WJEC GCSE CHEMISTRY

CHEMISTRY



EXAM QUESTION PACK

UNIT C2 HIGHER TIER 0240 PAPERS

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0240/02

ADDITIONAL SCIENCE
HIGHER TIER
CHEMISTRY 2

A.M. TUESDAY, 29 January 2013

45 minutes

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

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020001

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.

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Answer **all** *questions.*

1. *(a)* Complete the following table of information about the atoms of some elements. [5]

The Periodic Table of Elements shown on the back cover of this examination paper may be helpful in answering this question.

Element	Symbol	Number of protons	Number of neutrons	Number of electrons
sodium	$^{23}_{11}Na$	11	12	11
calcium	$^{40}_{20}Ca$	20	.....	.....
aluminium	.....	13	14	13
.....	$^{39}_{19}K$	19	.....	19

(b) Atoms of different elements each have a different mass, known as the relative atomic mass (A_r). The relative atomic mass compares the masses of different atoms on a scale which gives hydrogen a mass of 1. State why the actual mass of an atom is not used. [1]

.....

.....

(c) Calculate the relative molecular mass (M_r) of nitric acid, HNO_3. [2]

$A_r(H) = 1$ $A_r(N) = 14$ $A_r(O) = 16$

$M_r(HNO_3)$ = ...

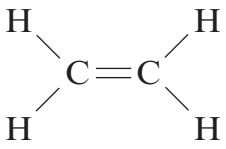
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2. *(a)* Complete the table below by giving the structural formulae for methane and ethane. [2]

Name	methane	ethane	ethene
Formula	CH_4	C_2H_6	C_2H_4
Structural formula			

(b) Ethene can be produced during a process known as cracking.

$$C_{12}H_{26} \longrightarrow C_{10}H_{22} + C_2H_4$$

State **two** conditions necessary for cracking to take place. [2]

..... and .....

(c) Polythene is produced from ethene.

(i) Name the process taking place when polythene is produced from ethene. [1]

.....

(ii) Give **one** use of polythene. [1]

.....

(iii) Give **one** reason why the recycling of plastics such as polythene is important for the environment. [1]

.....

.....

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7

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3. *(a)* (i) Nappies contain a type of smart material that is capable of absorbing many times its own weight of water. Name this type of smart material. [1]

.....

(ii) In terms of structure, state how this type of smart material is able to absorb such a large amount of water. [1]

.....

.....

(iii) Apart from nappies, give **one** other use for this type of smart material. [1]

.....

(b) Shape memory alloys are another type of smart material. State the property of shape memory alloys that makes them more suitable than traditional materials for making spectacle frames. [1]

.....

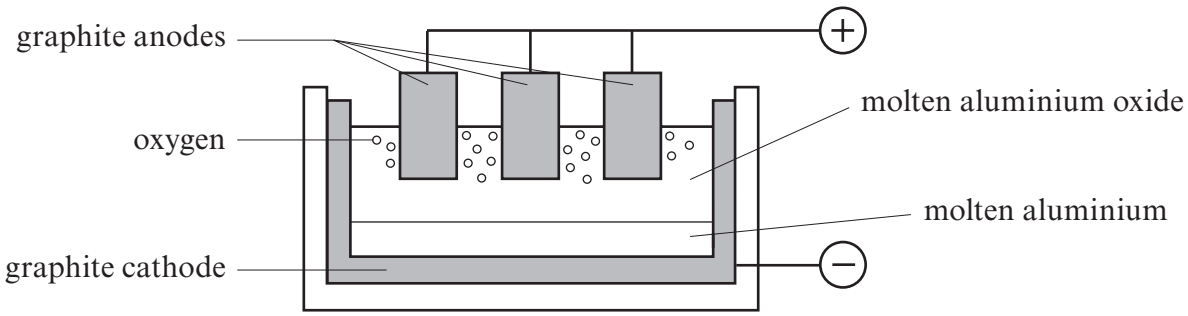
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4. The following diagram shows the apparatus used in industry to extract aluminium from its ore by the process of electrolysis.



(a) Name the type of energy required for electrolysis to take place. [1]

.....

(b) The electrolyte used in this process is molten aluminium oxide.

(i) Use the table of common ions inside the back cover of this examination paper to give the symbols of the ions present in aluminium oxide. [1]

..... and .....

(ii) Why do aluminium ions move towards the cathode? [1]

.....

.....

(c) State why the aluminium oxide must be molten in order for electrolysis to take place. [1]

.....

.....

(d) Give the **word** equation for the overall reaction taking place. [2]

..... ⟶ ..... + ...

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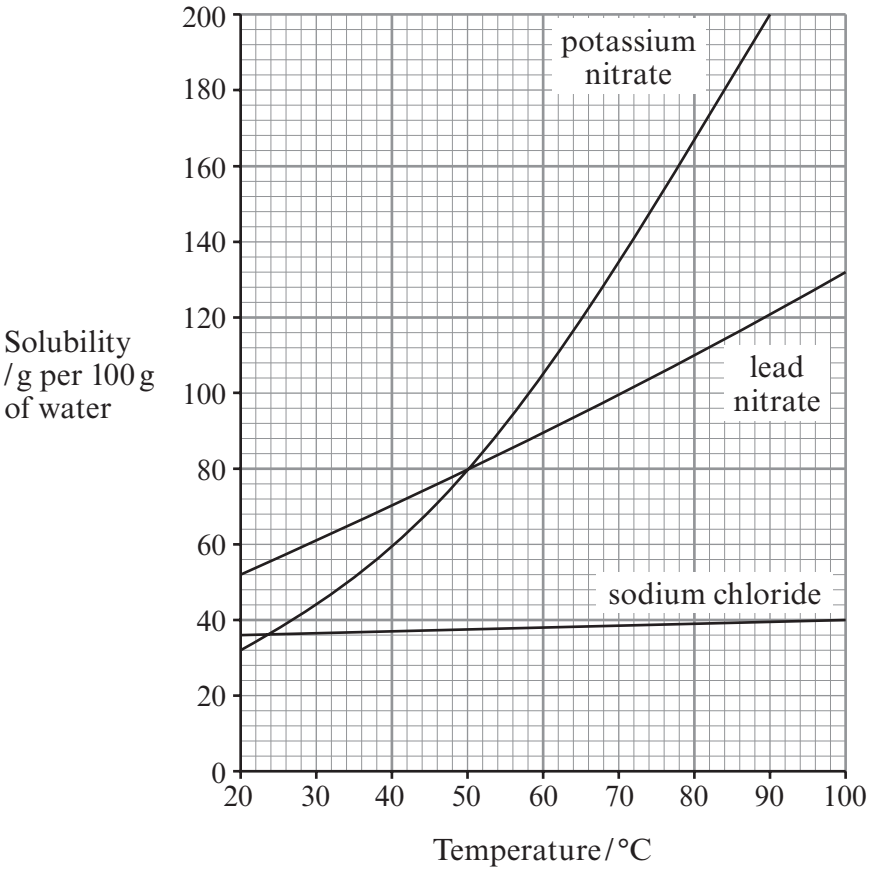
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5. The following graph shows the solubility curves for potassium nitrate, lead nitrate and sodium chloride.



(a) Give the temperature at which the solubility is the same for both potassium nitrate and lead nitrate. [1]

..... °C

(b) Give the solubility of sodium chloride at 60 °C. [1]

..... g per 100 g of water

(c) Calculate the mass of crystals that would form if 100 cm^3 of a saturated solution of potassium nitrate was cooled from 90 °C to 30 °C. [1]

Mass of crystals formed = ... g

3

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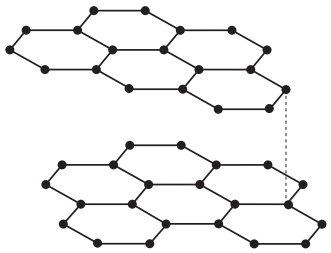
6. *(a)* Potassium reacts with chlorine to form potassium chloride. Draw diagrams to show the electronic changes that take place as potassium ions and chloride ions are formed. Include the charges on the ions.

The electronic structures of the elements are as follows. [3]

potassium = 2,8,8,1 chlorine = 2,8,7

(b) Chlorine gas, Cl_2, consists of chlorine molecules.
Draw a diagram to show the bonding in a chlorine molecule. [2]

(c) The following diagram shows the structure of graphite.



Explain why graphite can be used as a lubricant. [2]

.....

.....

.....

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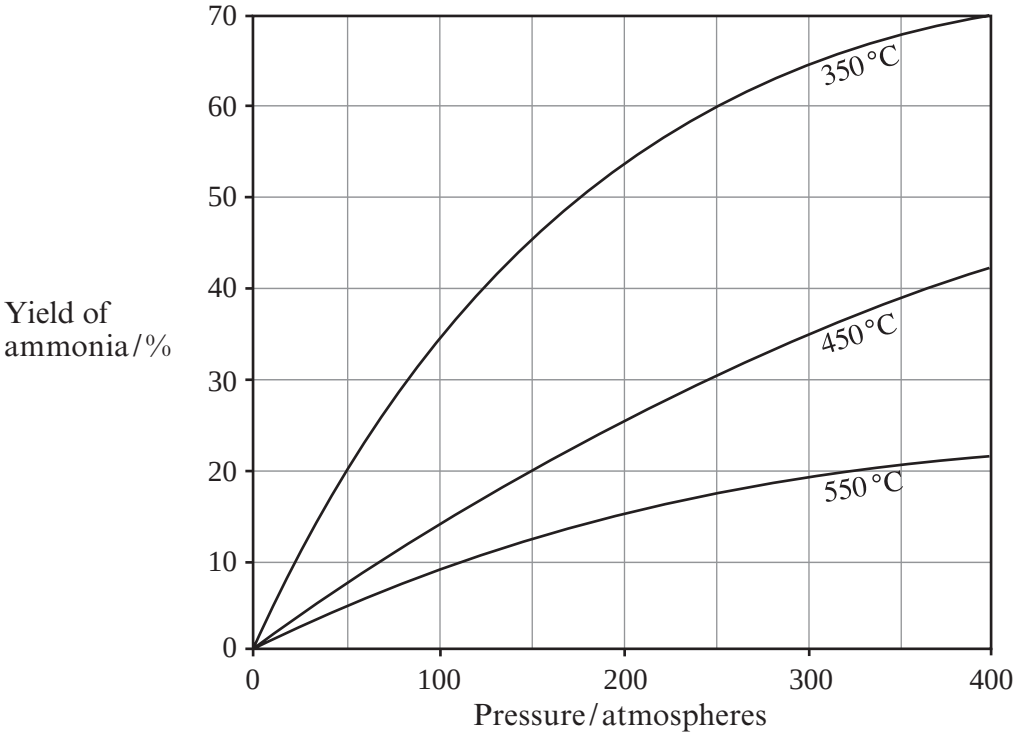
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7. Ammonia is produced from atmospheric nitrogen by the Haber process.

(a) Complete and balance the symbol equation for the reaction. [2]

$$N_2 + \square\ \square \rightleftharpoons \square\ NH_3$$

(b) The following graph shows how the yield of the reaction depends on the conditions used.



(i) Use the graph above to give the yield of ammonia at a pressure of 400 atmospheres and a temperature of 350 °C. [1]

..... %

(ii) The industrial process is carried out at 450 °C and 200 atmospheres of pressure which gives a yield of less than 30%.

Give a reason for using

I a temperature of 450 °C rather than 350 °C, [1]

.....

.....

II a pressure of 200 atmospheres rather than 400 atmospheres. [1]

.....

.....

