

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.

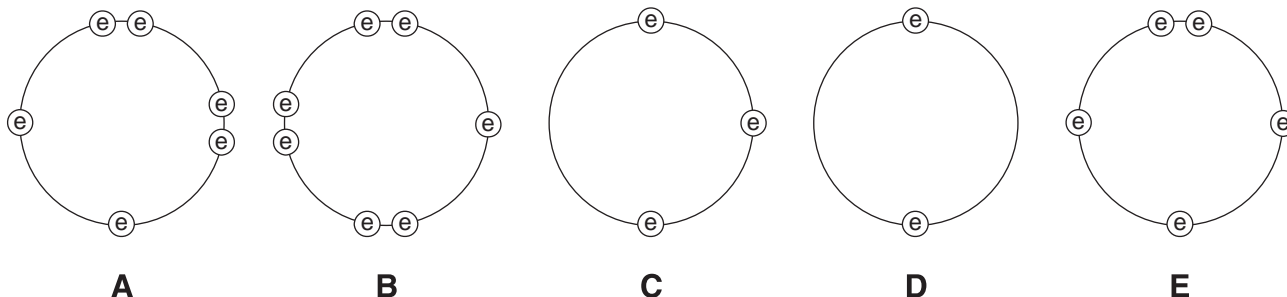
You may use a calculator.
You may use a pencil for any diagrams, graphs, or rough working.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.
A copy of the Periodic Table is printed on page 16.

For Examiner's Use	
Section A	
B8	
B9	
B10	
B11	
Total	

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]

- 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 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.

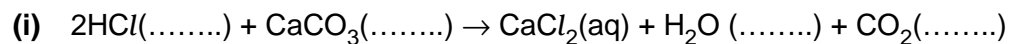
..... [2]

[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 cm³ of 1.5 mol/dm³ hydrochloric acid was used.

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

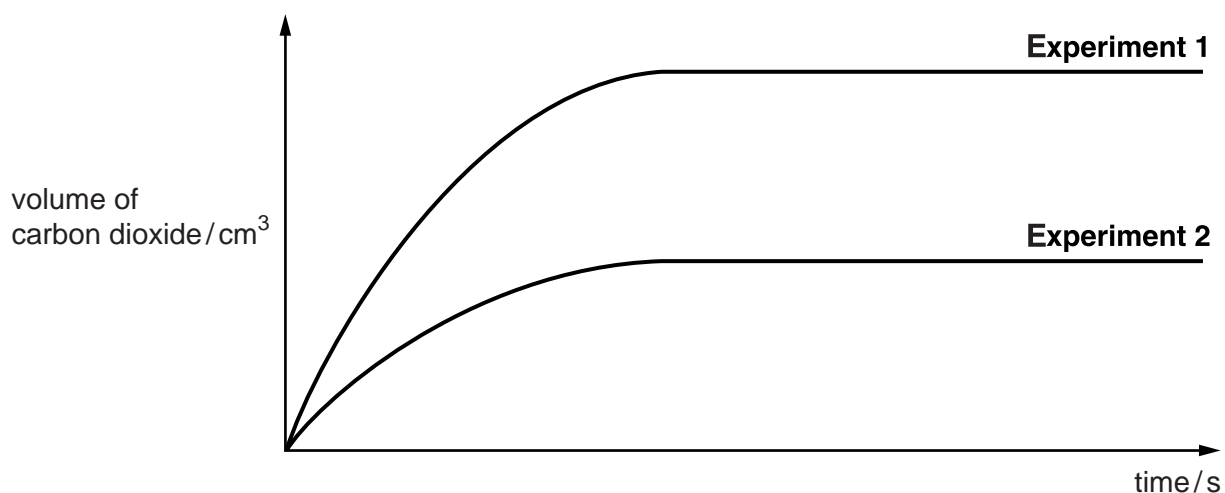


(ii) Calculate the total volume of carbon dioxide that is made from this reaction at r.t.p.

[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.

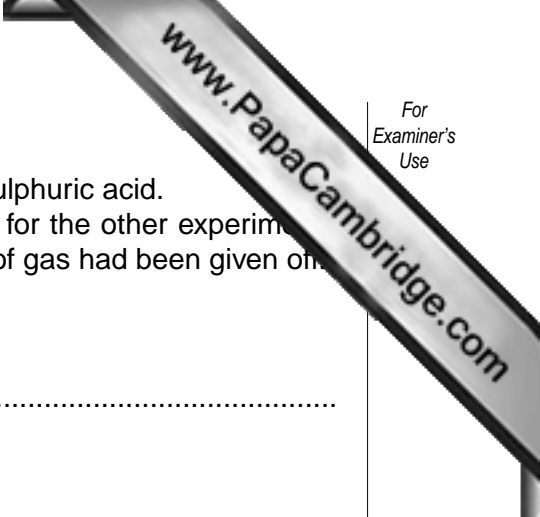


Suggest the **concentration** and **volume** of acid used for **Experiment 2**.

concentration mol/dm³

volume cm³

[2]



(c) **Experiment 3** was carried out using 25 cm³ of 1.5 mol/dm³ 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_2O		

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

.....

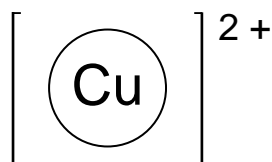
- (ii) What is the oxidation number of copper in cuprite, Cu_2O ?

.....

- (iii) Calculate the percentage of copper by mass in Cu_2O .

[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 ₄ hydrocarbons	9	10
C ₅ to C ₈ hydrocarbons	27	40

The refinery sells ethene and C₅ to C₈ hydrocarbons. Ethene is used to make addition polymers, and C₅ to C₈ 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 C₅ to C₈ hydrocarbons.

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

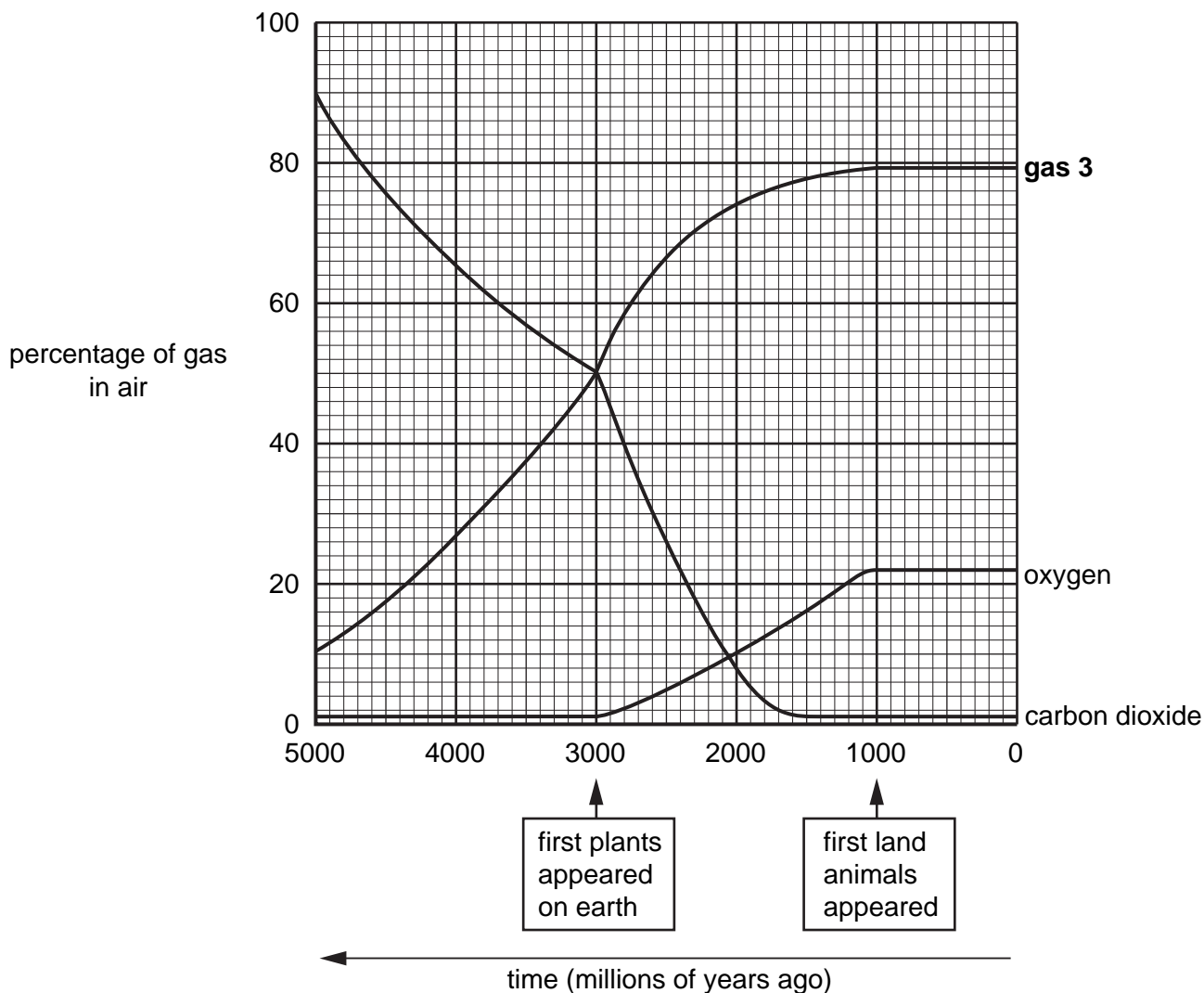
[Total: 2 marks]

