Surname	Centre Number	Candidate Number
Other Names		0

GCSE

240/02

ADDITIONAL SCIENCE
HIGHER TIER
CHEMISTRY 2

A.M. WEDNESDAY, 25 May 2011

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**5**	
3.	**5**	
4.	**5**	
5.	**5**	
6.	**5**	
7.	**5**	
8.	**7**	
9.	**4**	
10.	**4**	
Total	**50**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

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

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

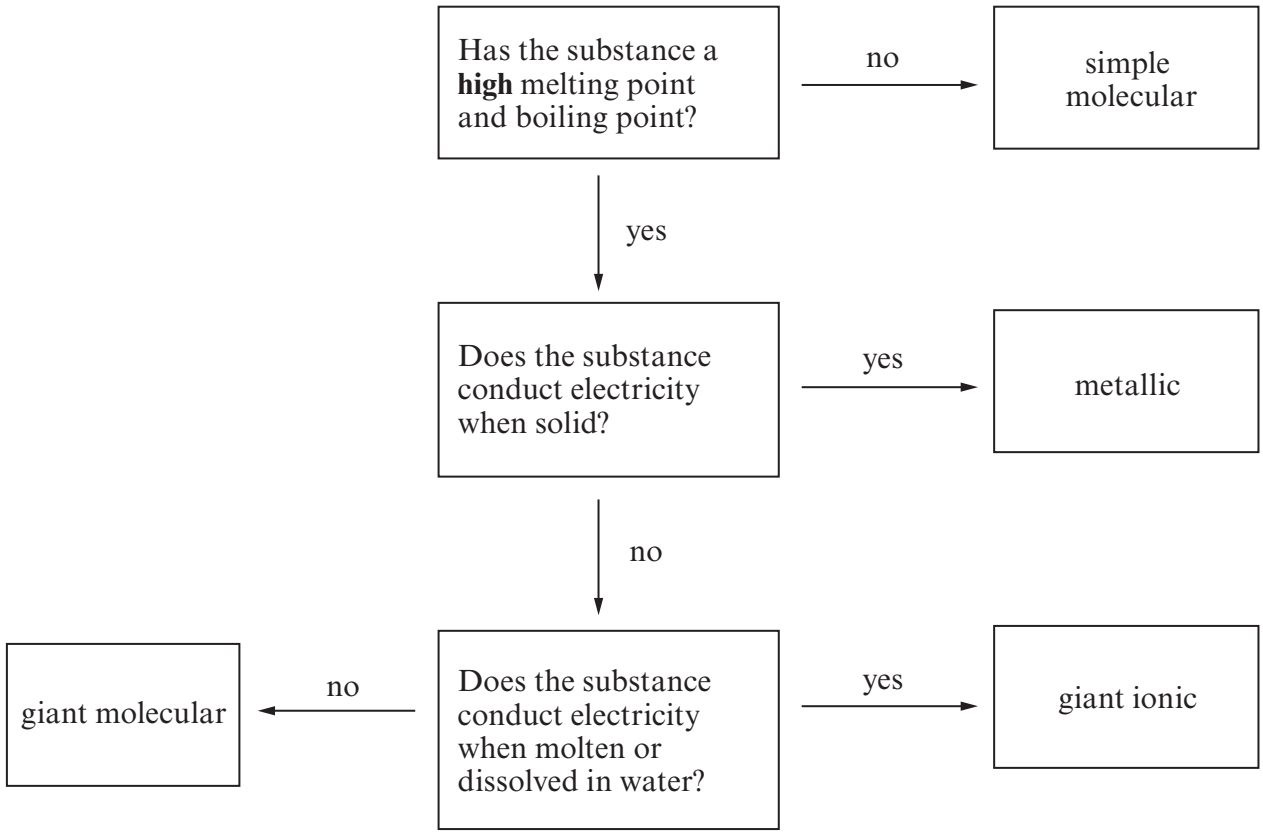
The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

Answer **all** *questions.*

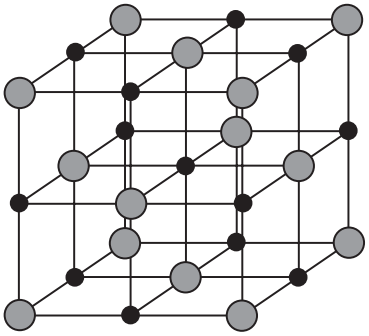
1. *(a)* The flow chart below can be used to identify the type of structure found in different substances.



