



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CHEMISTRY

0620/23

Paper 2

October/November 2013

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

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

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

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

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

You may lose marks if you do not show your working or if you do not use appropriate units.

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.

This document consists of **15** printed pages and **1** blank page.



1 (a) Choose from the list of metals below to answer the following questions.

- aluminium
- barium
- calcium
- iron
- lithium
- silver

Each metal can be used once, more than once or not at all.

- (i) Which metal has an atom with three electrons in its outer electron shell?
..... [1]
- (ii) Which **two** metals are in the same Period of the Periodic Table?
..... and [1]
- (iii) Which metal has an atom with three protons in its nucleus?
..... [1]
- (iv) Which metal has a nitrate which is used to test for halide ions?
..... [1]
- (v) Which metal is used in food containers because of its resistance to corrosion?
..... [1]

- (b) Describe **two** chemical properties of iron.
- 1.
 - 2. [2]

- (c) Describe briefly how iron from the blast furnace is made into steel.
-
-
- [2]

[Total: 9]

2 Helium is in Group 0 of the Periodic Table.

(a) Describe the structure of a helium atom. Use your Periodic Table to help you.
In your answer, include

- the type and number of subatomic particles present,
- the position of these particles in the atom,
- the relative charges on the particles.

.....

.....

.....

.....

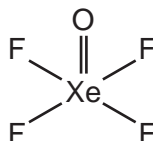
.....

..... [5]

(b) Give **one** use of helium.

..... [1]

(c) Some elements in Group 0 can form compounds with fluorine and oxygen.
The structure of one of these compounds is shown below.



Calculate the relative molecular mass of this compound.
Use your Periodic Table to help you.
You must show all your working.

[2]

(d) Fluorine is a diatomic molecule. It melts at -220°C and boils at -188°C .

(i) What is the physical state of fluorine

at room temperature,

at -200°C ? [2]

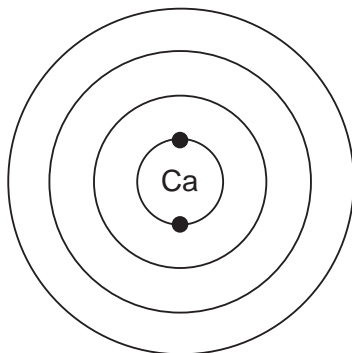
(ii) What is meant by the term *diatomic*?

..... [1]

[Total: 11]

3 This question is about calcium and some calcium compounds.

- (a) Calcium is in Group II of the Periodic Table.
Complete the diagram below to show the electronic structure of calcium.

