

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CHEMISTRY



Paper 3 (Extended)

0620/03

May/June 2005

1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials required.

Candidate
Name

--

Centre
Number

--	--	--	--	--

Candidate
Number

--	--	--	--

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.

You may use a pencil for any diagrams, graphs or rough working.

WRITE IN THE BOXES PROVIDED ON THE QUESTION PAPER

DO **NOT** WRITE IN THE BARCODE.

DO **NOT** WRITE IN THE GREY AREAS BETWEEN THE PAGES.

Do not use staples, paper clips, highlighters, glue or correction fluid.

You may use a calculator.

Answer **all** questions.

The number of marks is given in brackets [] at the end of each question or part questions.

A copy of the Periodic Table is printed on page 16.

For Examiner's Use

1	
2	
3	
4	
5	
6	
Total	

This document consists of **14** printed pages and **2** blank pages.



1 Three of the halogens in Group VII are:

chlorine
bromine
iodine

For
Examiner's
Use

(a) (i) How does their colour change down the Group?

..... [1]

(ii) How does their physical state (solid, liquid or gas) change down the Group?

..... [1]

(iii) Predict the colour and physical state of fluorine.

colour

physical state [2]

(b) Describe how you could distinguish between aqueous potassium bromide and aqueous potassium iodide.

test

result with bromide

result with iodide [3]

(c) 0.015 moles of iodine react with 0.045 moles of chlorine to form 0.030 moles of a single product. Complete the equation.



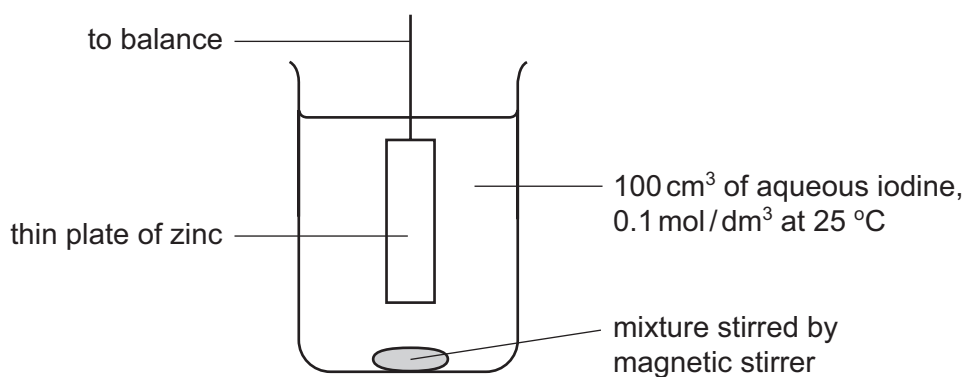
(d) Traces of chlorine can be separated from bromine vapour by diffusion.
Which gas would diffuse the faster and why?

.....

..... [2]

- 2 The following apparatus was used to measure the rate of the reaction between zinc and iodine.

For
Examiner's
Use



The mass of the zinc plate was measured every minute until the reaction was complete.

- (a) Write an ionic equation for the redox reaction that occurred between zinc atoms and iodine molecules.

..... [2]

- (b) Describe how you could show by adding aqueous sodium hydroxide and aqueous ammonia that a solution contained zinc ions.