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(c) One use of ammonia is in the production of nitric acid.

The first stage in the process involves the oxidation of ammonia.

$$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$$

(i) Using the equation above, calculate the mass of nitric oxide, NO, produced from the oxidation of 255 tonnes of ammonia. [3]

$A_r(N) = 14$ $A_r(H) = 1$ $A_r(O) = 16$

Mass of nitric oxide = ... tonnes

(ii) Calculate the atom economy of this reaction. [2]

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

Atom economy = ... %

10

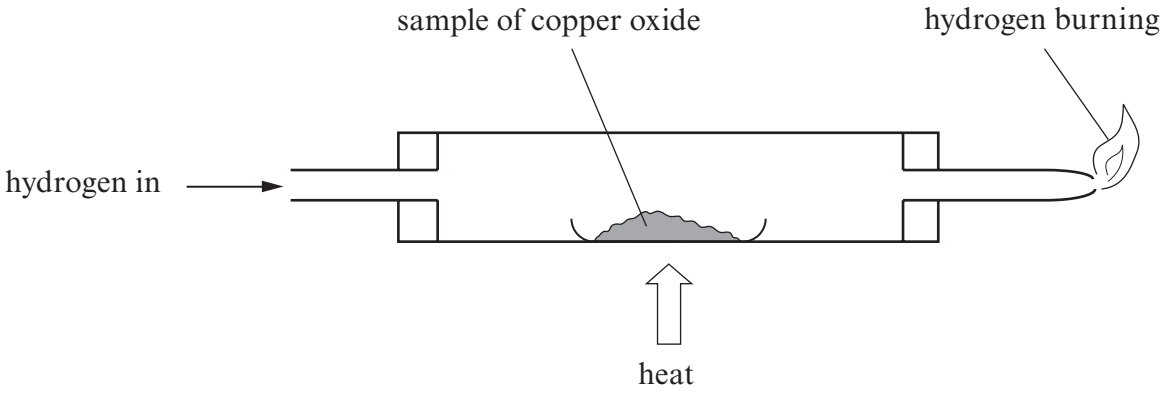
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8. A sample of 3.6 g of copper oxide is reduced by heating in a stream of hydrogen gas, using the apparatus shown below. After heating, 3.2 g of copper had been produced.



(a) Give the meaning of the term *reduction.* [1]

.....

(b) Use the figures given above to calculate

(i) the mass of oxygen in the copper oxide, [1]

Mass of oxygen = ... g

(ii) the empirical formula for this oxide of copper. [3]

You must show your working.

$A_r(O) = 16$ $A_r(Cu) = 64$

Empirical formula .....

5

END OF PAPER

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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^{+}		
Zinc	Zn^{2+}		

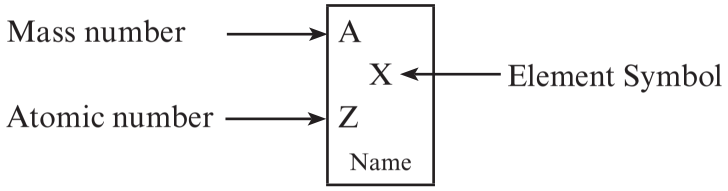
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PERIODIC TABLE OF ELEMENTS

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:



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(0240-02)

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GCSE MARKING SCHEME

CHEMISTRY (LEGACY)

JANUARY 2013

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2013 examination in GCSE CHEMISTRY (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

Unit	Page
C1 (LEGACY)	1
C2 (LEGACY)	17
C3 (LEGACY)	31

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GCSE CHEMISTRY (LEGACY)

C2 Mark Scheme - January 2013

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)	(i)		1	**A**			
			(ii)		1	artificial snow			
		(b)			1	forehead thermometers			
		(c)	(i)		1	carbon	C		
			(ii)		1	they are fixed in place			
			(iii)		1	similar structure to asbestos / can be inhaled / may cause lung problems		dangerous	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
2		(a)	(i)		1	low density / good conductor **of electricity**		good conductor	
			(ii)		1	good conductor **of heat**		good conductor	
		(b)			1	hard / strong / low density			
		(c)			1	joint replacements / pins / plates	named joint		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)			1	ammonium sulphate	$(NH_4)_2SO_4$		
		(b)			1	nitric (acid)	HNO_3		
		(c)			1	neutralisation	exothermic		
		(d)	(i)		2	**C** (1) doesn't contain nitrogen / N (1)			
			(ii)		2	**B** (1) contains nitrogen **and** sulphur / N **and** S (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)			2	calcium (1) magnesium (1)	Ca Mg		
		(b)			5	**Method** : add soap solution to water sample (1), shake (1), measure height of froth / scum (1) **Fair test** : same volume of water / same amount of soap solution / shake for same amount of time or same number of times any two for (1) each	alternative suitable methods e.g add soap slowly from burette (1) shake (1) and record volume needed to form permanent lather (1)	same temperature	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)	(i)		1	magnesium zinc copper must be in correct order	Mg Zn Cu		
			(ii)		2	magnesium sulphate (1) zinc (1)	$MgSO_4$ Zn		
		(b)	(i)		1	carbon is able to reduce the iron oxide both needed	removes O from the iron oxide	displaces	
			(ii)	I	1	aluminium is more reactive than carbon	aluminium is too reactive	aluminium is reactive	
				II	1	electrolysis			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)			4	diagrams are in the following order graphite diamond sodium chloride copper ice all correct for (4) three correct for (3) two correct for (2) one correct for (1)			
		(b)			1	copper and graphite both needed			

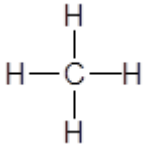
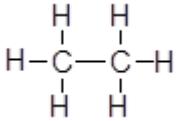
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	(a)			5	20 20 $^{27}_{13}Al$ potassium 20			
		(b)			1	individual atoms are too small / light			
		(c)			2	1 + 14 + (16 × 3) (1) 63 (1) correct answer only (2)			

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
8	2	(a)			2	 (1)  (1)			
		(b)			2	heat (1) catalyst (1)	high temperature / any temp >400 °C		
		(c)	(i)		1	polymerisation		addition	
			(ii)		1	packaging / household containers / electrical insulation / moisture barriers in construction industry			
			(iii)		1	don't decompose / less need for landfill sites / litter can pose problems to wildlife			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	3	(a)	(i)		1	hydrogel	polymer gel		
			(ii)		1	(strong cross links create an) open structure			
			(iii)		1	artificial muscles / robot actuators / absorbers of toxic chemicals / water retainers for plants / artificial snow	in compost	compost	
		(b)			1	regain shape (after being bent) / supereleastic / more difficult to break			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	4	(a)			1	electrical	electricity	heat	
		(b)	(i)		1	Al^{3+} and O^{2-} both needed			
			(ii)		1	opposite charges attract (each other)		Al is positive and cathode is negative	
		(c)			1	ions must be free to move			
		(d)			2	aluminium oxide (1) aluminium + oxygen (1)	 correct formulae		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)			1	50			
		(b)			1	38 ± 1			
		(c)			1	156			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)			3	K atom loses 1 electron (1) Cl atom gains 1 electron (1) K^+ and Cl^- ions form (1) diagrams must show situation before and after bonding clearly - NO ambiguity e.g. electron on atom/ion at the same time or charges associated with atoms			
		(b)			2	pair of electrons shared between two chlorine atoms (1) full octet around both chlorine atoms (1)			
		(c)			2	layers are able to slide over each other (1) weak forces between layers (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			2	H_2 (1) balancing 3 and 2 (1)			
		(b)	(i)		1	70 %			
			(ii)	I	1	faster reaction at 450 °C / too slow at 350 °C			
				II	1	equipment needed for high pressure expensive / too dangerous at high pressure		expensive	
		(c)	(i)		3	$M_r(NH_3) = 17$ **and** $M_r(NO) = 30$ (1) 255/17 = 15 (1) 15 × 30 = 450 (1) correct answer only (3)			
			(ii)		2	theoretical mass of product = 120 **and** total mass of reactants = 228 (1) 120 / 228 × 100 = 52.6 % (1) cao (2)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)			1	loss of oxygen			
		(b)	(i)		1	0.4 g			
			(ii)		3	mass / A_r 3.2 / 64 = 0.05 0.4 /16 = 0.025 either for (1) correct ratio = 2:1 (1) formula = Cu_2O (1)			

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0240/02

ADDITIONAL SCIENCE
HIGHER TIER
CHEMISTRY 2

A.M. MONDAY, 21 May 2012

45 minutes

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

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ADDITIONAL MATERIALS

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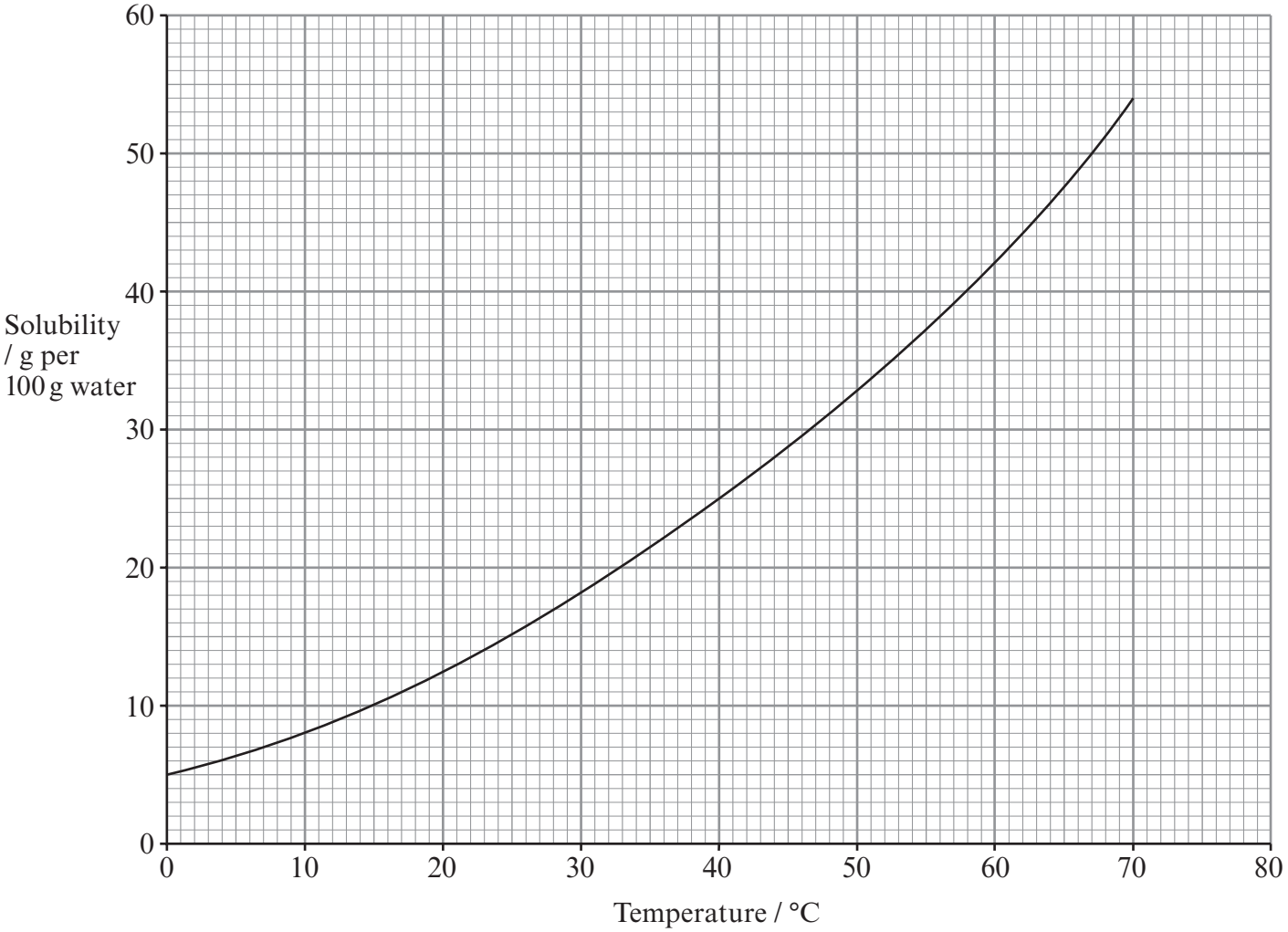
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Examiner only

Answer **all** *questions.*

1. The graph below shows the solubility of potassium dichromate in water at different temperatures.



The table below shows the solubility of potassium chloride in water at different temperatures.