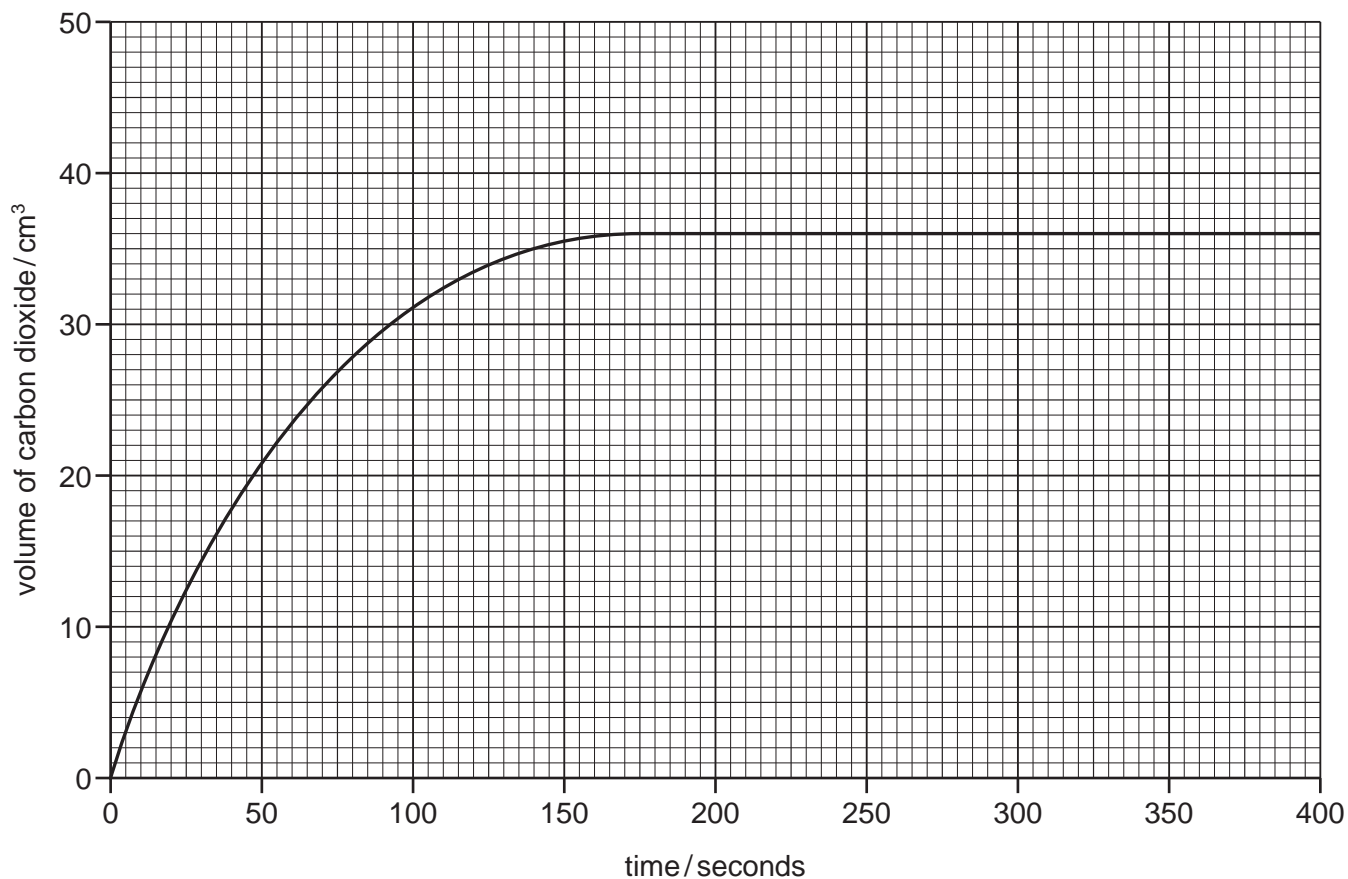


[2]

- (b) Calcium reacts with hydrochloric acid to form a salt with the formula CaCl_2 .
State the name of this salt.

..... [1]

- (c) Calcium carbonate reacts with hydrochloric acid.
The course of this reaction can be followed by measuring the volume of carbon dioxide given off at various time intervals.
The graph below shows the results obtained from an experiment using 0.15 g of calcium carbonate in small pieces.



- (i) What volume of gas is given off in the first 75 seconds of the reaction?

..... [1]

- (ii) On the grid opposite, sketch the line you would expect for the same reaction using large pieces of calcium carbonate. Assume that the mass of the calcium carbonate and all other conditions remain the same. [2]

- (iii) What would happen to the rate of this reaction if:

the temperature is increased,

.....

the concentration of hydrochloric acid is decreased?

..... [2]

- (d) When calcium carbonate is heated at high temperatures, calcium oxide and carbon dioxide are formed.

- (i) Which **one** of the following words best describes this reaction?
Put a ring around the correct answer.

combustion **decomposition** **exothermic** **reduction**

[1]

- (ii) Describe a test for carbon dioxide.

test

result [2]

- (e) Calcium oxide can be used to neutralise acidic industrial waste.

- (i) Complete the word equation for the reaction of calcium oxide with nitric acid.

calcium oxide + nitric acid → +

..... [2]

- (ii) State **one** other use of calcium oxide.

