury 80	
ne Periodic I able of the Elements						64 <b>Cu</b> Copper	108 <b>Ag</b> Silver 47	197 <b>Au</b> Gold 79	
e oi tue	Group					Nickel	106 Pd Palladium 46	195 <b>Pt</b> Platinum 78	
alc I ab	Gr					59 <b>Co</b> Cobalt 27	103 <b>Rh</b> Rhodium 45	192 <b>Ir</b> Iridium 77	
			Hydrogen			56 <b>Fe</b> Iron	Ruthenium	190 <b>Os</b> Osmium 76	
-						55 <b>Mn</b> Manganese 25	Tc Technetium 43	186 <b>Re</b> Rhenium 75	
						52 <b>Cr</b> Chromium 24	96 <b>Mo</b> Molybdenum 42	184 <b>W</b> Tungsten 74	
						51 V Vanadium 23	Niobium 41	181 <b>Ta</b> Tantalum 73	
						48 <b>Ti</b> Titanium 22	91 Zr Zirconium 40	178 <b>Hf</b> Hafnium 72	
						Scandium 21	89 <b>Y</b>	139 <b>La</b> Lanthanum 57 *	227
		=		9 Be Beryllium 4	24 Mg Magnesium	40 <b>Ca</b> Calcium	Strontium	137 <b>Ba</b> Barium 56	226 <b>Ra</b> Radium 88
		_		7 <b>Li</b> Lithium	Na Sodium	39  K Potassium 19	Rb Rubidium 37	133 Cs Caesium 55	<b>Fr</b> Francium 87

175 <b>Lu</b>		<b>Lr</b> Lawrencium 103
173 <b>Yb</b>	Ytterbium 70	Nobelium 102
169 <b>Tm</b>	Thulium 69	Md Mendelevium 101
167 <b>Er</b>	Erbium 68	Fm Fermium 100
165 <b>Ho</b>	67	Einsteinium 99
162 <b>Dy</b>	Dysprosium 66	Cf Californium 98
159 <b>Tb</b>	Terbium 65	<b>BK</b> Berkelium 97
157 <b>Gd</b>	Gadolinium 64	Cm Curium 96
152 <b>Eu</b>	Europium 63	Am Americium 95
150 <b>Sm</b>	Samarium 62	<b>Pu</b> Plutonium 94
Pm	Promethium 61	Np Neptunium 93
441 <b>Nd</b>	Neodymium 60	238 <b>U</b> Uranium 92
141 <b>Pr</b>	Praseodymium 59	<b>Pa</b> Protactinium 91
140 <b>Ce</b>	Serium	232 <b>Th</b> Thorium

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).

b = proton (atomic) number

a = relative atomic massX = atomic symbol

Key

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