result with sodium hydroxide

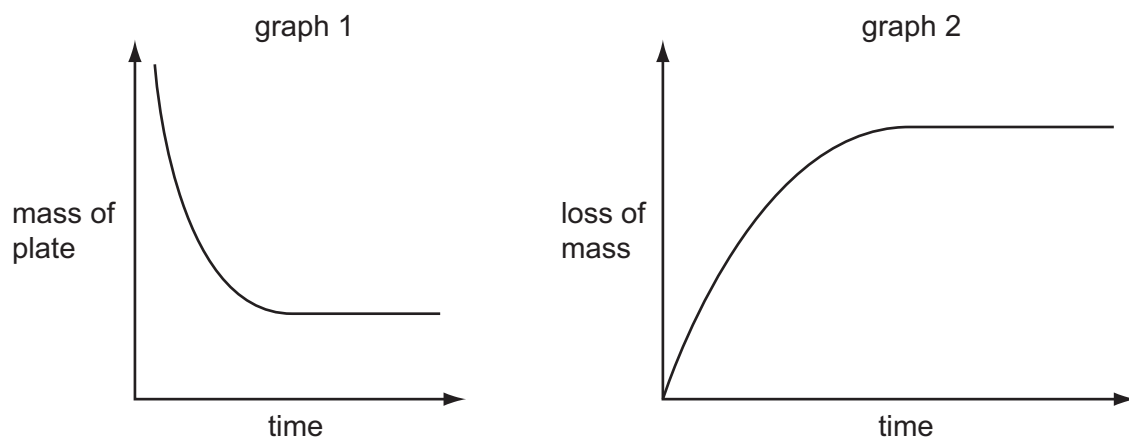
excess sodium hydroxide

result with aqueous ammonia

excess aqueous ammonia [3]

(c) From the results of this experiment two graphs were plotted.

For
Examiner's
Use



(i) Which reagent iodine or zinc was in excess? Give a reason for your choice.

..... [1]

(ii) Describe how the shape of graph 1 would change if 100cm^3 of 0.05 mol/dm^3 iodine had been used.

.....

..... [2]

(iii) On graph 2, sketch the shape if the reaction had been carried out using 100 cm^3 of 0.1 mol/dm^3 iodine at 35°C instead of at 25°C . [2]

- 3 A South Korean chemist has discovered a cure for smelly socks. Small particles of silver are attached to a polymer, poly(propene), and this is woven into the socks.

For
Examiner's
Use

(a) (i) Give the structural formula of the monomer.

[1]

(ii) Draw the structural formula of the polymer.

[2]

(iii) Suggest which one, monomer or polymer, will react with aqueous bromine and why?

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

(b) To show that the polymer contains silver the following test was carried out.

The polymer fibres were chopped into small pieces and warmed with nitric acid. The silver atoms were oxidised to silver(I) ions. The mixture was filtered. Aqueous sodium chloride was added to the filtrate and a white precipitate formed.

(i) Why was the mixture filtered?

..... [1]

(ii) Explain why the change of silver atoms to silver ions is oxidation.

..... [1]

(iii) Give the name of the white precipitate.

..... [1]

- (c) The unpleasant smell is caused by carboxylic acids. Bacteria cause the fats on the skin to be hydrolysed to these acids. Silver kills the bacteria and prevents the hydrolysis of the fats.

- (i) Fats are esters. Give the name and structural formula of an ester.

name [1]

structural formula

[1]

- (ii) Complete the word equation.

Ester + water \longrightarrow carboxylic acid + [1]

- (d) Propanoic acid is a weak acid.

- (i) The following equation represents its reaction with ammonia.



Explain why propanoic acid behaves as an acid and ammonia as a base.

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

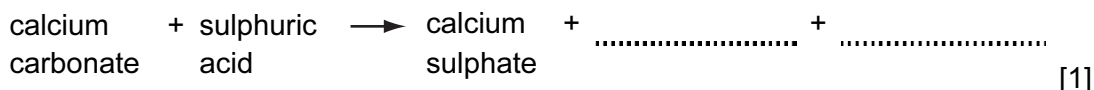
- (ii) Explain the expression *weak acid*.

..... [1]

- 4 The Carlsbad caverns in New Mexico are very large underground caves. Although the walls of these caves are coated with gypsum (hydrated calcium sulphate), the caves have been formed in limestone.

(a) It is believed that the caves were formed by sulphuric acid reacting with the limestone.

(i) Complete the word equation.



(ii) Describe how you could test the water entering the cave to show that it contained sulphate ions.

test

result [2]

(iii) How could you show that the water entering the cave has a high concentration of hydrogen ions?

..... [1]

(b) Hydrogen sulphide gas which was escaping from nearby petroleum deposits was being oxidised to sulphuric acid.

(i) Complete the equation for this reaction forming sulphuric acid.



(ii) Explain why all the hydrogen sulphide should be removed from the petroleum before it is used as a fuel.

.....

..... [1]

- (iii) Draw a diagram to show the arrangement of the valency electrons in one molecule of the covalent compound hydrogen sulphide.
Use o to represent an electron from a sulphur atom.
Use x to represent an electron from a hydrogen atom.