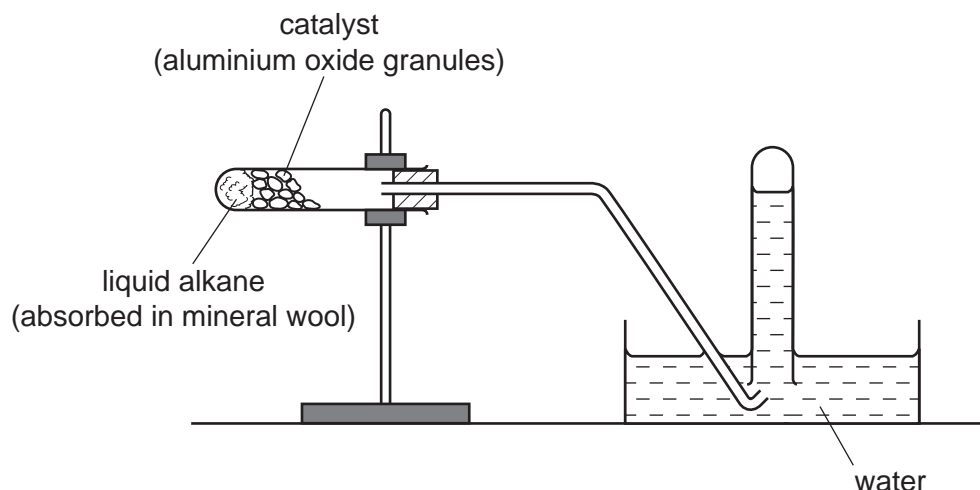
..... [1]

- (iii) When calcium oxide reacts with water, heat is given off.
State the name given to a chemical reaction which gives off heat.

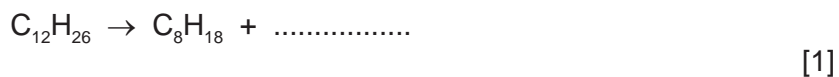
..... [1]

[Total: 15]

- 4 The diagram shows how a liquid alkane can be cracked in a school laboratory to form a mixture of gaseous and liquid hydrocarbons.



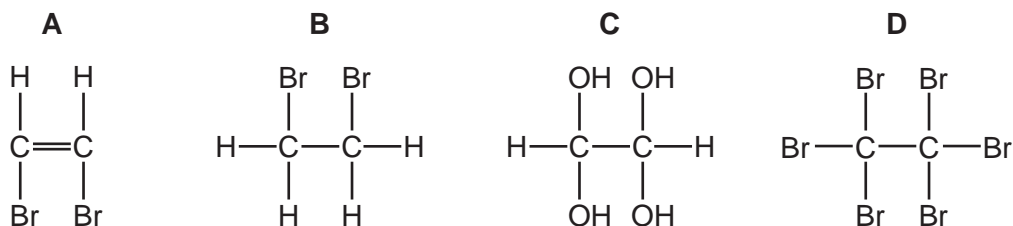
- (a) What piece of apparatus is missing from the diagram?
 [1]
- (b) On the diagram above, put an **X** to show where the gas is collected. [1]
- (c) What is the purpose of the catalyst?
 [1]
- (d) Complete the equation to show the cracking of dodecane, $C_{12}H_{26}$, to form octane and **one** other substance.



- (e) Cracking produces a mixture of shorter-chain alkanes and alkenes.
- (i) Describe what you would observe when a few drops of bromine water are added to an alkene.

..... [1]

- (ii) Which one of the following compounds, **A**, **B**, **C** or **D**, is formed when bromine water reacts with ethene?



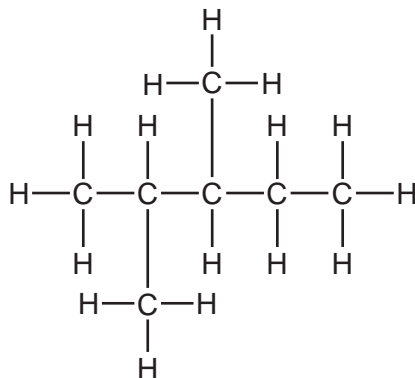
..... [1]

- (iii) Poly(ethene) is made by combining ethene monomers.
Which one of the following describes this reaction?
Tick **one** box.

decomposition	<input type="checkbox"/>
neutralisation	<input type="checkbox"/>
oxidation	<input type="checkbox"/>
polymerisation	<input type="checkbox"/>

[1]

- (f) Many alkanes found in petrol are branched hydrocarbons.
One example is shown below.