Temperature / °C	0	20	40	60	80
Solubility / g per 100 g water	28	34	40	46	52

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(a) Plot the graph of the solubility of potassium chloride on the grid on the opposite page. [3]

(b) Using the graphs give

(i) the temperature at which the solubility is the **same** for both potassium chloride and potassium dichromate, [1]

Temperature = ... °C

(ii) the **difference** between the solubilities of potassium chloride and potassium dichromate at 30 °C. [1]

Difference = ... g per 100 g of water

5

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2. The table below shows information about the atoms of three 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. [4]

Element	Symbol	Number of protons	Number of neutrons	Number of electrons
beryllium	$^{9}_{4}Be$	4		4
phosphorus		15	16	15
argon	$^{40}_{18}Ar$		22	

4

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3. *(a)* Copper, magnesium, silver and zinc were added separately to solutions containing copper nitrate, magnesium nitrate, silver nitrate and zinc nitrate.

The table shows the results obtained from the series of experiments.

Metal	Metal nitrate solution			
	copper nitrate	magnesium nitrate	silver nitrate	zinc nitrate
copper	no reaction	no reaction	silvery-grey crystals form on copper foil	no reaction
magnesium	brown solid forms and blue solution turns colourless	no reaction	silvery-grey solid forms	silvery-grey solid forms
silver	no reaction	no reaction	no reaction	no reaction
zinc	brown solid forms and blue solution turns colourless	no reaction	silvery-grey solid forms	no reaction

(i) Use the information in the table above to place the metals copper, magnesium, silver and zinc in order of reactivity. [2]

Most reactive .....

.....

.....

Least reactive .....

(ii) Write a **word** equation for the reaction between copper and silver nitrate. [2]

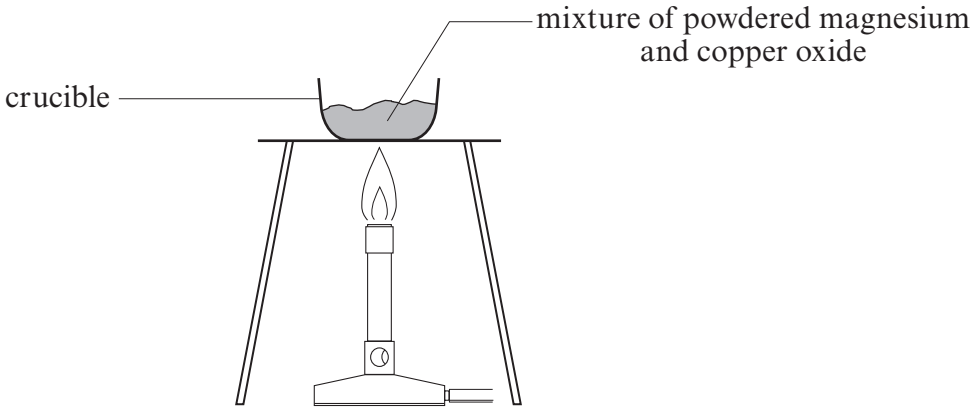
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(b) The apparatus in the diagram below can be used to show the violent reaction between magnesium and copper oxide. Both solids are in **powdered** form and well mixed together.



After a few minutes of heating a violent reaction occurs. Tiny brown specks and a white powdery substance remain.

Explain, **using this reaction**, the terms oxidation and reduction. [2]

.....

.....

.....

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4. Scientists have developed a range of new materials known as smart materials. Smart materials have unusual properties and are now being used to make everyday items.

For each of the following items name the **type** of smart material being used and describe the **unusual property** that makes it a smart material.

(a) Lenses for sunglasses

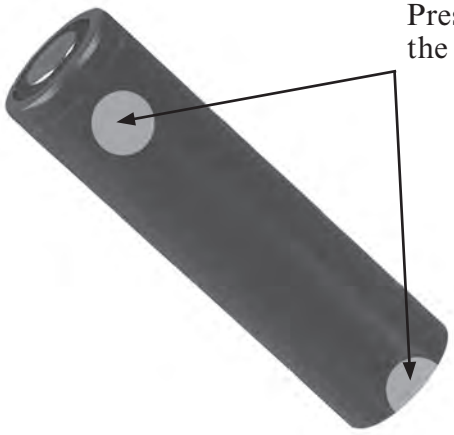


Type ..... [2]

Unusual property .....

.....

(b) Battery test strips



Pressing both white dots completes a circuit, causing the strip to heat up and change its appearance.

Type ..... [2]

Unusual property .....

.....

4

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5. *(a)* Three samples of tap water, **A**, **B** and **C**, are to be tested for hardness using soap solution.

It is suspected that sample **A** is the most hard and sample **C** the least hard.

Describe an experiment you would carry out to show that the above statement is true. Include your expected observations. [4]

.....

.....

.....

.....

.....

(b) State why hard water is considered to be

(i) good for our health, [1]

.....

(ii) a problem in kettles and boilers. [1]

.....

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6. *(a)* The table below shows the electronic structures of four elements.

Element	Electronic structure
hydrogen	1
carbon	2,4
fluorine	2,7
sodium	2,8,1

(i) Show by means of a diagram, the electronic changes that take place during the formation of sodium fluoride from sodium and fluorine. [3]

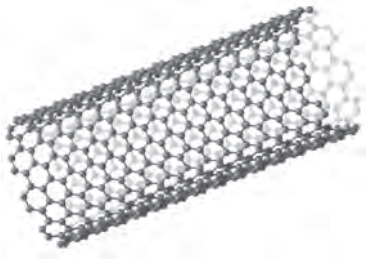
(ii) Show by means of a diagram, the bonding in a methane molecule, CH_4. [2]

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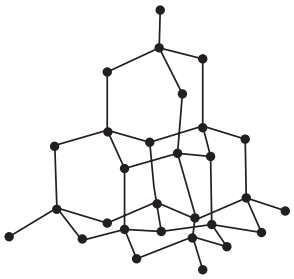
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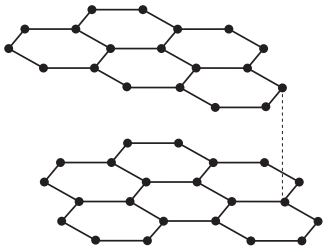
(b) The diagrams below show three different forms of the element carbon.



carbon nanotube



diamond



graphite

State the type of bonding and structure common to each of the three forms of carbon. [2]

Bonding .....

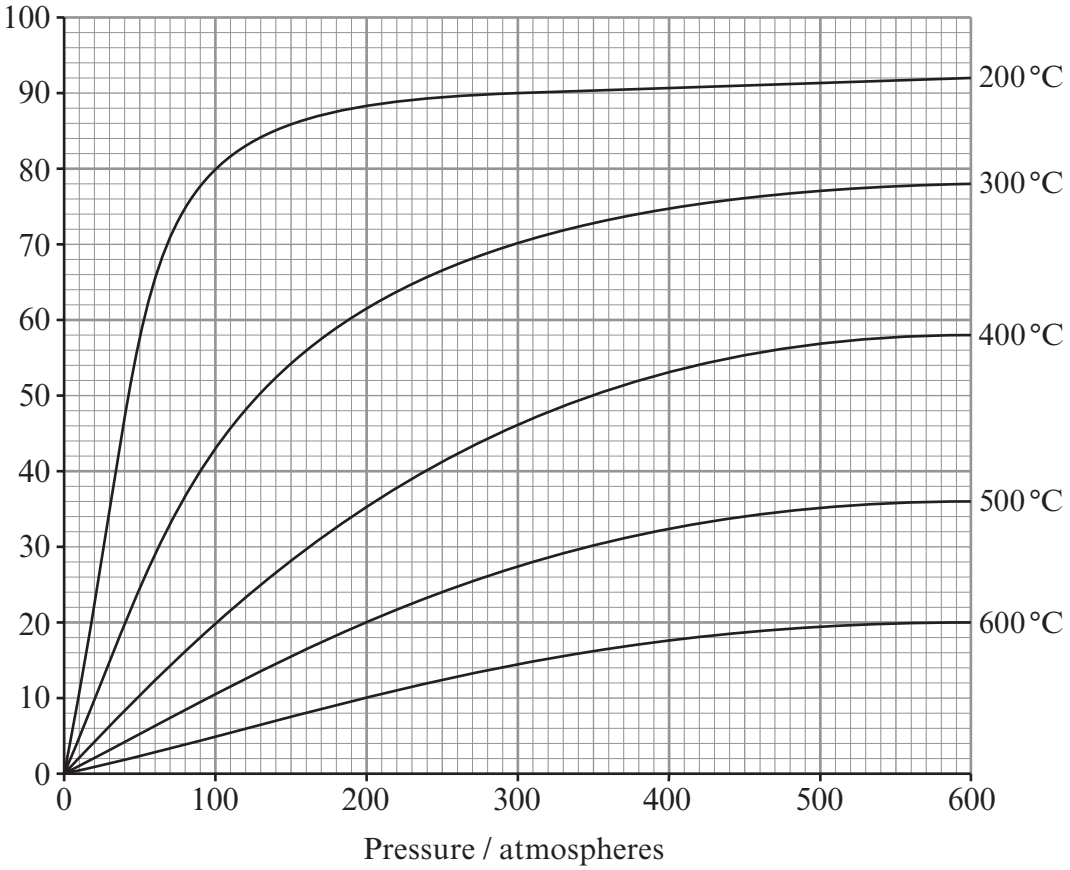
Structure .....

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7. *(a)* The graphs below show how the yield of ammonia depends on the temperature and pressure used in its production.



(i) Use the appropriate graph to find the percentage yield of ammonia at a pressure of 200 atmospheres and a temperature of 500 °C. [1]

..... %

(ii) State the effect on the yield of ammonia of

I. increasing the pressure, [1]

.....

II. increasing the temperature. [1]

.....

(b) Farmers use nitrogenous fertilisers, containing ammonium compounds, to increase crop yields.

Describe a chemical test you would carry out on a sample of fertiliser to show that it contained ammonium ions. Include the results expected for a positive identification of the gas formed. [2]

.....

.....

5

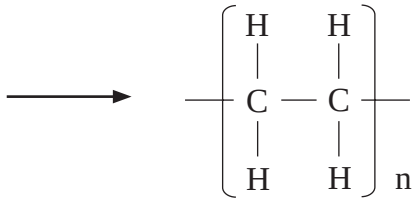
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8. *(a)* Ethene is used to make the polymer polythene.

(i) Complete and balance the **symbol** equation below for the production of polythene from ethene. [2]



(ii) Give the name for the type of polymerisation taking place in the production of polythene from ethene. [1]

.....

(iii) Give the reason why ethene can undergo this type of polymerisation. [1]

.....

(b) Polythene is a thermoplastic. State and explain, in terms of **structure**, why a thermoplastic is unsuitable for making cups to hold boiling water. [2]

.....

.....

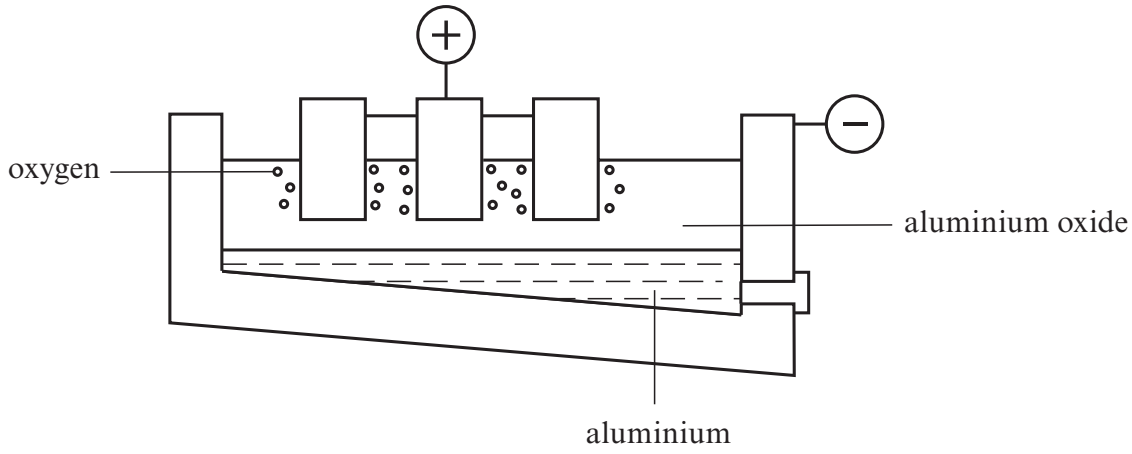
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9. Aluminium is extracted from molten aluminium oxide by electrolysis.



(a) Complete and balance the following electrode equations. [2]

At the cathode Al^{3+} + ... ⟶ Al

At the anode ..... – $4e^-$ ⟶ O_2

(b) The overall equation for the extraction of aluminium is shown below.

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

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

(i) Calculate the mass of aluminium you would expect to extract from 10.2 tonnes of aluminium oxide. [3]

.....

.....

.....

.....

(ii) During an actual process 4.3 tonnes of aluminium was formed from 10.2 tonnes of aluminium oxide. Calculate the percentage yield for this reaction. [2]

.....

.....

.....

7

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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^{+}		

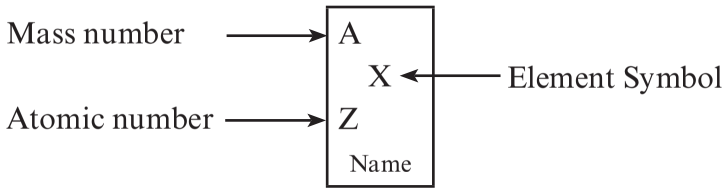
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PERIODIC TABLE OF ELEMENTS

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:



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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY (LEGACY)

SUMMER 2012

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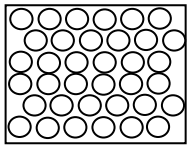
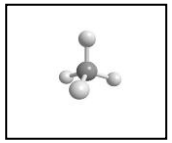
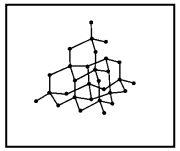
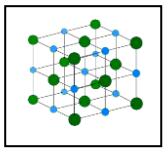
INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2012 examination in GCSE SCIENCE - CHEMISTRY (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

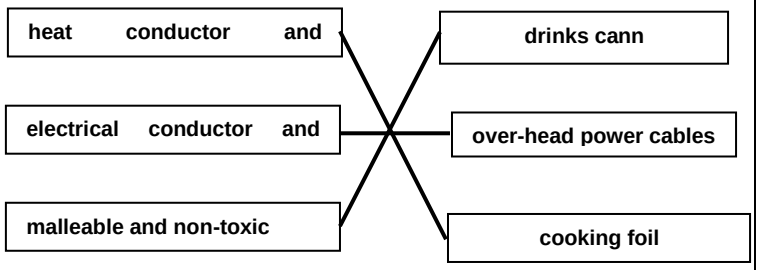
WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)	(i)		1	**A**			
			(ii)		1	**C**			
		(b)	(i)		4	aluminium  (1) methane  (1) diamond  (1) sodium chloride  (1)			
			(ii)		1	sodium chloride	NaCl		

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
2		(a)	(i)		1	aluminium oxide / alumina	Al_2O_3		cryolite bauxite
			(ii)		1	cathode / negative (electrode)	– (minus sign)		
			(iii)		1	oxygen	O_2 carbon dioxide / CO_2	O	
		(b)			2	nearby power station (1) coastal position (1)			
		(c)			2	 all correct (2) any one correct (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)			1	nitrogen: atmosphere hydrogen: natural gas - both needed	air		
		(b)			2	reactants : nitrogen + hydrogen (1) product: ammonia (1)	N_2 + H_2 NH_3 (ignore balancing)	reference to N and H	 *liquid* ammonia
		(c)	(i)		1	forms a liquid / condenses	liquefies		
			(ii)		1	put back into the reactor/ recycled / put back into the reaction / used again			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)			1	thermochromic (materials)			
		(b)			1	hydrogels			
		(c)			1	shape memory alloys			
		(d)			1	photochromic (materials)			

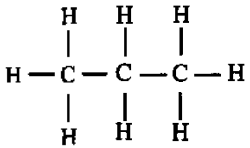
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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5		(a)			3	Must imply • all three give a lather (1) • Bangor gives more lather than Wrexham & Brecon (1) the harder the water, the less lather is formed (1)	bubbles /foam / froth / suds = lather	reference to 'scum'	No lather
		(b)			1	• 1 cm^3 soap solution / same amount of soap solution / same volume of soap solution • 10 cm^3 water / same amount of water / same volume of water • shaken for 10s / shaken for the same time • same size test tube • same temperature - any one			

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6									
		(a)	(i)		1				
			(ii)		1	12	C_5H_{12}		
		(b)			2	(4×12) + (10×1) (1) = 58 (1) ***award 2 marks if correct answer given without any working***			
		(c)	(i)		2	• stronger / doesn't rip easily (1) • waterproof / water resistant (1) • non-biodegradable / doesn't rot (1) a***ny two from three marking points***	strong / stretches	durable/ flexible/ tougher lasts longer	light /harder easily coloured can be re-used
			(ii)		2	• lighter / less dense (1) • does not corrode (1)	does not rust/ low maintenance/ doesn't have to be painted	tough / can be recycled easily coloured / easily shaped	

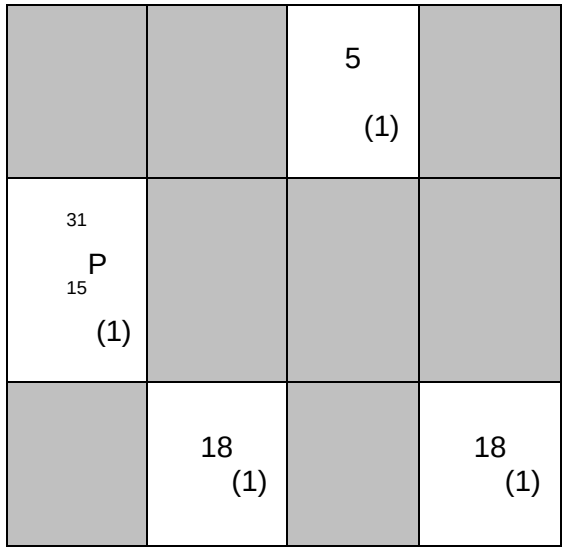
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	(a)	(i)		3	all points plotted correctly (2) any 4 plotted correctly (1) tolerance ± ½ square line of 'best fit' (1) ***drawn with a ruler*** ***judgement by eye***			
		(b)	(i)		1	65 ±1 ***i.e. anywhere from 64-66 ^{o}C***			
			(ii)		1	19 ±1 ***i.e. anywhere from 18-20 g per 100g of water***			

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
8	2				4				

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	3	(a)	(i)		2	most reactive: **magnesium** **zinc** **copper** least reactive: **silver** all correct (2) any 2 correct (1)	Mg Zn Cu Ag		metal nitrates
			(ii)		2	reactants: copper + silver nitrate (1) products: silver + copper nitrate (1)	Cu + $AgNO_3$ Ag + $Cu(NO_3)_2$		
		(b)			2	***magnesium gains oxygen*** to form magnesium oxide - ***oxidation*** (1) **copper oxide** ***loses oxygen*** to form copper - ***reduction*** (1) no reference to specific reaction e.g. gaining oxygen is oxidation and losing oxygen is reduction - 1 mark			

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	4	(a)			2	photochromic (1) darkens/changes colour (on exposure) to (sun)light (1)		Sun changes 'appearance'	
		(b)			2	thermochromic (1) changes colour with heat (1)		changes 'appearance'	

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	5	(a)			4	• (add) equal volume of soap solution *(or 'add soap solution 1cm^3 at a time until a permanent lather is formed)* (1) • (use) equal volume of water sample (1) • shake for an equal number of times/ equal time (1) [add soap, shake to give lather (1) if none of the first three marks credited] • **C** has most lather and **A** least lather (*or **C** needs least soap and **A** needs most)* **comparative answer needed** (1)	equal amounts equal amounts 'shake equally'		
		(b)	(i)		1	• strengthens bones • strengthens teeth • reduces heart disease • does not dissolve lead from lead pipes		• healthier • better for you • tastes better • *good for* bones • *good for* teeth	
			(ii)		1	• limescale / scale / boiler scale / fur blocks kettles • limescale/ scale/ boiler scale / fur blocks boilers	• cost of water softener	• wastes money • wastes energy • wastes electricity / gas	reference to 'scum' and 'wasting soap'

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)	(i)		3	sodium atom loses 1 electron (1) fluorine atom gains 1 electron (1) *neutral atoms needed* *only one transferred electron allowed* Na^+ and F^- ions formed (1) *octet of electrons around F^- not needed* *discrete pair of ions needed for this mark*			
			(ii)		2	(four) **shared pair(s)** of electrons (1) **octet of electrons** around C atom (1)			
		(b)			2	bonding: covalent (1) structure: giant molecular (1)	giant covalent		'giant'

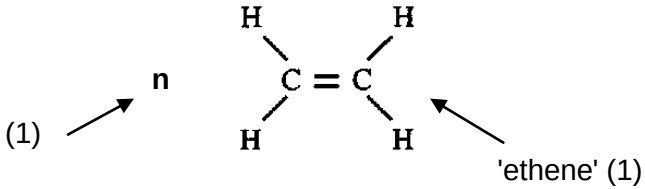
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)	(i)		1	20			
			(ii)	I	1	increases	goes up		
				II	1	decreases	goes down		
		(b)			2	(add warm) sodium hydroxide (solution) (1) damp (red) litmus paper turns blue or damp universal indicator turns blue / purple (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)	(i)		2	 ***ignore brackets around ethene***	C_2H_4		
			(ii)		1	addition			additional
			(iii)		1	• (it contains) a double bond / C=C bond • it is unsaturated		• it is an alkene	
		(b)			2	• softens on heating / loses its shape on heating (1) • no bonding between chains/ chains can slide over each other / weak forces between chains (1)	• diagram showing no links between chains	reference to melting / change of state tangled molecules chains	reference to layers

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	(a)			2	3e / $3e^-$ (1) $2O^{2-}$ (1)			
		(b)	(i)		3	$M_r(Al_2O_3)$ = 102 (1) 2(102) form 4(27) **or** 204 forms 108 (1) 10.2 forms 5.4 (1) ***award 3 marks for correct answer if no working shown***	10.4/102 = 0.1 0.1 : 0.2 0.2 (27) = 5.4		
			(ii)		2	4.3/5.4 × 100(1) = 79.62 % (1) *accept values from 79.6-80%* ***award 2 marks for correct answer if no working shown*** ***- mark consequentially***			

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Surname	Centre Number	Candidate Number
Other Names		0

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GCSE

0240/02

ADDITIONAL SCIENCE
HIGHER TIER
CHEMISTRY 2

A.M. THURSDAY, 26 January 2012

45 minutes

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

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1. *(a)* Complete the following table of information about some elements.