Complete the table below using the flow chart. [4]

Substance	Melting point / °C	Boiling point / °C	Electrical conductivity	Structure
aluminium oxide	2072	2980	conducts electricity only when molten	
ammonia	–77	–34	does not conduct electricity	
silicon dioxide	1610	2230	does not conduct electricity	
titanium	1667	3277	conducts electricity when solid	

(b) The diagram below shows the structure of sodium chloride.

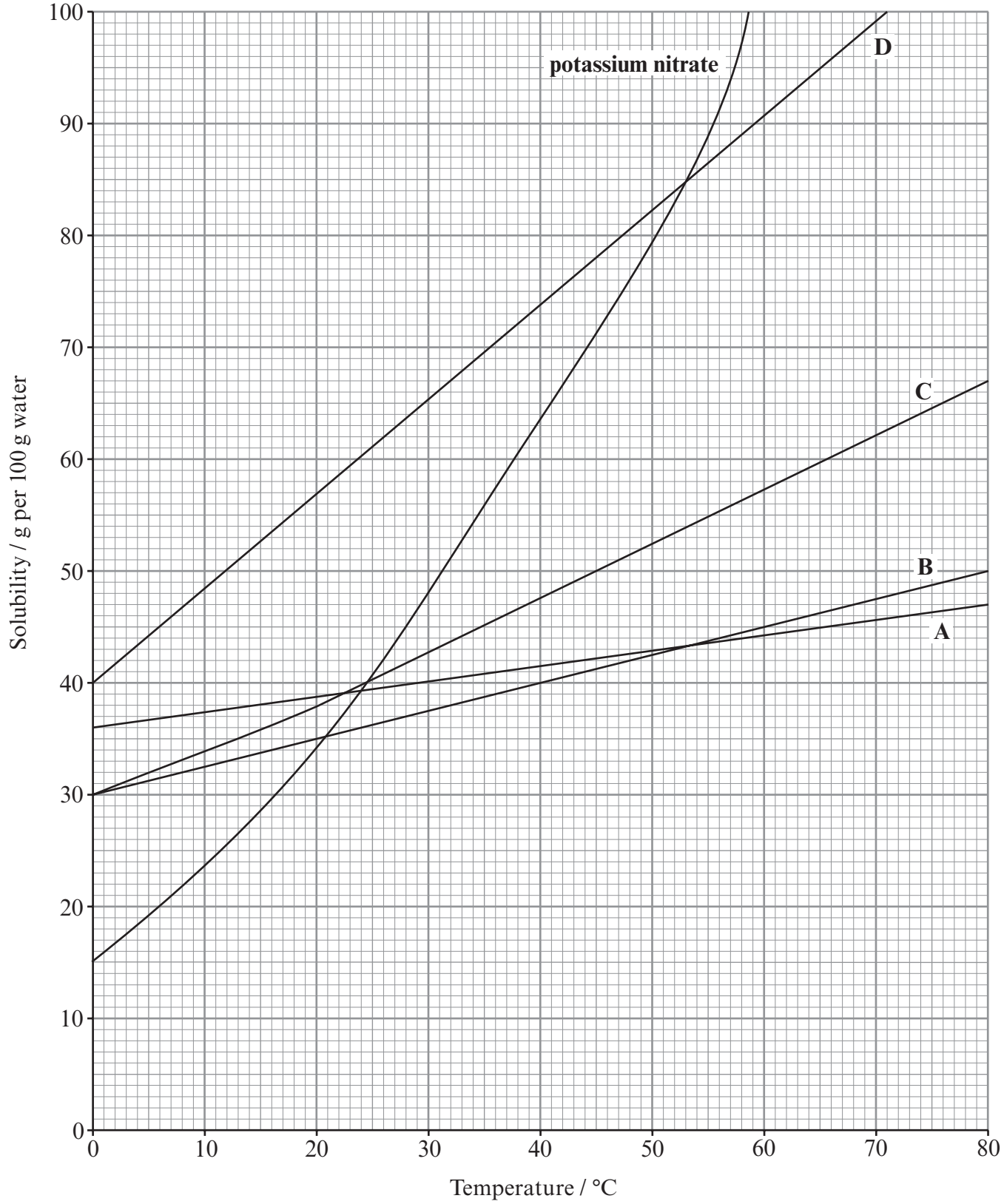


Describe the electrical conductivity of sodium chloride. [1]

.....