- (i) Write the molecular formula for this hydrocarbon.

..... [1]

- (ii) What is meant by the term *hydrocarbon*?

..... [1]

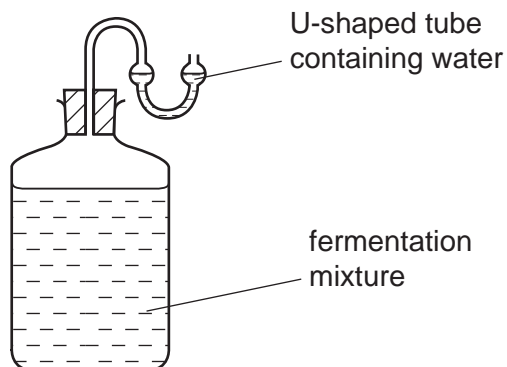
- (g) State the name of the **two** products formed when a hydrocarbon burns in excess air.

..... and [2]

[Total: 11]

5 Ethanol can be made by fermentation.

For
Examiner's
Use



(a) Apart from yeast, what other substances are present in the reaction mixture?
Tick **two** boxes.

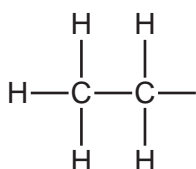
- copper sulfate
- ethene
- sugar
- methane
- water

[2]

(b) What method is used to separate ethanol from the rest of the reaction mixture?

..... [1]

(c) Complete the structure of ethanol.



[1]

(d) Ethanol belongs to the alcohol homologous series.

Which **one** of the following compounds also belongs to the alcohol homologous series?
Put a ring around the correct answer.

butene **hexane** **ethanoic acid** **octanol**

[1]

(e) Describe **one** other way, apart from fermentation, by which ethanol can be made on an industrial scale. Include the necessary reaction conditions in your answer.

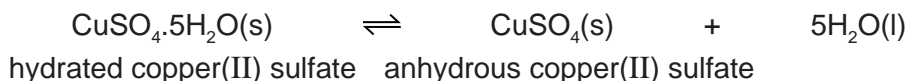
.....

.....

..... [3]

[Total: 8]

6 (a) When hydrated copper(II) sulfate is heated, the following reaction occurs:



(i) What does the sign \rightleftharpoons mean?

..... [1]

(ii) Explain how this reaction is used as a chemical test for water.

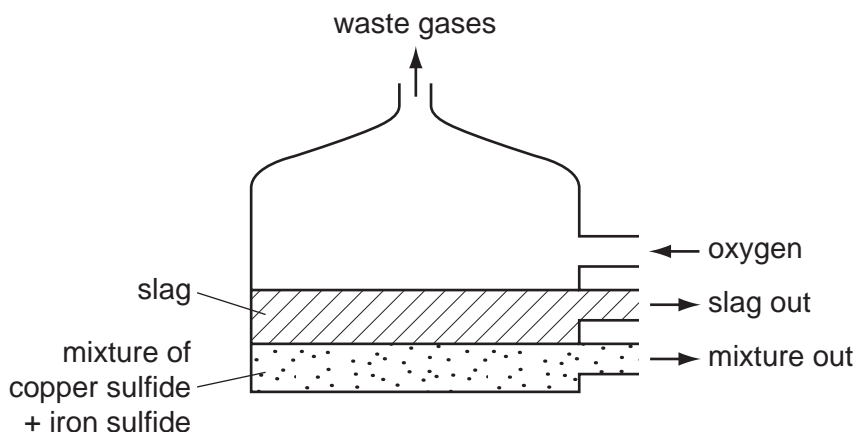
.....
..... [2]

(iii) Copper(II) sulfate is a salt.
Sodium chloride is also a salt. Solid sodium chloride does not conduct electricity.
Suggest **two** things you could do to make solid sodium chloride conduct electricity.