[2]

- (c) Sulphuric acid is manufactured by the Contact Process. Sulphur dioxide is oxidised to sulphur trioxide by oxygen.



- (i) Name the catalyst used in this reaction.

..... [1]

- (ii) What temperature is used for this reaction?

..... [1]

- (iii) Describe how sulphur trioxide is changed into sulphuric acid.

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

- (d) Gypsum is hydrated calcium sulphate, $\text{CaSO}_4 \cdot x\text{H}_2\text{O}$. It contains 20.9% water by mass. Calculate x.

M_r : CaSO_4 , 136; H_2O , 18.

79.1 g of CaSO_4 = moles

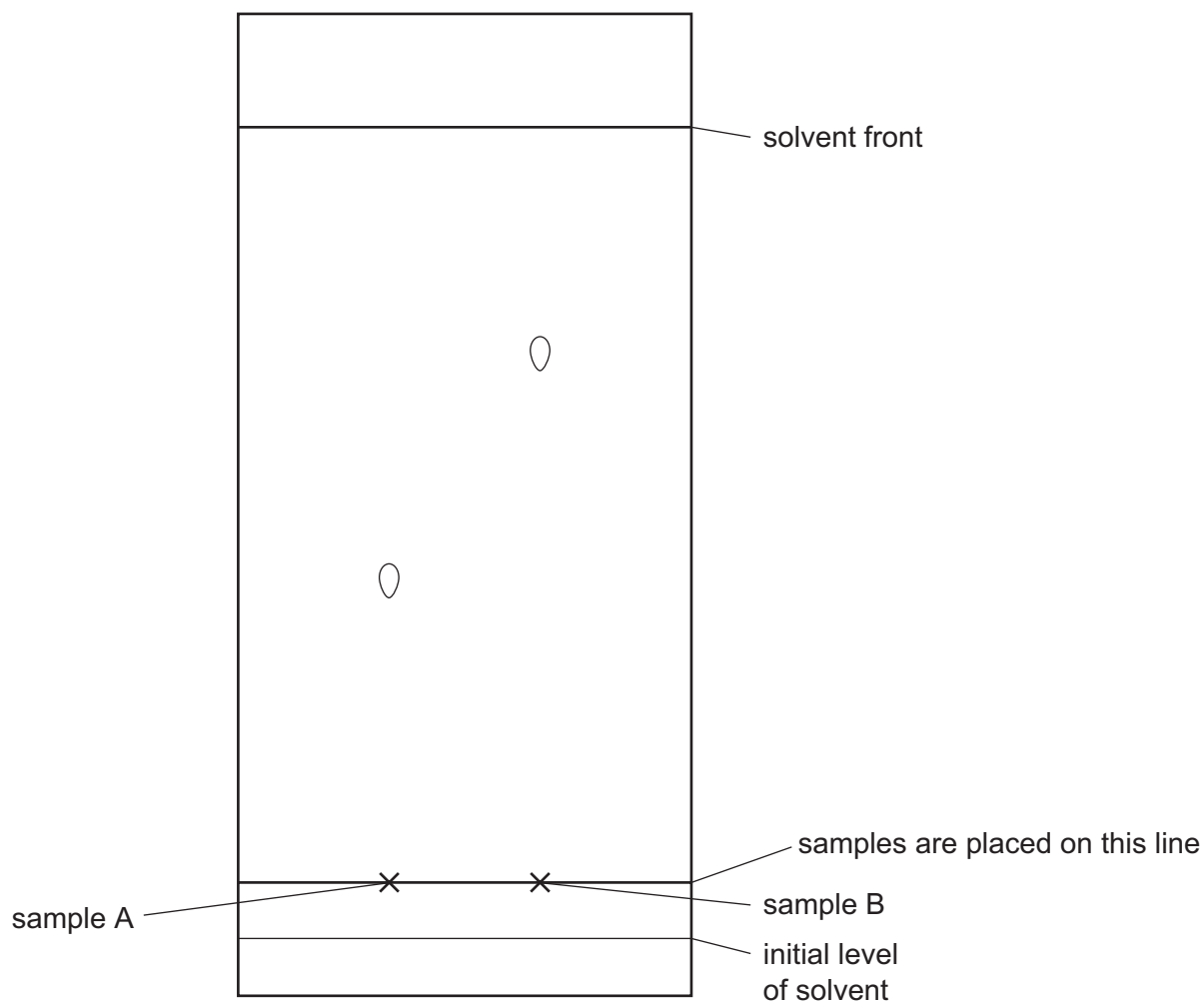
20.9 g of H_2O = moles

x = [3]

- 5 Enzymes are biological catalysts. They are used both in research laboratories and in industry.