The Periodic Table of Elements shown on the **back cover of this examination paper** may help in answering this question. [4]

Element	Symbol	Number of protons	Number of neutrons	Number of electrons
carbon	$^{12}_{6}C$		6	6
magnesium	$^{24}_{12}Mg$	12	12	
phosphorus	$^{31}_{15}P$	15		15
argon		18	22	18

(b) Calculate the relative molecular mass (M_r) of sulphuric acid, H_2SO_4. [2]

$A_r(H) = 1$ $A_r(O) = 16$ $A_r(S) = 32$

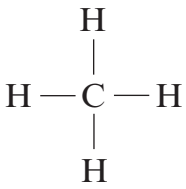
$M_r(H_2SO_4)$ = ...

6

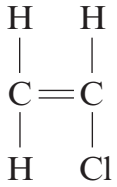
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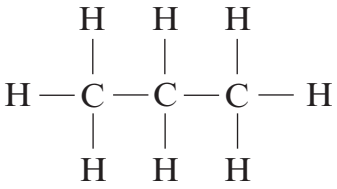
2. The following diagrams show the structural formulae of four substances, **A**, **B**, **C** and **D**.



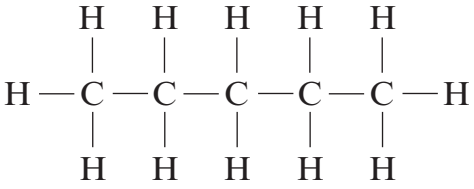
A



B



C



D

(a) The molecular formula of **A** is CH_4.

Give the molecular formula of **D**. ..... [1]

(b) Give the letter for the substance that is **not** a hydrocarbon. ..... [1]

(c) Butane contains four carbon atoms.

Draw the **structural** formula of butane. [1]

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3. *(a)* The following table contains the chemical names and formulae of some common fertilisers.

Name	Formula
sodium nitrate	$NaNO_3$
ammonium phosphate	$(NH_4)_3PO_4$
ammonium sulphate	$(NH_4)_2SO_4$
calcium nitrate	$Ca(NO_3)_2$

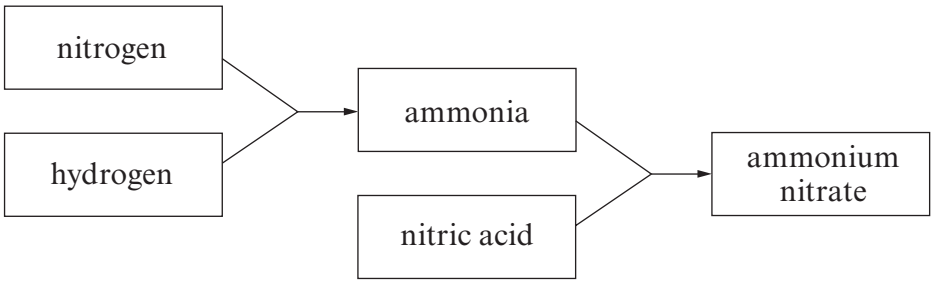
(i) **Name** the **two** elements that are found in all the above fertilisers. [1]

..... and .....

(ii) Name the acid used to neutralise ammonia in the production of ammonium sulphate. [1]

.....

(b) The following flow diagram shows how ammonium nitrate is manufactured from nitrogen, hydrogen and nitric acid.



(i) Which substance appearing in the flow diagram comes from the atmosphere? [1]

.....

(ii) Complete the **word equation** for the formation of ammonium nitrate. [1]

..... + ... ⟶ ammonium nitrate

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(c) When farmers use fertilisers, some fertiliser can be washed out of the soil into lakes. This can result in the overgrowth of algae. When algae die and decay, oxygen is removed from the lakes.

(i) State why farmers use fertilisers. [1]

.....

.....

(ii) Give **one** consequence of the removal of oxygen from lakes. [1]

.....

.....

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4. The following table shows five substances and examples of their uses.

Substance	Use
nitinol	spectacle frames
aluminium	greenhouse frames
photochromic pigment	lenses for glasses
polymer gel	nappies
shape memory polymer	car bodies

The main reason for using nitinol in spectacle frames is that the frame, if bent, can return to its original shape.

Give the **main reason** for the given use of each of the remaining four substances.

(a) Aluminium in greenhouse frames. [1]

.....

.....

(b) Photochromic pigment in lenses for glasses. [1]

.....

.....

(c) Polymer gel in nappies. [1]

.....

.....

(d) Shape memory polymer in car bodies. [1]

.....

.....

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5. *(a)* Iron can be extracted from iron oxide by heating with carbon.

The word equation for the reaction is

iron oxide + carbon ⟶ iron + carbon monoxide

(i) State which substance is oxidised during the reaction. [1]

.....

(ii) Balance the chemical equation for this reaction by giving the appropriate numbers in the boxes. [1]

Fe_2O_3 + ☐ C ⟶ ☐ Fe + ☐ CO

(b) Iron can also be extracted from iron oxide using aluminium powder.

Complete the **word equation** for this reaction. [1]

iron oxide + aluminium ⟶ ..... + ...

(c) You are given some iron filings, copper foil, copper sulphate solution, iron sulphate solution and a few test tubes.

Describe an experiment that you could carry out to determine which of the two metals is the more reactive. Give the expected observation(s) and the conclusion you would reach. [3]

.....

.....

.....

.....

.....

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Examiner only

6. *(a)* Water is often described as being soft or hard.

State what is meant by *hard water*. [1]

.....

.....

(b) Pupils in a year 11 class were asked to determine the relative hardness of water samples **A** and **B**. Details of the experiments carried out by two different groups are given below.

Experiment 1

In this experiment, water and soap solution were mixed and shaken and the height of the lather measured.

The results for experiment 1 are given in the following table.

Water sample	Volume of water used / cm^3	Volume of soap solution used / cm^3	Time of shaking / s	Height of lather produced / cm
A	100	24	20	4
B	100	12	20	3

Experiment 2

In this experiment 1 cm^3 soap solution was added to the water samples and shaken. This procedure was then repeated until the height of the lather was 4 cm in both samples. The volume of soap solution required to obtain a lather height of 4 cm was then recorded.

The results for experiment 2 are given below.

Water sample	Volume of water used / cm^3	Time of shaking / s	Height of lather / cm	Volume of soap solution required / cm^3
A	50	20	4	12
B	50	20	4	6

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(i) State how experiment 1 could be changed to make it a **fair test**. [1]

.....

.....

(ii) State which water sample is the harder, giving a reason for your answer. [1]

Harder water .....

Reason .....

.....

(iii) Both water samples were passed through an ion exchange resin and experiment 2 was repeated. State what you would expect to happen, giving a reason for your answer. [1]

.....

.....

.....

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7. *(a)* Calcium reacts with chlorine to form calcium chloride.

Using the electronic structures below, show by means of a **diagram** the electronic changes that take place during the formation of calcium chloride. **Show the charges on the ions formed**. [3]

calcium = 2,8,8,2 chlorine = 2,8,7

(b) (i) Using the electronic structures below, show by means of a **diagram** the bonding in an ammonia molecule, NH_3. [2]

nitrogen = 2,5 hydrogen = 1

(ii) State the type of **bonding** that is present in ammonia. [1]

.....

6

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Examiner only

8. *(a)* Ethane, C_2H_6, and ethene, C_2H_4, are hydrocarbons.

Draw the **structural** formulae for **both** of these hydrocarbons. [2]

Ethane Ethene

(b) The polymer polythene is obtained from ethene.

(i) Name the process used to obtain ethene from large hydrocarbons. [1]

.....

(ii) State whether polythene is an example of a saturated or an unsaturated hydrocarbon, giving a reason for your answer. [1]

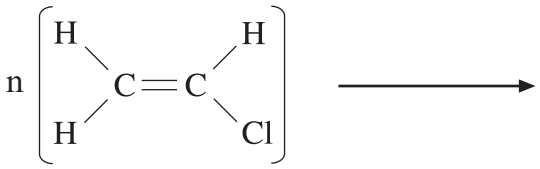
Polythene is .....

Reason .....

.....

(c) (i) Polyvinyl chloride, PVC, is formed by addition polymerisation of vinyl chloride.

Complete the **symbol** equation for making PVC. [2]



.....

(ii) When PVC is warmed it softens.

State the name given to this **type** of plastic. [1]

.....

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Examiner only

9. Copper can be extracted from copper oxide using hydrogen. The equation for the reaction is shown below.

$$CuO + H_2 \longrightarrow Cu + H_2O$$

(a) Calculate the mass of copper oxide that is required to extract 127 tonnes of copper. [3]

$M_r(CuO) = 79.5$ $A_r(Cu) = 63.5$

Mass of copper oxide = ... tonnes

(b) If only 101.6 tonnes of copper was obtained during the extraction, calculate the percentage yield for the reaction. [2]

Percentage yield of copper = ... %

5

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Examiner only

10. Describe how the gas ammonia can be produced from ammonium chloride and how this gas can be identified. [3]

.....

.....

.....

.....

.....

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Turn over.