1.
2. [2]

(b) Copper ore contains copper, iron and sulfur.
Copper is extracted by heating copper ore with sand and oxygen.

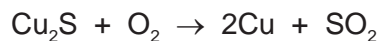
(i) In the first stage of this process, the copper ore is heated in a furnace.
A liquid mixture containing copper sulfide and iron sulfide is formed. The sand reacts with the impurities to form a slag.



What information in the diagram above suggests that the slag is less dense than the mixture of copper and iron sulfides.

..... [1]

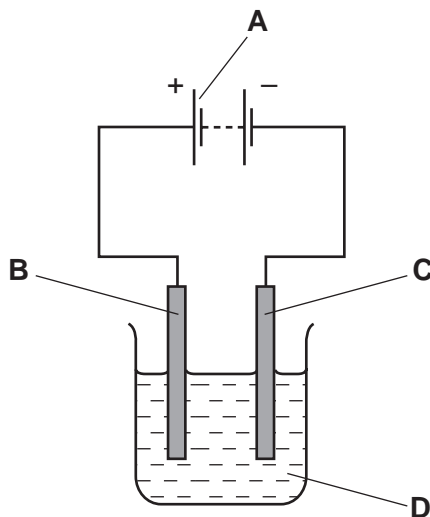
(ii) In a later stage, copper sulfide is reacted with more oxygen.



How does this equation show that the sulfur in copper sulfide gets oxidised?

..... [1]

(iii) Copper is purified by electrolysis using copper electrodes.



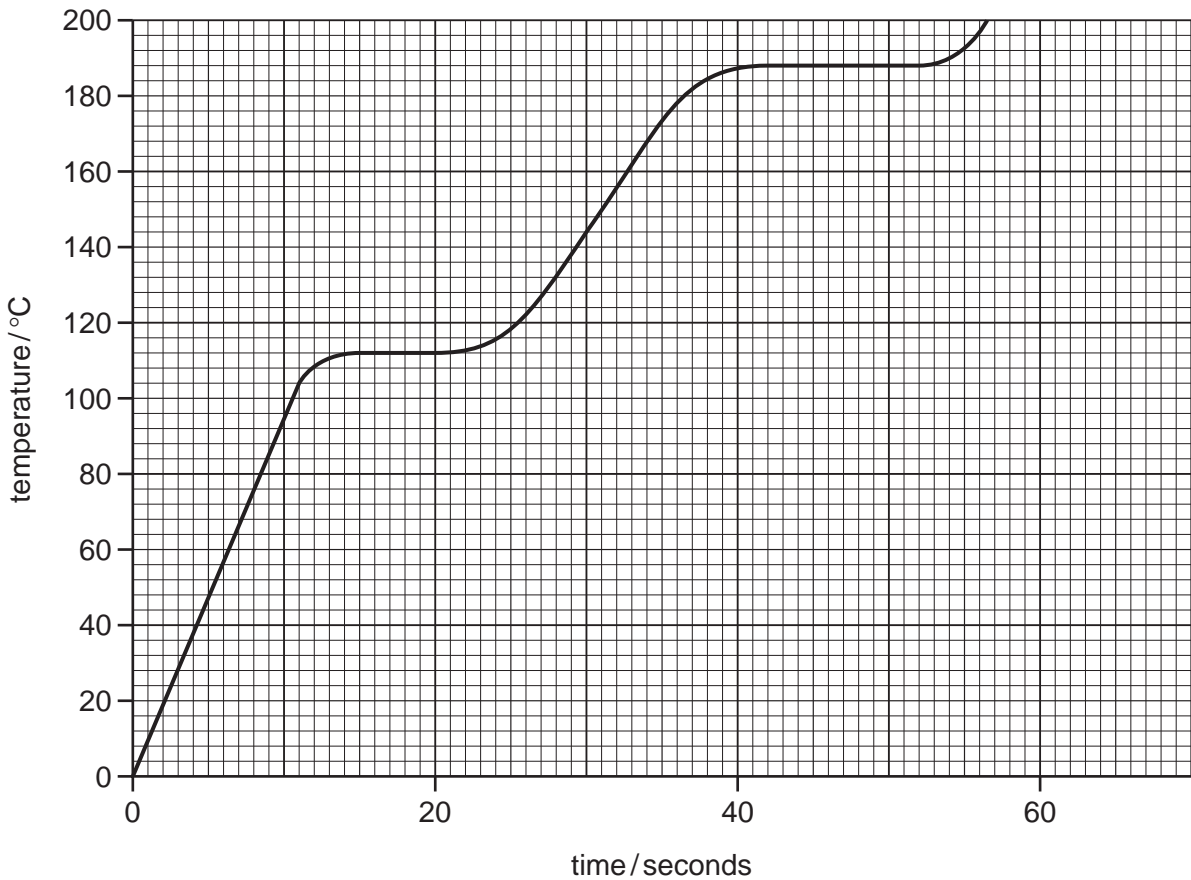
Which letter, **A**, **B**, **C** or **D**, in the diagram above represents