.....

2. The graph below shows the solubility of potassium nitrate and four substances, **A**, **B**, **C** and **D**, in water at various temperatures.



Use the graph to answer parts (a)-(e).

Give the letter of the substance which

(a) has the **lowest** solubility at 70 °C, [1]

.....

(b) has the **same** solubility as potassium nitrate at 53 °C, [1]

.....

(c) has the solubility that **changes** the **least** with temperature, [1]

.....

(d) forms 21 g of solid when a saturated solution in 100 g of water at 65 °C is cooled to 40 °C, [1]

.....

(e) forms the **smallest** mass of solid when a saturated solution in 100 g of water at 20 °C is cooled to 0 °C. [1]

.....

Examiner only

3. The table below shows information about the atoms of four elements.

Use the data and key on the Periodic Table of Elements shown on the **back page of this examination paper** to complete the table. [5]

Element	Symbol and data	Number of protons	Number of neutrons	Number of electrons
lithium	$^{7}_{3}$Li	3	4	3
beryllium	$^{9}_{4}$Be			4
aluminium		13	14	
	$^{31}_{15}$P	15	16	15

5

Examiner only

4. *(a)* Chemists have designed a wide variety of steels for different uses.

The raw material for the manufacture of all steels is cast iron which is formed in the blast furnace. Wrought iron can be formed from cast iron by removing all the carbon. Some steels contain iron and carbon only, whereas others contain one or more different metals.

The table below shows the content and properties of materials formed from cast iron.

Material	Content	Properties
wrought iron	100 % iron	very malleable but very weak
mild steel	iron plus 0.15-0.3 % carbon	malleable, ductile, easily shaped
medium carbon steel	iron plus 0.35-0.7 % carbon	strong but less ductile than mild steel
high carbon steel	iron plus 0.7-1.5 % carbon	harder but more brittle than medium steel
cast iron	iron plus 2-5 % carbon	very strong but very brittle
stainless steel	iron plus 16-26 % chromium and 8-22 % nickel	malleable, ductile, corrosion resistant

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Use the information in the table to answer parts (i)-(iv).

(i) Name the material that contains **most** carbon. [1]

.....

(ii) Describe **one** effect of increasing the % of carbon in these materials. [1]

.....

(iii) Choose, giving a reason, the type of steel you would use to make car bodies. [1]

.....

(iv) Surgical instruments, such as scalpels, are sterilised by steam cleaning.
Give the reason why stainless steel is chosen to make surgical instruments. [1]

.....

(b) Recycling steel on a large scale saves 50 % of the energy used in the extraction of iron.

Give **one** advantage, apart from saving energy, of the large scale recycling of steel. [1]

.....

Examiner only

5. ***Smart material*** is the name given to a range of modern materials whose properties change with a change in the surroundings.

(a) Thermochromic pigments are used in fridge thermometers. [1]

Describe the special property of thermochromic pigments which allows them to be used in this way.

.....

.....

Fridge thermometer

(b) Name the **type** of smart material that is used to make spectacle lenses that darken in sunlight. [1]

.....

(c) Nitinol is an example of a shape memory alloy.

coiled nitinol

State what must be done to a coiled piece of nitinol for it to regain its original shape. [1]

.....

(d) Another type of smart material is used to manufacture *self-repairing car bodies.*

Small dents in car bodies can be easily repaired.

(i) Name the **type** of smart material used to manufacture self-repairing car bodies. [1]

.....

(ii) Describe the special property of the smart material named in part (i). [1]

.....

