



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education



CANDIDATE  
NAME

CENTRE  
NUMBER

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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. .... [1]
2. .... [1]

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

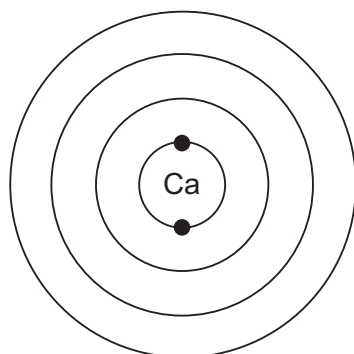
.....  
.....  
..... [2]

[Total: 9]



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.

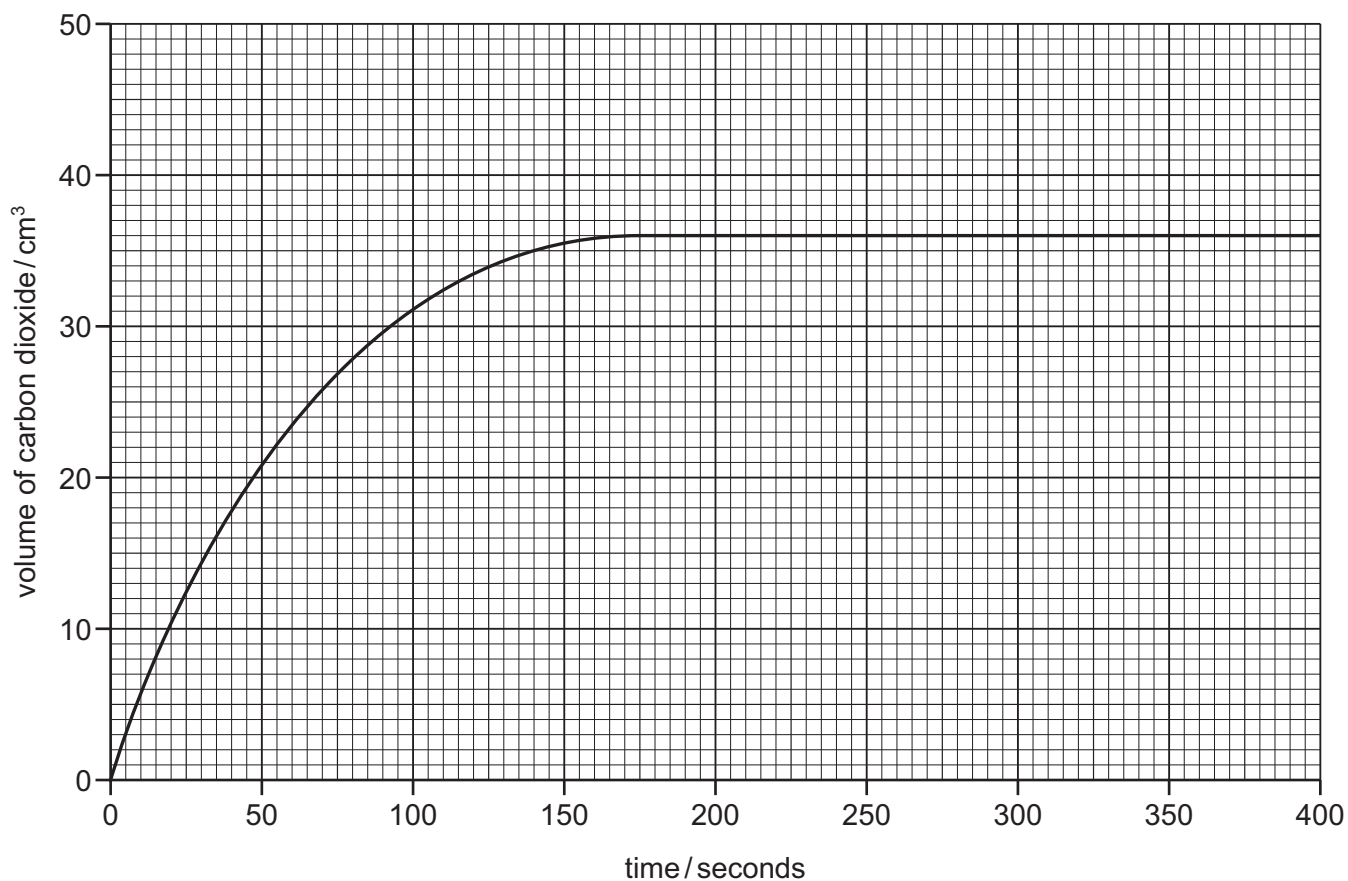


[2]

- (b) Calcium reacts with hydrochloric acid to form a salt with the formula  $\text{CaCl}_2$ .  
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.