For
Examiner's
Use

- (a) Enzymes called proteases can hydrolyse proteins to amino acids. The amino acids can be separated and identified by chromatography. The diagram below shows a typical chromatogram.



- (i) The R_f value of a sample = $\frac{\text{distance travelled by sample}}{\text{distance travelled by solvent front}}$

Some R_f values for amino acids are:

glutamic acid = 0.4 glycine = 0.5 alanine = 0.7 leucine = 0.9

Identify the two amino acids on the chromatogram.

A is B is [2]

- (ii) Explain why the chromatogram must be exposed to a locating agent before R_f values can be measured.

..... [1]

- (iii) Measuring R_f values is one way of identifying amino acids on a chromatogram. Suggest another.

..... [1]

- (iv) The synthetic polymer, nylon, has the same linkage as proteins. Draw the structural formula of nylon.

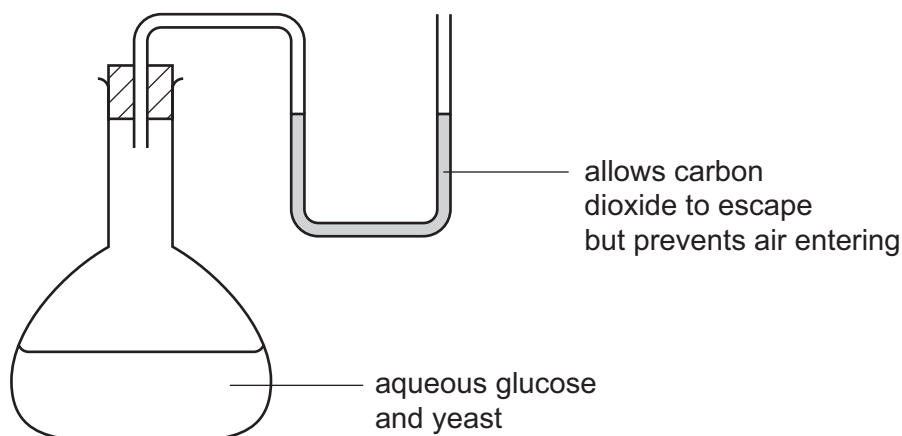
[3]

- (b) Enzymes called carbohydrases can hydrolyse complex carbohydrates to simple sugars which can be represented as $\text{HO} - \boxed{\phantom{\text{CH}_2\text{OH}}} - \text{OH}$. Draw the structure of a complex carbohydrate.

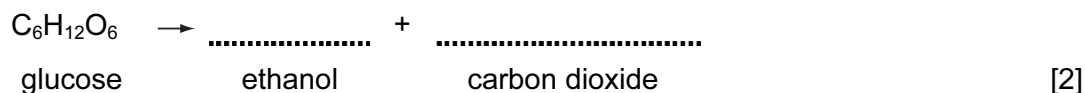
[2]

- (c) Fermentation can be carried out in the apparatus drawn below. After a few days the reaction stops. It has produced a 12% aqueous solution of ethanol.

For
Examiner's
Use



- (i) Complete the equation.



- (ii) Zymase catalyses the anaerobic respiration of glucose. Define the term *respiration*.

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

- (iii) Suggest a reason why the reaction stops after a few days.

..... [1]

- (iv) Why is it essential that there is no oxygen in the flask?

..... [1]

- (v) What technique is used to concentrate the aqueous ethanol?