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]

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

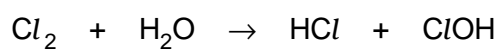
aqueous potassium chloride
aqueous potassium bromide
aqueous potassium iodide

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 in two test tubes.

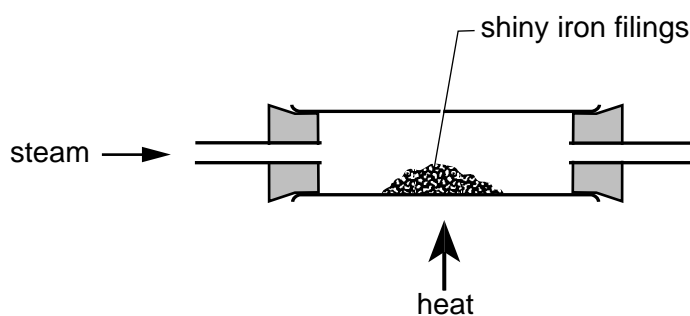
- (a) Draw a labelled diagram to show the apparatus used.
- (b) (i) Give the formulae of all the ions present in the solution.
 (ii) Write half equations for the reactions at the anode and cathode. Use the half equations to construct an overall equation for the reaction and give tests for any gases evolved.
 (iii) Use your equations to explain how the composition of the solution changes after the electrolysis has been running for some time.
- (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.

[6]

[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.
- (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
- (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.

[3]

[3]

[4]

[Total: 10 marks]

DATA SHEET
The Periodic Table of the Elements

		Group									
		I	II	III	IV	V	VI	VII	VIII	IX	X
7	3	Li Lithium	Be Beryllium	H Hydrogen	B Boron	C Carbon	N Nitrogen	O Oxygen	F Fluorine	Ne Neon	He Helium
23	11	Na Sodium	Mg Magnesium		Al Aluminium	Si Silicon	P Phosphorus	S Sulphur	Cl Chlorine	Ar Argon	
39	19	K Potassium	Ca Calcium		Ga Gallium	Ge Germanium	As Arsenic	Se Selenium	Br Bromine	Kr Krypton	
85	37	Rb Rubidium	Sr Strontium		In Indium	Sn Tin	Sb Antimony	Te Tellurium	I Iodine	Xe Xenon	
133	55	Cs Caesium	Ba Barium		Tl Thallium	Pb Lead	Bi Bismuth	Po Polonium	At Astatine	Rn Radon	
87	37	Fr Francium	Ra Radium		Tl Thallium	Pb Lead	Bi Bismuth	Po Polonium	At Astatine	Rn Radon	
226	88	Fr Francium	Ra Radium		Tl Thallium	Pb Lead	Bi Bismuth	Po Polonium	At Astatine	Rn Radon	
227	89	Ac Actinium			Tl Thallium	Pb Lead	Bi Bismuth	Po Polonium	At Astatine	Rn Radon	

140	58	Ce Cerium	Pr Praseodymium	Nd Neodymium	Pm Promethium	Sm Samarium	Eu Europium	Gd Gadolinium	Tb Terbium	Dy Dysprosium	Ho Holmium	Er Erbium	Tm Thulium	Yb Ytterbium	Lu Lutetium
232	90	Th Thorium	Pa Protactinium	U Uranium	Np Neptunium	Pu Plutonium	Am Americium	Cm Curium	Bk Berkelium	Cf Californium	Es Einsteinium	Fm Fermium	Md Mendelevium	No Nobelium	Lr Lawrencium

58-71 Lanthanoid series
90-103 Actinoid series

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).