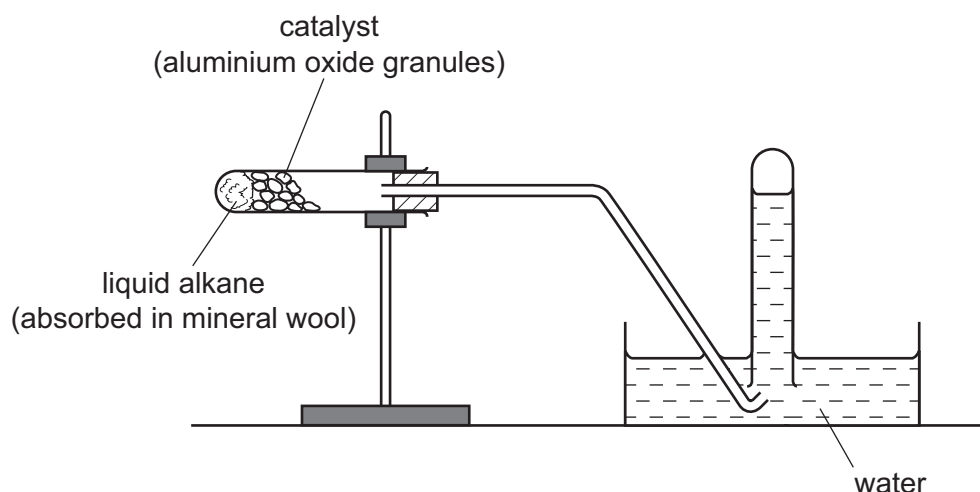
..... [1]

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

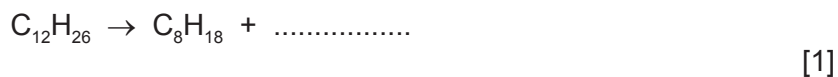
..... [1]

[Total: 15]

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



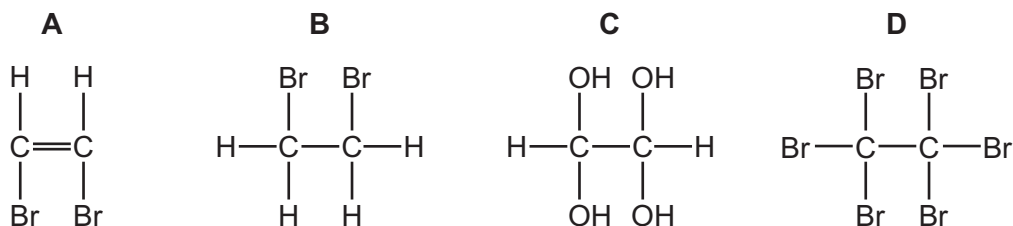
- (a) What piece of apparatus is missing from the diagram?  
..... [1]
- (b) On the diagram above, put an **X** to show where the gas is collected. [1]
- (c) What is the purpose of the catalyst?  
..... [1]
- (d) Complete the equation to show the cracking of dodecane,  $C_{12}H_{26}$ , to form octane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

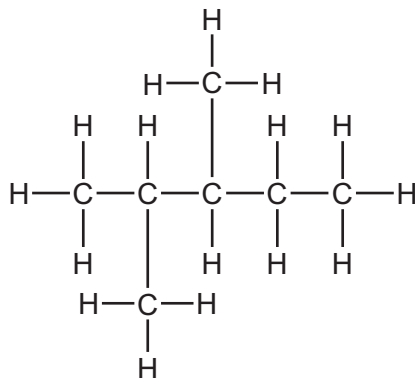
neutralisation

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*?

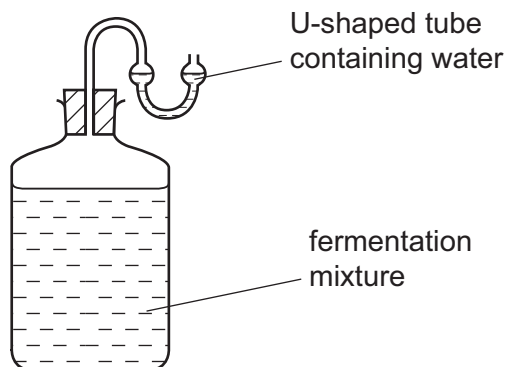
..... [1]

- (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.

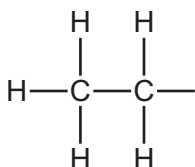
- copper sulfate
- ethene
- sugar
- methane
- water

[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.

.....

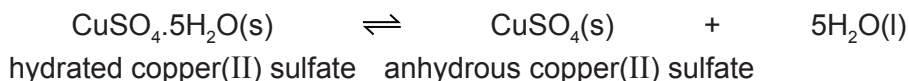
.....

..... [3]

[Total: 8]



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]

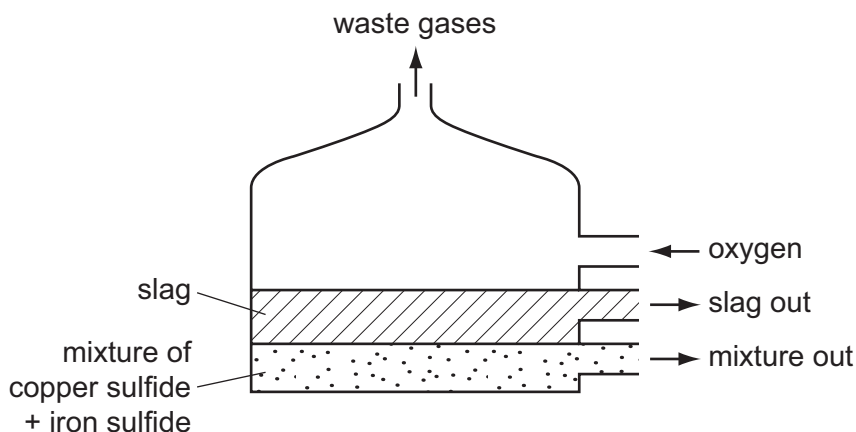
(iii) Copper(II) sulfate is a salt.

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]

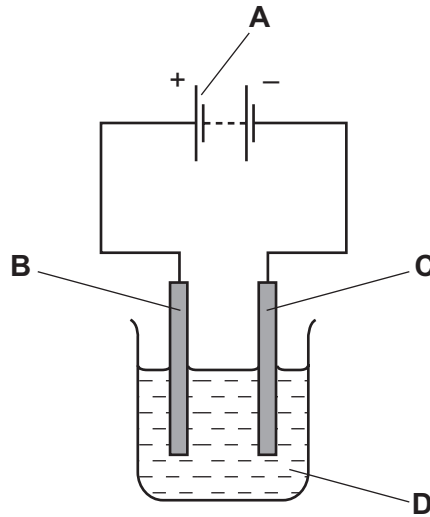
- (ii) In a later stage, copper sulfide is reacted with more oxygen.



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

..... [1]

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



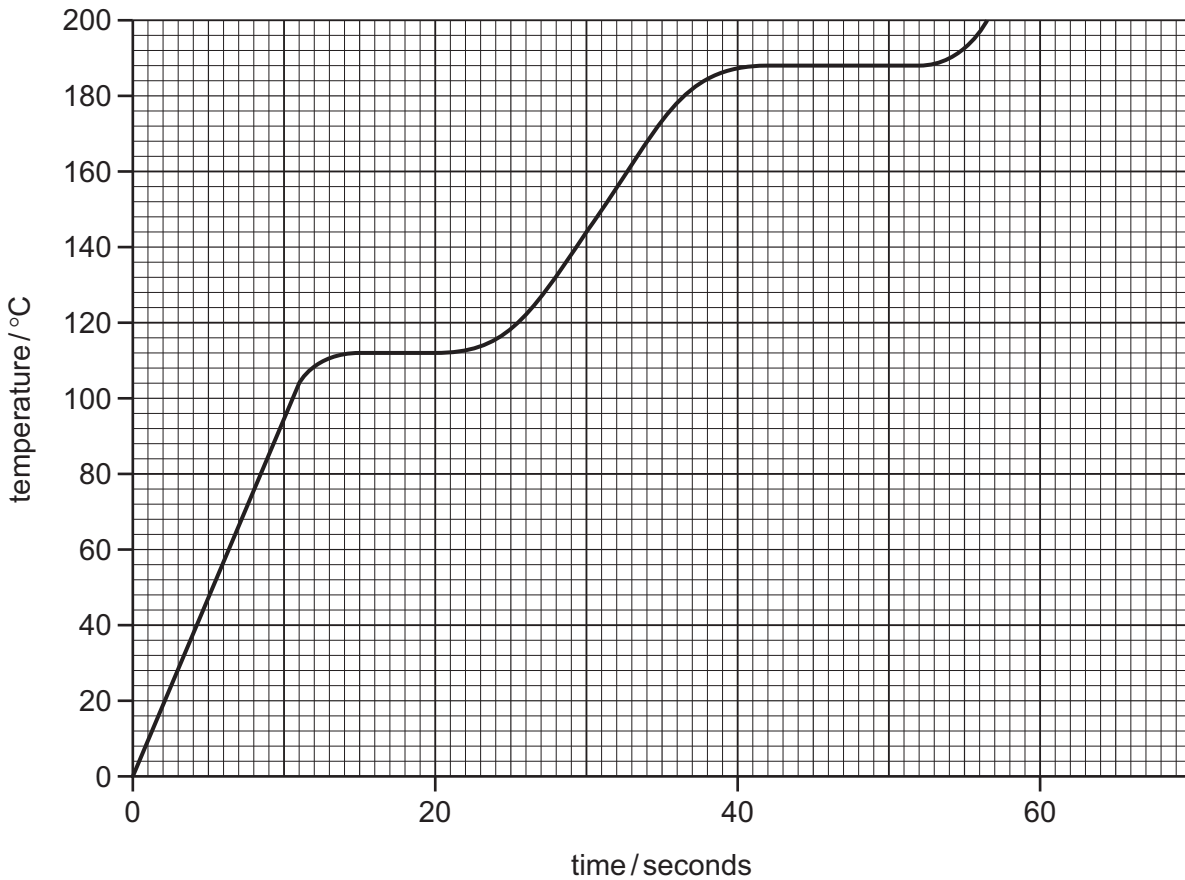
Which letter, **A**, **B**, **C** or **D**, in the diagram above represents

the cathode, .....

the electrolyte? ..... [2]

[Total: 9]

- 7 The graph below shows how the temperature rises with time when a solid, **P**, is 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**, .....

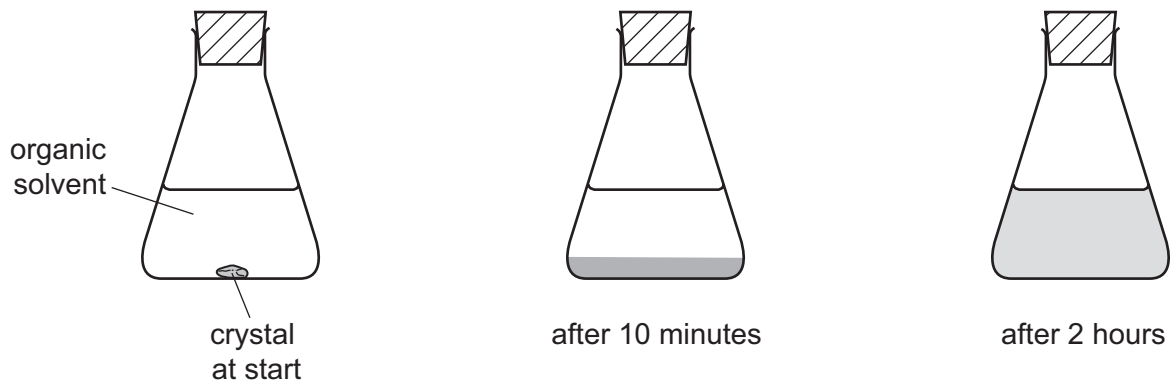
the state of **P** at 160 °C. .... [2]

- (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  
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.

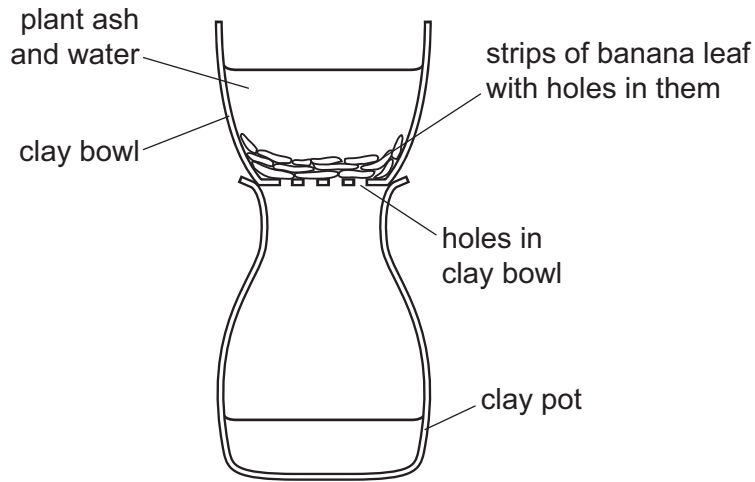
.....  
.....  
..... [2]