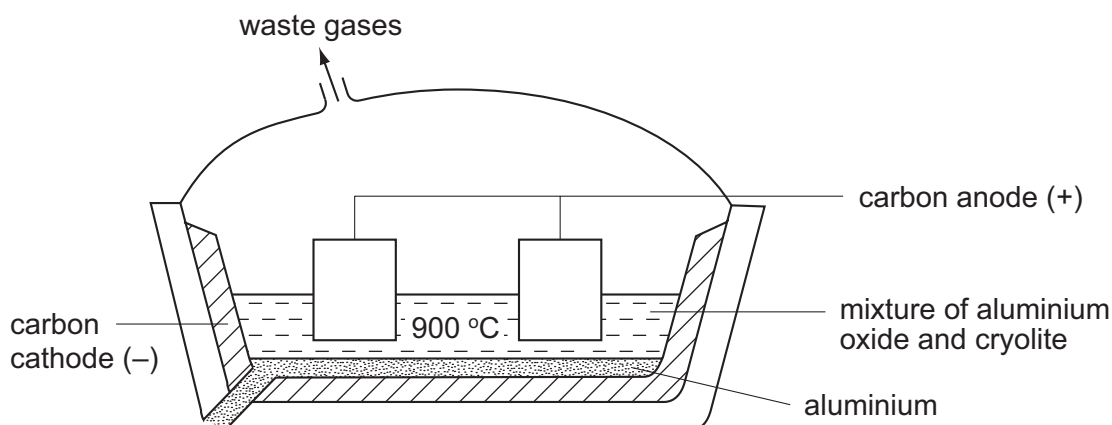
..... [1]

- 6 The position of aluminium in the reactivity series of metals is shown below.

magnesium
aluminium
zinc
copper

For
Examiner's
Use

- (a) Aluminium is extracted by the electrolysis of its molten oxide.



- (i) Name the main ore of aluminium.

..... [1]

- (ii) Why does the molten electrolyte contain cryolite?

..... [1]

- (iii) Oxygen is produced at the positive electrode (anode). Name another gas which is given off at this electrode.

..... [1]

- (b) Aluminium reacts very slowly with aqueous copper(II) sulphate.



- (i) Which of the two metals has the greater tendency to form ions?

..... [1]

- (ii) Describe what you would see when this reaction occurs.

..... [1]

- (iii) Explain why aluminium reacts so slowly.

..... [1]

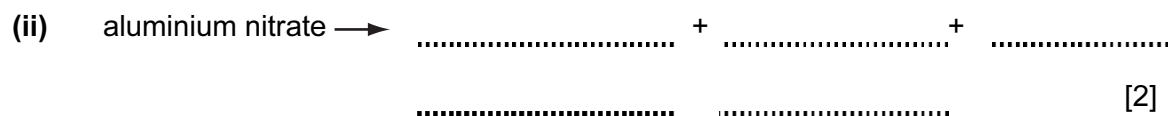
- (c) Complete the following table by writing “reaction” or “no reaction” in the spaces provided.

For
Examiner's
Use

oxide	type of oxide	reaction with acid	reaction with alkali
magnesium	basic
aluminium	amphoteric

[2]

- (d) Predict the equations for the decomposition of the following aluminium compounds.



BLANK PAGE

BLANK PAGE

Every reasonable effort has been made to trace all copyright holders where the publishers (i.e. UCLES) are aware that third-party material has been reproduced. The publishers would be pleased to hear from anyone whose rights they have unwittingly infringed.

University of Cambridge International Examinations is part of the University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

DATA SHEET

The Periodic Table of the Elements

Group																		
I	II											III	IV	V	VI	VII	0	
		<div>1 H Hydrogen 1</div>																
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	210 Po Polonium 84	222 At Astatine 85	222 Rn Radon 86	
226 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89																

*58-71 Lanthanoid series
90-103 Actinoid series

a

X

b

a = relative atomic mass

X = atomic symbol

b = proton (atomic) number

Key

140	Ce	Cerium	58	141	Pr	Praseodymium	59	144	Nd	Neodymium	60	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	238	Pa	Protactinium	91	238	U	Uranium	92	238	Pu	Plutonium	94	238	Np	Neptunium	93	238	Am	Americium	95	238	Cm	Curium	96	238	Bk	Berkelium	97	238	Cf	Californium	98	238	Es	Einsteinium	99	238	Fm	Fermium	100	238	Md	Mendelevium	101	238	No	Nobelium	102	238	Lr	Lawrencium	103

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