3

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FORMULAE FOR SOME COMMON IONS

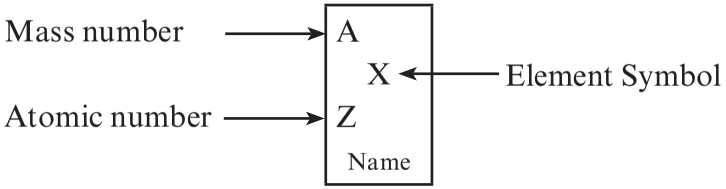
POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)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

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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 Sulfur	$^{35}_{17}$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:



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WJEC
CBAC

GCSE MARKING SCHEME

SCIENCE – CHEMISTRY (LEGACY)

JANUARY 2012

STEMUP.CO.UK

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2012 examination in GCSE SCIENCE – CHEMISTRY (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

Unit	Page
C1 (Legacy)	1
C2 (Legacy)	17

UNIT C2 (LEGACY)

January 2012 Chemistry 2 Mark Scheme – Foundation Tier only questions

Q.1	Mark	Answer	Accept	Neutral answer	Do not accept
(a) (i)	1	**C**			
(ii)	1	**B**			
(iii)	1	**A**			
(b) (i)	1	5			
(ii)	1	7			
(c)	1	nucleus			

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Q.2	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	3	wellington boot ---------- waterproof coffee cup ---------- good heat insulator electric plug casing --------- does not conduct electricity tooth brush ---------- strong, flexible and hard wearing all four correct = 3 marks two correct = 2 marks one correct = 1 mark			
(b)	1	PVC, PTFE, polystyrene, nylon, polyester, acrylic, etc			
(c)	1	lighter / does not corrode or rust / easier to mould	can be coloured	waterproof	

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Q.3	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	2	to make superelastic spectacle frames (1) in coffeepot thermostat (1)			
(b)	1	photochromic pigment			

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Q.4	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	1	B A C			
(b) (i)	1	magnesium sulphate + copper	$MgSO_4$ + Cu		
(ii)	2	aluminium and copper oxide (1) copper and silver nitrate solution (1)			
(iii)	2	no reaction (1) silver is less reactive than magnesium/ magnesium is higher in the reactivity series (1)	 silver low in the series	more slowly than Mg	
(c)	1	electrolysis		reduction	

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Q.5	Mark	Answer	Accept	Neutral answer	Do not accept
(a) (i)	1	giant ionic			
(ii)	1	850			
(iii)	1	graphite		C	
(b) (i)	1	B			
(ii)	1	(simple) molecular			

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Q.6	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	2	C (1) most froth / lather formed (1)			
(b)	1	add sodium carbonate / distil / pass through ion-exchange resin	boil		
(c)	1	stronger teeth / stronger bones reduce heart illness better taste / good for making beer		strong teeth/bones	

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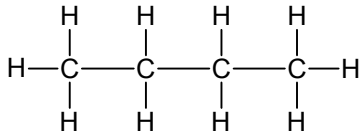
Q.7	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	3	6 points correct = 2 marks 5 points correct = 1 mark smooth curve going through all the points = 1 mark			
(b) (i) (ii)	1 1	40 ±1 47.5 ±1			

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Common questions

Q.8/1	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	4	6 (1) 12 (1) 16 (1) $^{40}_{18}$Ar (1)			
(b)	2	correct answer = 98 (2) M_r = 2 + 32 + (4x16) (1)			

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Q9/2	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	1	C_5H_{12}			
(b)	1	B			
(c)	1				

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Q.10/3	Mark	Answer	Accept	Neutral answer	Do not accept
(a) (i)	1	nitrogen and oxygen (1) both needed for the mark		N and O	
(ii)	1	sulphuric acid	H_2SO_4		
(b) (i)	1	nitrogen	N_2		N
(ii)	1	ammonia + nitric acid	$NH_3 + HNO_3$		
(c) (i)	1	increase growth / faster growth / bigger plants / healthy plants / improves soil / cheaper food / increase profit / releases land for other purposes			better plants/cheaper
(ii)	1	reduces the amount of fish		decrease in living organisms	

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Higher Tier only questions

Q.4	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	1	does not corrode		light/cost/malleable	
(b)	1	changes colour when exposed to sunlight / light			
(c)	1	has the ability to absorb a **lot** of liquids		absorbs water	
(d)	1	has the ability to regain its (original) shape when heated			

Q.5	Mark	Answer	Accept	Neutral answer	Do not accept
(a) (i) (ii)	1 1	carbon 3 → 2 3			
(b)	1	iron + aluminium oxide			
(c)	3	• place iron in the copper sulphate (solution) • the iron in copper sulphate experiment gives a (black/brown) solid / changes colour • (reaction has taken place therefore) iron more reactive than copper			

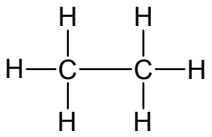
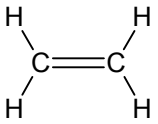
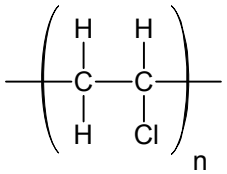
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Q.6	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	1	water that does not lather well / easily with soap water that contains calcium / magnesium ions / compounds	forms scum with soap	long <u>time</u> to lather	
(b) (i)	1	use the same amount of soap (solution) for both samples			
(ii)	1	A – requires more soap in experiment 2	A – less lather per cm^3 of soap (solution) /		
(iii)	1	volume of soap (solution) required to produce lather is less / the same for samples A and B – the ion exchange unit removes the hardness / softens the water / removes Ca^{2+}/replaces Ca^{2+} with Na^+	doubling volume of soap (solution) only produces small increase in lather (height) in experiment 1		

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Q.7	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	3	diagrammatic representation showing clearly **one** Ca atom losing 2 outer electrons (1) **two** Cl atoms gaining one electron each (1) Ca^{2+} and Cl^- (both needed) (1) there must be no ambiguity e.g. electrons cannot be on atoms and ions at the same time			
(b) (i)	2	shared pair of electrons between the N atom and the three H atoms (1) full octet around the N (1)			
(ii)	1	covalent			

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Q.8	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	2	 (1)  (1)			
(b) (i)	1	cracking			
(ii)	1	saturated – polythene has no double bonds / **only** contains single bonds		cannot add more hydrogen atoms contains single bonds	
(c) (i)	2				
(ii)	1	thermoplastic	thermosoftening plastics		

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Q.9	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	3	63.5 tonnes of Cu would come from 79.5 tonnes of CuO (1) 63.5 x 2 (127) tonnes of Cu would come from 2 x 79.5 tonnes of CuO (1) answer = 159 tonnes of CuO (1) [3 marks for correct answer]			
(b)	2	percentage yield = $\frac{101.6 \times 100}{127}$ (1) = 80 (1) [2 marks for correct answer]			$\frac{63.5}{79.5} \times 100 = 79.9\%$

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Q.10	Mark	Answer	Accept	Neutral answer	Do not accept
	3	(warm) with sodium hydroxide (1) **damp** (red) litmus (1) goes blue (1)	**damp** universal indicator paper goes blue / purple		

Surname	Centre Number	Candidate Number
Other Names		0

WJEC CBAC

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.

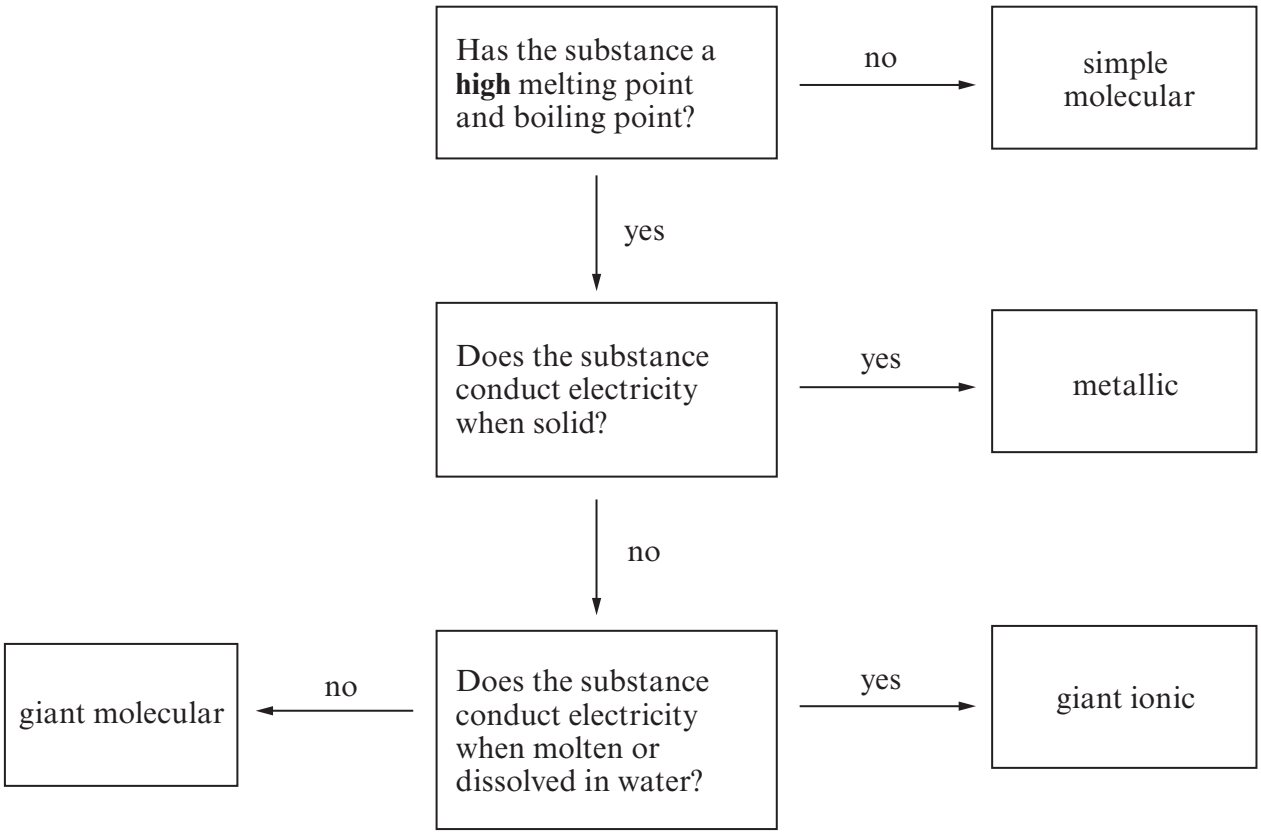
You are reminded of the necessity for good English and orderly presentation in your answers.

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.

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Answer **all** *questions.*

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



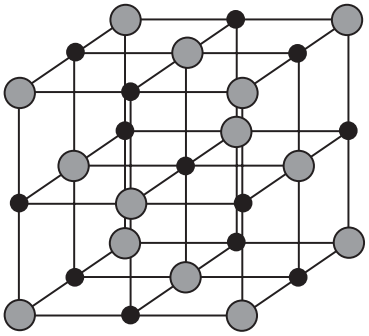
Complete the table below using the flow chart. [4]

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	

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



Describe the electrical conductivity of sodium chloride. [1]

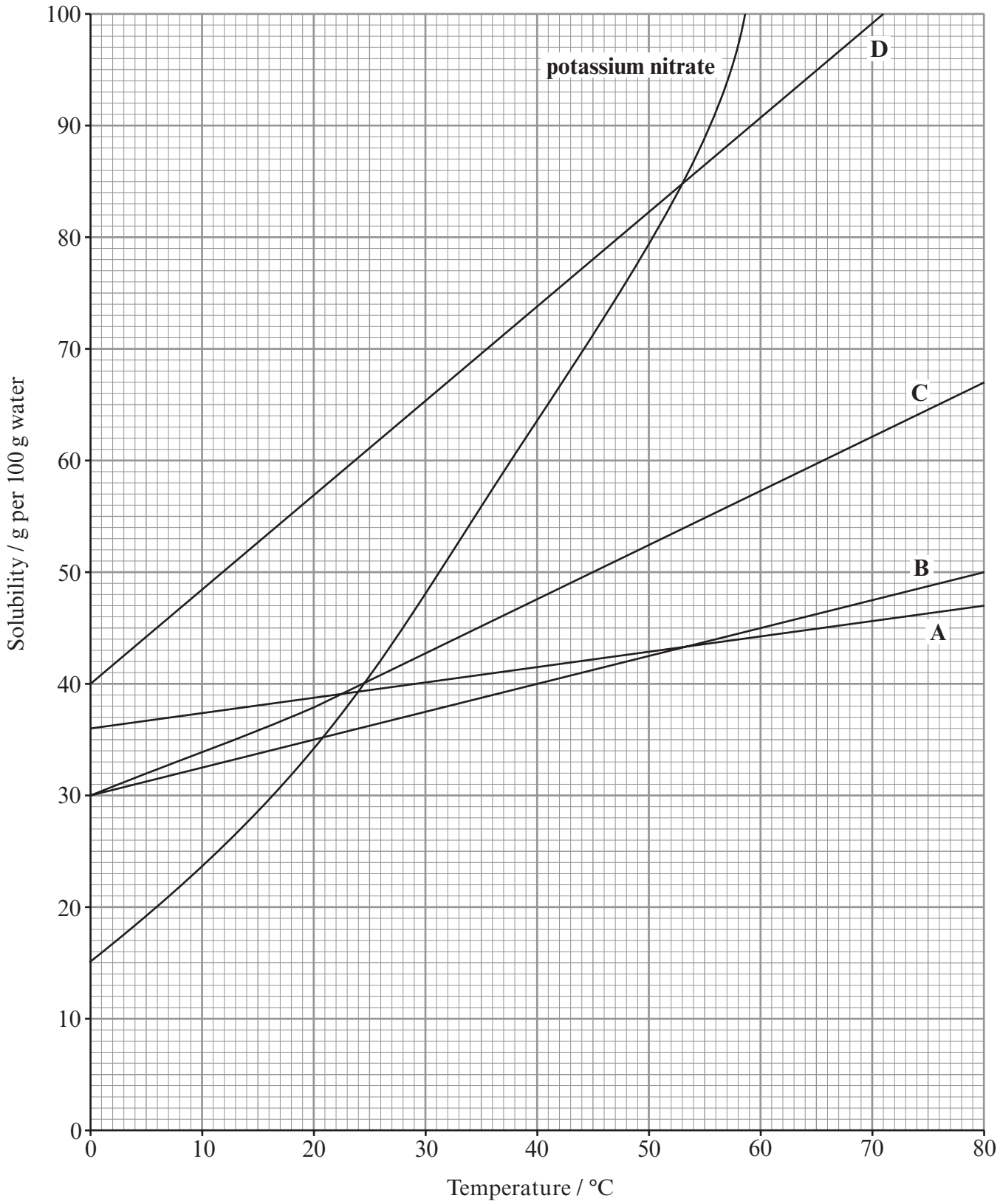
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2. The graph below shows the solubility of potassium nitrate and four substances, **A**, **B**, **C** and **D**, in water at various temperatures.



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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]

.....

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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

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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

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]

.....

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

(a) 

Fridge thermometer

Thermochromic pigments are used in fridge thermometers. [1]

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

.....

.....

(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]

.....

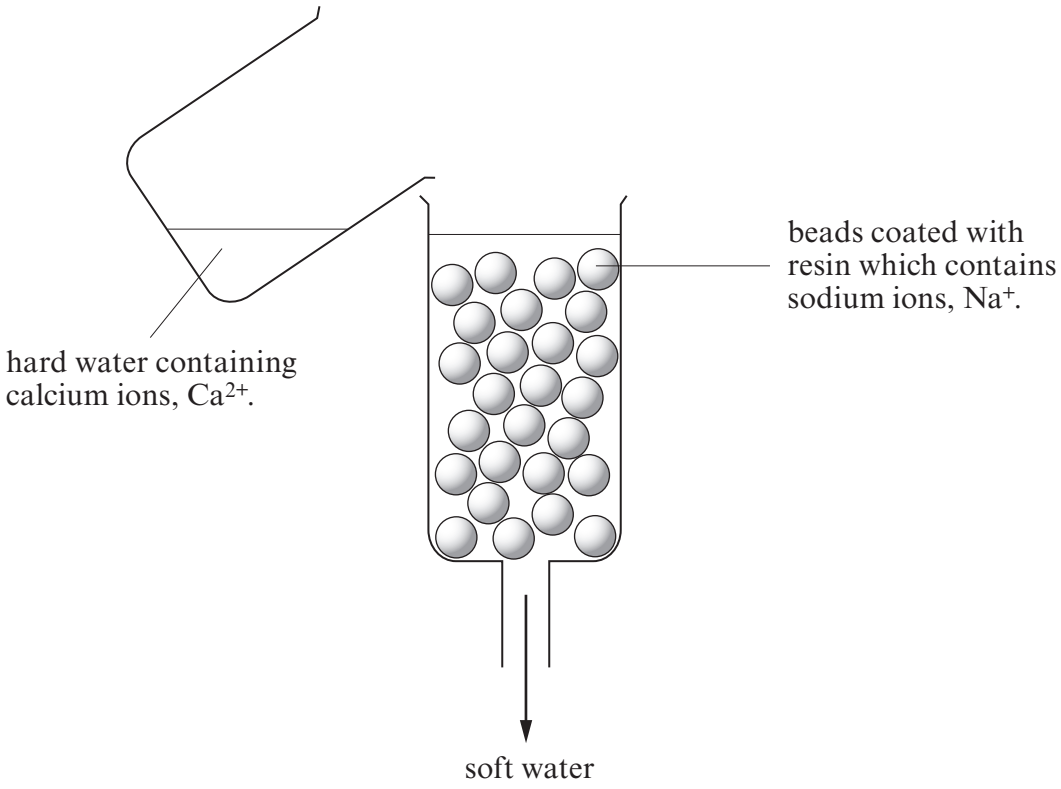
(ii) Describe the special property of the smart material named in part (i). [1]

.....

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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]

.....

.....

.....

.....

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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]

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8. Ammonia is manufactured by reacting nitrogen and hydrogen.

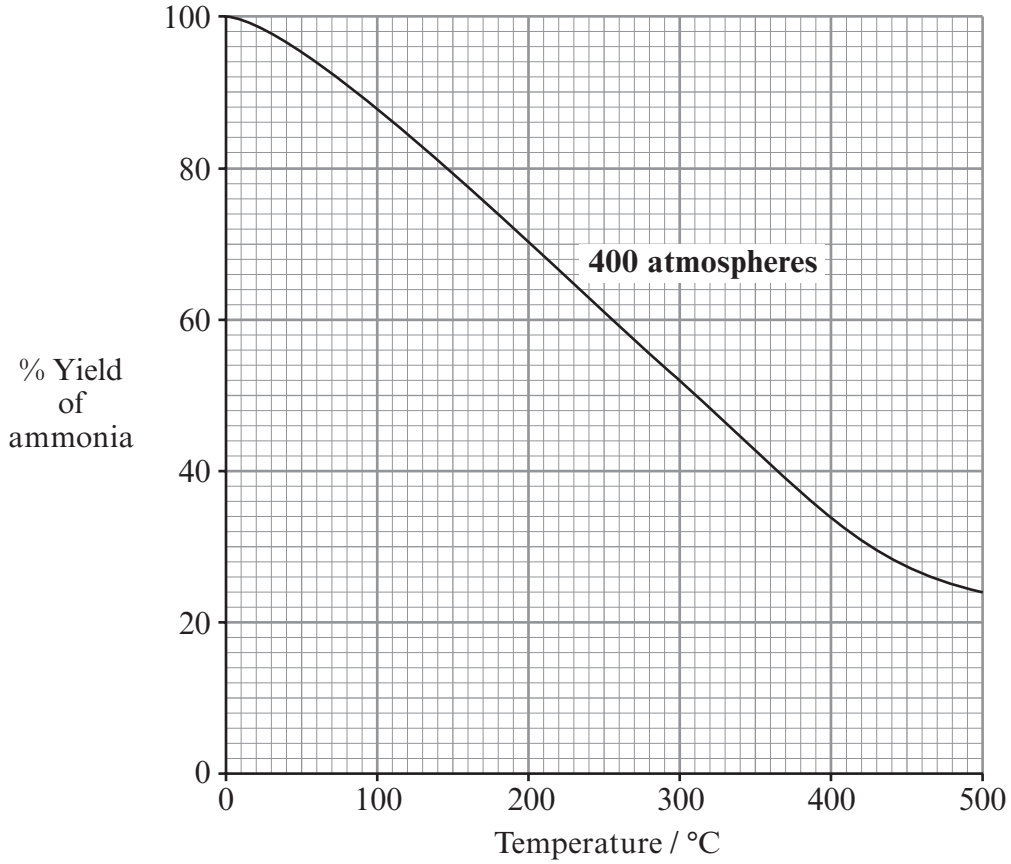
(a) Balance the **symbol** equation below which represents the formation of ammonia. [1]

$$N_2 + \ldots\ldots H_2 \rightleftharpoons \ldots\ldots NH_3$$

(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]

.....

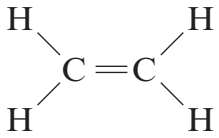
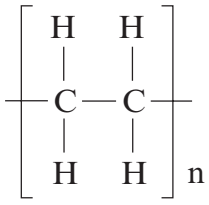
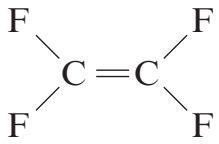
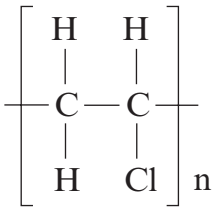
(iii) Sketch the graph you would expect at a pressure of 200 atmospheres. [2]
Label this graph ***200 atmospheres***.

Turn over.

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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]

.....

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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

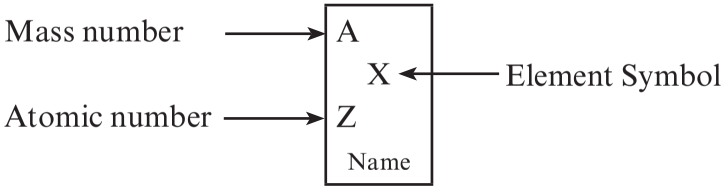
POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)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

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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:



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Candidate Name	Centre Number	Candidate Number
		0

WJEC CBAC

GCSE

240/02

ADDITIONAL SCIENCE
HIGHER TIER
CHEMISTRY 2

A.M. MONDAY, 17 January 2011

45 minutes

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

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Answer **all** *questions.*

1. The following table contains some information about elements **A**, **B**, **C**, **D**, **E** and **F**. These letters are **not** chemical symbols.
Element **F** has an error in its information.

Element	Mass number	Atomic number	Number of protons	Number of neutrons	Number of electrons
A	19	9	9	10	9
B	24	12	12	12	12
C	35	17	17	18	17
D	37	17	17	20	17
E	40	18	18	.....	18
F	40	20	20	20	21

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

Each letter may be used once, more than once or not at all.

(i) I. Complete the table above by giving the number of neutrons in element **E**. [1]

II. Use the Periodic Table of Elements on the back cover of this examination paper to decide which of the elements, **A**, **B**, **C**, **D**, **E** or **F**, is argon. [1]

.....

(ii) One element appears **twice** in the above table. Give the **two** letters of that element and explain your choice. [2]

Letters ..... and .....

Explanation .....

.....

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(iii) State the error in the information about element **F**. [1]

.....

(iv) A sodium atom can be represented in the following way:

$$^{23}_{11}\mathbf{Na}$$

Write the information for element **A** in the same form. [1]

.....

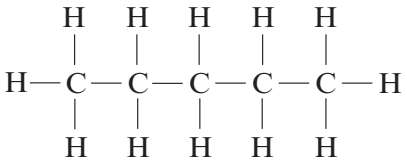
$$\mathbf{A}$$

.....

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2. *(a)* Complete the following table. [2]

Name	ethane	pentane
Formula	C_2H_6	
Structural formula		

(b) Polystyrene is an example of a polymer. Name **one** *other* polymer. [1]

.....

(c) Different substances have different properties that allow them to be used in different ways.
The following table contains information about five different substances labelled **A**, **B**, **C**, **D** and **E**.

Substance	Properties
A	gas at room temperature colourless does not conduct heat does not conduct electricity
B	solid at room temperature grey colour good conductor of electricity ductile
C	liquid at room temperature colourless does not conduct heat poor conductor of electricity
D	solid at room temperature white colour does not conduct electricity rigid does not melt easily on heating
E	solid at room temperature white colour does not conduct heat does not conduct electricity flexible

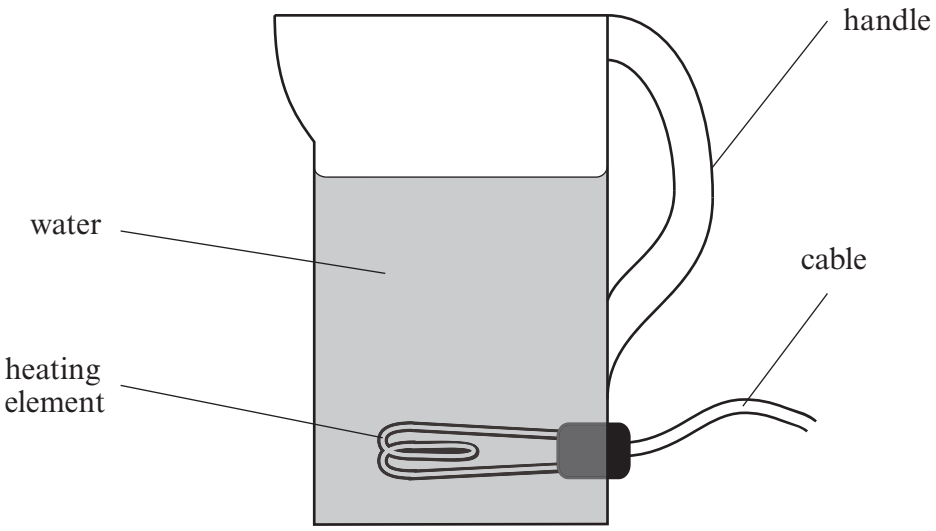
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Use only the information in the table to answer parts (i), (ii) and (iii).

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

The diagram below shows the main parts of a kettle.



State, giving **one** reason, which of the five substances, **A**, **B**, **C**, **D** or **E**, could be used to make the

(i) heating element, [2]

Substance .....

Reason .....

(ii) outer coating of the cable, [2]

Substance .....

Reason .....

(iii) handle. [2]

Substance .....

Reason .....

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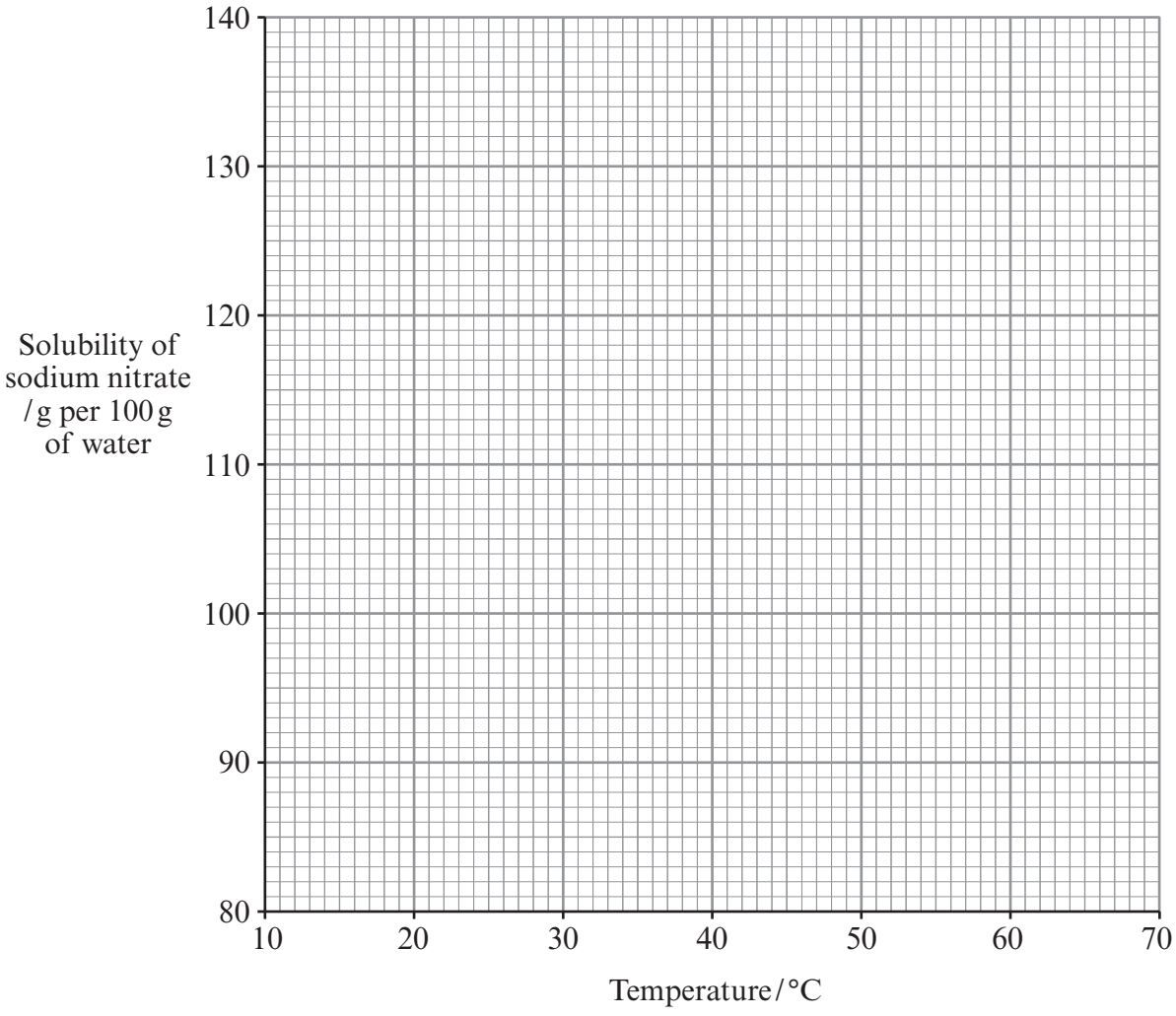
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3. Sodium nitrate dissolves in water to form a solution.
The table below shows the solubility of sodium nitrate in 100 g of water at different temperatures. The maximum mass of solute that can dissolve in 100 g of solvent is called the solubility of a substance.

Temperature / °C	Solubility of sodium nitrate / g per 100 g of water
20	88
30	95
40	103
50	112
60	122
70	133

(i) Plot the points on the grid below and draw the solubility curve for sodium nitrate. [3]



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(ii) Use the graph to predict the solubility of sodium nitrate at 10 °C. [1]

..... g per 100 g of water.

(iii) Use the graph to calculate the mass of sodium nitrate that would dissolve in **50 g** of water at 45 °C. [2]

.....

.....

.....

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4. Smart materials are materials whose properties change with change in their surroundings. Polymer gels and shape memory polymers are two examples of smart materials.

(i) Describe the special properties of each of these smart materials. [2]

Polymer gels .....

.....

Shape memory polymers .....

.....

(ii) Give **one** use for each of these two types of smart materials. [2]

Use of polymer gels

.....

Use of shape memory polymers

.....

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5. (i) Sodium reacts with oxygen to form sodium oxide.

Using the electronic structures below, show by means of a **diagram** the electronic changes that take place during the formation of sodium oxide. **Show the charges on the ions formed**. [3]

sodium = 2,8,1 oxygen = 2,6

(ii) Using the electronic structures below, show by means of a **diagram** the bonding in a water molecule. [2]

hydrogen = 1 oxygen = 2,6

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6. *(a)* (i) Large saturated hydrocarbons can be broken down into smaller more useful hydrocarbon molecules.

Explain the term *saturated*. [1]

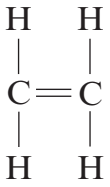
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(ii) When decane, $C_{10}H_{22}$, is passed over aluminium oxide catalyst at 500 °C, the following reaction takes place.

$$C_{10}H_{22} \longrightarrow C_8H_{18} + C_2H_4$$

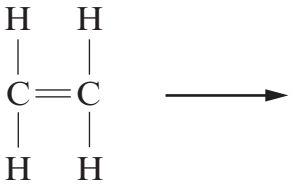
decane — octane — substance **A**

I. The structural formula of substance **A** is [1]



Name substance **A**. .....

II. When substance **A** is heated under high pressure with a different catalyst it undergoes polymerisation.
Complete and balance the **symbol equation** which represents the polymerisation of C_2H_4. [2]

..... 

.....

(b) Polystyrene is an example of a thermoplastic and bakelite is an example of a thermosetting plastic. Describe an experiment that could be carried out to distinguish polystyrene from bakelite, **giving the results you would expect for both**. [3]

.....

.....

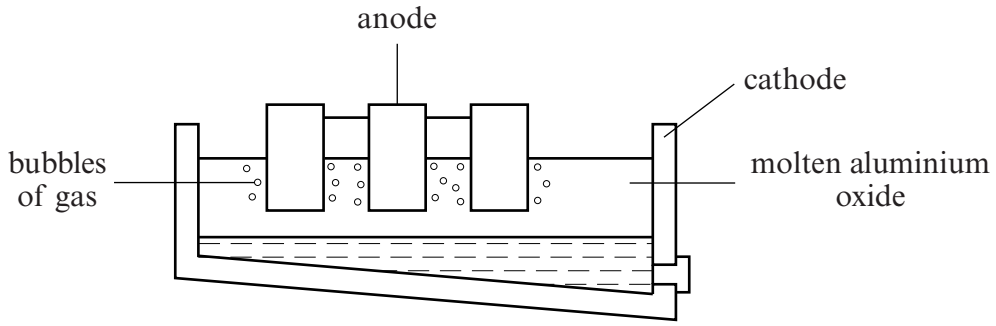
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7. The following diagram shows the apparatus used for the electrolysis of molten aluminium oxide.



(i) Explain why the aluminium oxide needs to be **molten**. [1]

.....

.....

(ii) State what happens to the aluminium ions, Al^{3+}, during electrolysis. [1]

.....

.....

(iii) Complete and balance the electrode equation for the reaction that takes place at the anode. [2]

..... O^{2-} – ..... e^- ⟶ .....

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8. *(a)* Excess chlorine reacted with 1.12 g of iron to produce 3.25 g of iron chloride.

(i) Calculate the mass of chlorine in 3.25 g of iron chloride. [1]

.....

(ii) Calculate the simplest formula of the iron chloride. [3]

Show your workings.

A_r(Fe) = 56; A_r(Cl) = 35.5

.....

.....

.....

.....

(b) (i) Ammonium sulphate, $(NH_4)_2SO_4$, is made industrially by reacting ammonia, NH_3, with sulphuric acid, H_2SO_4.
The reaction that takes place is as follows.

$$2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$$

Use the above equation to calculate how many tonnes of ammonia would be needed to produce 66 tonnes of ammonium sulphate. [3]

A_r(H) = 1; A_r(N) = 14

The relative molecular mass, M_r, of ammonium sulphate, $(NH_4)_2SO_4$, is 132.

.....

.....

.....

.....

.....

(ii) A gas jar is thought to contain ammonia gas. Describe how you could show that the gas is ammonia, **giving the expected results**. [2]

.....

.....

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FORMULAE FOR SOME COMMON IONS

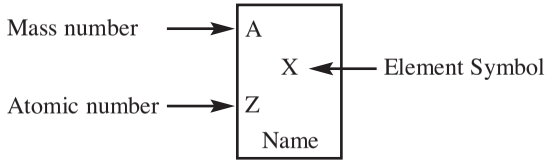
POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)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

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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:



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