the cathode,

the electrolyte? [2]

[Total: 9]

- 7 The graph below shows how the temperature rises with time when a solid, **P**, is heated steadily and changes to a liquid and then to a gas.



- (a) Use the information on the graph to deduce

the melting point of **P**,

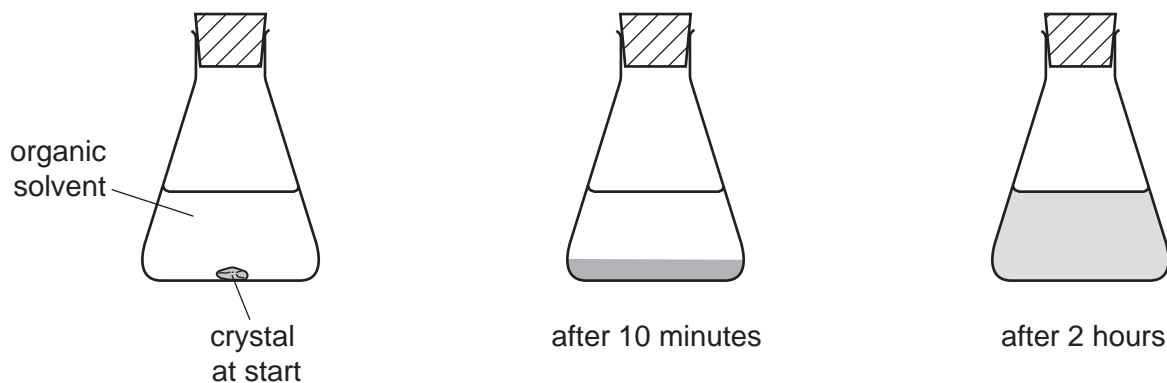
the state of **P** at 160 °C. [2]

- (b) Explain what happens to the arrangement and motion of the particles when a solid changes to a liquid.

arrangement

motion [2]

- (c) A student placed a purple crystal in a flask of organic solvent.
After 10 minutes, the crystal had completely disappeared and a dense purple colour was observed at the bottom of the flask.
After 2 hours, the purple colour had spread throughout the solvent.



Use the kinetic particle theory to explain these observations.

.....

.....

.....

..... [3]

[Total: 7]

8 (a) State **two** differences between a mixture and a compound.

.....

