UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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.

For Examiner's Use

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]

For Examiner's Use

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.

.....

.....

.....

.....

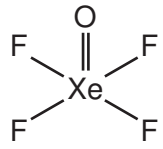
.....

..... [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*?

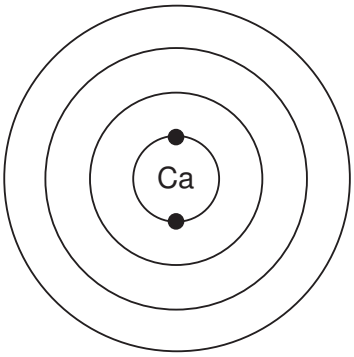
..... [1]

[Total: 11]

For Examiner's Use

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.

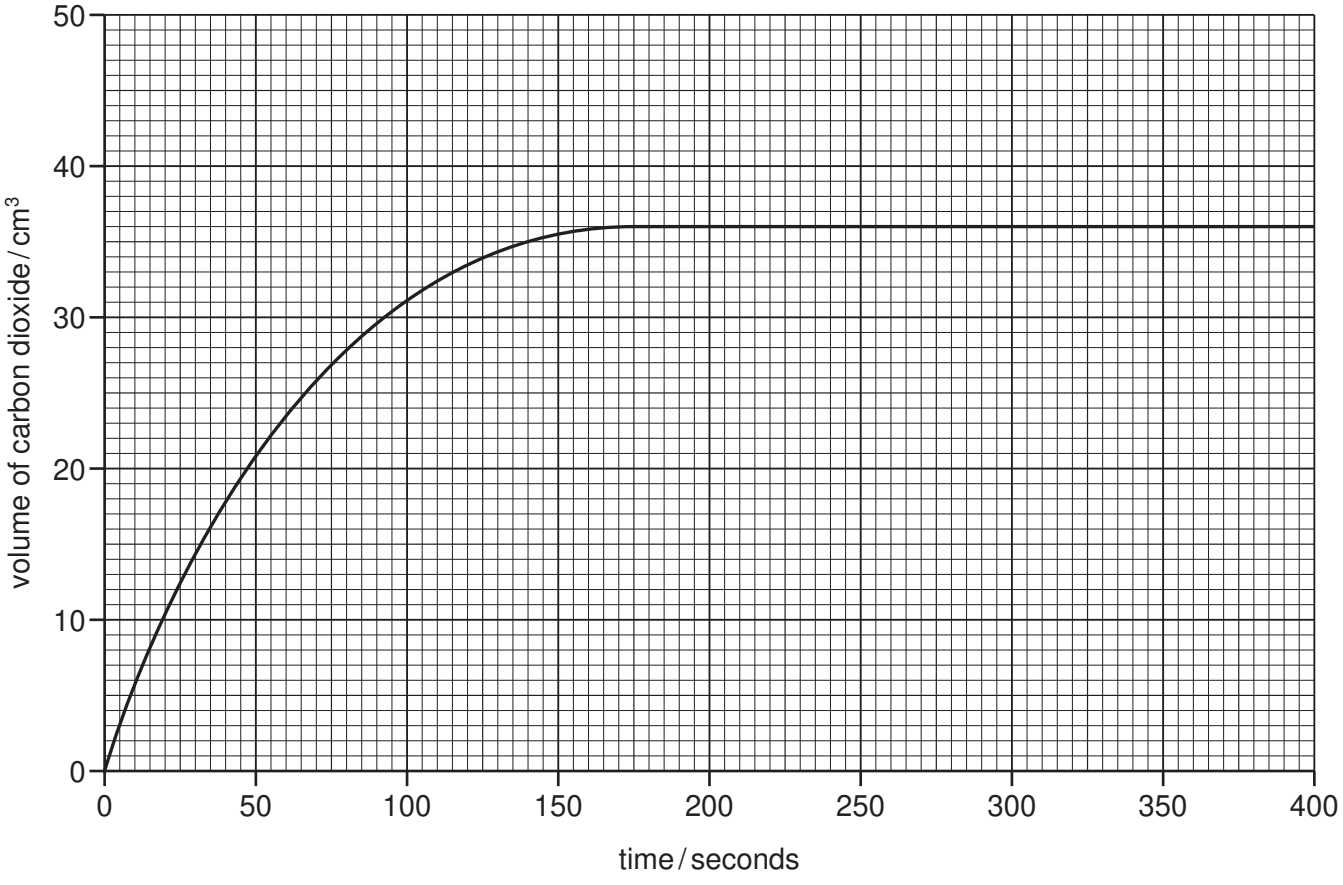


[2]

(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.