5

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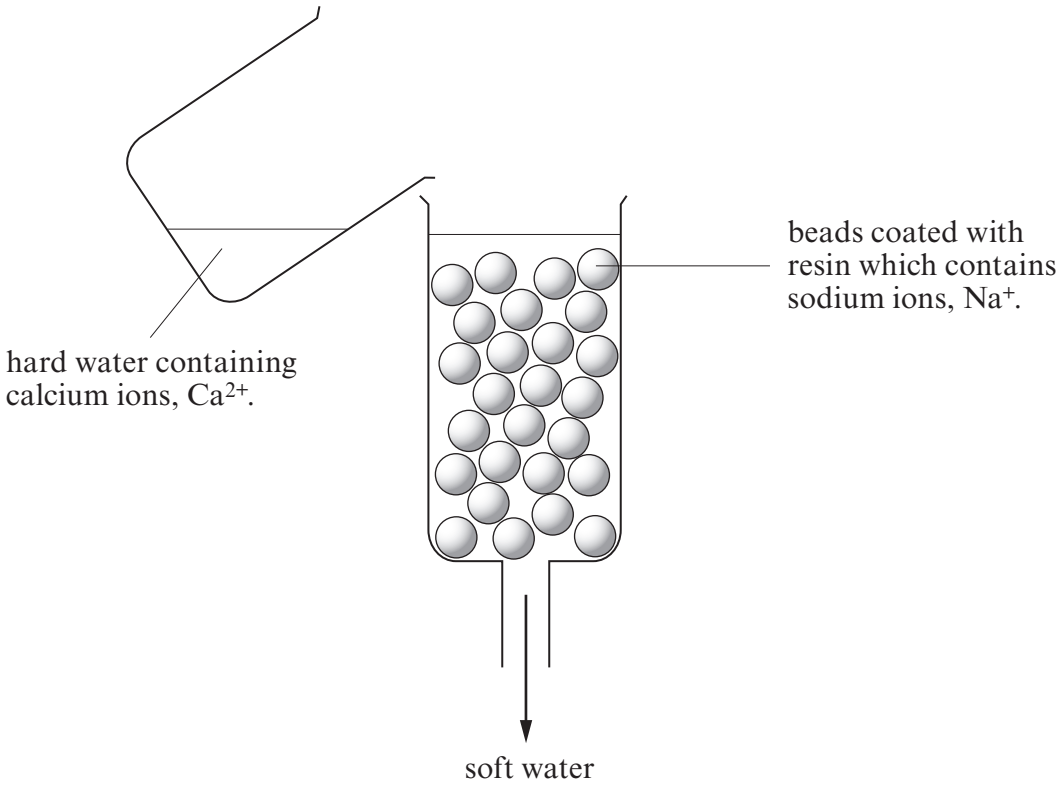
6. *(a)* The diagram below shows an ion exchange resin used to soften hard water.



(i) State how hard water is softened by passing over the resin. [1]

.....

(ii) Why will the ion exchange resin eventually stop working after continued use? [1]

.....

(iii) Name a solution which can be passed through the column to regenerate the resin. [1]

.....

(b) There are advantages and disadvantages to living in a hard water area.
In your opinion do the advantages of living in a hard water area outweigh the disadvantages?
Give **two** reasons to support your answer. [2]

.....

.....

.....

.....

7. The table below shows the electronic structures of three elements.

Element	Electronic structure
hydrogen	1
fluorine	2,7
magnesium	2,8,2

Fluorine forms magnesium fluoride with magnesium and it forms hydrogen fluoride with hydrogen.

Show by means of diagrams, or otherwise, the electronic changes that take place during the formation of

(a) magnesium fluoride from magnesium and fluorine, [3]

(b) hydrogen fluoride from hydrogen and fluorine. [2]