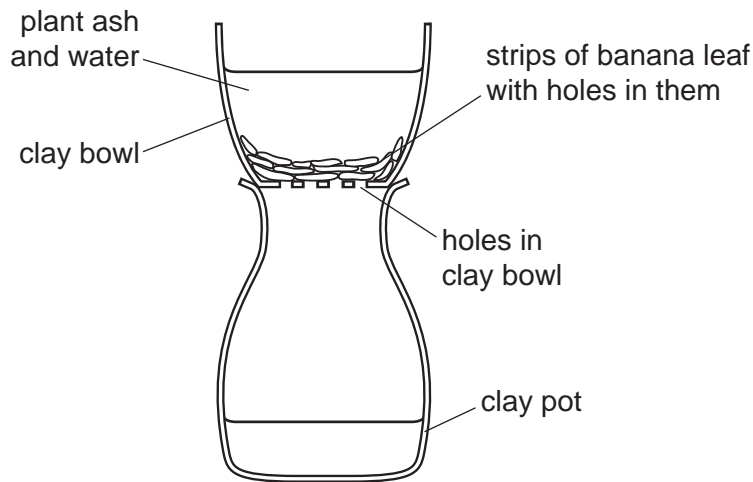
 [2]

(b) Plant ash is a mixture of large insoluble particles and salts which are soluble in water.

In parts of Africa, salts are traditionally obtained from plant ash.

Water is added to the plant ash.

The apparatus shown below is then used to remove the insoluble particles.



Explain how this apparatus separates the salts from the insoluble particles.

.....

 [2]

- (c) The composition and solubility of some salts found in the ash from the papyrus plant are shown in the table below.

salt	ion present in the salt	mass of salt per 100g of ash/g	solubility of salt in g/dm ³
magnesium sulfate	Mg ²⁺ and SO ₄ ²⁻	5	220
potassium carbonate	K ⁺ and CO ₃ ²⁻	10	1120
potassium chloride	K ⁺ and Cl ⁻	18	359
potassium sulfate		4	122
sodium carbonate	Na ⁺ and CO ₃ ²⁻	12	70
sodium chloride	Na ⁺ and Cl ⁻	40	359

- (i) Which salt in the table has the lowest solubility in g/dm³?

..... [1]

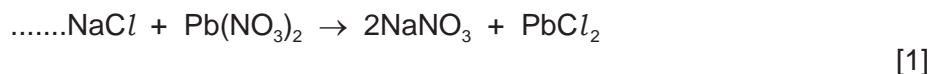
- (ii) Which negatively-charged ion is present in the highest amount in the ash?

..... [1]

- (iii) Write the symbols for the **two** ions present in potassium sulfate.

..... [2]

- (d) Sodium chloride reacts with lead(II) nitrate to form sodium nitrate and lead(II) chloride. Complete the symbol equation for this reaction.



- (e) Complete the following sentence about the formation of chloride ions.

Chloride ions are formed when chlorine atoms gain [1]

[Total: 10]