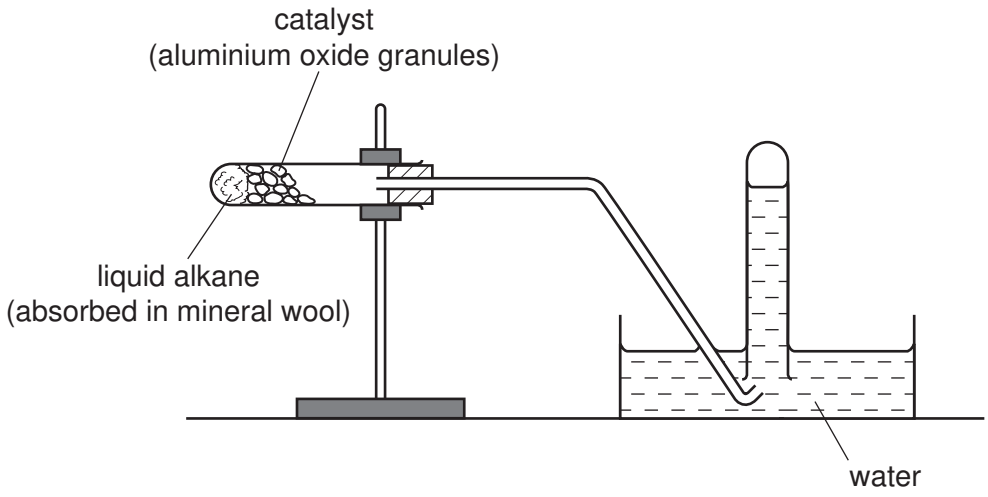
..... [1]

[Total: 15]

[Turn over

For Examiner's Use

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.

$$C_{12}H_{26} \rightarrow C_8H_{18} + ...$$

[1]

(e) Cracking produces a mixture of shorter-chain alkanes and alkenes.

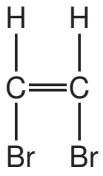
(i) Describe what you would observe when a few drops of bromine water are added to an alkene.

..... [1]

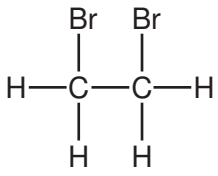
For Examiner's Use

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

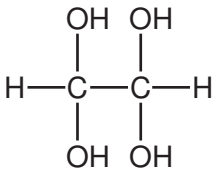
A



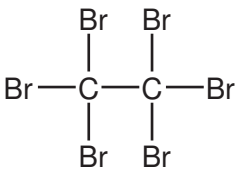
B



C



D



..... [1]

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

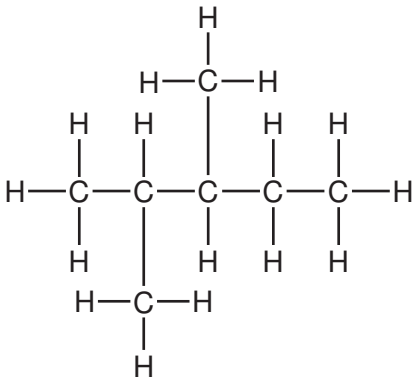
decomposition ☐

neutralisation ☐

oxidation ☐

polymerisation ☐ [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*?

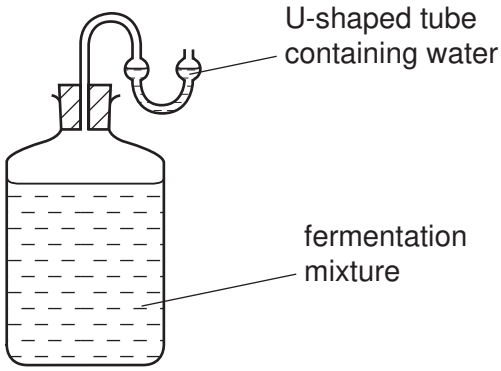
..... [1]

(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.



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

copper sulfate	☐
ethene	☐
sugar	☐
methane	☐
water	☐

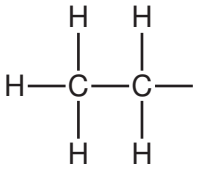
[2]

(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]

For Examiner's Use

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

$$CuSO_4.5H_2O(s) \rightleftharpoons CuSO_4(s) + 5H_2O(l)$$

hydrated copper(II) sulfate anhydrous copper(II) sulfate

(i) What does the sign $\rightleftharpoons$ mean?

..... [1]

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

.....