(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 100 g of ash/g	solubility of salt in g/dm <sup>3</sup>
magnesium sulfate	Mg <sup>2+</sup> and SO <sub>4</sub> <sup>2-</sup>	5	220
potassium carbonate	K <sup>+</sup> and CO <sub>3</sub> <sup>2-</sup>	10	1120
potassium chloride	K <sup>+</sup> and Cl <sup>-</sup>	18	359
potassium sulfate		4	122
sodium carbonate	Na <sup>+</sup> and CO <sub>3</sub> <sup>2-</sup>	12	70
sodium chloride	Na <sup>+</sup> and Cl <sup>-</sup>	40	359

- (i) Which salt in the table has the lowest solubility in g/dm<sup>3</sup>?

..... [1]

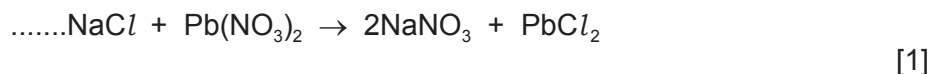
- (ii) Which negatively-charged ion is present in the highest amount in the ash?

..... [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 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>N</b> Nitrogen 7	15 <b>O</b> Oxygen 8	16 <b>F</b> Fluorine 9	17 <b>Ne</b> Neon 10	18 <b>Ar</b> Argon 18	19 <b>K</b> Potassium 19	20 <b>Ca</b> Calcium 20	21 <b>Sc</b> Scandium 21	22 <b>Ti</b> Titanium 22	23 <b>V</b> Vanadium 23	24 <b>Cr</b> Chromium 24	25 <b>Mn</b> Manganese 25	26 <b>Fe</b> Iron 26	27 <b>Co</b> Cobalt 27	28 <b>Ni</b> Nickel 28	29 <b>Cu</b> Copper 29	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36	37 <b>Rb</b> Rubidium 37	38 <b>Sr</b> Strontium 38	39 <b>Y</b> Yttrium 39	40 <b>Zr</b> Zirconium 40	41 <b>Nb</b> Niobium 41	42 <b>Mo</b> Molybdenum 42	43 <b>Tc</b> Technetium 43	44 <b>Ru</b> Ruthenium 44	45 <b>Rh</b> Rhodium 45	46 <b>Pd</b> Palladium 46	47 <b>Ag</b> Silver 47	48 <b>Cd</b> Cadmium 48	49 <b>In</b> Indium 49	50 <b>Sn</b> Tin 50	51 <b>Sb</b> Antimony 51	52 <b>Te</b> Tellurium 52	53 <b>I</b> Iodine 53	54 <b>Xe</b> Xenon 54	55 <b>Cs</b> Caesium 55	56 <b>Ba</b> Barium 56	57 <b>La</b> Lanthanum 57	72 <b>Hf</b> Hafnium 72	73 <b>Ta</b> Tantalum 73	74 <b>W</b> Tungsten 74	75 <b>Re</b> Rhenium 75	76 <b>Os</b> Osmium 76	77 <b>Ir</b> Iridium 77	78 <b>Pt</b> Platinum 78	79 <b>Au</b> Gold 79	80 <b>Hg</b> Mercury 80	81 <b>Tl</b> Thallium 81	82 <b>Pb</b> Lead 82	83 <b>Bi</b> Bismuth 83	84 <b>Po</b> Polonium 84	85 <b>At</b> Astatine 85	86 <b>Rn</b> Radon 86	87 <b>Fr</b> Francium 87	88 <b>Ra</b> Radium 88	89 <b>Ac</b> Actinium 89	†
												133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> Lanthanum 57	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	186 <b>Re</b> Rhenium 75	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	212 <b>Po</b> Polonium 84	210 <b>At</b> Astatine 85	210 <b>Rn</b> Radon 86	226 <b>Fr</b> Francium 87	227 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	†																																			
												140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	159 <b>Tb</b> Terbium 65	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71	232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92	238 <b>Pa</b> Protactinium 91	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103																														

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

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

Key

a	<b>X</b>
b	

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

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