DATA SHEET
The Periodic Table of the Elements

		Group																																																																																																																																																																																																																																																																																				
I	II	III	IV	V	VI	VII	0																																																																																																																																																																																																																																																																															
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10	18 Ar Argon 18	19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	104 Rf Rutherfordium 104	105 Db Dubnium 105	106 Sg Seaborgium 106	107 Bh Bohrium 107	108 Hs Hassium 108	109 Mt Meitnerium 109	110 Ds Darmstadtium 110	111 Rg Roentgenium 111	112 Cn Copernicium 112	113 Nh Nihonium 113	114 Fl Flerovium 114	115 Mc Moscovium 115	116 Lv Livermorium 116	117 Ts Tennessine 117	118 Og Oganesson 118	119 Uu Ununennium 119	120 Uub Unbinilium 120	121 Uut Untrium 121	122 Uuq Unquadium 122	123 Uuq Unquadium 123	124 Uub Unbinilium 124	125 Uut Untrium 125	126 Uuq Unquadium 126	127 Uub Unbinilium 127	128 Uut Untrium 128	129 Uuq Unquadium 129	130 Uub Unbinilium 130	131 Uut Untrium 131	132 Uuq Unquadium 132	133 Uub Unbinilium 133	134 Uut Untrium 134	135 Uuq Unquadium 135	136 Uub Unbinilium 136	137 Uut Untrium 137	138 Uuq Unquadium 138	139 Uub Unbinilium 139	140 Uut Untrium 140	141 Uuq Unquadium 141	142 Uub Unbinilium 142	143 Uut Untrium 143	144 Uuq Unquadium 144	145 Uub Unbinilium 145	146 Uut Untrium 146	147 Uuq Unquadium 147	148 Uub Unbinilium 148	149 Uut Untrium 149	150 Uuq Unquadium 150	151 Uub Unbinilium 151	152 Uut Untrium 152	153 Uuq Unquadium 153	154 Uub Unbinilium 154	155 Uut Untrium 155	156 Uuq Unquadium 156	157 Uub Unbinilium 157	158 Uut Untrium 158	159 Uuq Unquadium 159	160 Uub Unbinilium 160	161 Uut Untrium 161	162 Uuq Unquadium 162	163 Uub Unbinilium 163	164 Uut Untrium 164	165 Uuq Unquadium 165	166 Uub Unbinilium 166	167 Uut Untrium 167	168 Uuq Unquadium 168	169 Uub Unbinilium 169	170 Uut Untrium 170	171 Uuq Unquadium 171	172 Uub Unbinilium 172	173 Uut Untrium 173	174 Uuq Unquadium 174	175 Uub Unbinilium 175	176 Uut Untrium 176	177 Uuq Unquadium 177	178 Uub Unbinilium 178	179 Uut Untrium 179	180 Uuq Unquadium 180	181 Uub Unbinilium 181	182 Uut Untrium 182	183 Uuq Unquadium 183	184 Uub Unbinilium 184	185 Uut Untrium 185	186 Uuq Unquadium 186	187 Uub Unbinilium 187	188 Uut Untrium 188	189 Uuq Unquadium 189	190 Uub Unbinilium 190	191 Uut Untrium 191	192 Uuq Unquadium 192	193 Uub Unbinilium 193	194 Uut Untrium 194	195 Uuq Unquadium 195	196 Uub Unbinilium 196	197 Uut Untrium 197	198 Uuq Unquadium 198	199 Uub Unbinilium 199	200 Uut Untrium 200	201 Uuq Unquadium 201	202 Uub Unbinilium 202	203 Uut Untrium 203	204 Uuq Unquadium 204	205 Uub Unbinilium 205	206 Uut Untrium 206	207 Uuq Unquadium 207	208 Uub Unbinilium 208	209 Uut Untrium 209	210 Uuq Unquadium 210	211 Uub Unbinilium 211	212 Uut Untrium 212	213 Uuq Unquadium 213	214 Uub Unbinilium 214	215 Uut Untrium 215	216 Uuq Unquadium 216	217 Uub Unbinilium 217	218 Uut Untrium 218	219 Uuq Unquadium 219	220 Uub Unbinilium 220	221 Uut Untrium 221	222 Uuq Unquadium 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268	269 Uut Untrium 269	270 Uuq Unquadium 270	271 Uub Unbinilium 271	272 Uut Untrium 272	273 Uuq Unquadium 273	274 Uub Unbinilium 274	275 Uut Untrium 275	276 Uuq Unquadium 276	277 Uub Unbinilium 277	278 Uut Untrium 278	279 Uuq Unquadium 279	280 Uub Unbinilium 280	281 Uut Untrium 281	282 Uuq Unquadium 282	283 Uub Unbinilium 283	284 Uut Untrium 284	285 Uuq Unquadium 285	286 Uub Unbinilium 286	287 Uut Untrium 287	288 Uuq Unquadium 288	289 Uub Unbinilium 289	290 Uut Untrium 290	291 Uuq Unquadium 291	292 Uub Unbinilium 292	293 Uut Untrium 293	294 Uuq Unquadium 294	295 Uub Unbinilium 295	296 Uut Untrium 296	297 Uuq Unquadium 297	298 Uub Unbinilium 298	299 Uut Untrium 299	300 Uuq Unquadium 300

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

Key

a	X
b	

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.).

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