..... [2]

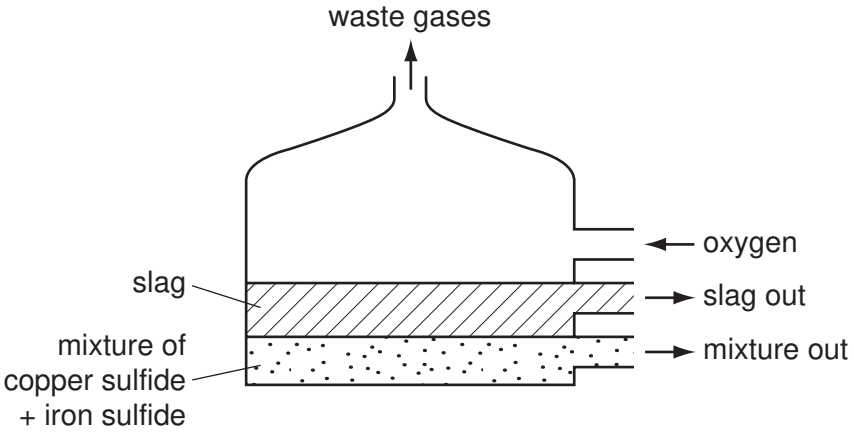
(iii) Copper(II) sulfate is a salt.
Sodium chloride is also a salt. Solid sodium chloride does not conduct electricity.
Suggest **two** things you could do to make solid sodium chloride conduct electricity.

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]

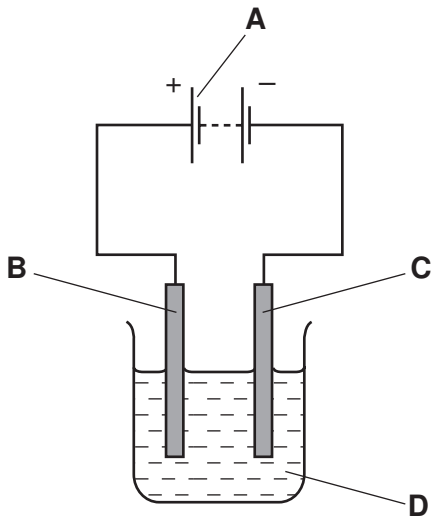
(ii) In a later stage, copper sulfide is reacted with more oxygen.

$$Cu_2S + O_2 \rightarrow 2Cu + SO_2$$

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

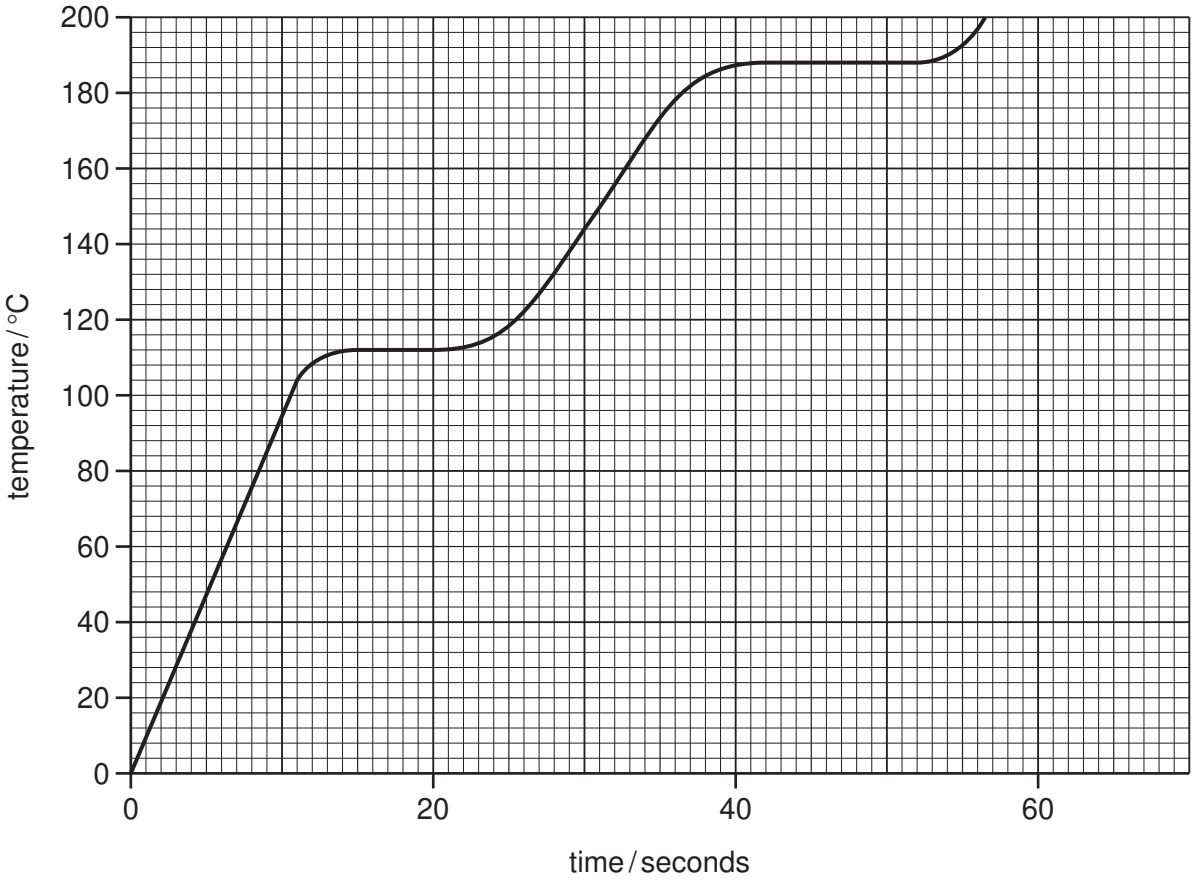
the cathode, ...

the electrolyte? ..... [2]

[Total: 9]

For Examiner's Use

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.

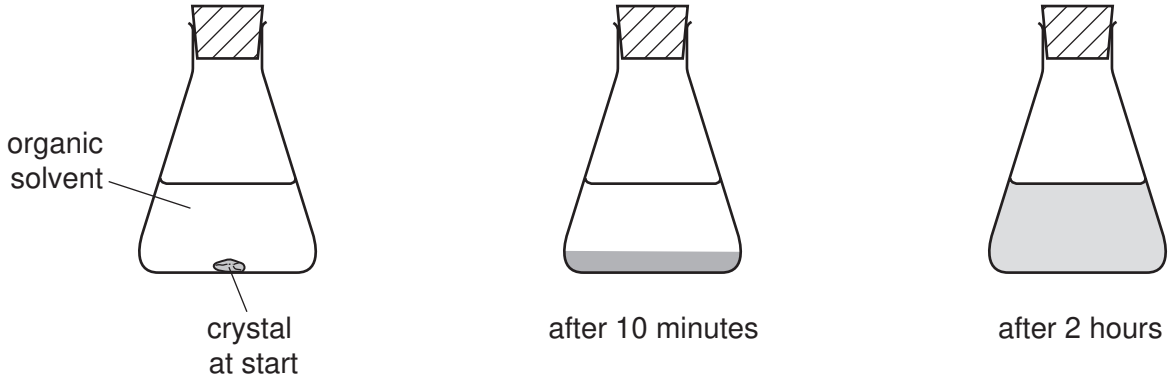
arrangement .....

motion ..... [2]

[Turn over

For Examiner's Use

(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]

For Examiner's Use

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

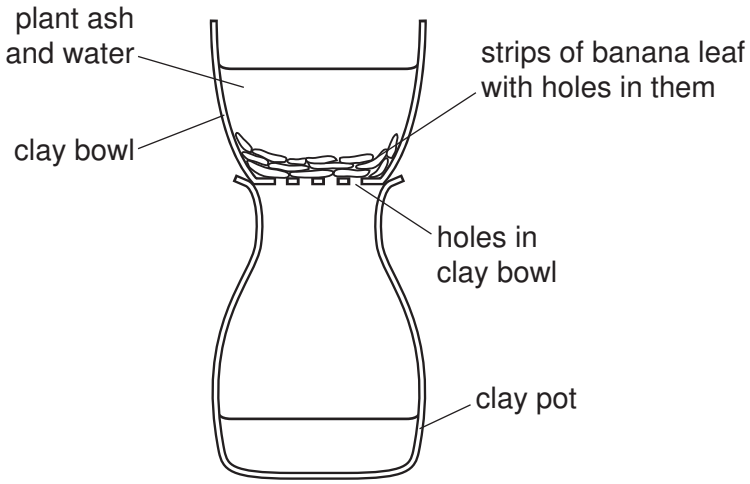
.....

.....

..... [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 100 g 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 / dm^3?

..... [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.

$$\text{.....NaCl} + \text{Pb(NO}_3\text{)}_2 \rightarrow 2\text{NaNO}_3 + \text{PbCl}_2$$

[1]

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

Chloride ions are formed when chlorine atoms gain ..... . [1]

[Total: 10]

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	0
							1 H Hydrogen 1									4 He Helium 2
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 Sulfur 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	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	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	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

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

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

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