Examiner only

8. Ammonia is manufactured by reacting nitrogen and hydrogen.

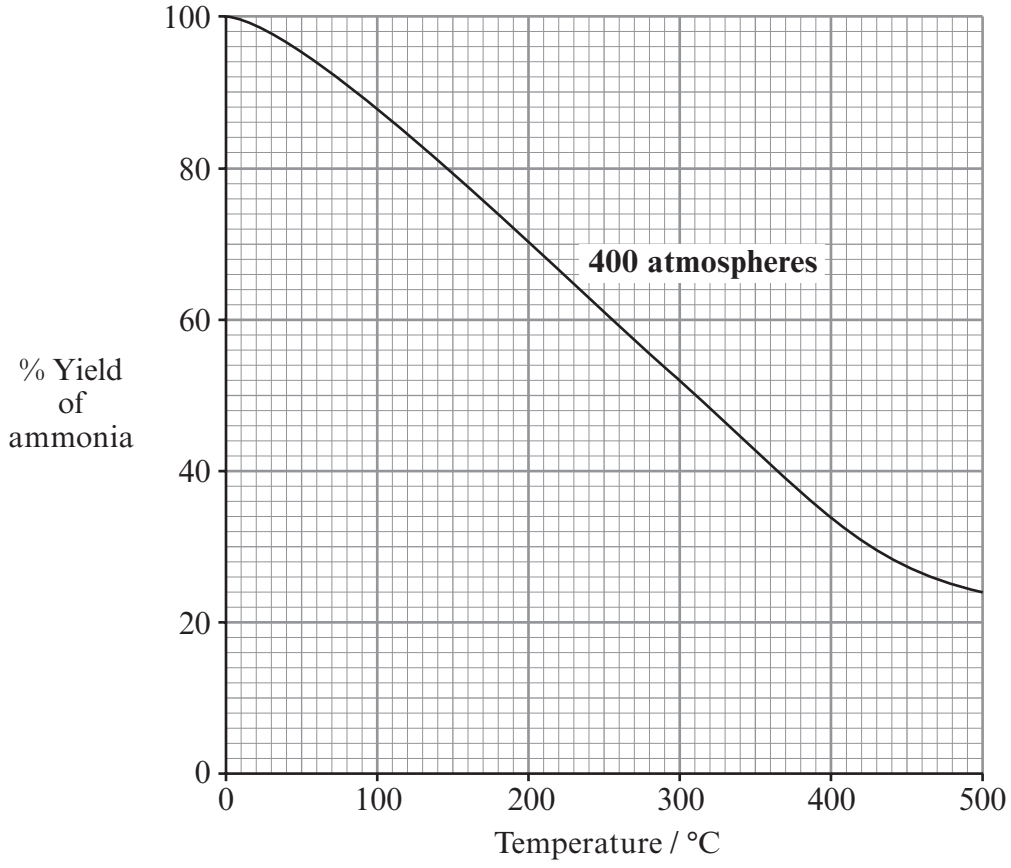
(a) Balance the **symbol** equation below which represents the formation of ammonia. [1]

$$N_2 + \text{.....} H_2 \rightleftharpoons \text{.....} NH_3$$

(b) The table below shows the % yield of ammonia under different pressure and temperature conditions.

Pressure / atmospheres	Temperature / °C					
	0	100	200	300	400	500
400	100	88	70	52	34	24
100	92	74	48	30	18	8

The graph below shows the % yield of ammonia at different temperatures at 400 atmospheres.



(i) Plot the results for the % yield of ammonia at 100 atmospheres and draw a smooth curve through the points. Label this graph ***100 atmospheres***. [3]

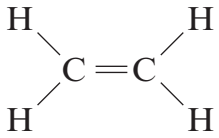
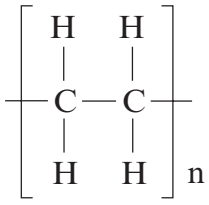
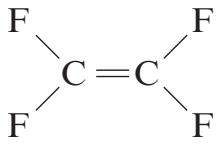
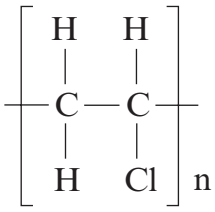
(ii) Calculate the difference in the % yield of ammonia if the pressure is decreased from 400 to 100 atmospheres at 350 °C. [1]

.....

(iii) Sketch the graph you would expect at a pressure of 200 atmospheres. [2]
Label this graph ***200 atmospheres***.

9. The table below shows some information about monomers and the polymers that can be made from them.

(a) Complete the table. [3]

Name of monomer	Structural formula of monomer	Name of polymer	Repeating unit for the polymer
		polyethene	
tetrafluoroethene		polytetrafluoroethene PTFE	
vinylchloride		polyvinylchloride PVC	

(b) All three polymers in the table are formed by the same type of polymerisation.

Give the **name** for this type of polymerisation. [1]

.....

Examiner only

10. The equation below shows how aluminium is formed from its oxide during electrolysis.

$$2Al_2O_3 \longrightarrow 4Al + 3O_2$$

(a) (i) State why aluminium oxide has to be in the molten form for electrolysis to take place. [1]

.....

(ii) State what must happen to an aluminium ion, Al^{3+}, for it to become an aluminium atom. [1]

.....

(b) Use the formula below to calculate the atom economy for the extraction of aluminium from its oxide. [2]

$$\text{Atom economy} = \frac{\text{theorectical mass of required product}}{\text{total mass of reactants used}} \times 100\%$$

$A_r(O) = 16$ $A_r(Al) = 27$

.....

.....

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulphate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		

Turn over.

PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulphur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key: