WJEC GCSE CHEMISTRY

CHEMISTRY



EXAM QUESTION PACK

UNIT C2 FOUNDATION TIER 4472 PAPERS

STEMUP

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/01

S16-4472-01

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
FOUNDATION TIER

A.M. THURSDAY, 19 May 2016

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**8**	
3.	**7**	
4.	**7**	
5.	**4**	
6.	**4**	
7.	**6**	
8.	**12**	
9.	**6**	
Total	**60**	

4472
010001

ADDITIONAL MATERIALS

In addition to this paper you will need 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.

Assessment will take into account the quality of written communication (QWC) used in your answer to question **9**.

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)* Draw a line from the reactants to the products they form. [2]

Reactants	Products
lithium and oxygen	sodium chloride
sodium and chlorine	lithium hydroxide and hydrogen
iron and fluorine	lithium oxide
lithium and water	iron fluoride

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(b) Flame tests can be used to detect the presence of alkali metal ions.

red	**yellow**	**blue**	**lilac**

Choose from the box the colours of the flames produced by the following ions. [2]

Ion	Colour
lithium	
sodium	

(c) Lithium oxide has the formula Li_2O. Calculate the M_r of lithium oxide. [2]

A_r(Li) = 7 A_r(O) = 16

M_r = ...

6

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Turn over.

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2. A pupil studied the reaction between calcium carbonate powder and hydrochloric acid.

calcium carbonate + hydrochloric acid ⟶ calcium chloride + carbon dioxide + water

(a) State what would be **seen** during this reaction. [1]

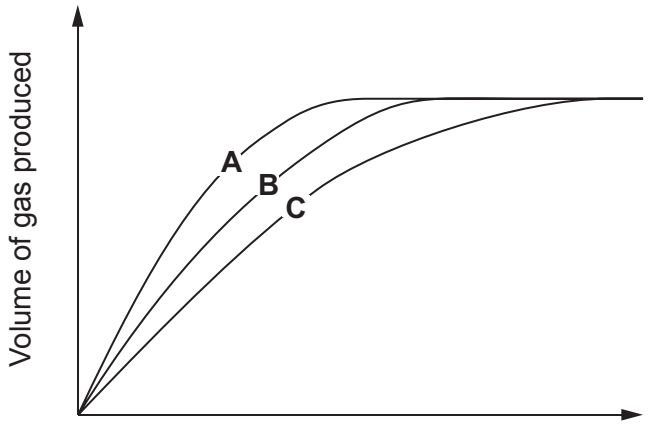
.....

(b) Choose from the box the apparatus that would **not** be suitable for measuring the volume of gas produced. [1]

measuring cylinder	**conical flask**	**gas syringe**	**burette**

.....

(c) The same pupil investigated the reaction at three different temperatures.
The following graphs show the volume of gas produced over time during these three reactions.



(i) State which reaction, **A**–**C**, was carried out at the highest temperature.
Give a reason for your answer. [1]

.....

.....

(ii) Apart from temperature, state **two** factors that could be changed in order to alter the rate of this reaction. [2]

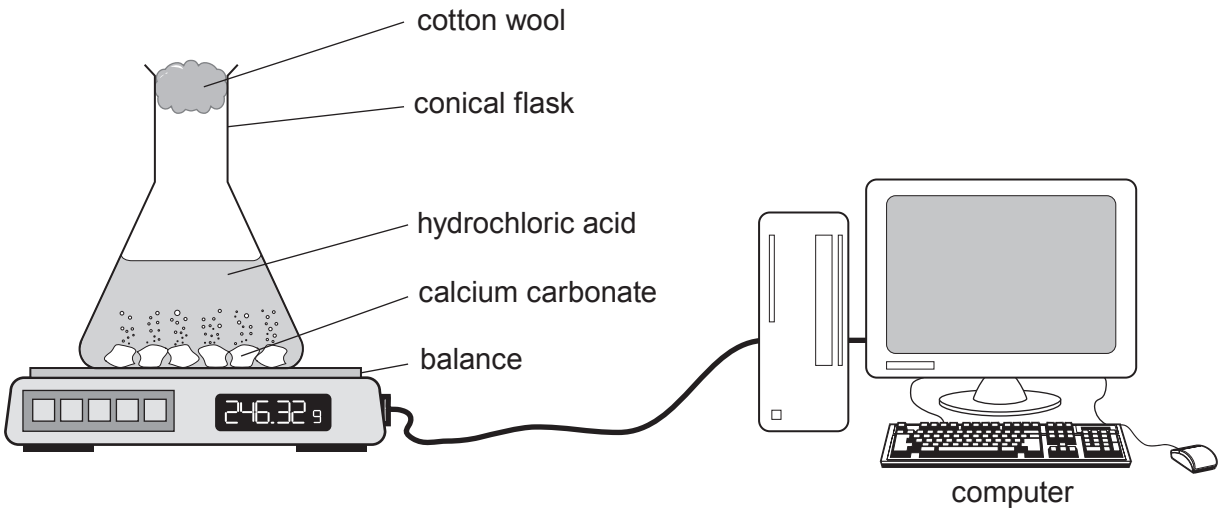
..... and .....

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(d) Another pupil suggested that the same reaction could be studied using a balance.



(i) Explain how this method works. [2]

.....

.....

.....

(ii) Give **one** advantage of connecting the balance to a computer. [1]

.....

.....

8

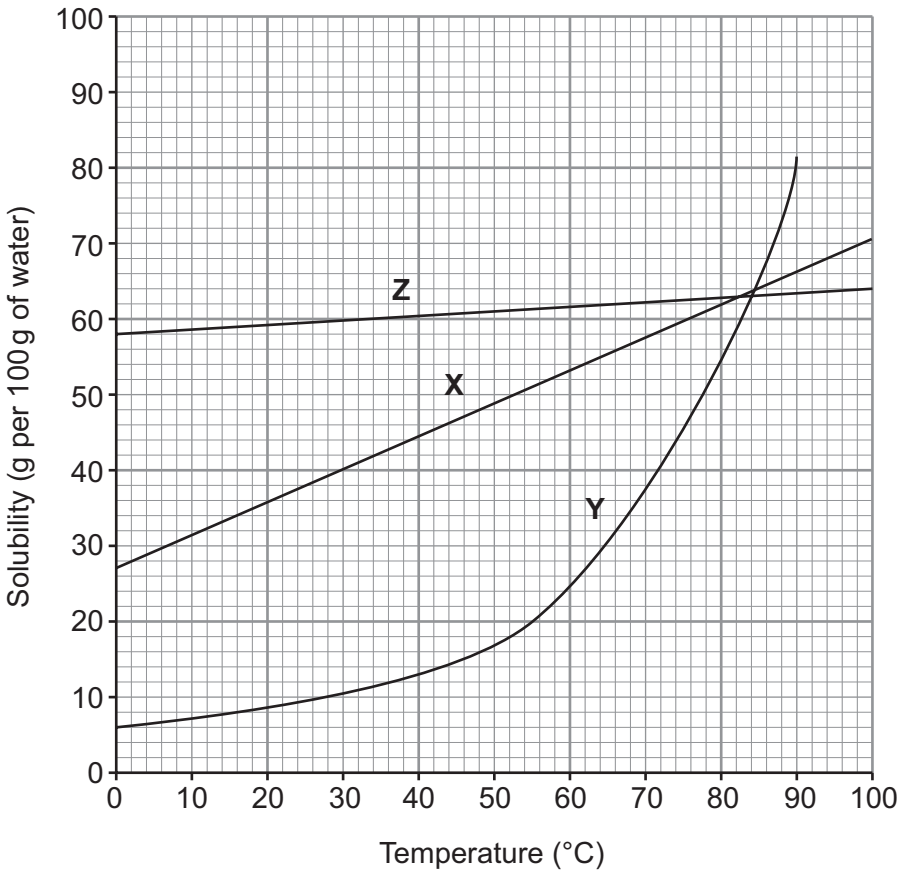
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3. The following graphs show the solubility curves for three substances, **X**, **Y** and **Z**.



(a) Give the letter of the substance, **X**, **Y** or **Z**, whose solubility changes most with temperature. [1]

.....

(b) Give **one** similarity and **one** difference between the solubilities of substances **X** and **Z** as the temperature increases. [2]

Similarity .....

Difference .....

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(c) The solubility of another substance, **W**, was recorded at different temperatures.

The results are shown in the table.

Temperature (°C)	0	20	40	60	80	100
Solubility (g per 100 g of water)	15	20	27	36	47	60

(i) Plot a graph of these results on the same grid and draw a suitable line. [3]

(ii) Use the data to calculate the mass of crystals formed if a saturated solution of **W** containing 100 g of water was cooled from 80 °C to 40 °C. [1]

Mass = ... g

7

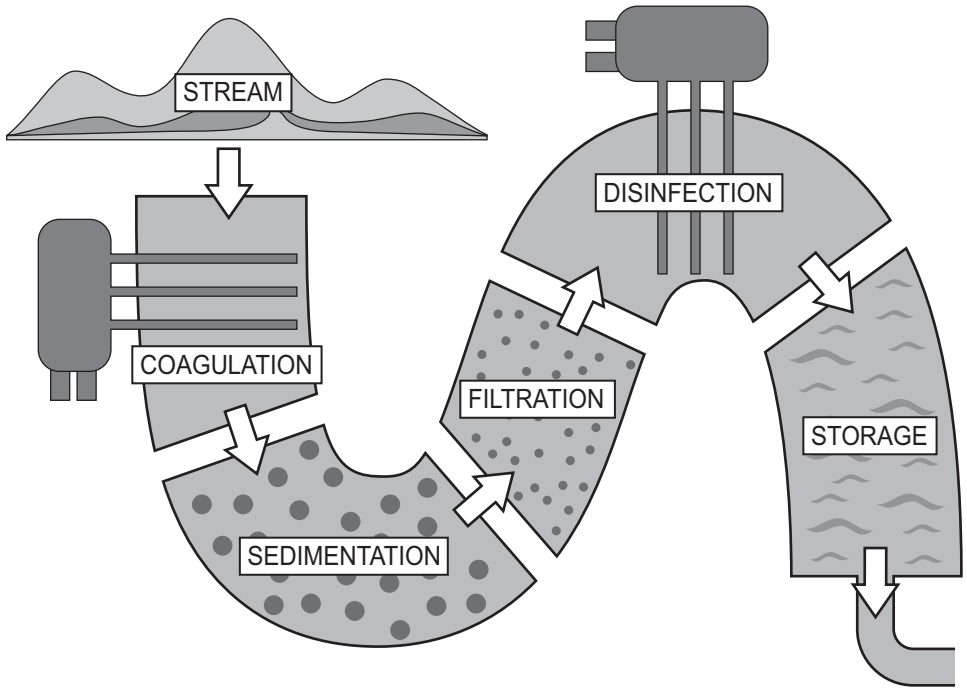
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4. The diagram shows the stages involved in the treatment of our mains water supply.



(a) State the purpose of the filtration stage. [2]

.....

.....

(b) Disinfection is the stage that makes the water safe to drink. State how this is done and how it makes the water safe to drink. [2]

.....

.....

(c) State why hosepipe bans are sometimes introduced during the summer. [1]

.....

.....

(d) Desalination removes salt from seawater by distillation to produce drinking water. Explain how this process can be carried out. [2]

.....

.....

.....

7

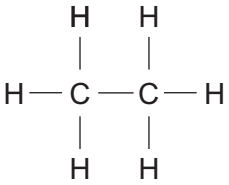
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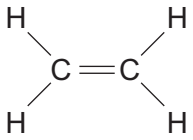
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5. *(a)* The following diagrams show the structures of an alkane and an alkene.

Name both compounds. [1]





....

(b) Describe **one** similarity and **one** difference between the structures of alkanes and alkenes. [2]

Similarity

.....

.....

Difference

.....

.....

(c) Butane is an alkane containing four carbon atoms and ten hydrogen atoms.
Draw its structural formula. [1]

4

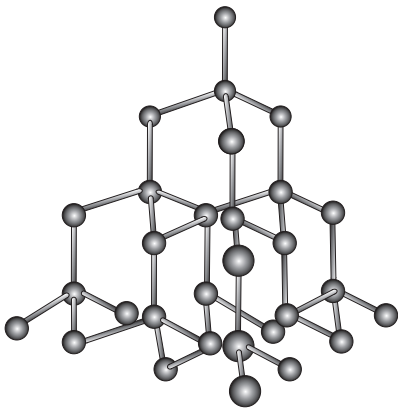
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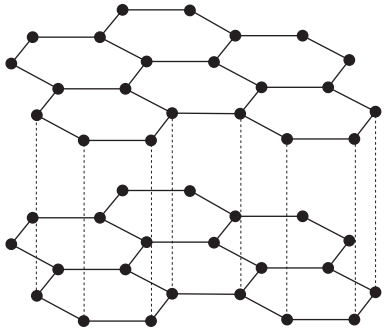
6. The following boxes show some information about the structures of diamond and graphite.

Diamond



Each carbon atom is bonded strongly to four others. All four outer electrons are used in bonding.

Graphite



Each carbon atom is bonded strongly to three others. They form layers that are held together weakly. Three electrons are involved in bonding whilst the other moves freely between the layers.

(a) State why both substances have high melting points. [1]

.....

.....

(b) State which of the above substances will conduct electricity. Give a reason for your answer. [1]

Substance .....

Explanation .....

.....

(c) Graphite is used in pencils. Explain in terms of structure why this is possible. [2]

.....

.....

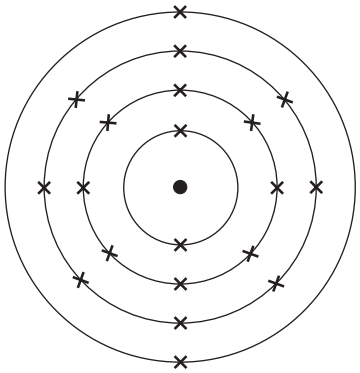
4

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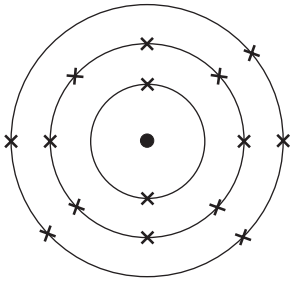
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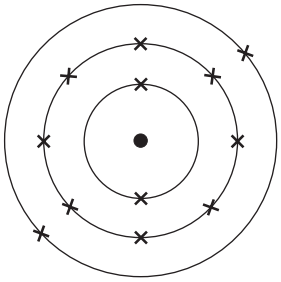
7. The following diagrams show the electronic structures of five different elements, **A**–**E**.



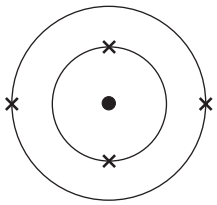
A



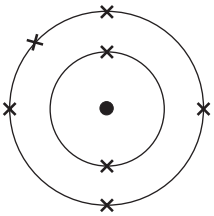
B



C



D



E

(a) State which elements, **A**–**E**, are found in Period 2 of the Periodic Table. Give a reason for your choice. [2]

.....

.....

(b) State which element, **A**–**E**, has an atomic number of 15. Give a reason for your answer. [1]

.....

.....

(c) Aluminium can be represented as $^{27}_{13}\mathbf{Al}$.

State what this tells you about the structure of its atoms. [3]

.....

.....

.....

6

Turn over.

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8. *(a)* Sodium bromide is formed by reacting sodium with bromine, Br_2.

Write the balanced **symbol** equation for the reaction. [2]

..... + ... ⟶ .....

(b) A scientist has **solid** samples of sodium chloride and sodium iodide but is not sure which is which.

Describe how silver nitrate solution could be used to distinguish between them.

Give the observations expected for both substances. [3]

.....

.....

.....

.....

(c) During a chemical reaction, aluminium combines with chlorine to produce aluminium chloride, $AlCl_3$.

$$2Al + \square\ Cl_2 \longrightarrow \square\ AlCl_3$$

(i) Balance the equation. [1]

(ii) Calculate the percentage of chlorine present in aluminium chloride, $AlCl_3$. [3]

$A_r(Al) = 27$ $A_r(Cl) = 35.5$

Percentage chlorine = ... %

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(d) Electrolysis can be used to extract aluminium from its oxide. The equation for the reaction is as follows.

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

204 tonnes of aluminium oxide are expected to produce 108 tonnes of aluminium. However, only 81 tonnes are actually made.

(i) Calculate the percentage yield of this process. [1]

Percentage yield = ...%

(ii) Suggest reasons why the actual amount produced was lower than expected. [2]

.....

.....

.....

12

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9. Describe what is meant by a *smart material*. Use thermochromic and photochromic materials to support your answer, giving everyday uses of each. [6 QWC]

6

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^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

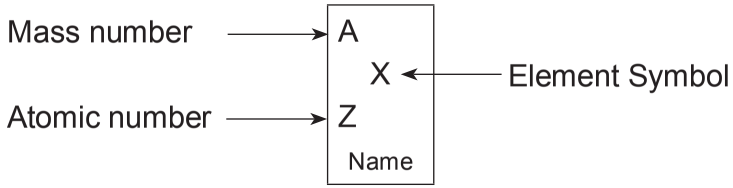
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PERIODIC TABLE OF ELEMENTS

1	2											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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(4472-01)

GCSE MARKING SCHEME

SUMMER 2016

SCIENCE - CHEMISTRY C2
4472/01/02

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INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was 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 conference was to ensure that the marking scheme was 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' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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GCSE Science - Chemistry 2

Summer 2016

Mark Scheme

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		*(a)*			2	lithium and oxygen → lithium oxide sodium and chlorine → sodium chloride iron and fluorine → iron fluoride lithium and water → lithium hydroxide and hydrogen all 4 for (2) any 2/3 (1)			
		(b)			2	lithium red (1) sodium yellow (1)	orange		
		(c)			2	30 (2) if incorrect allow (1) for recognising the presence of two Li atoms and one O atom			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
2		*(a)*			1	bubbles / powder disappears			
		(b)			1	conical flask			
		(c)	(i)		1	**A** – has steepest curve / finishes first / gives same volume of gas in least time	fastest reaction / highest rate		
			(ii)		2	surface area (of solid) (1) concentration (of acid) (1)	size of particles catalyst	stirring strength of acid	
		(d)	(i)		2	gas produced **escapes** from flask (1) mass decreases (1)		calcium carbonate gets smaller	
			(ii)		1	continuous or more regular readings / automatically recorded / graph can be produced by computer / stores results		more accurate / precise / reliable / fair / no human error	

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
3		*(a)*			1	**Y**			
		(b)			2	solubilities of both increase (with temperature) / both same at 82 °C (1) **X** has large increase and **Z** has small increase / **X** less soluble than **Z** below 82 °C / **X** more soluble than **Z** above 82 °C (1)		both straight lines	
		(c)	(i)		3	all points correct (2) [(1) for minimum four correct] curve through points (1)			
			(ii)		1	20	value based on incorrectly drawn graph		

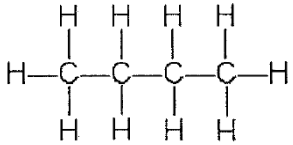
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		*(a)*			2	removes (small) insoluble particles (2) removes (small) particles (1)		dirt / mud / bits / solids / molecules	sticks / stones
		(b)			2	chlorine is added / chlorination (1) kills bacteria / germs (1)	 removes bacteria	add disinfectant	
		(c)			1	to conserve / save water (during drought conditions)		doesn't rain much to prevent waste	
		(d)			2	boil (1) condense vapour (to give pure water for drinking) (1)	evaporate		

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5		*(a)*			1	ethane and ethene (both needed)		C_2H_6 and C_2H_4	
		(b)			2	both are hydrocarbons / both contain carbon and hydrogen (atoms only) (1) double bond (between carbon atoms) in alkenes / alkenes are unsaturated (1)	alkanes have single bonds **only**	covalent bonding	
		(c)			1		methylpropane structure		

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
6		*(a)*			1	strong bonds (between carbon atoms)		many bonds	
		(b)			1	graphite - due to **electrons moving** freely (between layers)	electrons delocalised		
		(c)			2	layers held weakly (1) layers can move over each other (to leave mark on paper) (1)	 layers can rub off		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	*(a)*			2	**D** and **E** (1) both contain 2 shells (occupied by electrons) (1)			
		(b)			1	**B** because it has a total of 15 **electrons**	2,8,5	15 protons	
		(c)			3	any three for (1) each • contains 13 protons • contains 13 electrons • contains 14 neutrons • electronic configuration is 2,8,3 / has 3 electron shells / has 3 outer shell electrons		atomic number mass number	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	*(a)*			2	NaBr (1) correctly balanced (1) $2Na + Br_2 \rightarrow 2NaBr$	Na^+Br^-		
		(b)			3	prepare a solution of both solids (1) (add silver nitrate solution to both –) sodium chloride would give a white **precipitate** (1) sodium iodide would give a yellow **precipitate** (1)	award (1) for both colours if no mention of precipitate		
		(c)	(i)		1	correctly balanced $2Al + 3Cl_2 \rightarrow 2AlCl_3$			
			(ii)		3	$M_r(AlCl_3) = 133.5$ or $A_r(Cl) \times 3 = 106.5$ (1) $\frac{106.5}{133.5} \times 100$ 79.8% - accept any value from 79.7 - 79.8 (1)	80%		79%
		(d)	(i)		1	75%			
			(ii)		2	any two for (1) each • reactants are impure • process incomplete • loss of products			incorrect measurements

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Question Number		Sub-section			Mark	Answer
FT	HT					
9	3				6	**Indicative content:** Properties – both change **colour** reversibly according to change in conditions photochromic changes in response to **light** whereas thermochromic changes in response to **heat** Uses – photochromic – sunglasses lenses / windows thermochromic – thermometers / childrens feeding bowls / mugs etc **5-6 marks:** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks:** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks:** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	4	*(a)*			2	more oxygen dissolves at lower temperature (1) more dissolved oxygen will sustain / support more fish (1)			
		(b)			2	9 (mg per dm^3) – read from graph (1) 0.9 g (1) award (2) for correct answer only			
		(c)			2	0.014 g oxygen in 1 dm^3 (1) $\frac{3.3}{0.014}$ = 235 (1) accept any sensible value based on calculation			

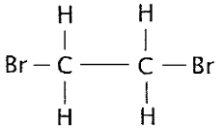
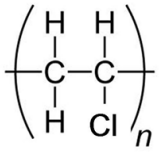
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	*(a)*			4	the higher the concentration the faster the reaction / higher the rate (1) more particles in **given volume** when concentration is higher (1) more successful collisions **per second** / more chance of successful collisions (1) same argument using 'double' the rate and 'twice' the number of particles etc. (1)		stronger than acid	
		(b)	(i)		1	mass being lost is very small / would not register on a one decimal place balance		more accurate	
			(ii)		3	both M_r values H_2 = 2 and CO_2 = 44 (1) CO_2 is a heavier gas (1) loss in mass would be greater / smaller (percentage) error in measurements (1)	more accurate results		

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	6	*(a)*	(i)		2	bromine is decolourised / (orange) solution turns colourless (1) addition reaction has taken place (1)	 double bond present / broken alkenes are unsaturated	clear	
			(ii)		1			$C_2H_4B_{r2}$	
		(b)	(i)		1				
			(ii)		3	when heated thermoplastics melt / soften / can be reshaped (1) no bonds between chains / weak forces between chains (1) chains are able to slide over one another (1)	 no crosslinks		 'layers' in place of chains

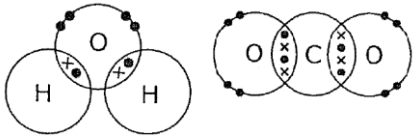
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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	7	*(a)*	(i)		3	become more reactive up group or converse (1) any 2 for (1) each • chlorine will displace both bromine (from bromide) and iodine (from iodide) therefore most reactive • iodine doesn't displace either of the others so least reactive • bromide displaces iodine (from iodide) but not chlorine (from chloride) therefore more reactive than iodine but less reactive then chlorine	Cl > Br > I		
			(ii)		3	reactant formulae Cl_2 + KI (1) product formulae I_2 + KCl (1) balancing $Cl_2 + 2KI \rightarrow I_2 + 2KCl$ (1) all formulae must be correct to award balancing mark	ionic equation		
		(b)			3	$M_r(AgBr) = 188$ and $M_r(AgNO_3) = 170$ (1) $\frac{47}{188} = 0.25$ (1) $0.25 \times 170 = 42.5$ (1) award (3) for correct answer only accept alternative method ecf possible here			

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Question Number						
FT	HT	Sub-section			Mark	Answer
	8				6	**Indicative content:** Description of covalent bonds as sharing pairs of electrons with one electron coming from each atom involved in the bonding allowing all atoms to get full outer electron shells Dot and cross diagrams showing bonding present in both water and carbon dioxide  Comparison of single bond as being one shared pair and covalent as two shared pairs. Reference to need for double bonds in carbon dioxide in order to fill outer electron shells **5–6 marks:** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3–4 marks:** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1–2 marks:** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/01

W16-4472-01

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
FOUNDATION TIER

P.M. TUESDAY, 12 January 2016

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**5**	
3.	**7**	
4.	**7**	
5.	**4**	
6.	**5**	
7.	**7**	
8.	**6**	
9.	**5**	
10.	**6**	
Total	**60**	

4472
010001

ADDITIONAL MATERIALS

In addition to this paper you will need 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.

Assessment will take into account the quality of written communication (QWC) in your answer to question **10**.

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.

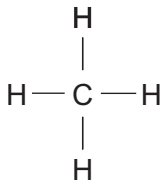
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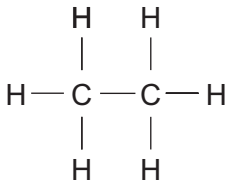
Examiner only

Answer **all** *questions.*

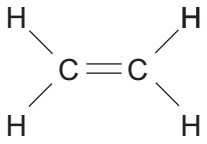
1. *(a)* The structural formulae of some hydrocarbons are shown below.



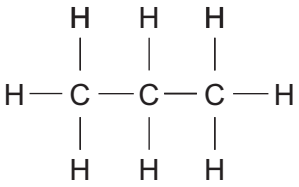
A



B



C



D

(i) Give the **letter** of the hydrocarbon called methane. [1]

.....

(ii) Give the **letter** of the hydrocarbon used to make polythene. [1]

.....

(iii) Give the **letter** of the hydrocarbon represented by the molecular formula C_2H_6. [1]

.....

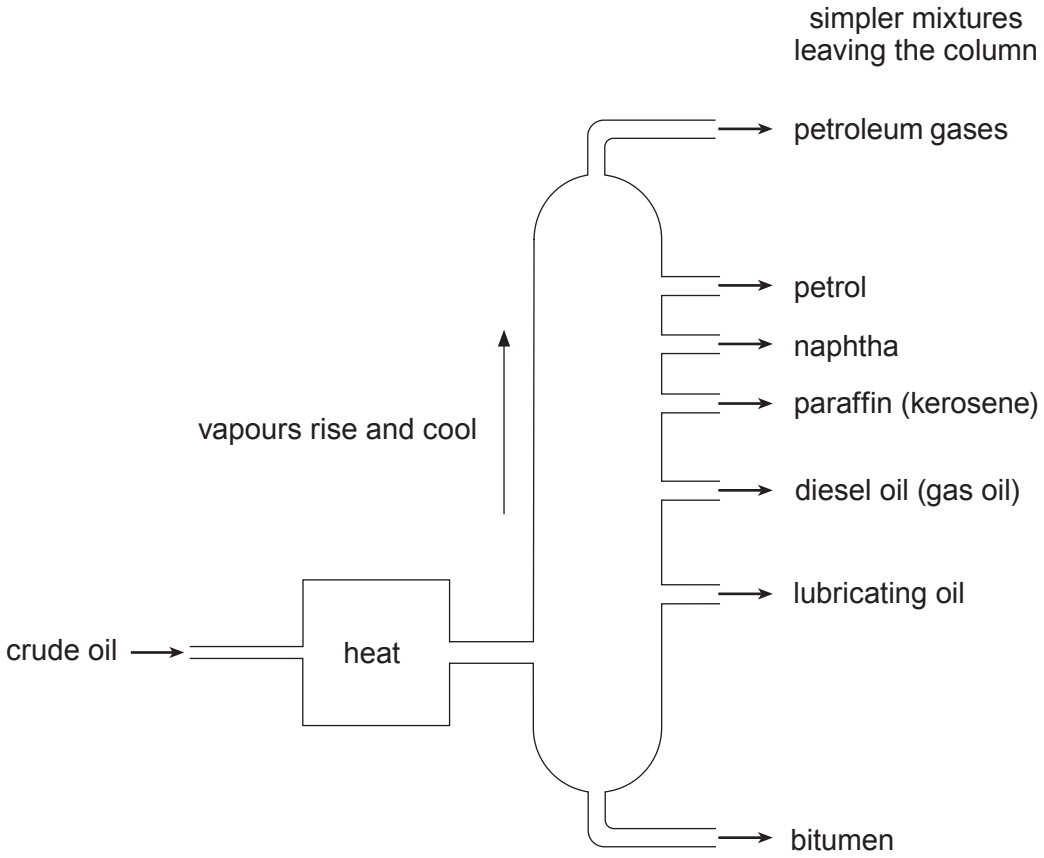
(b) An alkane contains four carbon atoms and ten hydrogen atoms. Draw its **structural formula**. [1]

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(c) The diagram below shows how crude oil is separated in a fractionating column.



boiling point	**condensation**	**colour**	**freezing**	**fractions**
fractional distillation	**polymers**	**polymerisation**	**melting point**	**boiling**

Use **only** terms from the box above to answer parts (i)-(iv).

(i) Name the change of state that takes place when crude oil is heated. [1]

.....

(ii) Name the change of state that takes place when vapours cool. [1]

.....

(iii) State the general name given to the simpler mixtures leaving the column. [1]

.....

(iv) Hydrocarbons of similar size are collected at the same level. State the property on which this depends. [1]

.....

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2. *(a)* The table below shows the properties of the particles found in atoms.

Particle	Mass	Charge
proton	1	+1
neutron	1	0
electron	very small	-1

(i) All atoms are neutral. Name the **two** particles **always** found in equal numbers in atoms. [1]

..... and .....

(ii) Name the particle **not** found in the nucleus of an atom. [1]

.....

(iii) The mass number of a beryllium atom is 9. It contains 4 protons. Give the number of neutrons found in this atom. [1]

.....

(b) Calculate the relative formula mass (M_r) of sodium hydrogencarbonate, $NaHCO_3$. [2]

$A_r(H) = 1$ $A_r(C) = 12$ $A_r(O) = 16$ $A_r(Na) = 23$

$M_r(NaHCO_3)$ = ...

5

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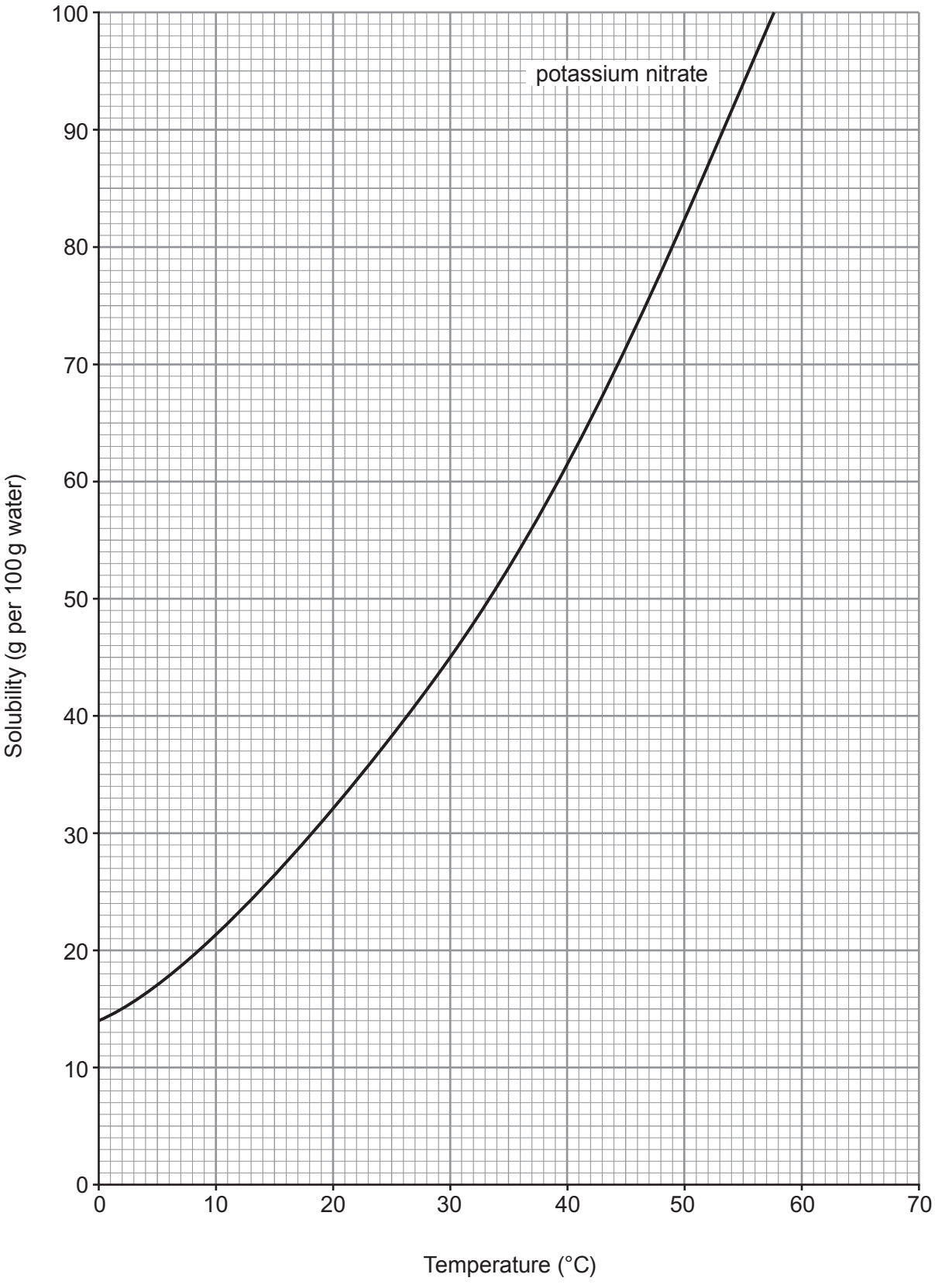
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3. *(a)* The graph below shows how the solubility of potassium nitrate in water changes with temperature.



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

Temperature (°C)	0	20	40	60
Solubility (g per 100 g water)	53	64	75	86

(i) Plot the results from the table on the grid opposite and draw a suitable line. [3]

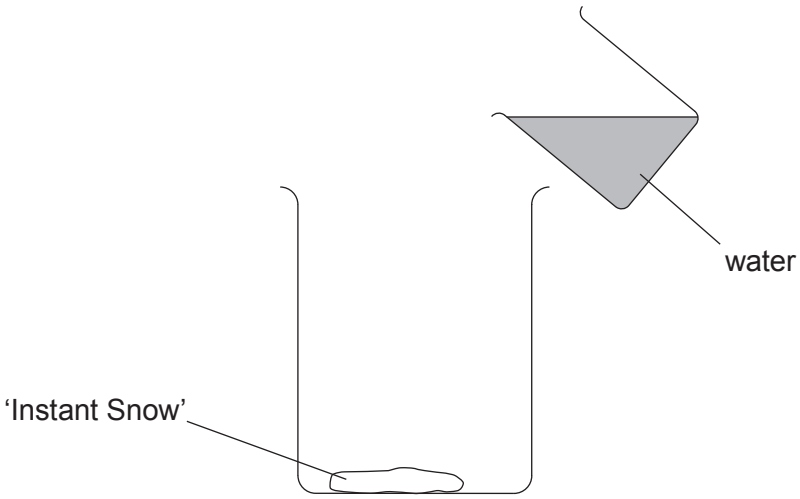
(ii) Use your line to predict the solubility of potassium bromide at 70 °C. [1]

Solubility = ... g per 100 g water

(iii) Give the temperature at which the two compounds have the **same** solubility. [1]

Temperature = ... °C

(b) 'Instant Snow' is a hydrogel and is used to make fake snow.



1 g of 'Instant Snow' is put into a beaker and 150 cm^3 of water added.

Describe what you would **see** when the water is added to the hydrogel. [2]

.....

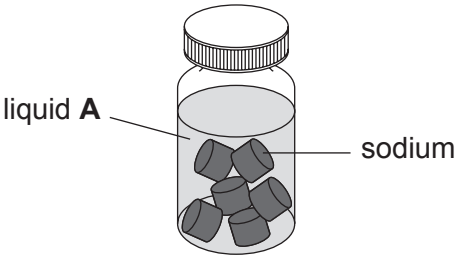
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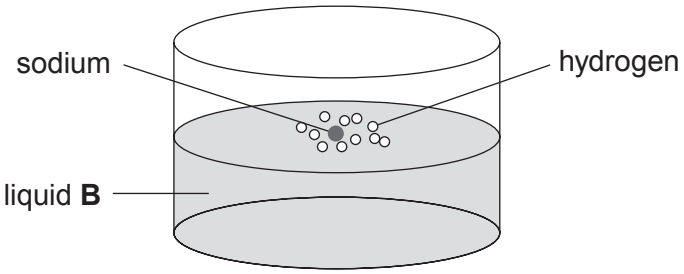
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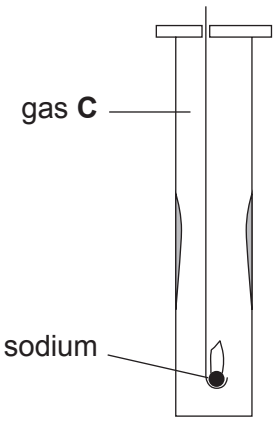
4. *(a)* The diagrams below show the storage and some reactions of the metal sodium.



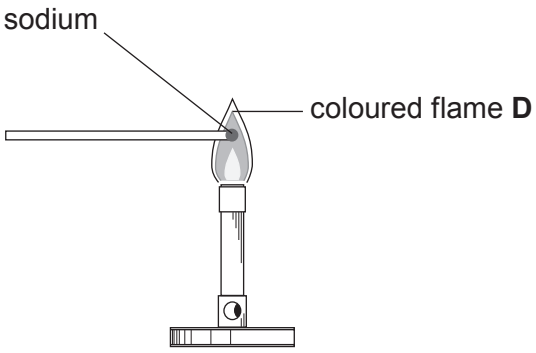
Sodium is stored in liquid **A**



Sodium reacts quickly with liquid **B** forming hydrogen gas and sodium hydroxide solution



Sodium forms sodium chloride when burned in gas **C**



A flame test using sodium gives coloured flame **D**

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Use **only** words from the box below to answer parts (i) and (ii).

oxygen	**hydrogen**	**water**	**lilac**	
bromine	**oil**	**yellow**	**chlorine**	**red**

(i) Give the name of [3]

liquid **A**, ...

liquid **B**, ...

gas **C**. .....

(ii) Give the colour of flame **D**. ..... [1]

(b) State **one** safety precaution a teacher would take when using sodium in a laboratory. [1]

.....

(c) Complete and balance the equation for the reaction between sodium and oxygen. [2]

$$\square\ Na + O_2 \longrightarrow \square$$ .....

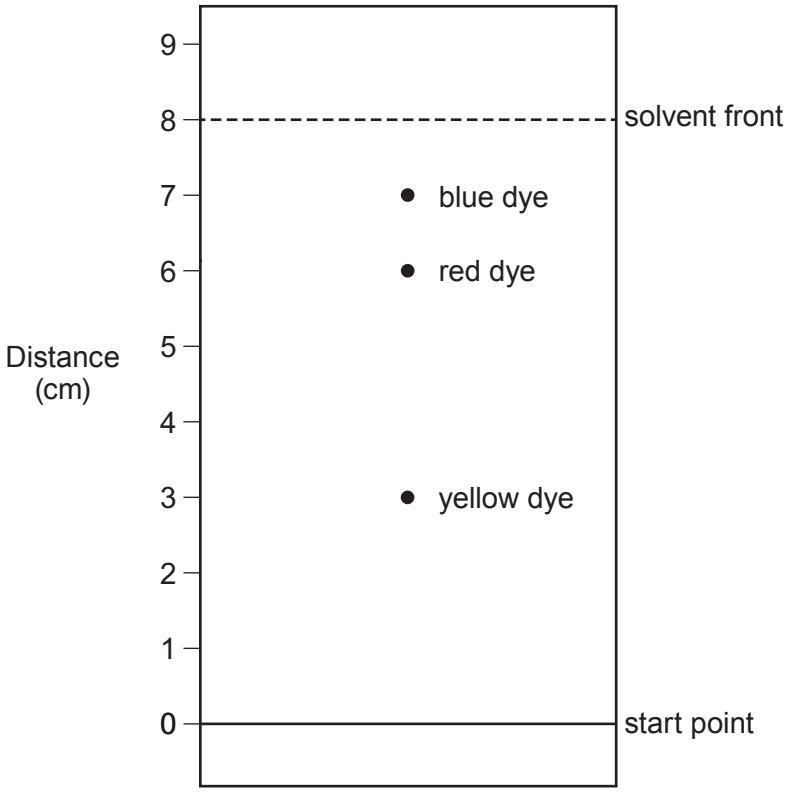
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5. The chromatogram of a black ink is shown below.



(a) Explain why the different dyes separate. [2]

.....

.....

.....

(b) The R_f value of a substance is given by the formula:

$$R_f = \frac{\text{distance moved by the substance}}{\text{distance moved by the solvent front}}$$

State which dye has the R_f value of 0.75. Show your working. [2]

Dye .....

4

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6. *(a)* The table below shows the ions present in four different bottled waters from Wales, France, Austria and Scotland.

Ions present	Typical analysis (mg/l)			
	Bottled water			
	Wales	France	Austria	Scotland
calcium	12	80	132	40
magnesium	8	26	63	10
potassium	2	1	3	1
sodium	12	6	16	6
hydrogencarbonate	67	360	413	150
chloride	15	7	5	6
sulfate	17	13	277	5

Explain, in terms of the ions present, which is the hardest water. [2]

.....

.....

(b) The pictures below show how water pipes and heating elements can be affected by hard water.



water pipe



electric kettle heating element

Give the name of the substance formed and state why its formation is considered a disadvantage in both of these examples. [3]

.....

.....

.....

5

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

Symbol	Number of protons	Number of neutrons	Number of electrons
$^{19}_{9}F$	9	10	9
$^{35}_{17}Cl$	.....	18	.....
$^{16}_{8}O$	8	.....	8
.....	8	10	.....

(b) **From the table** give the names of the two **different** elements found in the same period in the Periodic Table. [1]

..... and .....

(c) Using × to represent an electron, draw the electronic structure of fluorine. [1]

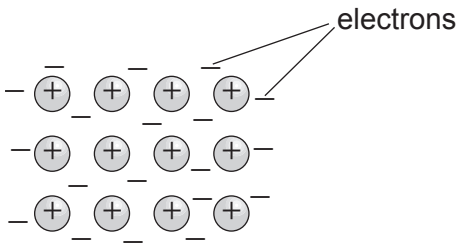
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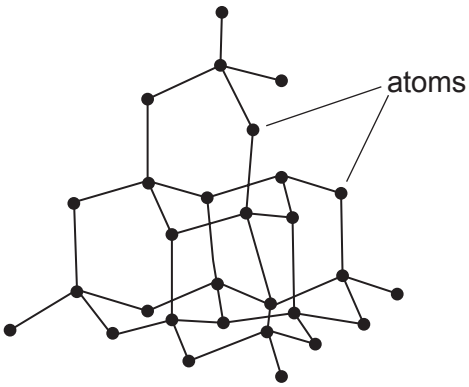
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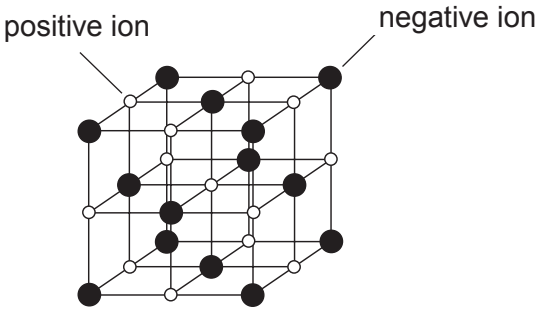
8. The following diagrams show the structures of some substances.



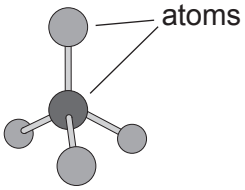
A



B



C



D

(a) Name the types of giant structure shown in **A** and **C**. [2]

A .....

C .....

(b) (i) State which substance, **A**, **B**, **C** or **D**, conducts electricity when solid. Give a reason for your answer. [2]

Letter .....

Reason .....

.....

(ii) State which substance, **A**, **B**, **C** or **D**, is a compound with a high melting point. Give a reason for your answer. [2]

Letter .....

Reason .....

.....

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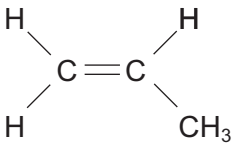
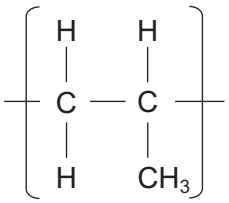
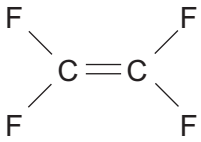
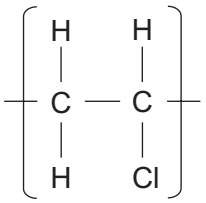
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9. *(a)* The table below shows some information about monomers and the polymers that can be made from them. [3]

Complete the table.

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

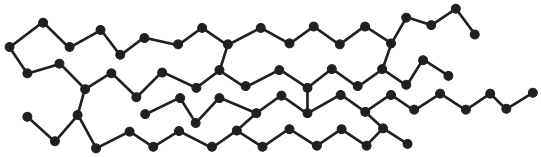
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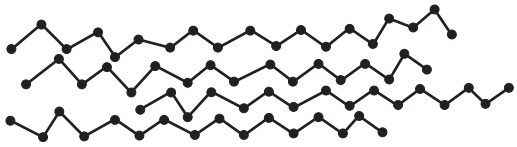
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(b) ‘PEX’ is a form of polythene used to make domestic hot water pipes.

The structures below show the polymer structures of PEX and polythene.



PEX



polythene

Explain, in terms of structure, why PEX is better for making domestic hot water pipes than polythene. [2]

.....

.....

.....

5

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10. The diagram below shows the main stages in the treatment of public water supplies.



Describe what happens in each stage of the process. [6 QWC]

6

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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^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

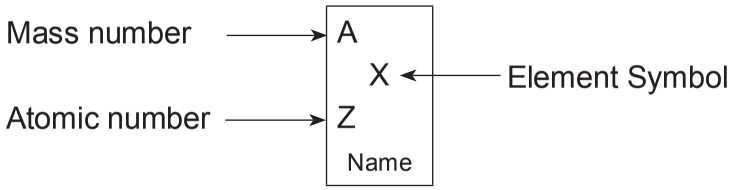
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PERIODIC TABLE OF ELEMENTS

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 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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(4472-01)

GCSE MARKING SCHEME

JANUARY 2016

SCIENCE – CHEMISTRY C2
4472/ 01/02

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INTRODUCTION

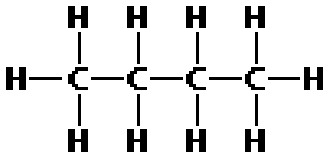
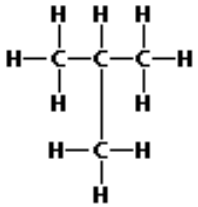
This marking scheme was used by WJEC for the January 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was 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' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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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**			
			(iii)		1	**B**			
		(b)			1				
		(c)	(i)		1	boiling			
			(ii)		1	condensation			
			(iii)		1	fractions	fraction		
			(iv)		1	boiling point			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)	(i)		1	protons and electrons – **both** needed			
			(ii)		1	electron			
			(iii)		1	5			
		(b)			2	84 (2) If answer incorrect or missing award (1) for evidence of correct interpretation of formula e.g. (1 x Na) + (1 x H) + (1 x C) + (3 x O) or 23 + 1 + 12 + 3(16)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)	(i)		3	all points plotted correctly (2) any **three** correct (1) straight line of best fit – ruler used (1)			
			(ii)		1	91.5 ± 0.5 consequential marking			
			(iii)		1	49 ± 0.5 consequential marking			
		(b)			2	water gets absorbed by the hydrogel (1) hydrogel expands / puffs up / swells (1)	water goes into the hydrogel / disappears	it increases	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)	(i)		3	**A** oil (1) **B** water (1) **C** chlorine (1)	liquid paraffin H_2O Cl_2		paraffin chloride / Cl^-
			(ii)		1	yellow		orange	
		(b)			1	any of following for (1) • use small pieces of sodium / excess water • use tweezers / tongs • wear goggles / face shield / use safety screen		use screen / wear gloves	glass screen
		(c)			2	correct formula for sodium oxide – Na_2O (1) *formula must be correct to award balancing mark* balancing ...4... and ...2... (1)	$Na^+_2\ O^{2-}$		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)			2	dyes soluble in water (1) dyes have different solubilities and therefore travel at different speeds (up the paper) / different distances in the same time (1) **both** marks can be awarded for one statement e.g. the more soluble the dye the faster it travels / the further it travels in a given time			
		(b)			2	red (1) working shown including values of 6 **and** 8 taken from chromatogram (1)			

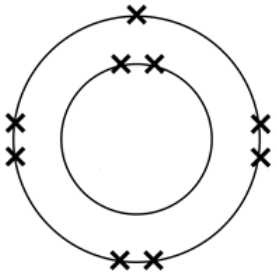
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)			2	Austria (1) highest levels of Ca^{2+} **and** highest levels of Mg^{2+} (1)	 'calcium' for Ca^{2+} 'magnesium' for Mg^{2+}		
		(b)			3	limescale / fur / calcium carbonate / magnesium carbonate (1) water pipe – causes blockages / stops water flowing / causes explosions (1) heating elements – prevents heat transfer / wastes energy / less efficient (1)	$CaCO_3$ / $MgCO_3$ costs more to heat water	 costs more	scum / limestone

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	(a)			5	17 (1) 8 (1) $^{18}_{8}O$ (1) 17 (1) 8 (1)			
		(b)			1	fluorine / F **and** oxygen / O **either** order		F_2 and O_2	
		(c)			1			2,7	

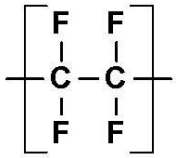
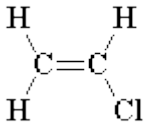
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	(a)			2	**A** metallic / metal (1) **C** giant ionic / ionic (1)			
		(b)	(i)		2	**A** (1) free electrons / mobile electrons / delocalised electrons / sea of electrons (1)		electrons	
			(ii)		2	**C** (1) any of following for (1) • contains more than one type of particle / ion • has strong bonds between ions / strong ionic bonds If **B** given, award (1) for strong bonds between **atoms**		strong bonds	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	3	(a)			3	polypropene (1)  (1)  (1)	structure without brackets	ignore 'n'	
		(b)			2	links / bonds between **chains** prevent them from sliding over each other (1) any of following for (1) • PEX heat resistant • doesn't soften / lose shape / melt		high melting point	layers

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Question Number			
FT	HT	Mark	Answer
10	4	6	**Indicative content** Sedimentation: settling tank / settling process / large insoluble particles settle out Filtration: filter bed / layers of different sized particles / sand bed / top algae layer removes some bacteria / removes small insoluble particles Chlorination: kills bacteria **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

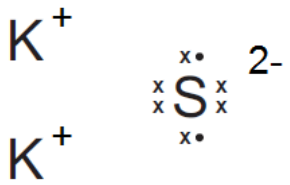
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)	(i)		2	substances **A** and **B** have the **same** solubility (1) 43 g / 100 g water at 27 °C – unit required for both (1)			
			(ii)		2	33 (1) g / grams (1)			
		(b)			2	both mixtures contain 6 / same number of compounds (1) both contain compounds **D** and **E** (1)	both contain compounds with retention time 8 and 11	lines / peaks	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)	(i)		2	 complete octet (1) correct charge on **both** ions (1)			
			(ii)		2	potassium (atoms) need to lose one electron and sulfur (atom) needs to gain two electrons (1) both atoms need a full outer electron shell to become stable (1) award (1) max if no direct reference to electrons in either statement			
		(b)			2	shared pair of electrons (1) each atom obtains a full outer electron shell (1) award (1) max if no direct reference to electrons in either statement			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			3	**A** lithium chloride (1) **B** lithium oxide (1) **C** lithium hydroxide (1)	LiCl / Li^+Cl^- Li_2O / $Li^+_2O^{2-}$ LiOH / Li^+OH^-		
		(b)			2	award (1) for correct formula FeF_3 if formula correct award (1) for correct balancing $\mathbf{2}Fe + \mathbf{3}F_2 \rightarrow \mathbf{2}FeF_3$			
		(c)			2	$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ (2) award (1) for correct ions and product but missing/incorrect state symbols	equation with 2 of each species		
		(d)			3	**Z** is bromine (1) doesn't react with Cl^- / doesn't react with halide ions above them in Group 7 (1) does react with I^- / does react with halide ions below them in Group 7 (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)			3	all points plotted correctly (2) any **three** correct (1) line of best fit through (0,0) (1)			
		(b)	(i)		1	0.4 dependent on line of best fit			
			(ii)		2	mass of oxygen value from part (b)(i) to be used both masses divided by appropriate A_r e.g. 0.4/16 and 0.6/24 (1) 0.025 : 0.025 1 : 1 (1)			
		(c)			1	reduces effect of errors in any one experiment / anomalous result credit to be awarded for the idea of 'averaging'		more accurate / reliable	

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Question Number				
FT	HT		Mark	Answer
	9	(a)	6	**Indicative content** **Structure** • giant molecule / layered structure • strong bonds within layers • weak bonds between layers • layers can slide over one another • delocalised electrons / free electrons / each atom forms three covalent bonds **Relate structure to correct property and uses** • free electrons ..... electrical conductor ..... electrodes • weak bond between layers ..... soft & greasy ..... pencils / lubricants • giant molecule / strong bond within layers ..... high melting point ..... brake shoes **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	(b)			1	(electrical) conductor / (thermal) conductor / high melting point / high boiling point			

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/01

S15-4472-01

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
FOUNDATION TIER

A.M. THURSDAY, 14 May 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**5**	
3.	**7**	
4.	**7**	
5.	**6**	
6.	**6**	
7.	**7**	
8.	**6**	
9.	**5**	
10.	**6**	
Total	**60**	

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010001

ADDITIONAL MATERIALS

In addition to this paper you will need 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.

Assessment will take into account the quality of written communication (QWC) used in your answer to question **10**.

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)* Draw a line from each type of structure to its property. One has been done for you. [2]

Structure	**Property**
metallic	gas or liquid at room temperature
ionic	conducts electricity when molten or in solution
simple molecular	malleable and ductile
giant covalent	high melting point

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(b) Smart materials have properties which change reversibly with a change in their surroundings. The box below shows the names of some smart materials.

hydrogel	**shape memory alloy**	**photochromic pigment**
thermochromic pigment	**shape memory polymer**	

From the box above, choose the smart material used in making each of the following items. [3]



Mug .....



Gumshield .....



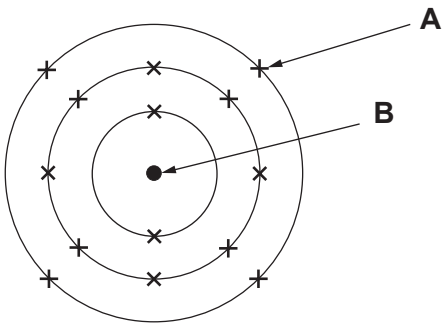
Disposable nappy .....

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2. The diagram shows an atom of silicon.



(a) Name particle **A**. ..... [1]

(b) **B** is the nucleus. Name the **two** types of particle present in the nucleus of an atom. [2]

..... and .....

(c) Use the information in the diagram to give

(i) the atomic number of silicon, ... [1]

(ii) the electronic structure of silicon. ..... [1]

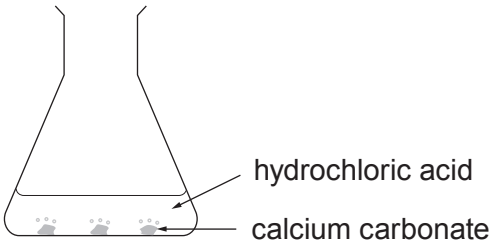
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3. An investigation was carried out to find the effect of different factors on the rate of reaction of calcium carbonate and hydrochloric acid.



The time taken for the calcium carbonate to disappear in each experiment is shown in the table below.

Experiment number	Form of calcium carbonate	Temperature of acid (°C)	Time taken for calcium carbonate to disappear (s)
1	marble chips	20	600
2	powder	20	150
3	marble chips	40	400

(a) (i) Use the results to describe the effect of changing temperature on reaction time. [1]

.....

.....

(ii) Name the factor that has changed between experiments 1 and 2 and describe what effect this factor has on reaction time. [2]

.....

.....

(iii) State **two** *other* factors that should be kept the same in order to make this investigation a fair test. [2]

Factor 1 .....

Factor 2 .....

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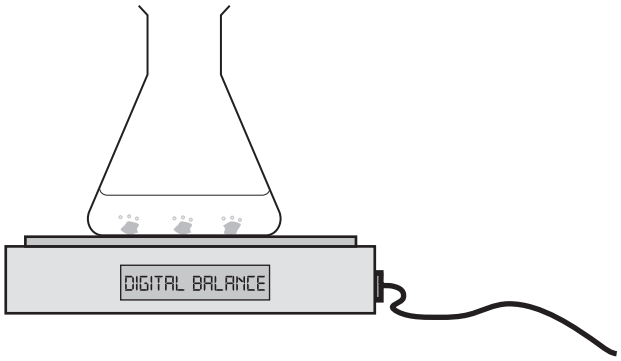
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Turn over.

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(b) The rate of reaction can also be investigated by recording the change in mass.



Explain what will happen to the mass during the reaction. [2]

.....

.....

.....

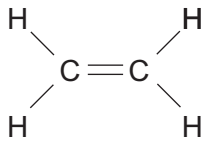
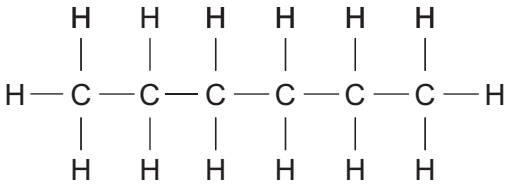
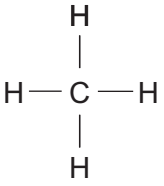
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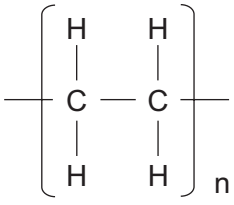
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4. The following table shows information about some organic compounds.

Name	Molecular formula	Structural formula
ethene	C_2H_4	
propane	C_3H_8	
hexane		
	CH_4	

(a) Complete the table by filling all **three** empty boxes. [3]

(b) (i) Name the compound from the table above that can be used to form the polymer represented by the following structure. [1]



Compound .....

(ii) Small reactive molecules, such as alkenes, that join together to form polymers are known as ..... . [1]

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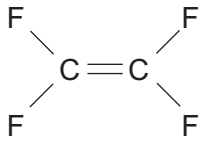
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(c) Another polymer can be formed from the following compound.



(i) Choose from the box below the name of the polymer produced from this compound. [1]

polyethene	**polypropene**	**polyvinylchloride**
polytetrafluoroethene		**polystyrene**

Polymer .....

(ii) Draw the repeating unit for this polymer. [1]

7

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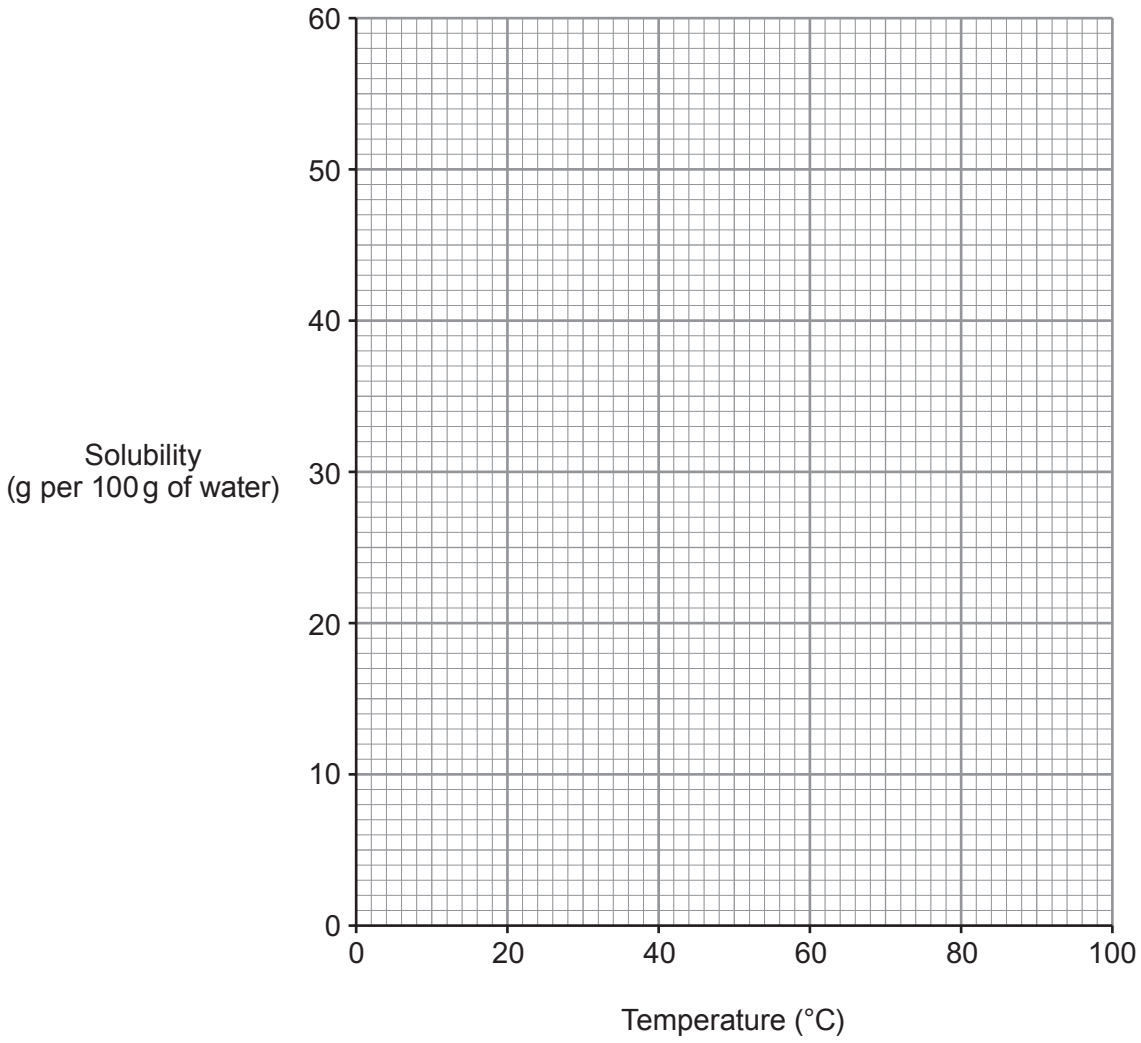
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5. The following table shows the solubility of potassium chlorate at different temperatures.

Temperature (°C)	Solubility (g per 100 g of water)
0	3.5
20	7.5
40	14.0
60	24.0
80	37.5
100	56.5

(a) Plot a graph to show the solubility of potassium chlorate on the grid below. Draw a suitable line. [3]



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(b) Describe how the solubility of potassium chlorate changes with temperature. [1]

.....

.....

(c) A saturated solution of potassium chlorate at 80 °C is cooled to 20 °C. Describe what you would see and explain why this happens. [2]

.....

.....

.....

.....

6

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6. Propane gas can be used as a fuel.

(a) Balance the following equation that shows the combustion of propane. [2]

$$C_3H_8 + \square\, O_2 \longrightarrow \square\, CO_2 + 4H_2O$$

(b) Hydrogen gas can also be used as a fuel. The following equation shows what happens when it burns.

$$H{-}H \quad H{-}H + O{=}O \longrightarrow H{-}O{-}H \quad H{-}O{-}H$$

The table below shows the bond energies involved in the reaction.

Bond	Energy (kJ)
H — H	436
O = O	495
H — O	463

The energy required to break all the bonds in the reactants can be calculated as shown below:

$2 \times$ H — H bonds $= 2 \times 436 = 872$

$1 \times$ O = O bond $= 495$

Energy required to break all the bonds in the reactants = 872 + 495 = 1 367 kJ

(i) Calculate the energy produced when all the bonds in the products are made. [2]

Energy produced when all the bonds in the products are made = ... kJ

(ii) Use the information given and your answer to part (i) to explain why the overall reaction is exothermic. [2]

.....

.....

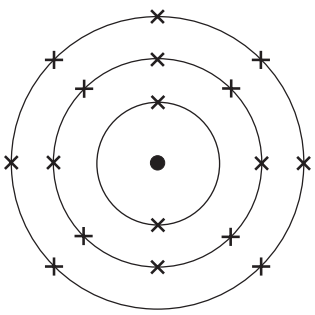
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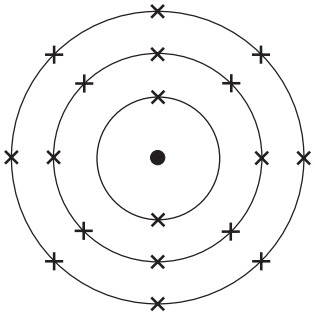
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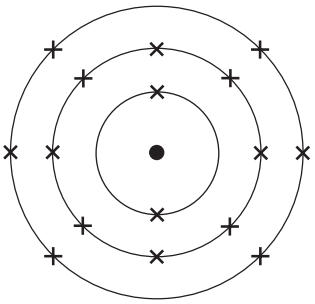
7. The following diagrams show the electronic structures of five elements, **A**–**E**.



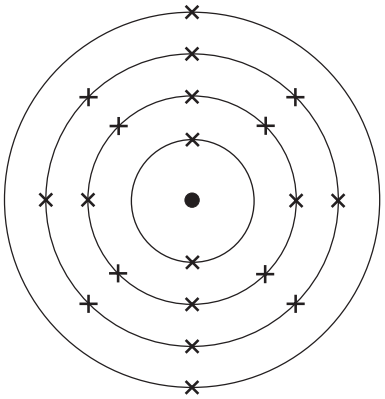
A



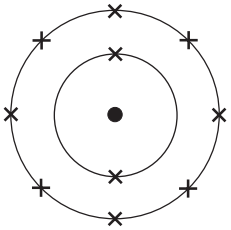
B



C



D



E

(a) (i) Give the letter of the element, **A**–**E**, that is in Period 2 of the Periodic Table. Give the reason for your choice in terms of electronic structure. [2]

Element .....

Reason .....

.....

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(ii) Give the letters, **A**–**E**, of **two** elements that are in Group 0 of the Periodic Table. Give the reason for your choice in terms of electronic structure. [2]

Elements ..... and .....

Reason .....

.....

(iii) Another element, **X**, is in the same group as element **E** but is one place above it. Draw a diagram of the electronic structure of element **X**. [1]

(b) Explain how the electronic structure of element **A** can be used to determine the number of protons in its nucleus. [2]

.....

.....

.....

7

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8. *(a)* Lithium, sodium and potassium are elements in Group 1 of the Periodic Table.

The following table shows what a student recorded when these elements reacted with water. Two of the observations are **incorrect**.

Element	Observations	pH of solution
lithium	bubbles slowly on the surface of the water	6
sodium	bubbles rapidly and melts into a ball	12
potassium	burns with an orange flame	13

Identify the errors and give the correct observations below. [2]

Error 1 .....

Correction .....

Error 2 .....

Correction .....

(b) A student carries out tests to prove that a powder contains sodium ions and chloride ions. The following box gives some tests for ions and some expected observations.

white precipitate	**yellow precipitate**	**no reaction**	**cream precipitate**
flame test	**add sodium hydroxide solution**		**add silver nitrate solution**
add universal indicator	**yellow flame**	**red flame**	**green flame**

Select the appropriate tests and results to complete the following table. [4]

Ion	Test used	Observation expected
sodium		
chloride		

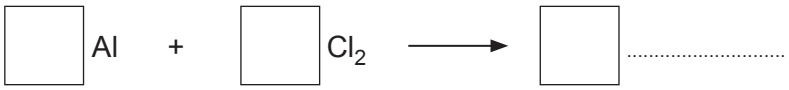
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9. *(a)* Aluminium reacts with chlorine to form aluminium chloride. Complete and balance the symbol equation for the reaction taking place. [2]



(b) Aluminium oxide, Al_2O_3, is found in bauxite.

(i) Calculate the relative formula mass (M_r) of aluminium oxide, Al_2O_3. [2]

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

M_r (Al_2O_3) = ...

(ii) Using your answer from part (i) calculate the percentage of oxygen present in aluminium oxide, Al_2O_3. [1]

Percentage oxygen present = ... %

5

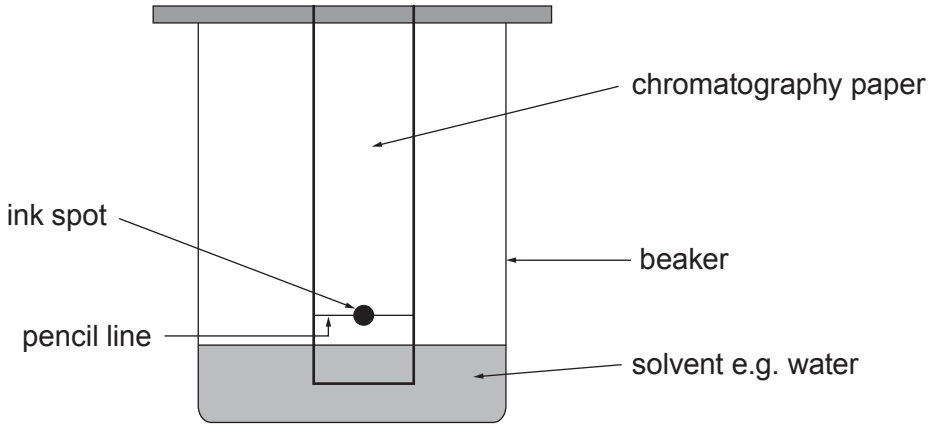
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10. Chromatography can be used to separate the pigments in ink.



Describe how chromatography can be used to determine whether two inks contain the same pigments. [6 QWC]

Your answer should include

- a description of how chromatography is carried out
- a description of what happens during the process
- how the results would show whether the two inks contain identical or different pigments.

You may include a diagram in your answer.

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6

END OF PAPER

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Turn over.

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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^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

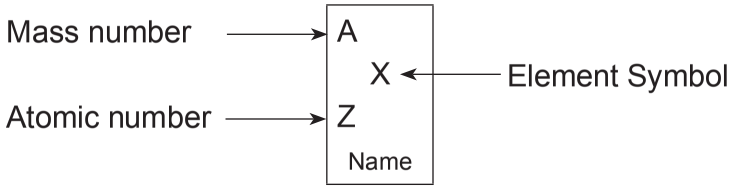
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PERIODIC TABLE OF ELEMENTS

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 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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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

SUMMER 2015

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2015 examination in GCSE SCIENCE - CHEMISTRY. 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.

	Page
C1	1
C2	17
C3	32

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)			2	metallic → malleable and ductile / high melting point simple molecular → gas or liquid at room temperature giant covalent → high melting point all 3 for (2) any 1 for (1)			
		(b)			3	thermochromic pigment (1) shape memory polymer (1) hydrogel (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			1	electron		e	
		(b)			2	proton (1) neutron (1)		p n	
		(c)	(i)		1	14			
			(ii)		1	2,8,4			

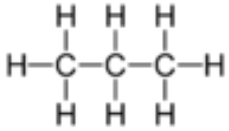
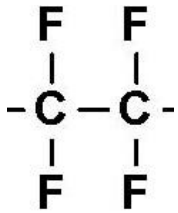
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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
3		(a)	(i)		1	the higher the temperature the shorter the reaction time	higher temp, faster reaction		
			(ii)		2	surface area (1) the greater the surface area the shorter the reaction time / faster reaction (1) or particle size (1) the smaller the particle size the shorter the reaction time / faster reaction (1) both marks could be credited for one statement e.g. smaller particles react faster	 ‘form’ of calcium carbonate ‘powder takes less time than chips’		molecules become smaller
			(iii)		2	volume of acid (1) concentration of acid (1) mass/weight of calcium carbonate (1) max (2)	'amount of' once only	pH type of acid	
		(b)			2	mass decreases (1) gas / carbon dioxide lost from container / released (1)	gets lighter	 gas produced	 incorrect gas named

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)			3	 (1) C_6H_{14} (1) methane (1)			
		(b)	(i)		1	ethene	C_2H_4		polyethene
			(ii)		1	monomers		unsaturated	
		(c)	(i)		1	polytetrafluoroethene	PTFE		
			(ii)		1			ignore brackets	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5		(a)			3	all points plotted correctly (2) 4 points plotted correctly (1) smooth **curve** through points (1)	½ square tolerance		
		(b)			1	the higher the temperature the higher the solubility	it increases with more heat	faster	higher solubility, higher temperature
		(c)			3	crystals form (1) any reference to crystals/solid/powder allows access to second mark even though first mark may not have been awarded as solubility is lower at lower temperature (1) both marks may be awarded based on a quantitative response	solid forms		it solidifies / potassium chlorate forms

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)			2	3 molecules of CO_2 (1) must get first mark to be awarded second 5 molecules of O_2 (1)			
		(b)	(i)		2	identification of all bonds made e.g. 4 x O–H (1) 1852 (1) award (2) for correct answer only (cao)	 max (1) if subtraction done		
			(ii)		2	485 kJ calculated (1) allow error carried forward (ecf) from (i) more energy given out than taken in (1)		negative value	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	(a)	(i)		2	**E** (1) two shells occupied / containing electrons (1)	Ne		
			(ii)		2	**B** and **E** (1) both have **full outer** shells of electrons (1)	Ar and Ne 8 electrons in outer shell		
			(iii)		1		2		
		(b)			2	electronic structure is 2,8,7 therefore 17 electrons / atomic number is 17 (1) number of electrons is equal to number of protons (1) both marks may be credited for one statement e.g. **total** number of electrons is equal to number of protons / contains 17 electrons therefore nucleus contains 17 protons (2)		any reference to adding number of electrons in each shell	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	(a)			2	pH6 – should be pH 11-12 (or alkaline) (1) burns with an orange flame – should be lilac flame (1)	8-14 / above 7 lithium with implication that reaction should be more rapid (but less rapid than reaction of sodium)		7 or above
		(b)			4	flame test (1) yellow flame (1) (add) silver nitrate (solution) (1) white precipitate (1) must have correct test for observation mark to be awarded	orange flame		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	3	(a)			2	$AlCl_3$ (1) formula must be correct to get balancing mark 2,3,2 (1)			
		(b)	(i)		2	102 (2) if incorrect allow (1) for (27 x 2) + (16 x 3) no ecf within part (i)			
			(ii)		1	47 ecf possible from part (i)	47.1		

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Question Number			
FT	HT	Mark	Answer
10	4	6	**Indicative content**: how it is carried out – spot of each ink on pencil line and dip end of paper in water, leave for water to rise up paper what happens – water dissolves ink and carries the components different distances according to their solubilities, appear as spots/streaks on paper / as chromatogram results – if inks contain the same pigments, the pattern of spots would be identical; different pattern if inks contain different pigments **5-6 marks:** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks:** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks:** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit.

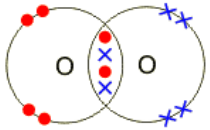
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)	(i)		1	84 – no tolerance			
			(ii)		2	32 (2) ecf possible from part (i) if incorrect award (1) for 16 or 200 – 168			
		(b)			3	both increase with temperature (1)**R** **R** - must have this for full marks any 2 of the following for (1) each KNO_3 non-linear increase/curve **and** KBr linear increase/straight line (1) solubilities the same at 50°C (1) below 50°C solubility of KNO_3 is lower than KBr **or** above 50°C solubility of KNO_3 is higher than KBr (1) solubility of KNO_3 increases more than solubility of KBr (1)			

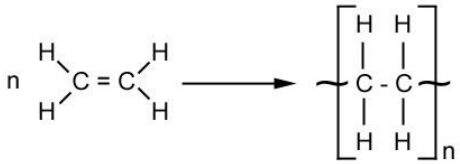
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)			3	many strong bonds in all directions in diamond (1) lots of energy needed to separate atoms / break bonds (1) weak bonds **between molecules** therefore less energy needed to separate them (1)	hydrogen is simple molecular but diamond is giant covalent for (1) if no other credit awarded		
		(b)			2	thermal/electrical conductivity (1) free moving / delocalised electrons between layers (1) or slippery / soft (1) layers able to move over each other / weak bonds / forces between layers (1) must have property for explanation mark to be awarded			brittle
		(c)			2	two shared pairs of electrons (1) outer shells of both atoms complete (1)  must have double bond to be awarded second mark			

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	7	(a)	(i)		2	$C_2H_4 + Br_2$ (1) $C_2H_4Br_2$(1)			
			(ii)		1	orange solution turns colourless			ethene goes colourless
		(b)	(i)		3	 (3) for correct equation otherwise double bond breaks in ethene (1) large number of molecules join together (1) to form a long chain polymer (1)			
			(ii)		2	speeds up the rate of the reaction (1) reduces energy required (for collision to be successful) (1)	reduces activation energy		
		(c)			4	**A** = thermoplastic / thermosoftening plastic **B** = thermoset **both** needed for (1) weak or no bonds between chains in **A** (1) bonds formed between chains in **B** (1) allowing chains of **A** to move over each other / chains of **B** cannot move over each other (1)	crosslinks		award (2) max for explanation if any reference to **layers**

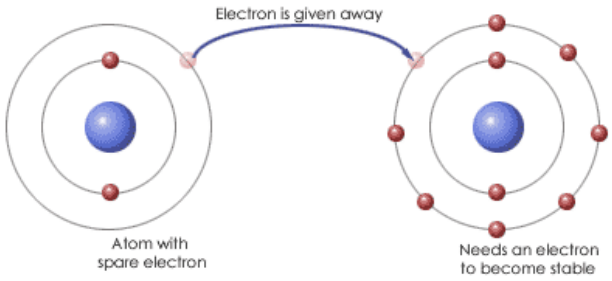
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)			3	$M_r(NaHCO_3)$ = 84 and M_r (Na_2CO_3) = 106 (1) 2 : 1 ratio (1) 126 → 79.5g (1) award (3) for cao			
		(b)			2	70/79.5 (1) 88.05 (1) ecf possible from part (a)			

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Question Number			
FT	HT	Mark	Answer
	9	6	**Indicative content:** diagram showing bonding in lithium chloride with no ambiguity  to form Li^+ and Cl^- (outer electrons only need be shown) description of bonding in words i.e. lithium atom loses an electron to become a positive ion, chlorine atom gains an electron to become a negative chloride ion, strong force of attraction between oppositely charged ions; high melting point due to strong bonds between the ions; conducts electricity when molten or in solution as charged ions are free to move; does not conduct when solid as ions are immobile **5-6 marks:** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks:** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks:** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/01

W15-4472-01

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
FOUNDATION TIER

A.M. TUESDAY, 13 January 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**3**	
3.	**9**	
4.	**4**	
5.	**5**	
6.	**5**	
7.	**6**	
8.	**7**	
9.	**9**	
10.	**8**	
Total	**60**	

4472 010001

ADDITIONAL MATERIALS

In addition to this paper you will need 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.

Assessment will take into account the quality of written communication (QWC) in your answer to question **10**.

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.

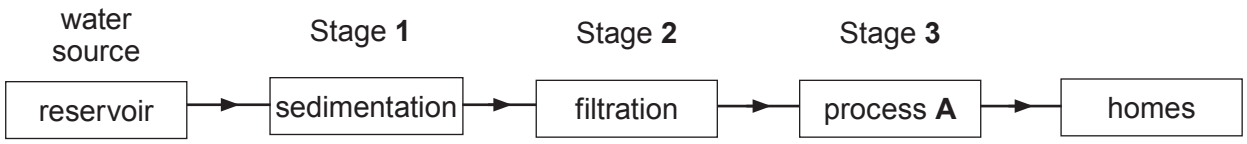
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Answer **all** *questions.*

1. *(a)* The diagram below shows the three main stages in the treatment of public water supplies.



(i) Reservoirs are a water source for public water supplies.
Give the name of **one** other source. [1]

.....

(ii) Give the number of the stage where large insoluble particles settle out and are removed from the water. [1]

Stage .....

(iii)

fluoridation	**chlorination**	**boiling**	**distillation**

In stage **3** the water is sterilised to kill bacteria and micro-organisms. Choose from the box above the name given to process **A**. [1]

Process **A** .....

(b) In drought conditions, suggest **one** way you could conserve water without affecting personal hygiene. [1]

.....

.....

4

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2. Draw a line to link each type of smart material to its property. [3]

Smart material	Property
thermochromic pigment	absorbs water up to 1000 times its volume
hydrogel	changes colour with changing temperature
shape memory alloy	regains its original shape when heated
photochromic pigment	changes colour with changing light intensity

4472 010003

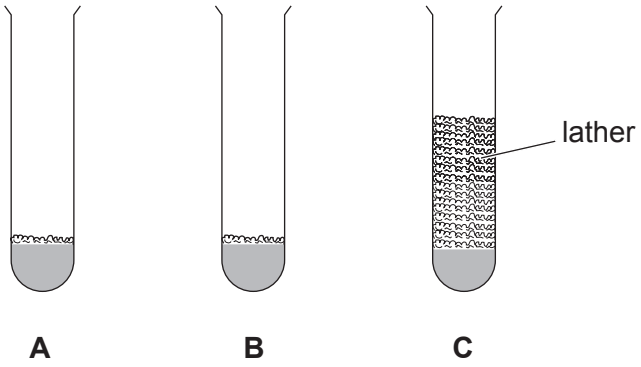
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3. *(a)* An investigation was carried out to compare the hardness of three water samples **A**, **B** and **C**.

(i) 1 cm^3 of soap solution was added to 5 cm^3 of the three water samples.
Each tube was shaken for 1 minute. The results are shown in the diagram below.



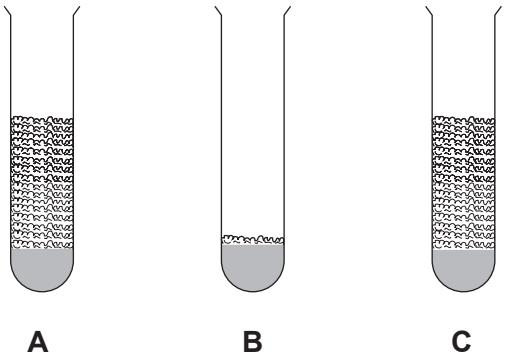
State which of the samples contain hard water. Give the reason for your answer. [2]

.....

.....

(ii) Water can contain temporary or permanent hardness. Water containing temporary hardness can be softened by boiling.

1 cm^3 of soap solution was added to 5 cm^3 of **boiled** samples of **A**, **B** and **C**.
Each tube was shaken for 1 minute. The results are shown below.



State what these results tell you about samples **A**, **B** and **C**. Include your reasoning. [2]

.....

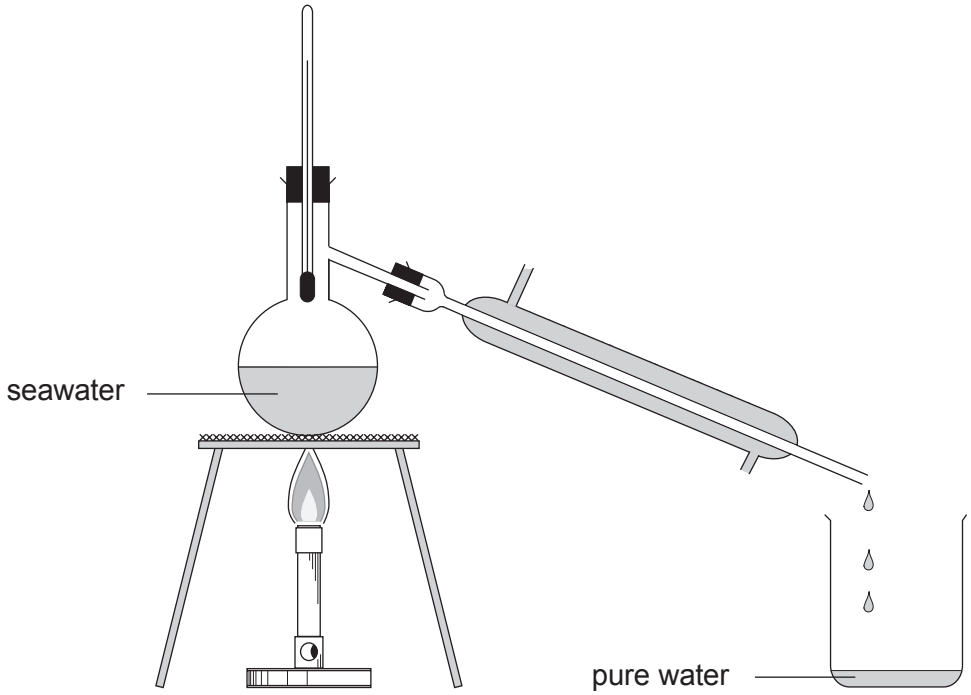
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(b) The diagram below shows apparatus that can be used to obtain pure water from seawater.



(i) Describe how pure water is separated from seawater. [3]

.....

.....

.....

.....

.....

.....

(ii) Suggest what you would **see** if 1 cm^3 of soap solution were added to 5 cm^3 of pure water in a test tube and the tube shaken for 1 minute. Give the reason for your answer. [2]

.....

.....

9

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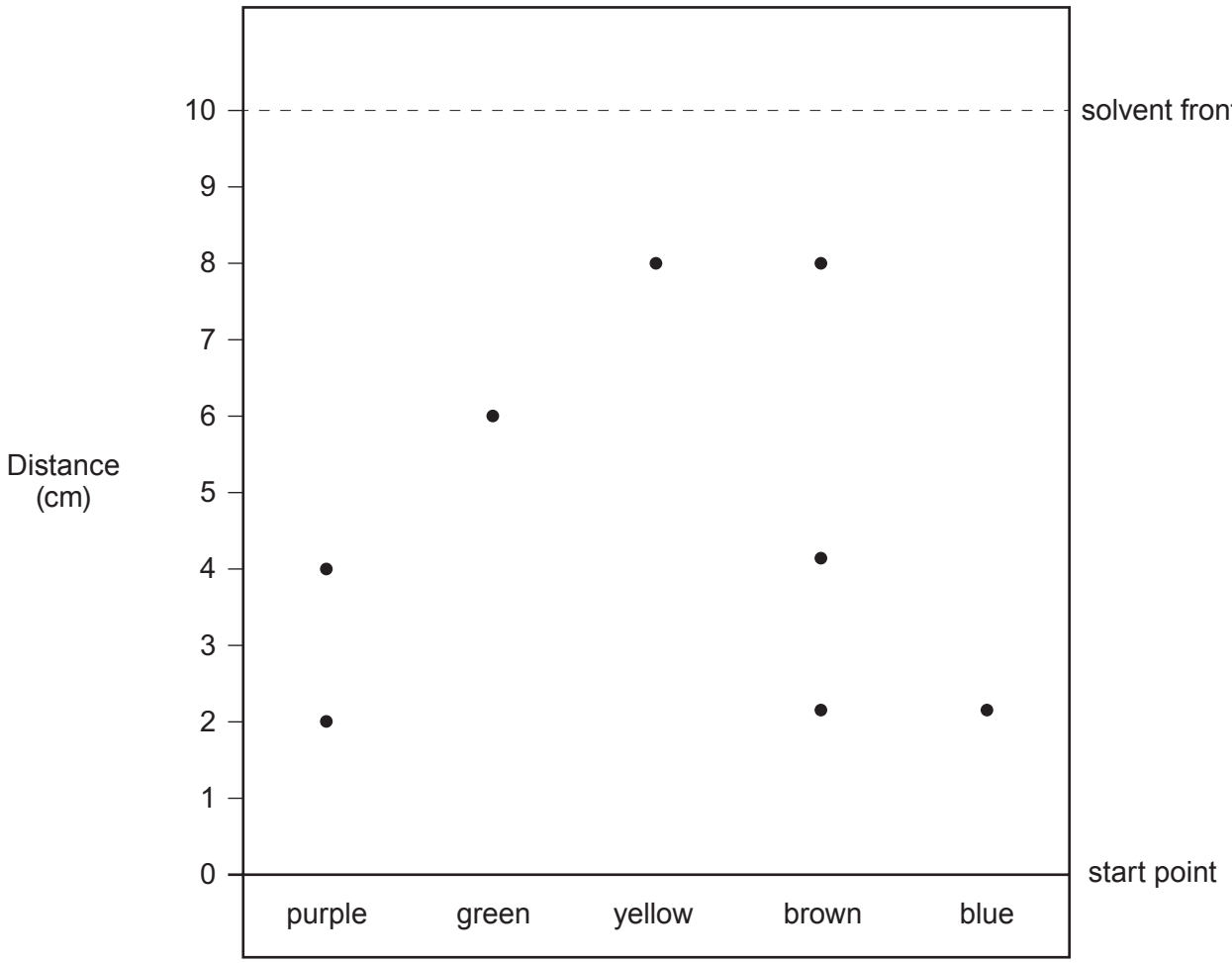
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4. The diagram below shows the chromatogram of several food colourings.



(a) Use the chromatogram to give the **two** food colourings that are mixed to make brown food colouring. [1]

..... and .....

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(b) The R_f value of a substance can be used to identify that substance.
The R_f value for a red food colouring is 0.4.

Use the equation below to calculate the distance this red food colouring would move on this chromatogram. [2]

distance moved = R_f × distance moved by the solvent

Distance moved = ... cm

(c) Give the reason why water is used as the solvent when obtaining this chromatogram of food colourings. [1]

.....

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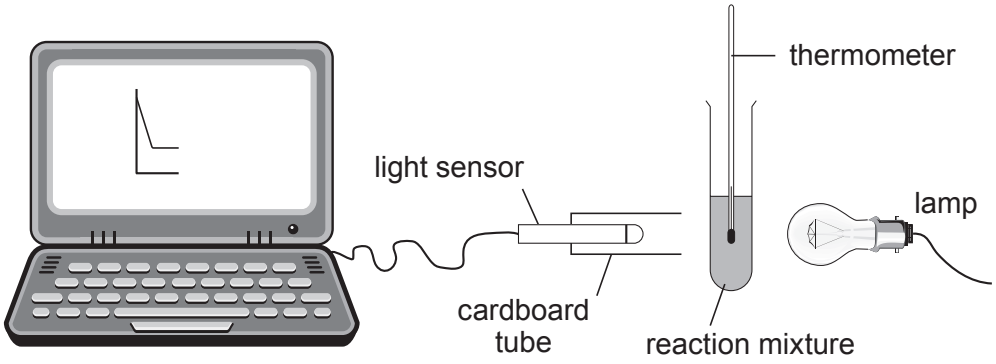
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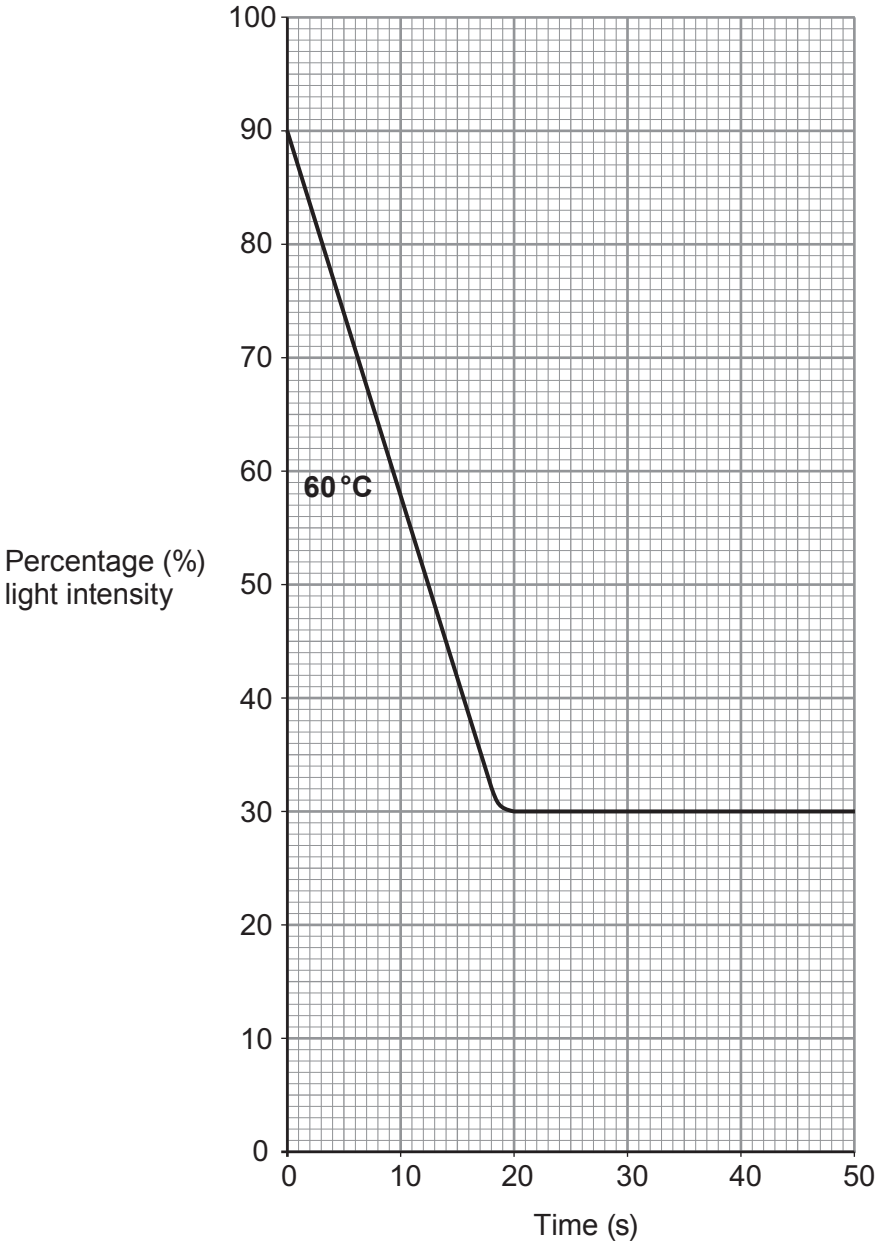
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5. Sodium thiosulfate solution reacts with dilute hydrochloric acid forming a yellow precipitate. This reaction was investigated using the equipment below.



5 cm^3 of dilute hydrochloric acid was added to 10 cm^3 sodium thiosulfate solution at 60 °C and the light intensity was measured over time. The results are shown on the grid below.



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(a) Use the graph to find the time taken for the reaction to stop. [1]

Time = ... s

(b) The experiment was repeated at 40 °C. The reaction stopped after 35 s. Carefully draw the graph of this experiment on the same grid. [1]

(c) Explain why the light intensity decreases as this reaction takes place. [2]

.....

.....

(d) Suggest **one** possible reason why the light intensity does not fall to 0 %. [1]

.....

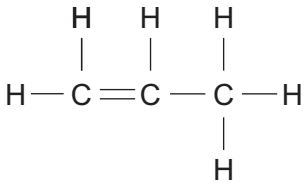
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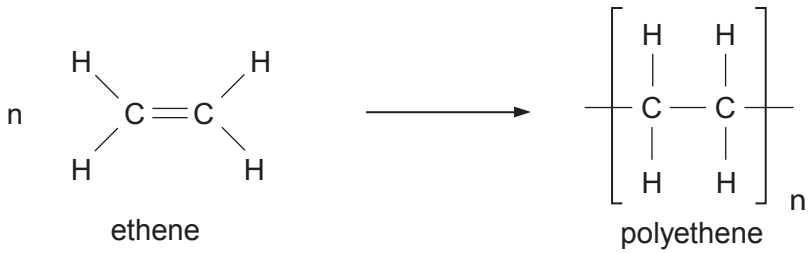
6. *(a)* The following diagram shows the structural formula of propene.



Give the molecular formula of propene. ..... [1]

(b) An alkane contains three carbon atoms and eight hydrogen atoms. Draw its structural formula. [1]

(c) The equation below shows the formation of polyethene from ethene.



Describe what happens to ethene molecules during the formation of polyethene. [3]

.....

.....

.....

.....

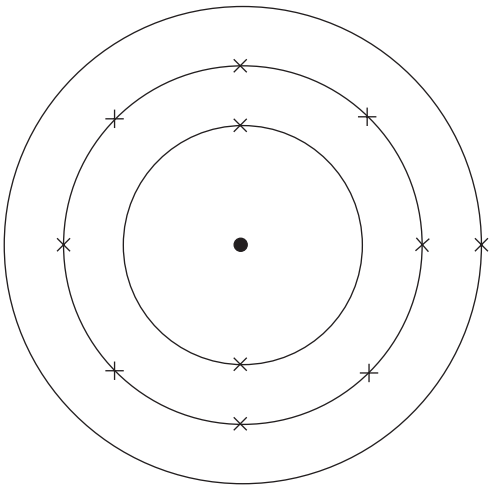
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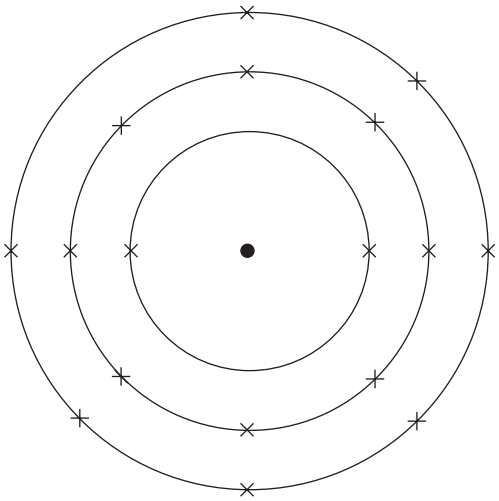
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7. *(a)* The diagrams below show the electronic structure of a sodium atom and a chlorine atom.



sodium atom



chlorine atom

(i) Give the number of electrons in the **outer** shell of [1]

a sodium atom, ...

a chlorine atom. .....

(ii) Sodium reacts with chlorine to form a white solid.

I State, in terms of electrons, what happens to sodium and chlorine atoms during this reaction. [2]

.....

.....

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

sodium + chlorine ⟶ .....

(b) Sodium chlorate, $NaClO_3$, is used to bleach paper.
Calculate the relative formula mass (M_r) of sodium chlorate. [2]

$A_r(O) = 16$ $A_r(Na) = 23$ $A_r(Cl) = 35.5$

$M_r(NaClO_3)$ = ...

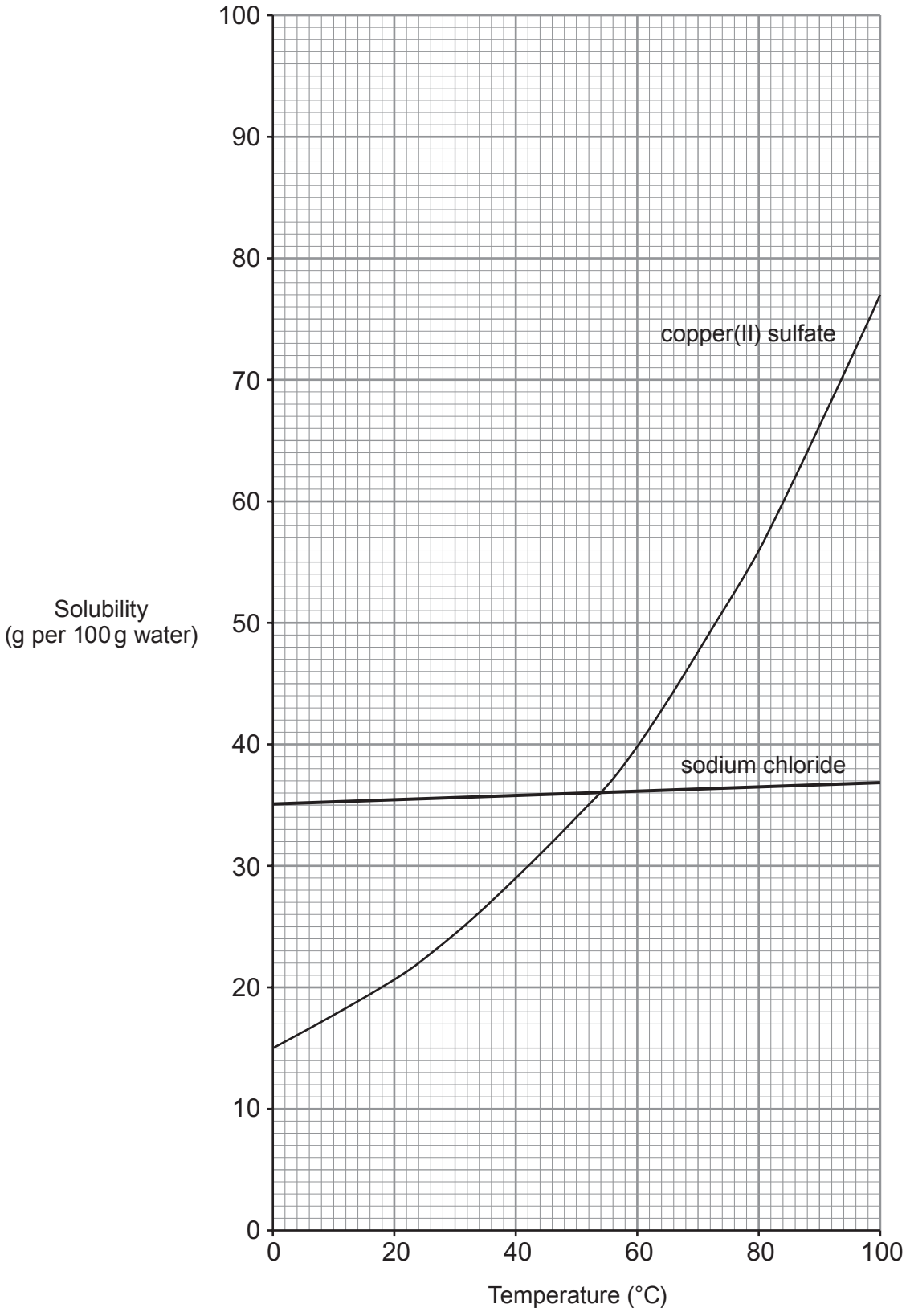
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8. The graphs below show the solubilities of sodium chloride and copper(II) sulfate in water at different temperatures.



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(a) Compare the solubilities of copper(II) sulfate and sodium chloride below 54 °C, at 54 °C and above 54 °C. [3]

.....

.....

.....

.....

(b) Calculate the mass of solid copper(II) sulfate that forms when a saturated solution in 50 g of water at 80 °C cools to 40 °C. [2]

Mass of solid copper(II) sulfate = ... g

(c) State why the temperature scale on a solubility graph ranges from 0 °C to 100 °C. [2]

.....

.....

7

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

Element	Symbol	Number of protons	Number of neutrons	Number of electrons
beryllium	$^{9}_{4}Be$	4	5	4
fluorine	$^{19}_{9}F$	9	.....	.....
calcium	.....	20	20	.....
argon	$^{40}_{18}Ar$	.....	22	18

(ii) Give the **names** of the elements which have the same mass number. [1]

..... and .....

(iii) Using **X** to represent an electron, draw the electronic structure of argon. [1]

(b) Boron has two isotopes, $^{11}_{5}B$ and $^{10}_{5}B$.

Give **one** similarity and **one** difference between the nuclei of these two boron atoms. [2]

Similarity .....

Difference .....

9

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10. Lithium, sodium and potassium are Group 1 metals.

(a) A teacher wanted to demonstrate the similarities and differences in how each metal reacted with water. She added a small piece of each metal separately to a trough of water.

Describe what you would **see** when each metal is added to water and state how the observations can be used to establish the trend in reactivity within the group. [6 QWC]

(b) The teacher then demonstrated the reaction of sodium with oxygen.

Complete and balance the symbol equation for this reaction. [2]

$\square$ Na + O_2 ⟶ $\square$ .....

8

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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^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

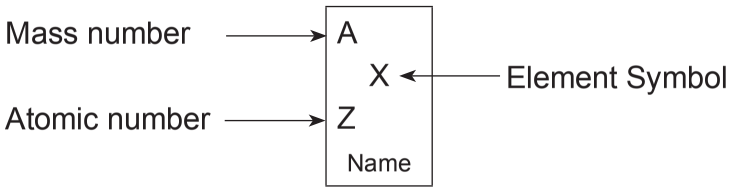
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PERIODIC TABLE OF ELEMENTS

1	2											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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(4472-01)

GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

JANUARY 2015

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2015 examination in GCSE SCIENCE - CHEMISTRY. 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.

	Page
C1	1
C2	15

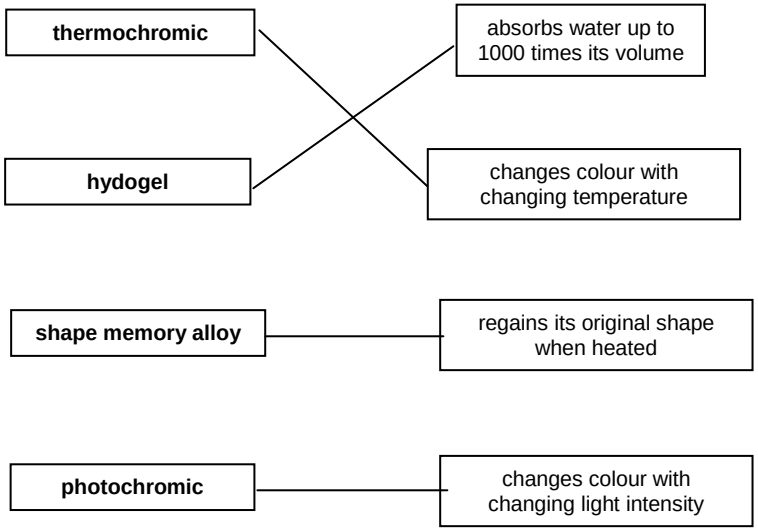
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		*(a)*	(i)		1	lakes / rivers / streams / aquifers / groundwater		surface water / rain / wells / springs	seawater sewers
			(ii)		1	1	sedimentation		
			(iii)		1	chlorination			
		(b)			1	stop washing cars/ windows stop watering gardens/ using a hose pipe don't run water when washing teeth/ low flush toilets/ dual flush toilets/ only run washing machine once a week/ only run washing machine with a full load/ shower instead of bath use waste water to flush toilets / clean car		don't wash don't use water collect rainwater use bottled water	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2					3	 all correct for 3 marks any two correct for 2 marks, any 1 correct for 1			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		*(a)*	(i)		2	A and B both needed (1) little / poor / no lather (1) second mark alone may be awarded if only A *or* B given			
			(ii)		2	A is temporary hard water and B is permanent (1) any of following for (1) • temporary is softened by boiling • permanent is not softened by boiling • temporary forms lather after boiling • permanent doesn't form lather after boiling		ignore reference to sample C unless incorrect	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
		(b)	(i)		3	• salt remains in flask / salt left behind • water boils / water turns to steam / steam enters condenser • steam condenses / steam turns back to water in condenser / steam cools to form water • distillation / desalination any 3 for (1) each maximum (1) for description of separation of ethanol and water			
			(ii)		2	a lot of lather / froth / bubbles / foam (1) (pure water) contains no dissolved solids / (pure water) contains no Ca^{2+} / (pure water) contains no Mg^{2+} (1)	accept diagram reference to calcium / magnesium		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		*(a)*			1	purple and yellow both needed			
		(b)			2	0.4 × 10 (1) 4 (1) award (2) for correct answer only (cao) no error carried forward (ecf)			
		(c)			1	(food colourings are) soluble (in water) / (food colouring) dissolve (in water)			

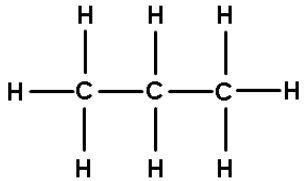
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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5		*(a)*			1	value in the range 19–20			
		(b)			1	line right of original graph from (0,90) to (35,30) – tolerance of 1 small square			
		(c)			2	precipitate formed/insoluble substance formed (1) light cannot travel through/ stops light / blocks light (1)	goes cloudy/ milky		
		(d)			1	any of following (apparatus) not light tight / light can get in around tube precipitate formed not dense enough / thick enough / precipitate formed does not block all the light		light all around / light present	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
6		*(a)*			1	C_3H_6		CH_2CHCH_3	
		(b)			1				
		(c)			3	• double bond opens (1) R • ethene molecules join together • long chain / single chain formed / polymer formed • addition reaction/ addition polymerisation any two for (1) each		becomes single bond loses double bond 'additional'	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7		*(a)*	(i)		1	sodium atom 1 chlorine atom 7 both needed			
			(ii)	I	2	sodium (atom) loses one electron (1) chlorine (atom) gains one electron (1) award (2) for electron transferred from sodium to chlorine maximum (1) if transfer of more than 1 electron implied			
				II	1	sodium chloride / NaCl			
		(b)			2	23 + 35.5 + 3(16) (1) 106.5 (1) award (2) for cao no ecf			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	1	*(a)*			3	two possible approaches either • below 54°C, NaCl more soluble (1) • at 54°C, solubilities the same (1) • above 54°C, $CuSO_4$ more soluble (1) or • below 54°C, $CuSO_4$ increases a lot with temperature, NaCl does not (1) • above 54°C, trend continues but $CuSO_4$ is more soluble than NaCl (1) • at 54°C, solubilities the same (1)	converse converse		
		(b)			2	56 – 29 = 27 (1) no tolerance 27/2 = 13.5 (1) ecf possible award (2) for cao			

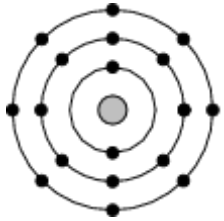
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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
		(c)			2	water freezes at 0°C / is ice at 0°C / is solid at 0°C / 0°C is the freezing point of water (1) water boils at 100°C / is steam at 100°C / is a gas at 100°C / 100°C is the boiling point of water (1)	these are the freezing point and boiling point of water (2) these are the fixed points of water (2) water is only liquid between these two temperatures (2) water is liquid between these temperatures (1)	melting point	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	2	*(a)*	(i)		5	<table><tr><th></th><th>symbol</th><th>protons</th><th>neutrons</th><th>electrons</th></tr><tr><td>fluorine</td><td></td><td></td><td>10</td><td>9</td></tr><tr><td>calcium</td><td>$^{40}_{20}Ca$</td><td></td><td></td><td>20</td></tr><tr><td>argon</td><td></td><td>18</td><td></td><td></td></tr></table> (1) for each correct answer			
			(ii)		1	calcium/Ca and argon /Ar both needed			
			(iii)		1			2,8,8	
		(b)			2	Similarity: (same) number of protons (1) Difference: (different) number of neutrons (1)	p for proton n for neutron	reference to atomic number and mass number	reference to electrons

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Question Number			Mark	Answer
FT	HT			
9	3	*(a)*	6 QWC	Indicative content • all three metals float, move about the water surface and produce bubbles • lithium reacts slowly without melting • sodium reacts quickly forming a sphere • potassium reacts violently forming a sphere and burning with a lilac flame • reactivity increases down the group *word /symbol equations not expected but creditworthy* 5-6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3-4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1-2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.
		(b)	2	Na_2O (1) correctly balanced (1) formula must be correct before balancing mark can be awarded

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	4	*(a)*			5	step 1 – use of soap solution to identify distilled water, needs fair testing element for both marks • add 1cm^3 soap (solution) to 5 cm^3 of each water sample (1) • shake for 1 minute/shake for the same time (1) • distilled water most froth (1) step 2 • boil unidentified samples and repeat step 1 (1) • temporary hard water lathers after boiling; permanent hard water still does not lather after boiling (1) credit alternative methods – up to (3) for method/fair test and up to (2) for conclusions	add soap to each water sample and shake (1)		washing up liquid
		(b)			1	reference to appliance needed furs up kettles/ kettles less efficient / boilers fur up / boilers less efficient / pipes fur up / pipes less efficient		reference to soap 'wastes energy' 'decreases efficiency' 'blocks pipes'	

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	5	*(a)*			3	two discrete diagrams needed - diagram 1 showing transfer of electrons - diagram 2 showing ions diagram 1 two potassium atoms lose 1 electron each (1) one sulfur atom gains 2 electrons (1) diagram 2 two K^+ ions and one S^{2-} ion formed (1) *octet of electrons around* S^{2-} *not needed*	if transferred electrons on both potassium and sulfur award (1)		
		(b)			2	two shared pairs of electrons (S—F) (1) octet of electrons around S and both F atoms (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	*(a)*			1	A steepest line / steepest graph / finishes in the shortest time both needed	greatest gradient / highest gradient / quickest reaction	precipitate	
		(b)			2	time = 22 (1) 0.045 / 0.0455 / 0.04545 (1) award (2) for cao	21 0.048 / 0.0476		0.05
		(c)			3	higher the temperature, faster the rate (1) particles have more energy / move faster at higher temperature (1) must be correct to award third mark therefore greater chance of (successful) collisions / more (successful) collisions per second (1)	more particles have required activation energy	more collisions	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	*(a)*			3	A iron(III) chloride / $FeCl_3$ (1) B sodium chloride / NaCl (1) C bromine / Br_2 (1)		iron chloride gas	iron(II) chloride Br
		(b)	(i)		2	$Ag^+ + Cl^-$ (1) AgCl (1) ignore state symbols			
			(ii)		3	$2AgNO_3 + MgBr_2 \rightarrow 2AgBr + Mg(NO_3)_2$ award (1) each for both products balancing (1) only award balancing mark if both products are correct			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	*(a)*			3	mass carbon and hydrogen divided by respective A_r values e.g. carbon 9/12 and hydrogen 2/1 (1) ratio of 3:8 (1) C_3H_8 (1) ecf possible if formula given is an alkane award (1) mark only for correct answer with no working			
		(b)			2	$M_r(C_4H_{10})$ = 58 (1) (48/58) × 100 = 82.76 (1) consequential marking	82.8 / 83		

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Question Number			
FT	HT	Mark	Answer
	9	6 QWC	Indicative content • ethene (monomer) contains a C=C bond/ ethene (monomer) is unsaturated • double bonds in ethene molecules 'open' • ethene molecules join together • long chain molecule formed/ polymer formed/ single molecule formed • balanced symbol equation, showing repeating unit • monomer & repeating unit, for example, for polypropene from propene/ PVC from chloroethene / polytetrafluoroethene from tetrafluoroethene 5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/01

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
FOUNDATION TIER

A.M. THURSDAY, 15 May 2014

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**3**	
2.	**4**	
3.	**7**	
4.	**5**	
5.	**10**	
6.	**7**	
7.	**5**	
8.	**6**	
9.	**7**	
10.	**6**	
Total	**60**	

4472
010001

ADDITIONAL MATERIALS

In addition to this paper you will need 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.

Assessment will take into account the quality of written communication (QWC) used in your answer to question **10**.

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.

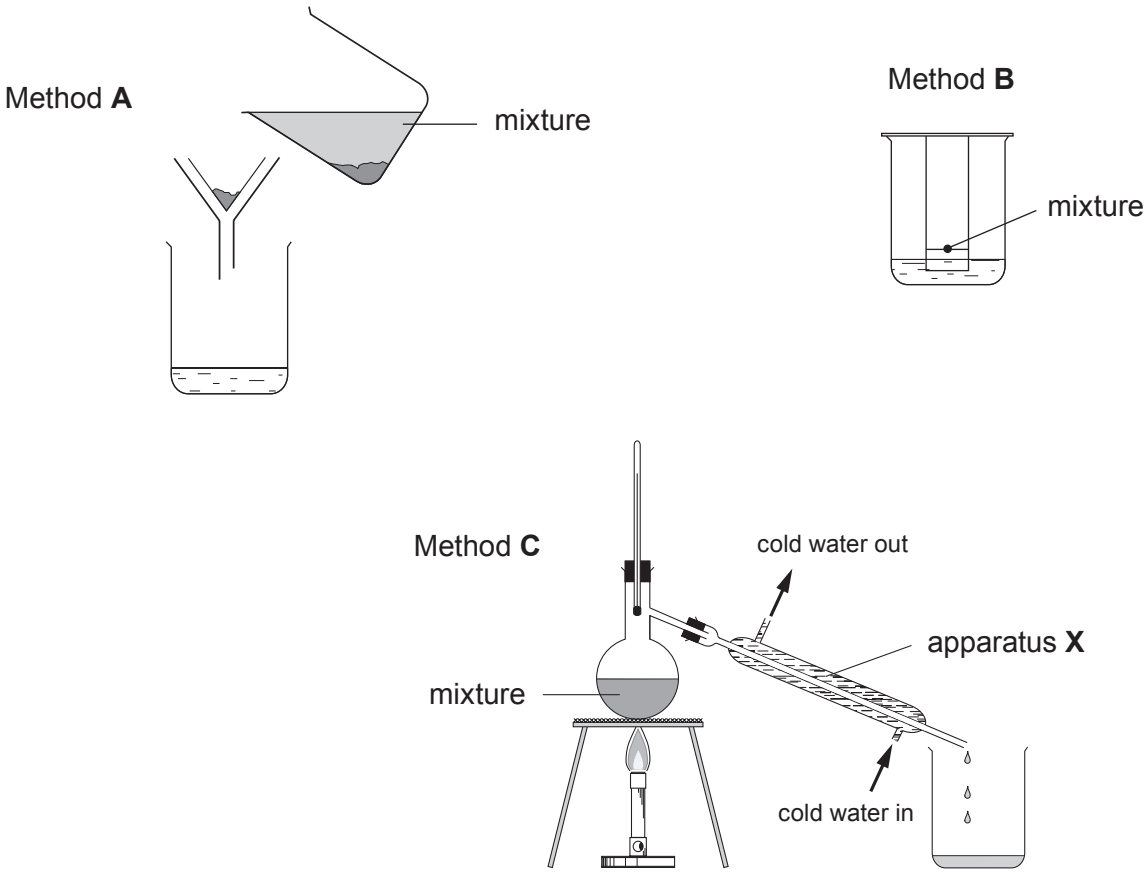
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Answer **all** *questions.*

1. The diagrams below show three methods, **A**, **B** and **C**, used to separate mixtures.



(a) The names of the separation methods and some of the pieces of apparatus used are given in the box below.

beaker	**distillation**	**chromatography**
condenser	**filter funnel**	**filtration**

Choose the answers to parts (i) and (ii) from the box.

(i) Name apparatus **X**. [1]

.....

(ii) Give the name of method **B**. [1]

.....

(b) Give the **letter** of the method you would use to separate ethanol from water. [1]

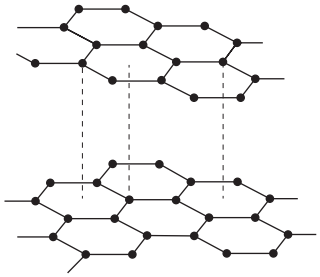
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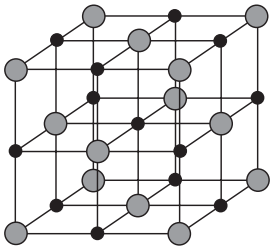
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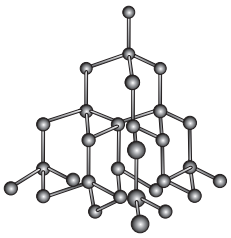
2. The following diagrams, **A**, **B**, **C** and **D**, show the structures of some substances.



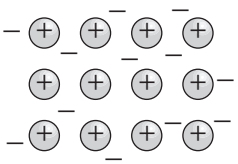
A



B



C



D

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(a) Give the letter of the structure which represents diamond. [1]

.....

(b) Name an element that has the structure **D**. [1]

.....

(c) Give the letter of a structure which is able to conduct electricity. [1]

.....

(d) Give the letter of the structure that represents sodium chloride. [1]

.....

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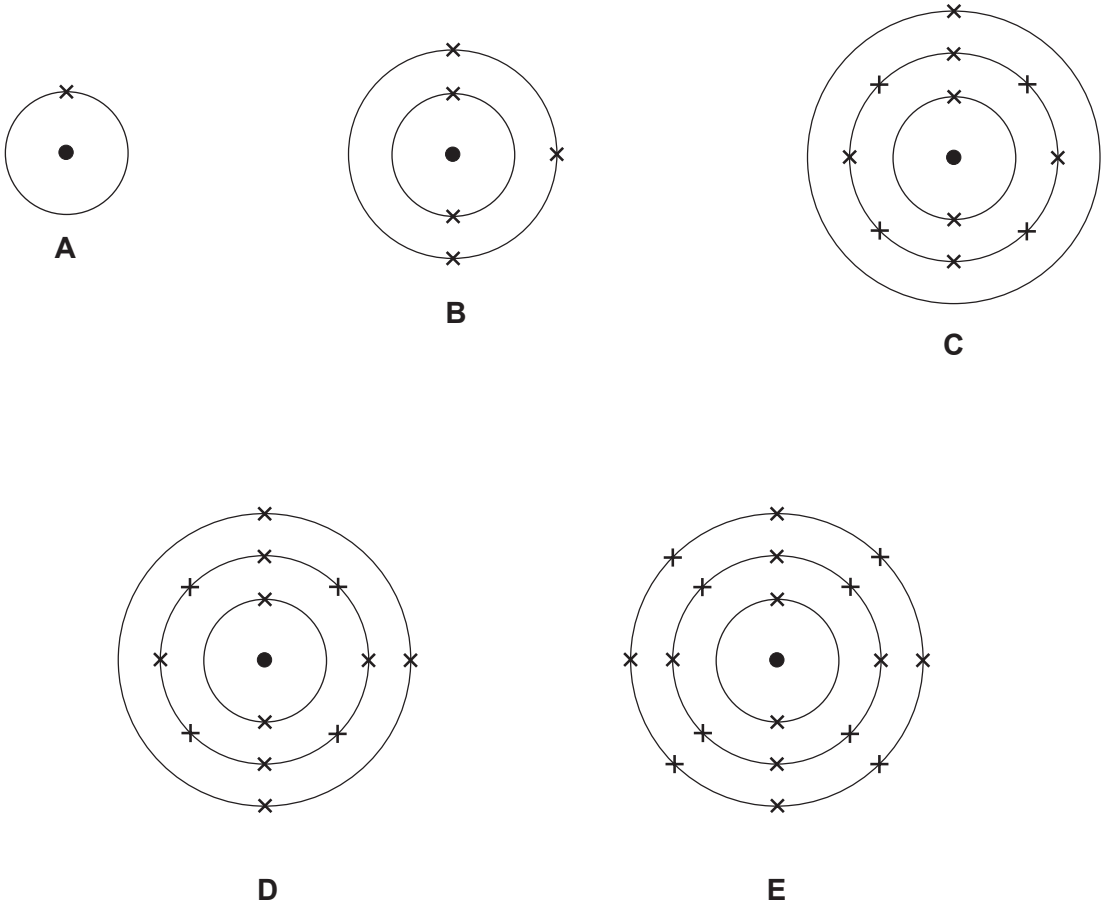
Turn over.

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3. *(a)* The following diagrams represent atoms of 5 different elements, **A**, **B**, **C**, **D** and **E**.

A, **B**, **C**, **D** and **E** are not chemical symbols.



(i) Give the electronic structure of **E**. ..... [1]

(ii) Which letter represents aluminium? ..... [1]

(iii) Give the letters of the **two** elements which are found in the same group of the Periodic Table and give a reason for your choice. [2]

.....

.....

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(b) (i) Calculate the relative formula mass (M_r) of sodium hydroxide, NaOH. [1]

A_r(Na) = 23 A_r(O) = 16 A_r(H) = 1

Relative formula mass = ...

(ii) Using your answer to part (i), calculate the percentage by mass of oxygen in sodium hydroxide, NaOH. [2]

Percentage by mass of oxygen = ... %

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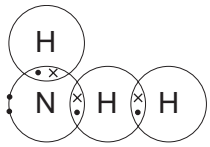
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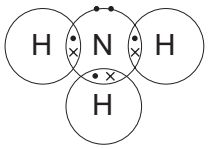
4. *(a)* (i) Ammonia, NH_3, is a compound that contains the elements nitrogen and hydrogen. The electronic structure for each element is given below.

N 2,5 H 1

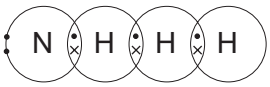
State which of the following dot and cross diagrams, **A**, **B** or **C**, represents the bonding in a molecule of ammonia. [1]



A



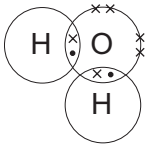
B



C

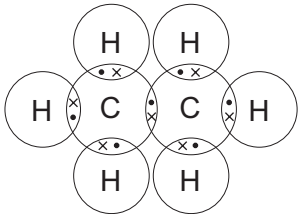
.....

(ii) Give the **name** of the substance represented by the following dot and cross diagram. [1]



.....

(b) The dot and cross diagram for a molecule of ethane is given below:



(i) State the total number of atoms in a molecule of ethane. [1]

.....

(ii) State the number of bonds that can be formed by a carbon atom. [1]

.....

(iii) Give the molecular formula for ethane. ..... [1]

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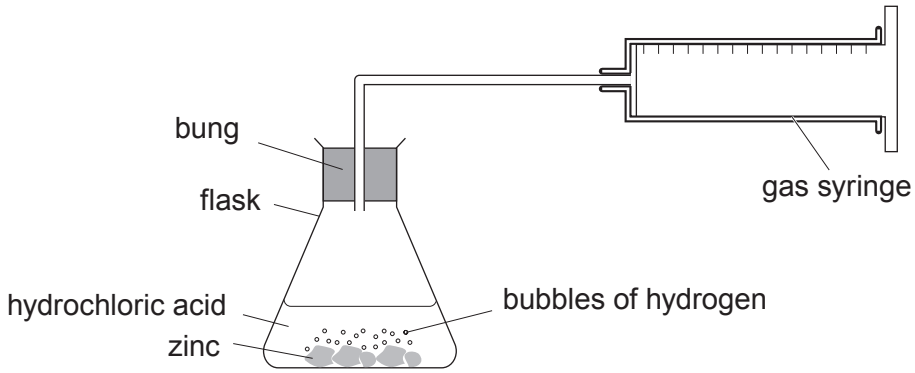
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5. *(a)* Zinc reacts with dilute hydrochloric acid to produce hydrogen gas.

The diagram below shows apparatus that can be used to investigate the rate of the reaction between zinc and hydrochloric acid. A small amount of copper sulfate is added because it acts as a catalyst for the reaction.



A few pieces of zinc were placed in excess dilute hydrochloric acid and the volume of hydrogen produced was recorded every 10 seconds. The experiment was carried out at room temperature. The results obtained are shown below.

Time (s)	0	10	20	30	40	50	60	70
Volume of hydrogen (cm^3)	0	8	33	40	45	48	49	49

(i) All the results were measured accurately but the volume recorded after 10 seconds is lower than expected. Suggest a possible reason for this. [1]

.....

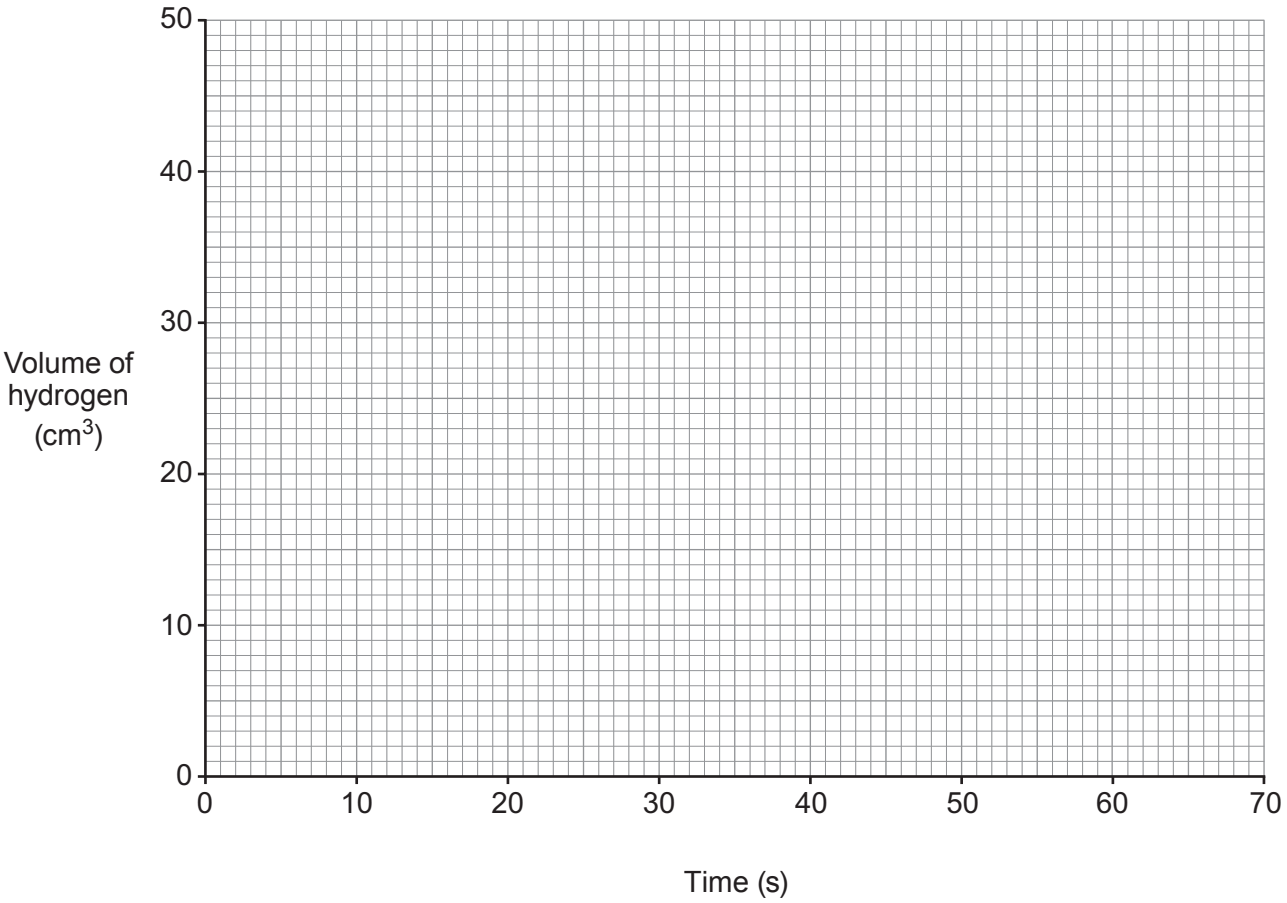
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(ii) Plot **all** the results from the table on the grid below and draw a suitable line. [3]



(iii) Use your graph to give the volume of hydrogen expected after 10 seconds. [1]

..... cm^3

(iv) State how the graph shows that the reaction has stopped. [1]

.....

.....

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(v) Choose statements from the box below to complete the following sentences.

less time	more time	the same time

Each statement may be used once, more than once or not at all. [2]

Using zinc **powder** instead of the larger pieces of zinc the reaction takes

..... .

When the experiment is repeated without the copper sulfate catalyst the reaction takes ..... .

(b) A chemical reaction takes twice as long if the temperature is decreased by 10 °C.

At 30 °C, milk undergoes a chemical reaction that makes it go sour in 1 day.

Calculate how long it will take milk to go sour at 10 °C. [2]

.....

.....

10

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6. *(a)* Draw a line to link each type of substance to the property that best describes it. [1]

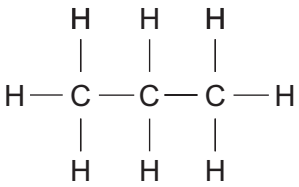
Type of substance	Property
shape memory polymer	does not change when heated
thermoplastic	regains original shape when heated
thermoset	softens when heated

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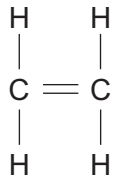
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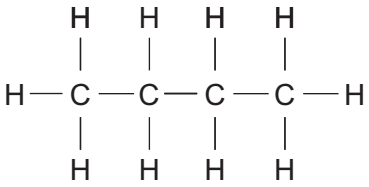
(b) The structural formulae of four organic compounds are shown below.



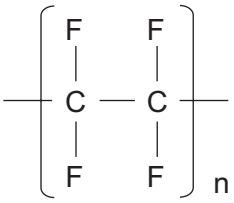
A



B



C



D

(i) Give the chemical name of compound **B**. ..... [1]

(ii) Give the letter of the compound that is **not** a hydrocarbon and give a reason for your answer. [2]

.....

.....

(iii) Give the letter of the compound that can undergo polymerisation and give a reason for your answer. [2]

.....

.....

(c) The molecular formula of propene is C_3H_6.

Draw the structural formula of propene. [1]

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7. *(a)* The following processes are used in the treatment of our water supply.

sedimentation **filtration** **chlorination**

State the purpose of each process. [3]

Sedimentation

.....

.....

Filtration

.....

.....

Chlorination

.....

.....

(b) Drinking water can be obtained by desalination.

State what is meant by *desalination* and name a process by which it can be carried out. [2]

.....

.....

5

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8. Potassium reacts vigorously with water.

(a) (i) Describe what you would **observe** when potassium reacts with water. [3]

.....

.....

.....

.....

(ii) During a class demonstration the potassium exploded. Suggest what might have caused this to happen. [1]

.....

.....

(b) Complete and balance the symbol equation for the reaction between potassium and water. [2]

$2K + 2H_2O \longrightarrow$ ..... + ...

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9. The table below shows the amount of soap solution required by different samples of water to form a permanent lather. In each case 25 cm^3 of the water samples were used and the soap solution was added 1 cm^3 at a time.

	Volume of soap solution added (cm^3)				
Sample	Test 1	Test 2	Test 3	Test 4	Mean
distilled water	2	2	2	2	2
A	8	8	9	7	8
B	11	18	12	13	
C	15	14	14	13	14
A after boiling	8	7	9	8	8
B after boiling	6	5	6	7	6
C after boiling	2	2	2	2	2

(a) Two pupils, David and Haf, calculated the mean value for sample **B**. David calculated a value of 13.5 and Haf calculated a value of 12. Show how both values were obtained. State which is the better value to use and give a reason for your choice. [3]

.....

.....

.....

.....

(b) State which of water samples **A**, **B** and **C** is the **least** hard. [1]

Water sample .....

(c) State which of water samples **A**, **B** and **C** contains **both** temporary and permanent hardness. Give the reason for you answer. [2]

Water sample .....

Reason .....

.....

(d) Name an ion which causes hardness in water. [1]

.....

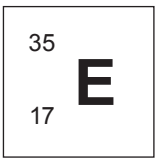
7

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10. An atom of element **E** is represented as follows.



State and explain what information this gives you about element **E**.

You may wish to refer to the key on the Periodic Table to help you answer this question. [6 QWC]

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^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

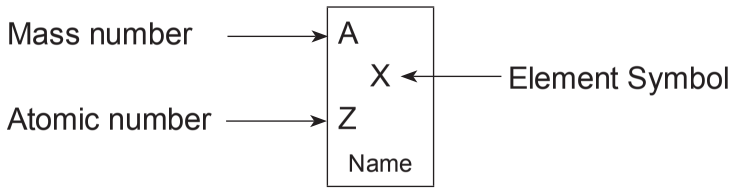
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PERIODIC TABLE OF ELEMENTS

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 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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(4472-01)

GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

SUMMER 2014

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2014 examination in GCSE SCIENCE - CHEMISTRY. 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.

	Page
C1	1
C2	19
C3	36

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Chemistry 2 – Foundation tier only questions

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		*(a)*	(i)		1	condenser			
			(ii)		1	chromatography			
		(b)			1	C	distillation		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		*(a)*			1	C			
		(b)			1	any named metal e.g. sodium, magnesium	symbol e.g. Na, Mg		
		(c)			1	A / D	graphite / metal named in part *(b)*	carbon	
		(d)			1	B			

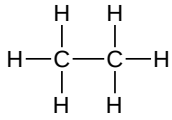
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		*(a)*	(i)		1	2, 8, 8			
			(ii)		1	D		Al	
			(iii)		2	B and D – both needed (1) they have the same number of electrons in their outer shell / they both have three electrons in their outer shell (1) 2nd mark may be awarded if A and C given	boron and aluminium		A and C
		(b)	(i)		1	40			
			(ii)		2	16 ÷ 40 (1) 40 (1) error carried forward from (i) correct answer only (2)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		*(a)*	(i)		1	B			
			(ii)		1	water		H_2O hydrogen oxide	hydroxide
		(b)	(i)		1	8			
			(ii)		1	4			
			(iii)		1	C_2H_6	CH_3CH_3		

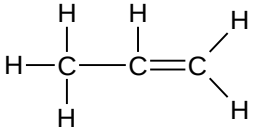
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		*(a)*	(i)		1	gas escaped during time taken to place the bung in the flask	gas syringe 'sticks'	human error	
			(ii)		3	all points plotted correctly [±½ square] (2) seven points plotted correctly (1) smooth curve drawn, not passing through (10,8) (1)	 curve through (10,8) if (0,0) not plotted		
			(iii)		1	value read correctly from graph [±½ cm^3] ecf possible from any curve – except to give 8			8
			(iv)		1	line continues horizontally / volume stops increasing		straight line	
			(v)		2	less time (1) more time (1)			
		(b)			2	4 days - correct answer only (2) if answer incorrect (1) for any indication of correct working e.g. from 30-20°C doubles time from 1 day to 2 days			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
6		*(a)*			1	shape memory polymer → regains original shape when heated thermoplastic → softens when heated thermoset → does not change when heated			
		(b)	(i)		1	ethene		C_2H_4 alkene	
			(ii)		2	D (1) fluorine atoms present / hydrocarbons include carbon and hydrogen atoms only / doesn't contain hydrogen atoms (1)			
			(iii)		2	B (1) it has a double bond (1)	ethene it is unsaturated		
		(c)			1				

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Chemistry 2 – Common questions

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	*(a)*			3	sedimentation – removes large particles/objects (1) filtration – removes smaller particles (1) chlorination – kills bacteria (1)			
		(b)			2	removal of salt from seawater (1) distillation (1)	 osmosis		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	*(a)*	(i)		3	burns - lilac flame (1R) Reserved mark • floats • moves • melts / spherical shape • effervesces / fizzes / bubbles • spits / sparks / pops any two for (1) each up to 2 max		dissolves disappears produces hydrogen	red / yellow / blue / green flame
			(ii)		1	the piece of potassium could have been too big / could have been too little water / water could have been hot / potassium could have stuck to the side of trough			
		(b)			2	$2KOH + H_2$ (2) (1) for KOH if any errors			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	3	*(a)*			3	David – mean of all four values (54 ÷ 4 = 13.5) (1) Haf – mean of three values, with indication which three were selected (1) Haf's value is better as she used repeatable values only / discarded the value that appears to be suspect (1)			
		(b)			1	A		8	
		(c)			2	B (1) some hardness has been removed by boiling but some remains (1)			
		(d)			1	calcium (ion) / magnesium (ion)	Ca^{2+} / Mg^{2+}		

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Question Number			
FT	HT	Mark	Answer
10	4	6 QWC	Indicative content • element has a mass number of 35 and atomic number of 17 • 17 protons given by atomic number; must have same number of electrons because atoms are neutral • 17 electrons arranged in shells; electronic structure 2, 8, 7 • element is in Period 3; number of occupied electron shells • element is in Group 7; number of electrons in the outer shell • element E is chlorine • number of neutrons is 18; difference between mass number and atomic number 5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Chemistry 2 – Higher tier only questions

Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	*(a)*			2	coal dust has a much greater surface are than lumps of coal (1) greater chance of collision / more collisions per unit time (1)		faster reaction	
		(b)			2	1 day - correct answer only (2) if answer incorrect (1) for any indication of correct working e.g. from 5-15°C halves time from 8 days to 4 days			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	*(a)*			2	first mark for sensible suggestion with second mark for linked point/explanation e.g. use more calcium oxide (1) more heat would be released on reaction (1) or use smaller pieces of calcium oxide (1) so that reaction occurs more quickly (1)	less water / better insulation on outer wall of can / thinner metal in inner wall	less food	
		(b)			2	bond making releases energy and bond breaking absorbs energy (1) reactions are exothermic if more energy is released than is absorbed (1) both marks could be gained by one statement e.g. reactions are exothermic if more energy is released in making bonds than is absorbed in breaking bonds (2)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	*(a)*	(i)		3	diagrammatic representation showing clearly two Na atoms losing 1 outer electron each (1) one O atom gaining 2 electrons (1) Na^+ and O^{2-} (both needed) (1) there must be no ambiguity e.g. electrons cannot be on atoms and ions at the same time			
			(ii)		1	sodium ion 2, 8 oxide ion 2, 8 both needed			
		(b)			3	simple molecular (1) weak bonds between molecules (1) only a small amount of energy needed to break them (1)	simple covalent	covalent	

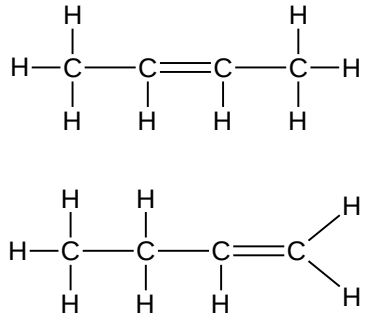
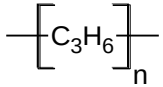
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	*(a)*			3	$Fe + Br_2$ (1) $FeBr_3$ (1) 2 3 2 (1) balancing mark only awarded if all formulae are correct			
		(b)			2	silver nitrate (solution) (1) cream / off-white precipitate (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	*(a)*			1	either of following 	correct structure for 2-methylpropene		
		(b)			4	double bonds open (1R) Reserved mark • propene molecules join together / form chains (1) • (addition) polymerisation (1) • repeat unit  (1) • any 2 of high temp / high pressure / catalyst (1) any 3 up to 3 max			condensation polymerisation

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	10	*(a)*			3	$M_r(Cu_2S) = 64 + 64 + 32 = 160$ (1) 1 mol of Cu_2S produces 2 mol of Cu or 160 tonnes of Cu_2S produces 128 tonnes of Cu (1) 20.5 tonnes of Cu_2S produces $\frac{128}{160} \times 20.5$ = 16.4 tonnes of Cu (1) error carried forward possible correct answer only (3)			
		(b)			2	4.1 tonnes of 'missing product' (1) $\frac{4.1}{16.4} \times 100 = 25\,\%$ (1) error carried forward from *(a)* correct answer only (2)			

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Question Number			
FT	HT	Mark	Answer
	11	6 QWC	Indicative content • correct order of reactivity, i.e. chlorine > bromine > iodine • observations relating to the reactions of halogens with iron, e.g. iron glows more brightly in chlorine than bromine • displacement reactions, e.g. chlorine reacts with potassium bromide to give bromine • appropriate word/symbol equations 5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/01

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
FOUNDATION TIER

A.M. TUESDAY, 14 January 2014

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**6**	
3.	**4**	
4.	**6**	
5.	**7**	
6.	**7**	
7.	**8**	
8.	**4**	
9.	**6**	
10.	**6**	
Total	**60**	

4472
010001

ADDITIONAL MATERIALS

In addition to this paper you will need 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.

Assessment will take into account the quality of written communication (QWC) in your answer to question **10**.

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.

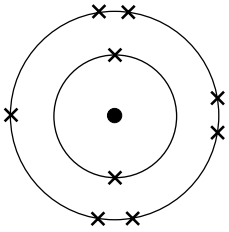
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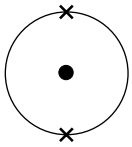
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Answer **all** *questions.*

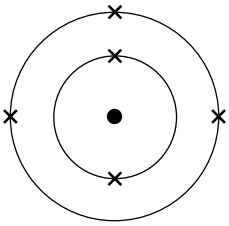
1. *(a)* The following diagrams represent five different atoms, **A–E**.



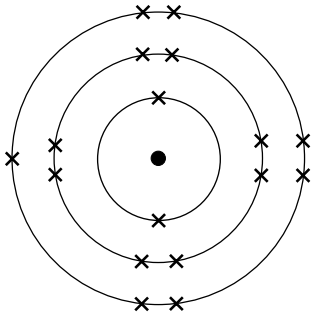
A



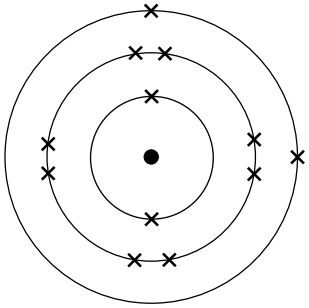
B



C



D



E

Use the diagrams to answer the following questions.

(i) Give the electronic structure of element **D**. ..... [1]

(ii) Give the letters, **A–E**, of the elements that are found in Period 3. [1]

..... and .....

(iii) Give the letters, **A–E**, of the elements that are found in Group 7. [1]

..... and .....

(iv) Give the atomic number of element **C**. ..... [1]

(b) Complete the following table to show the relative masses and charges of the particles found in an atom. [2]

Particle	Relative mass	Relative charge
proton	1	.....
neutron	.....	0
electron	0	−1

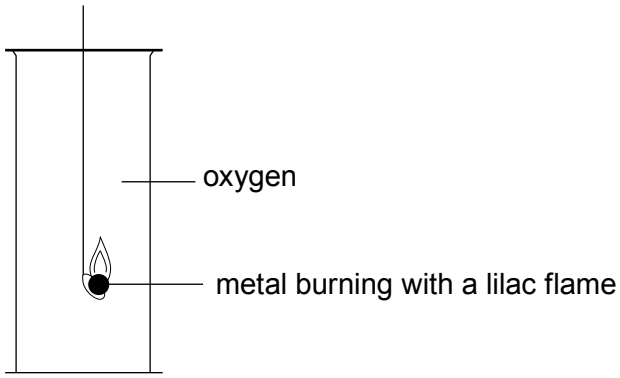
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2. A Group 1 metal is burned in a gas jar containing oxygen.



(a) Use the information in the diagram above to name the Group 1 metal. [1]

.....

(b) Write a **word** equation for the reaction taking place. [1]

..... + ... ⟶ .....

(c) Give the name of a Group 1 metal that would react **less** vigorously than the metal named in *(a)* above. [1]

.....

(d) A similar reaction can be carried out using chlorine instead of oxygen. The product obtained is a white solid.

(i) Choose from the box below a solution that could be used to show that the white solid contains chloride ions. [1]

limewater	**silver nitrate**	**sodium hydroxide**	**sulfuric acid**

Solution .....

(ii) State what must be done to the white solid in order to carry out the test. [1]

.....

(iii) Give the colour of the precipitate formed. [1]

.....

6

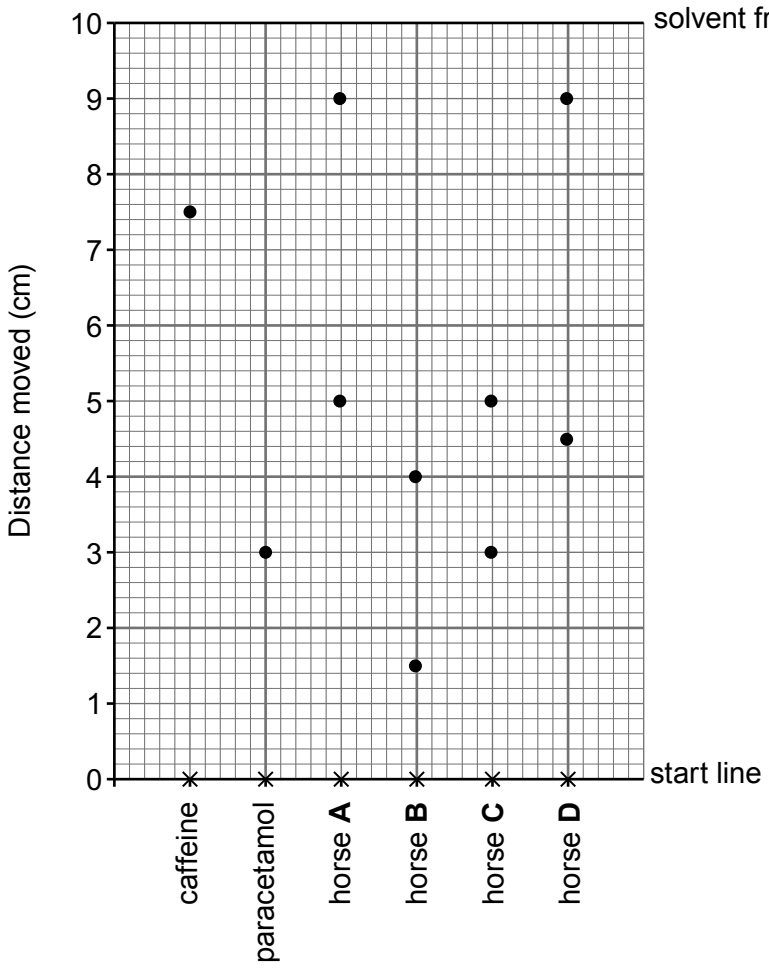
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4472 010003

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3. Chromatography can be used to test if racehorses have been given illegal drugs. Urine samples from four horses, **A–D**, were tested to find out whether they contained caffeine or paracetamol. The following diagram shows the results obtained.



(a) Give the letter of the horse, **A–D**, that had been given paracetamol. [1]

.....

(b) State, giving a reason, if any of the four horses had been given caffeine. [1]

.....

.....

(c) The R_f value can be used to identify a substance. Use the following equation to calculate the R_f value of paracetamol. [2]

$$R_f \text{ value} = \frac{\text{distance moved by paracetamol}}{\text{distance moved by solvent}}$$

R_f *value* = ...

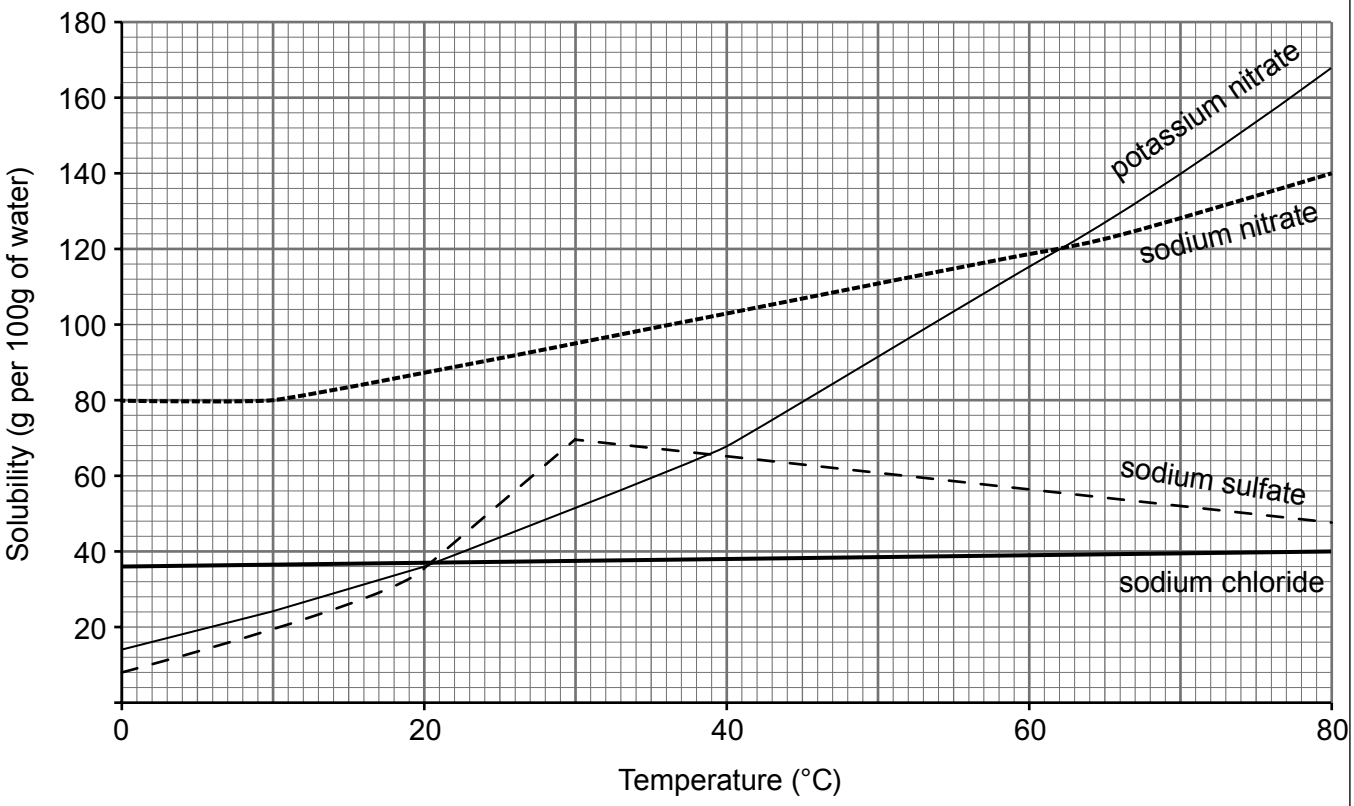
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4. The following graph shows how the solubility of four different substances varies with temperature.



(a) Name the substance that shows the smallest change in solubility. [1]

.....

(b) Give the temperature at which the solubility of potassium nitrate and sodium nitrate is the same.

..... °C [1]

(c) If a saturated solution of sodium nitrate in 100 g of water is cooled from 80 °C to 10 °C, calculate the mass of crystals that will be formed. [2]

Mass of crystals formed = ... g

(d) Describe, **using data from the graph**, how the solubility of sodium sulfate changes with temperature. [2]

.....

.....

.....

4472 010005

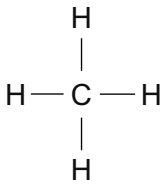
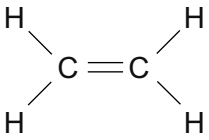
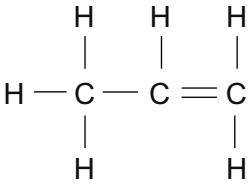
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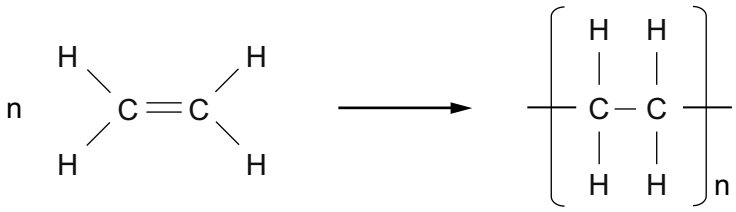
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5. The following table shows some information about four organic compounds.

Name	Molecular formula	Structural formula	Family of hydrocarbons
methane			
butane	C_4H_{10}		alkane
ethene	C_2H_4		
	C_3H_6		alkene

(a) **Complete** the table. [4]

(b) Ethene undergoes polymerisation to form polythene. The following equation shows the reaction taking place.



Describe what happens during this process. [2]

.....

.....

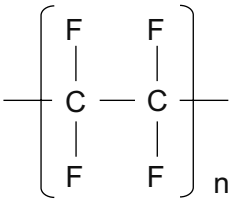
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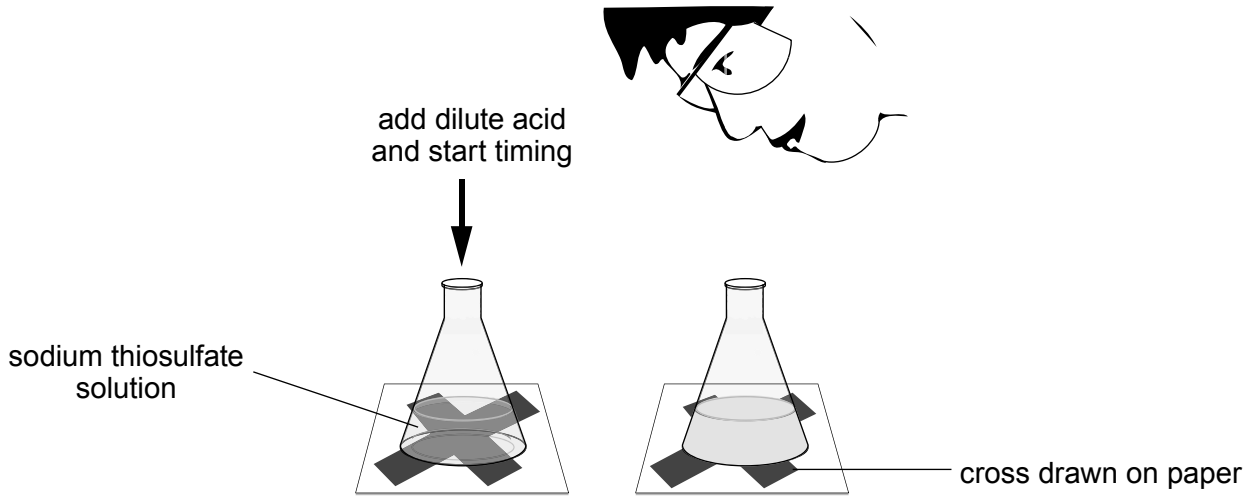
(c) Another polymer is PTFE. Its repeating unit is shown below.



Draw the structure of the monomer used to produce PTFE. [1]

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6. When sodium thiosulfate solution reacts with dilute acid, sulfur forms as a precipitate. The precipitate causes the solution to go cloudy. The rate of reaction can be measured by placing a cross beneath the flask and measuring the time taken for the cross to disappear.



A pupil studied the effect of temperature on the reaction and obtained the following results.

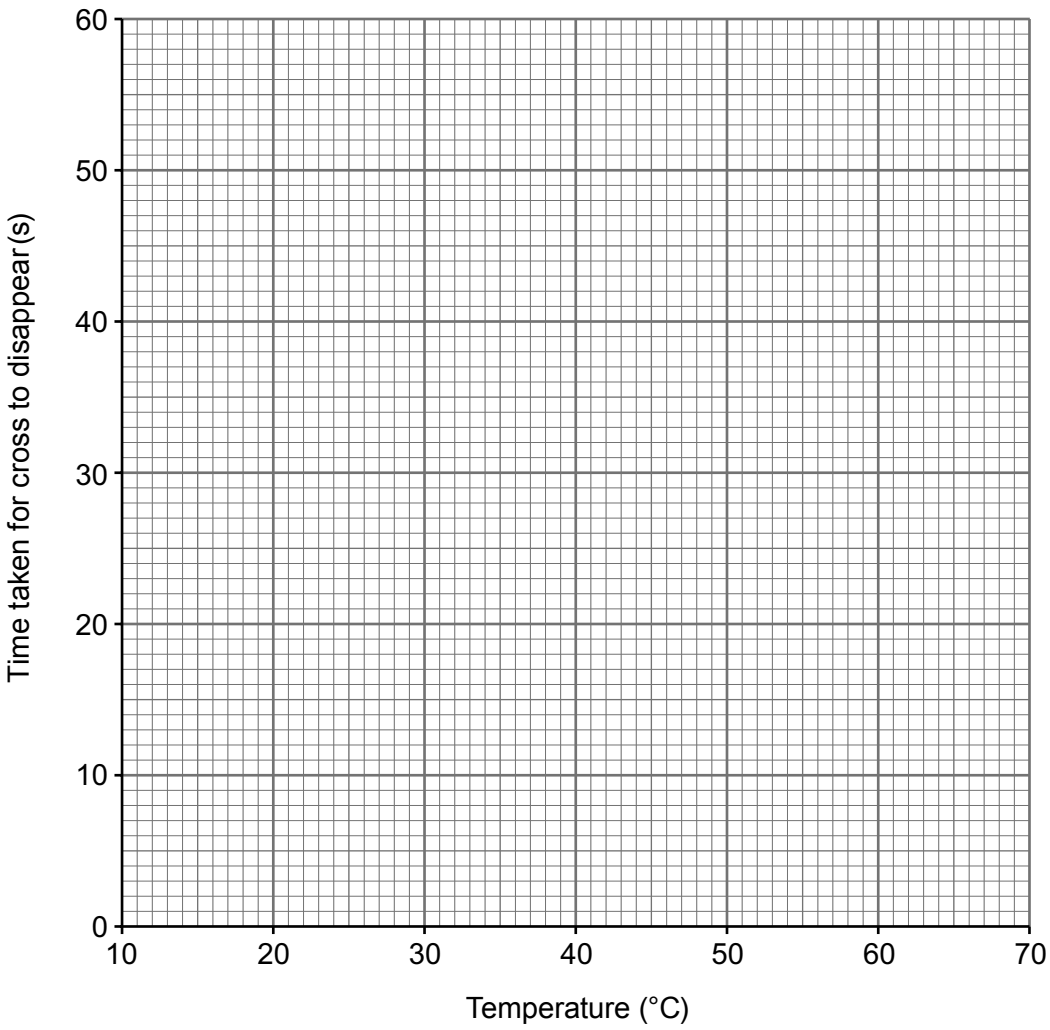
Temperature (°C)	20	30	40	50	60
Time taken for cross to disappear (s)	50	32	25	20	17

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(a) (i) Plot the results on the grid below and draw a suitable line. [3]



(ii) Describe the trend in the results. [1]

.....

.....

(iii) A second student carried out the same experiment using a higher concentration of acid. Draw the line you would expect him to obtain on the same grid. [1]

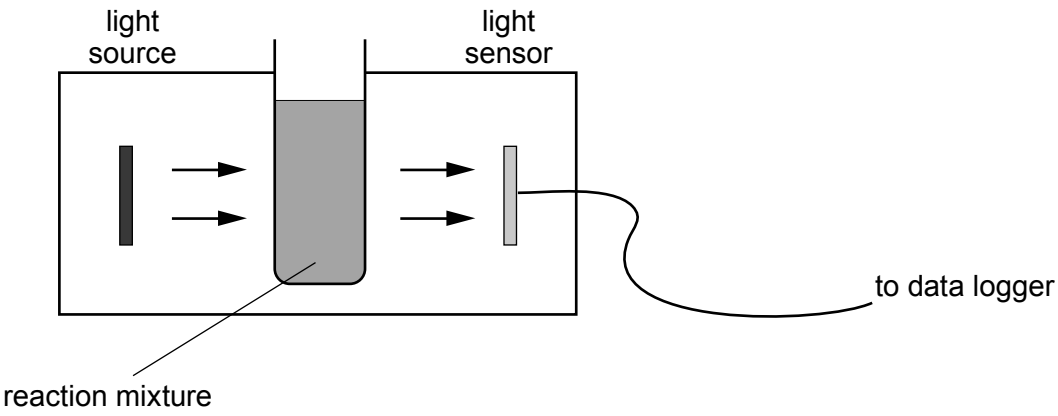
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(b) Another student suggested using a light sensor and data logger to study the reaction rate.



Describe how the light intensity detected by the sensor would change during the reaction and give **one** advantage of using a light sensor. [2]

.....

.....

.....

7

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7. The following table shows information about some atoms, **A–E**.

A–E are not the chemical symbols for the elements.

Atom	**A**	**B**	**C**	**D**	**E**
atomic number	3	6		10	11
mass number		12	14	20	23
number of protons	3	6	6	10	11
number of neutrons	4	6	8	10	
number of electrons	3	6	6	10	11

(a) **Complete** the table. [3]

(b) (i) Give the electronic structure of element **D**. ..... [1]

(ii) Use this information to explain why this element is found in Period 2 and Group 0. [2]

.....

.....

.....

(c) Choose the letters, **A–E**, of the atoms that represent isotopes and give a reason for your choice. [2]

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

Reason .....

.....

8

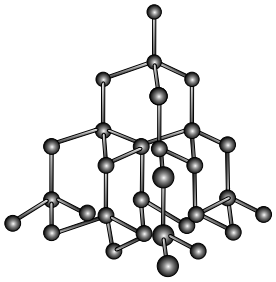
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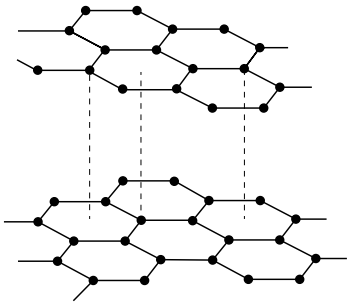
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8. The following diagrams show the structures of diamond, graphite and carbon nanotubes.



diamond



graphite



carbon nanotube

(a) Two of the structures shown above conduct electricity. Name both and give the reason why they are able to conduct electricity. [2]

Structures ..... and .....

Reason .....

.....

(b) Name the structure above that is used as a lubricant and give a reason why it is suitable for this use. [2]

.....

.....

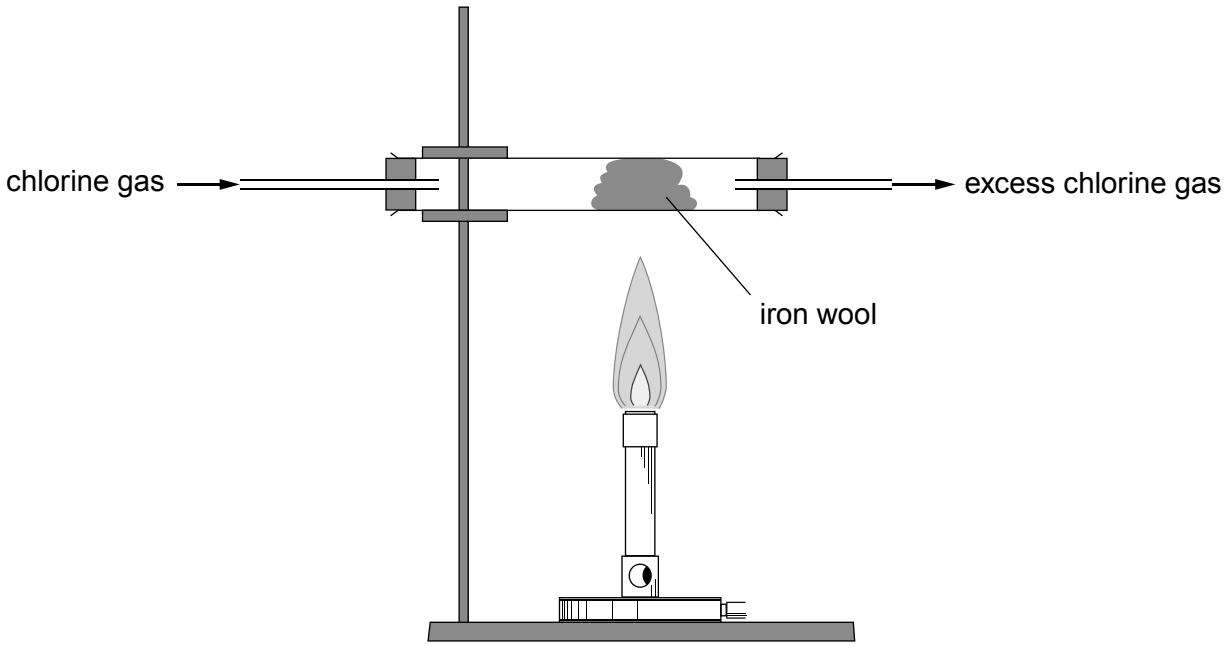
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9. The reaction of chlorine with iron can be demonstrated using the following apparatus.



(a) State why the reaction should be carried out in a fume cupboard. [1]

.....

.....

(b) The product of the reaction above is iron(III) chloride, $FeCl_3$. Complete and balance the following symbol equation for the reaction. [2]

□ ..... + □ ..... → □ $FeCl_3$

(c) Calculate the percentage by mass of chlorine in iron(III) chloride, $FeCl_3$. [3]

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

Percentage by mass of chlorine = ... %

6

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10. Thermochromic pigments, photochromic pigments and shape memory alloys are types of smart material.

Describe your understanding of smart materials. [6 QWC]

Your answer should include:

- what is meant by a smart material;
- some examples of smart materials, their special properties and uses.

.....

.....

.....

.....

.....

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END OF PAPER

6

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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^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

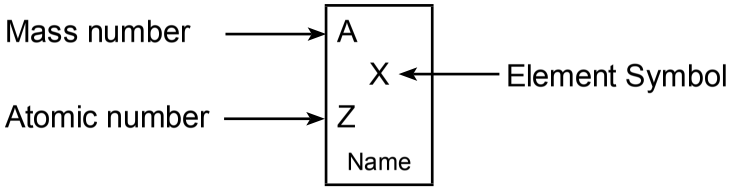
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PERIODIC TABLE OF ELEMENTS

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 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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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

JANUARY 2014

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2014 examination in GCSE SCIENCE - CHEMISTRY. 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.

	Page
C1	1
C2	15

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Chemistry 2 – Foundation Tier only questions

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)	(i)		1	2,8,7			
			(ii)		1	**D** and **E** (both needed)			
			(iii)		1	**A** and **D** (both needed)			
			(iv)		1	5			
		(b)			2	1 (1) +1 (1)		1	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
2		(a)			1	potassium	K		
		(b)			1	potassium + oxygen → potassium oxide follow through (ft) error from (a) only if Group 1 metal given	$K + O_2 \rightarrow K_2O$ (ignore balancing) consequential possible	gas	
		(c)			1	lithium / sodium ft only if Group 1 metal given is less reactive than that named in (a)	Li / Na		
		(d)	(i)		1	silver nitrate	$AgNO_3$		
			(ii)		1	dissolved (in water)	diluted / solution	liquid / molten	
			(iii)		1	white independent of (i)		milky	creamy

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)			1	horse **C**			
		(b)			1	no, none have a spot corresponding to caffeine	no samples match caffeine		
		(c)			2	3 (1) R_f value = 0.3 (1) correct answer only (cao) – 2 marks ft incorrect 'distance moved' only if value given divided by 10 i.e. correct distance moved by solvent – 1 mark			

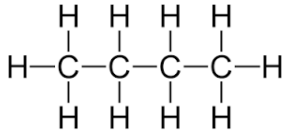
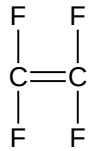
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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
4		(a)			1	sodium chloride	NaCl		
		(b)			1	62			
		(c)			2	140 – 80 (1) 60 (1) cao – 2 marks			
		(d)			2	increases (to maximum) then falls / up and down (1) maximum at 30 °C / maximum of 70 ± 2 g per 100 g water (1) rises more steeply than it falls – 2 marks			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)			4	*Name* propene (1) *Molecular formula* CH_4 (1) *Structural formula*  (1) *Family of hydrocarbons* – **both** needed (1) alkane alkene			
		(b)			2	double bond breaks / changes to single bond (1) **many** ethene molecules join together / form **long chain** or **polymer** (1)			
		(c)			1	 ignore ‘n’ and any brackets used			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)	(i)		3	all points plotted correctly (2) 4 correct (1) smooth curve through points (1)			 line drawn using ruler
			(ii)		1	the higher the temperature, the shorter the time / faster the reaction / higher the rate	'faster the rate'		'faster / quicker the **time**'
			(iii)		1	curve must be **below** original curve and **steeper** – ignore end point			
		(b)			2	light intensity decreases (1) continuous readings / graph plotted automatically / more precise end point (1)	light blocked more reliable than eyesight / more repeatable / no judgement required	 reference to 'reliability' or 'accuracy' or to 'human error' needs qualification	 '**no chance** of human error'

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	**1**	(a)			3	*mass number* 7 (1) *atomic number* 6 (1) *number of neutrons* 12 (1)			
		(b)	(i)		1	2,8			
			(ii)		2	two shells (containing electrons) outer shell is full / can't accept any more electrons		 8 in outer shell	
		(c)			2	**B** and **C** (1) same number of protons but different numbers of neutrons / same atomic number but different mass number (1) [marks linked i.e. second mark cannot be awarded if first is not given]		 reference to electrons	

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	**2**	(a)			2	graphite and nanotube (1) both have **free moving** / **delocalised** electrons (1)	mark independently		
		(b)			2	graphite (1) weak bonds **between** layers / **layers** able to slide over each other (1) [marks linked i.e. second mark cannot be awarded if first is not given]			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	**3**	(a)			1	chlorine gas is toxic / poisonous		harmful / dangerous / kills any reference to $FeCl_3$	
		(b)			2	Fe + Cl_2 (1) balancing 2,3,2 (1) [balancing mark only awarded if correct formulae included]			
		(c)			3	$M_r(FeCl_3)$ = 162.5 [or 3 × A_r(Cl) = 106.5] (1) 106.5 / 162.5 × 100 (1) 65.5% (1) cao – 3 marks	allow 66		

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Question Number			
FT	HT	Mark	Answer
10	**4**	6 QWC	**Indicative content** Materials that change their properties reversibly according to conditions; thermochromic pigments change colour according to temperature; photochromic pigments change colour according to light intensity; shape memory alloys can regain shape by heating / spring back in to shape (NITINOL) Uses: thermochromic pigments – forehead thermometers, baby spoons etc. photochromic pigments – lenses for sunglasses; UV marker pens etc. shape memory alloys – spectacle frames; stents in veins etc. **5–6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3–4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1–2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)	(i)		2	manganese dioxide is most effective / little effect with zinc oxide (1) full description of correct order of effect (2) more oxygen produced as time progresses / reaction slows down as time goes on (1) (2 max)			reference to one oxide being more '**reactive**' than another
			(ii)		2	same concentration of hydrogen peroxide same volume of hydrogen peroxide same mass/amount of metal oxide same temperature / specified temperature same particle size for each oxide any 3 for 2 marks; any 2 for 1 mark	 room temperature	same amount of hydrogen peroxide ignore time	
		(b)			2	two linked points required for 2 marks e.g. allows lower temperature to be used (1) which saves energy / improves efficiency / reduces costs (1) more product in the same time (1) which increases profitability / makes it more economical (1)	other relevant linked points		

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	6	(a)			1	*lithium* 2,1 *chlorine* 2,8,7 - **both** needed for 1 mark			
		(b)			3	lithium loses 1 electron (1) chlorine gains 1 electron (1) forms Na^+ and Cl^- (1) diagram clearly shows transfer with no ambiguity e.g. electron(s) not in two places at the same time			
		(c)			2	sharing 2 pairs of electrons (1) full octet around both oxygen (1)			
		(d)			3	lithium chloride is ionic **and** oxygen is covalent (1) strong bonds between <u>ions</u> in lithium chloride result in high melting point (1) weak bonds between <u>molecules</u> in oxygen result in low boiling point (1)	(1) only if 'particles' used instead of 'ions' and 'molecules'		

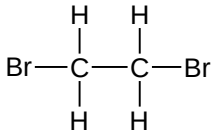
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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	7	(a)			3	**A** – potassium chloride (1) **B** – sodium iodide (1) **C** – lithium bromide (1)	KCl NaI LiBr	ions identified	
		(b)	(i)		1	chlorine is more reactive than bromine **and** displaces it from its halide			
			(ii)		3	reactants KBr + Cl_2 (1) products KCl + Br_2 (1) balancing 2,1,2,1 (1) [balancing mark only awarded if correct formulae included]			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)	(i)		1				
			(ii)		1	(bromine) turns colourless	decolourises	colour change ‘goes clear’	
		(b)			2	*Reaction* **A** addition (1) *Reaction* **B** polymerisation (1)	hydrogenation / reduction addition polymerisation	 additional	additional / polymerisation

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	(a)			3	1:2 ratio from equation (1) 12 tonnes C would produce 128 tonnes of copper (1) 1.5 tonnes C would produce 1.5/12 × 128 = 16 tonnes of copper (1) cao – 3 marks alternative method using moles moles C = 0.125 (1) moles Cu = 0.25 (1) mass Cu = 0.25 × 64 = 16 (1)	15.9 (3 marks)		
		(b)			1	75%	consequential		

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Question Number			
FT	HT	Mark	Answer
	10	6 QWC	**Indicative content:** **Ion exchange:** beads containing sodium ions; calcium / magnesium ions in hard water are exchanged for sodium ions; column can be recharged by passing sodium chloride solution through it. Advantages – works on both permanent and temporary hardness; continuous. Disadvantages – cost of column; need to recharge; waste water from recharging can cause limescale in sewage works; increased sodium levels in softened water. **Boiling:** boiling causes hydrogencarbonate ions to decompose forming scale on heating element. Advantages – no need for expensive equipment. Disadvantages – forms limescale; does not work on permanent hardness. Only effective with small volumes of water. **Washing soda:** reacts with calcium and magnesium ions to produce insoluble salts but produces scum. Effective with both permanent and temporary. **5–6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3–4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1–2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4472/01

ADDITIONAL SCIENCE/CHEMISTRY

CHEMISTRY 2
FOUNDATION TIER

P.M. MONDAY, 20 May 2013

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**4**	
3.	**7**	
4.	**4**	
5.	**6**	
6.	**4**	
7.	**7**	
8.	**8**	
9.	**5**	
10.	**5**	
11.	**6**	
Total	**60**	

4472
010001

ADDITIONAL MATERIALS

In addition to this paper you will need 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.

Assessment will take into account the quality of written communication (QWC) used in your answer to question **11**.

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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Examiner only

Answer **all** *questions.*

1. *(a)* Choose words from the box below to answer parts (i) and (ii).

chlorine	**copper**	**electron**
lithium	**magnesium**	**proton**

Give the name of

(i) a particle found in the nucleus of an atom, [1]

.....

(ii) an alkali metal. [1]

.....

(b) Complete the table below by naming the elements and the type of bonding present in ammonia, NH_3. [2]

Compound	Names of elements	Bonding
ammonia, NH_3		

4

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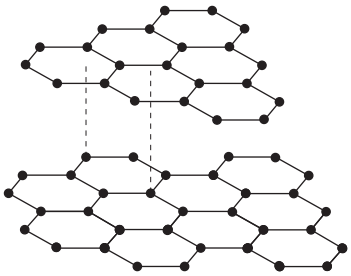
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2. *(a)* Draw a line to link each substance with its structure. [2]

One has already been done for you.

Substance	Structure
graphite	metallic
potassium	simple covalent
nitrogen	giant covalent
sodium chloride	giant ionic

(b) State which of the substances in part *(a)* has the structure shown by the following diagram. [1]



Substance .....

(c) Nitrogen is an example of an **element** with a simple covalent structure.

Name a **compound** with the same structure. [1]

.....

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3. *(a)* Atoms consist of particles called electrons, neutrons and protons.

Complete the following table by giving the charge on an electron and the mass of a neutron. [2]

	Mass	Charge
electron	negligible	.....
neutron	.....	neutral (0)
proton	1	positive (+1)

(b) Potassium is represented as $^{39}_{19}$K.

Element **X** has 9 electrons, 10 neutrons and 9 protons.

Write the information for element **X** in the same form as above. [1]

$^{\square}_{\square}$**X**

(c) Chlorine has two isotopes: chlorine-35 and chlorine-37.

Complete the table below. [2]

	chlorine-35	chlorine-37
Atomic number	17	17
Mass number	35	37
Number of electrons	.....	17
Number of neutrons	18	.....
Number of protons	17	17

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(d) The atomic number of sodium is 11.

Place a tick (✓) in the box next to the electronic structure of sodium. [1]

11	☐
2,9	☐
4,7	☐
2,4,5	☐
2,8,1	☐

(e) Element **Z** is found in Group 2 and in Period 4 of the Periodic Table.

Place a tick (✓) in the box next to the electronic structure of element **Z**. [1]

2,4	☐
4,2	☐
2,8,2	☐
2,8,8,2	☐
2,8,8,4	☐

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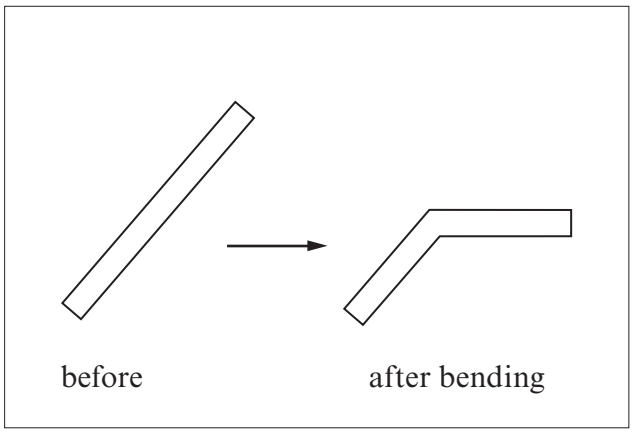
4. *(a)* The box below shows the names of some types of smart material.

hydrogel	**photochromic pigment**
shape memory alloy	**thermochromic pigment**

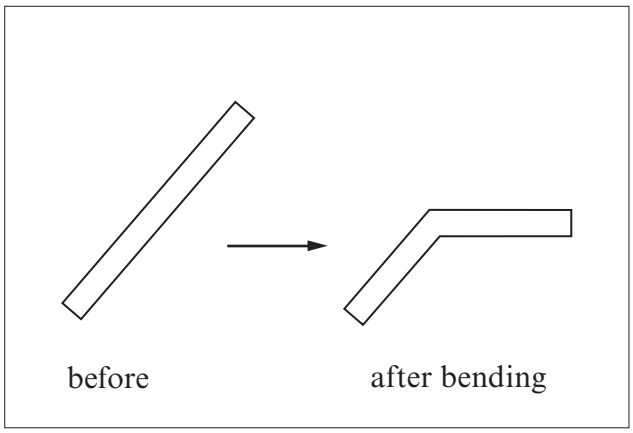
Choose from the box the type of smart material that changes colour with changing temperature. [1]

.....

(b) A teacher showed a class samples of two different types of plastic, **A** and **B**. One was a thermoplastic and the other a shape memory polymer. The teacher bent both samples and gave them to one of the students.



A



B

Describe what the student should do to find out which is the thermoplastic and which is the shape memory polymer.

Include the observations for **both** samples. [3]

.....

.....

.....

.....

4

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5. *(a)* Lithium, sodium, potassium and rubidium are the first four members of Group 1 in the Periodic Table.

The following table gives the melting points and boiling points of lithium, potassium and rubidium.

Element	Melting point (°C)	Boiling point (°C)
lithium	180	1330
sodium	-	-
potassium	64	774
rubidium	39	688

Using the information in the table, choose from below the pair of values most likely to be the melting point and the boiling point of sodium. [1]

Pair **A**	Pair **B**	Pair **C**	Pair **D**
59 910	113 735	98 890	134 1498

Pair ☐

(b) State why sodium is stored in oil. [1]

.....

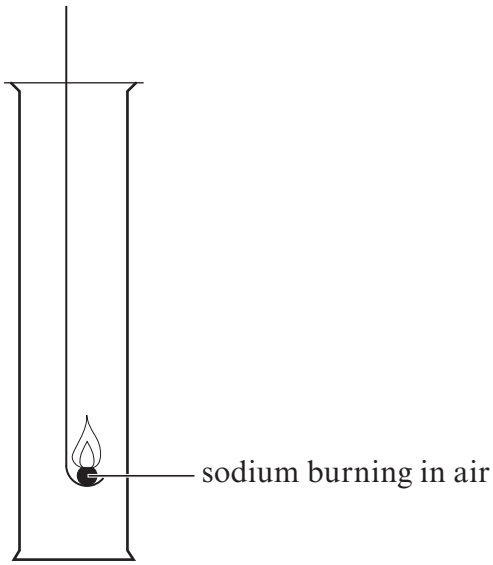
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(c) Sodium burns vigorously in air.



(i) Give the colour of the flame. [1]

.....

(ii) Give the **word** equation for the reaction that takes place when sodium burns in air. [2]

..... + ... ⟶ .....

(iii) Sodium also reacts vigorously with chlorine. Balance the symbol equation for the reaction between sodium and chlorine. [1]

$$\square\ Na + Cl_2 \longrightarrow \square\ NaCl$$

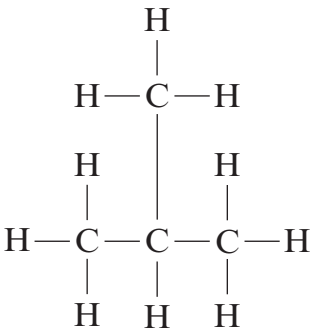
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6. *(a)* Give the **molecular** formula of the substance with the structural formula shown below.



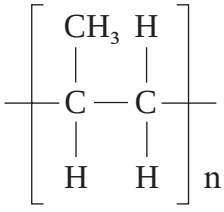
Molecular formula ..... [1]

(b) Give the name and the **structural** formula of the hydrocarbon with the molecular formula C_3H_8. [2]

Name .....

Structural formula

(c) Polypropene is represented as shown below.



Give the **molecular** formula of the monomer used to make polypropene. [1]

Molecular formula .....

4

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7. The following word equation represents the reaction between zinc and dilute hydrochloric acid.

zinc + hydrochloric acid ⟶ zinc chloride + hydrogen

You are asked to carry out an experiment to show how **particle size** affects the speed of this reaction.

(a) (i) Describe how you would carry out the experiment. [2]

.....

.....

.....

.....

(ii) State how you would make it a fair test. [2]

.....

.....

.....

(iii) State how you would know which particle size gives the fastest reaction. [1]

.....

.....

(b) A catalyst was added to the reaction mixture above.

(i) State how the catalyst would affect the **time** needed to produce a given volume of hydrogen. [1]

.....

.....

(ii) State how you would expect the catalyst to affect the total **volume** of hydrogen produced. [1]

.....

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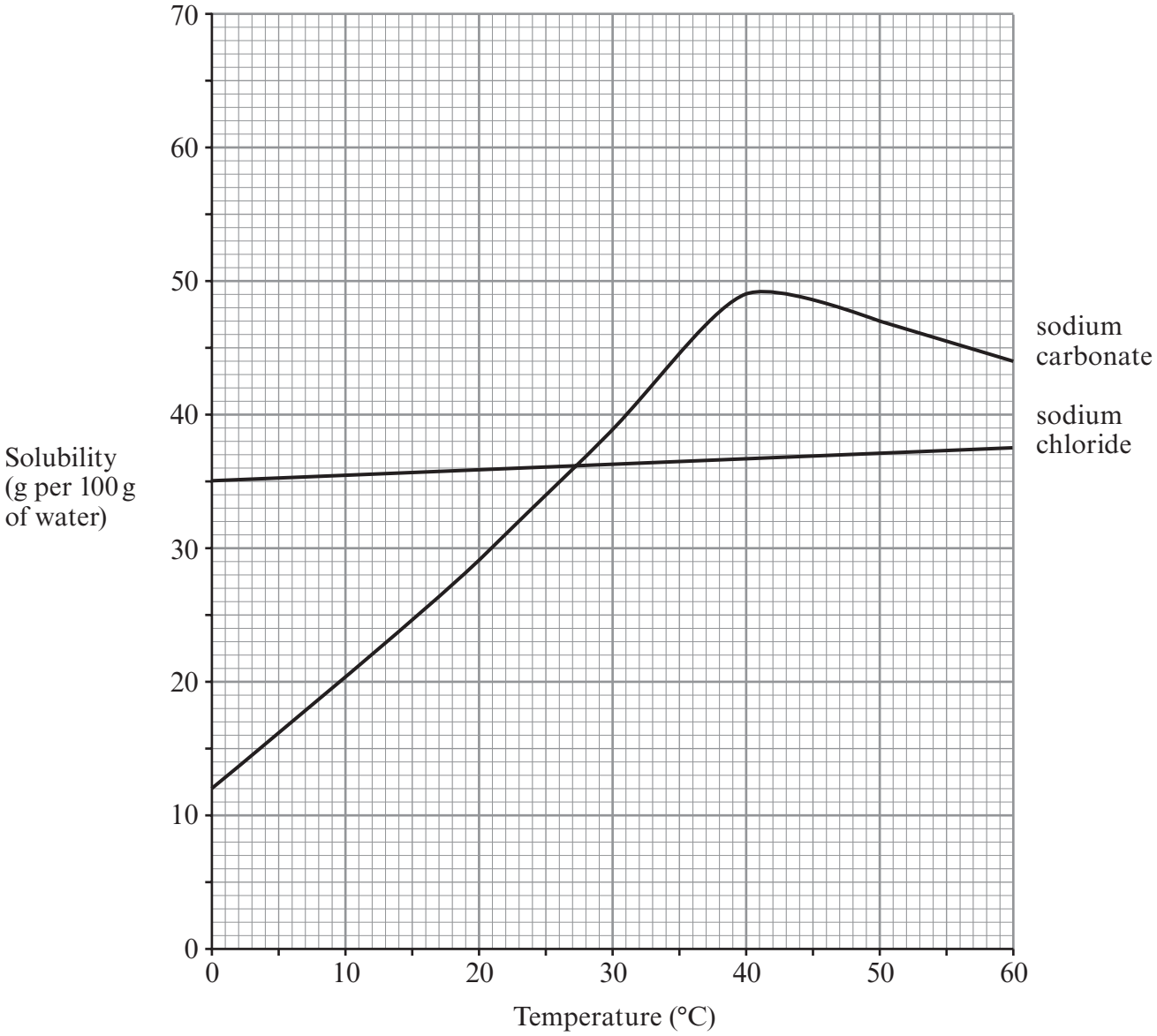
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8. The graphs below show the solubilities of sodium chloride and sodium carbonate in water at different temperatures.



(a) Describe the trend in the solubility of sodium carbonate. [1]

.....

.....

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(b) The table below shows the solubility of sodium bromate in water at different temperatures.

Temperature (°C)	0	10	20	30	40	50	60
Solubility (g per 100 g of water)	25	29	35	41	48	55	64

Plot the results from the table on the grid opposite and draw a suitable line. [3]

(c) List the three sodium compounds in order of solubility at 40 °C. [1]

Most soluble .....

.....

Least soluble .....

(d) The solubility of silver chloride is 0.0002 g in 100 g of water at room temperature, 20 °C.

You are given a mixture of sodium chloride and silver chloride powder. Describe how you would obtain a sample of silver chloride from the mixture. [3]

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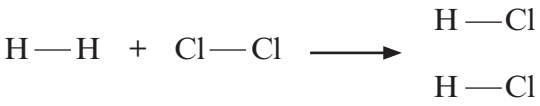
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9. The reaction between hydrogen and chlorine to give hydrogen chloride can be represented by the following equation.



The relative amounts of energy needed to break the bonds shown are given in the table below.

Bond	Amount of energy needed to break the bond (kJ)
H — H	436
Cl — Cl	242
H — Cl	431

NOTE: *The amount of energy **released** in making a bond is equal and opposite to that **needed** to break the bond.*

(a) Using the bond energy values in the table, calculate

(i) the relative energy needed to break all the bonds in the **reactants**, [2]

.....

.....

(ii) the relative energy given out when all the bonds in the **product** are formed. [2]

.....

.....

(b) Using your answers to part *(a)*, state whether the reaction between hydrogen and chlorine is exothermic or endothermic and give a reason for your answer. [1]

.....

.....

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10. *(a)* A group of students carry out an experiment to investigate the relative hardness of four samples of water, **A**, **B**, **C** and **D**.

The students add soap solution, 0.5 cm^3 at a time, to sample **A**. The mixture is shaken after each addition. The volume of soap solution needed to produce 1 cm of lather is recorded. They test samples **B**, **C** and **D** in exactly the same way. They then repeat the experiment after boiling each sample of water.

The results obtained are shown in the table below.

Water sample	Volume of soap solution needed (cm^3)	
	Before boiling	After boiling
A	10.5	10.5
B	1.5	1.5
C	6.0	1.5
D	9.5	7.0

(i) State which water sample is the hardest and give a reason for your answer. [1]

.....

.....

(ii) State which water sample contains both permanent and temporary hard water and give a reason for your answer. [2]

.....

.....

.....

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(b) A different group of students carry out a similar investigation with the same water samples, **A**, **B**, **C** and **D**.

Their results are as follows.

Water sample	Volume of soap solution needed (cm^3)	
	Before boiling	After boiling
A	6.0	6.0
B	1.0	1.0
C	3.5	1.0
D	5.5	3.0

Compare the results obtained by the two groups, commenting on the similarity and suggesting a reason for the difference. [2]

.....

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.....

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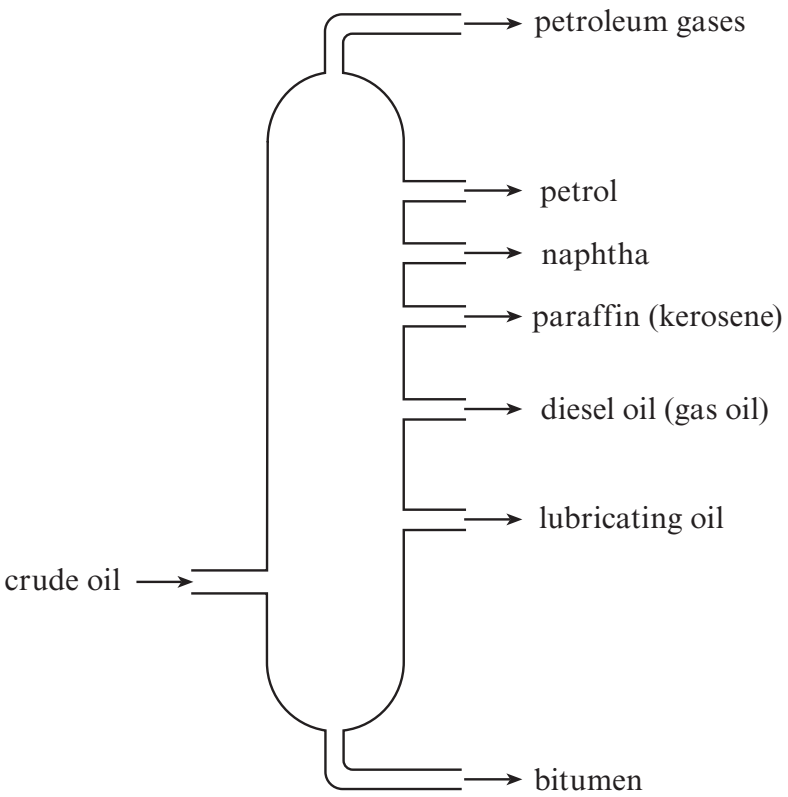
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11. The diagram below represents the separation of crude oil into useful fractions in industry.



Write an account of this industrial process. [6 QWC]

Include in your answer

- the name of the separation method,
- what crude oil is,
- a description of how crude oil is separated.

.....

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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^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

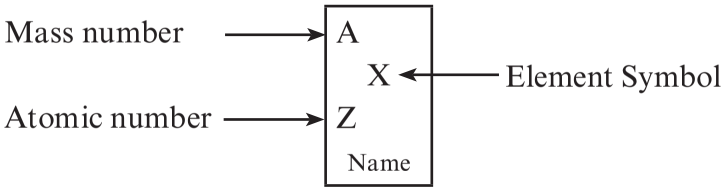
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PERIODIC TABLE OF ELEMENTS

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 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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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

SUMMER 2013

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2013 examination in GCSE SCIENCE - CHEMISTRY. 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.

	Page
Unit C1	1
Unit C2	17
Unit C3	34

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)	(i)		1	proton		p	
			(ii)		1	lithium	Li		
		(b)			2	nitrogen and hydrogen – both needed (1) covalent (1)		N and H simple	 giant

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			2	graphite ——— giant covalent potassium ——— metallic sodium chloride ——— giant ionic three correct answers (2) one correct answer (1)			
		(b)			1	graphite		giant covalent	
		(c)			1	carbon dioxide, water, etc	CO_2, H_2O, etc		

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)			2	negative / –1 (1) 1 (1)			
		(b)			1	19 9 – both needed			
		(c)			2	17 (1) 20 (1)			
		(d)			1	2,8,1			
		(e)			1	2,8,8,2			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)			1	thermochromic pigment			
		(b)			3	heat both / place in hot water (1) thermoplastic softens or melts (1) the shape memory polymer returns to its original shape / form (1)	stays the same	change temperature	

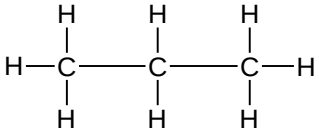
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)			1	C	98 and 890		
		(b)			1	to prevent sodium reacting with air/oxygen/water (vapour)	prevent from oxidising / corroding	because it reacts with air/oxygen/water (vapour)	
		(c)	(i)		1	yellow yellow/orange	orange		
			(ii)		2	sodium + oxygen (1) sodium oxide (1)	$Na + O_2$ (1) Na_2O (1) – ignore balancing		
			(iii)		1	$2Na + Cl_2 \rightarrow 2NaCl$			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)			1	C_4H_{10}			
		(b)			2	propane (1)  (1)			
		(c)			1	C_3H_6			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7		(a)	(i)		2	collection of gas (e.g. in a gas syringe or gas jar) (1) experiment repeated with different particle size of zinc (1)	mass method disappearing zinc		
			(ii)		2	same mass (or amount) of zinc / same volume (or amount) of acid / same concentration of acid / same temperature or room temperature – any two for (1) each		repeat readings same apparatus	
			(iii)		1	the fastest is the experiment that gives the volume of gas in the least time	fastest reaction is the one giving off most bubbles in a given time		
		(b)	(i)		1	less time / time decrease		faster reaction	
			(ii)		1	volume of gas remains the same			

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	1	(a)			1	solubility of sodium carbonate increases (until 40-43^{o}C) and then decreases			
		(b)			3	plotting 7 correct points (2) plotting 6 correct points (1) suitable line – must be curve (1)			
		(c)			1	sodium carbonate sodium bromate sodium chloride – correct order			
		(d)			3	recognise that sodium chloride is soluble and silver chloride is not (1) add (enough/excess) water (to remove/dissolve all the sodium chloride) (1) filter (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	2	(a)	(i)		2	436 + 242 (1) = 678 (1) – correct answer only (cao) (2)			
			(ii)		2	2 × 431 (1) = 862 (1) – cao (2)			
		(b)			1	exothermic since energy given out (as bonds made) > energy needed (to break the bonds) energy given by reaction is negative / –184 credit 'endothermic' with correct reason if calculation error followed through (ft)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
10	3	(a)	(i)		1	A – requires the most soap – both needed			
			(ii)		2	D (1) some hardness removed by boiling but not all / temporary hardness removed by boiling but permanent hardness remained (1) Alternative answer accepted for all candidates due to very common mis-interpretation of question on Welsh-medium papers A contains permanent hardness and C contains temporary hardness (1) A loses none of its hardness through boiling and C loses all of its hardness (through boiling) (1)			
		(b)			2	same trend / A still the hardest / B still the softest / D still contains both permanent and temporary hard water (1) different amount of water used / different concentration of soap solution / shaken for a different amount of time / different amount of lather formed (1)			

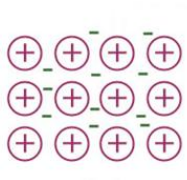
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Question Number			
FT	HT	Mark	Guidance
11	4	6	Indicative content: This method of separation is called fractional distillation. Crude oil is a mixture of hydrocarbons. The crude oil is heated and vaporised before entering the column. Smaller/lower boiling hydrocarbons will rise in the column and condense higher up the column. Hydrocarbons with similar boiling points condense at the same level in the column. (Boiling point depends on the size of the molecule – larger molecules have higher boiling points.) 5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.

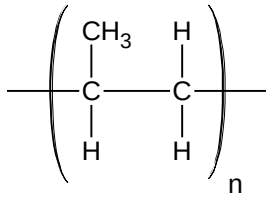
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)			1	2,8,1			
		(b)			2	 positive ions fixed positions electrons mobile / sea – all four points (2) – two/three points (1)			
		(c)	(i)		1	floats moves fizzes / bubbles goes into a round shape / melts – any two		vigorous reaction dissolves	
			(ii)		1	sodium hydroxide and hydrogen – both needed	$NaOH + H_2$	H	
		(d)			1	potassium burns / lilac flame		potassium moves faster	yellow / orange / red / green flame
		(e)			2	atoms get bigger / greater distance between the (positive) nucleus and the (outer) electron (1) outer electron more weakly held (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)	(i)		1	polytetrafluoroethene / PTFE		Teflon	
			(ii)	I	1				
				II	1	addition			additional
		(b)			2	both have long or large molecules / long chains of carbon atoms / polymer chains (1) (only) thermosets have crosslinking / strong bonds between chains (1)			reference to layers

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			1	lithium / Li^+	Li Ca Sr		
		(b)	(i)		1	cream precipitate	off white ppt		pale yellow ppt
			(ii)		2	$Ag^+ + Br^-$ (1) AgBr (1)			
		(c)	(i)		1	chlorine / fluorine	Cl_2 / F_2	Cl / F	
			(ii)		1	displacement	redox		

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)			1	any one from: some copper had not reacted reaction had not been completed heated to constant mass			
		(b)			3	mass of copper = 37.7 -25.0 = 12.7 mass of oxygen = 40.9 – 37.7 = 3.2 (1) n(Cu) = 12.7/63.5 n(O) = 3.2/16 (1) ratio 0.2/0.2 : 0.2/0.2 ie 1:1 formula CuO (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	(a)			3	*two discrete diagrams needed:* - *diagram 1 showing transfer of electrons* - *diagram 2 showing ions* diagram 1 two lithium atoms losing 1 electron each (1) one sulfur atom gaining 2 electrons (1) diagram 2 2 × Li^+ and S^{2-} formed (1)			
		(b)			2	magnesium and/or oxide ions have a greater charge than sodium and/or chloride ions (1) this gives a greater attraction between the ions / stronger ionic bonds / more energy is needed to break bonds (1)			
		(c)			2	shared electron pair between H atoms and adjacent O atoms and between the two O atoms (1) 8 electrons in outer shell of both O atoms (1)			

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Question Number			
FT	HT	Mark	Guidance
	10	6	Indicative content: For a chemical reaction to take place the reactant particles must collide. Increasing the concentration increases the number of particles in the same volume which gives a greater chance of the particles colliding, giving an increase in the rate of the reaction. As the temperature increases the reactant particles are moving faster, increasing the chance of a collision. At higher temperature the particles also have higher energy which increases the possibility of having sufficient energy during collision to overcome the activation energy and become a 'successful collision'. Therefore increasing the temperature also increases the speed of a reaction. 5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

New GCSE

4472/01

ADDITIONAL SCIENCE
FOUNDATION TIER
CHEMISTRY 2

A.M. MONDAY, 14 January 2013

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**6**	
2	**5**	
3	**4**	
4	**5**	
5	**8**	
6	**4**	
7	**4**	
8	**3**	
9	**7**	
10	**8**	
11	**6**	
Total	**60**	

4472
010001

ADDITIONAL MATERIALS

In addition to this paper you will need 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.

Assessment will take into account the quality of written communication (QWC) in your answer to question **11**.

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.

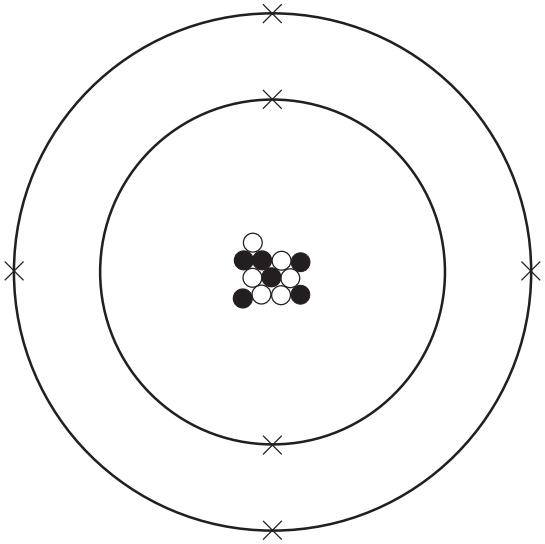
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Answer **all** *questions.*

1. *(a)* The diagram below shows an atom of carbon.



electron	**neutron**	**proton**

(i) Choose from the box above the names of the two types of particle found in the nucleus of a carbon atom. [1]

..... and .....

(ii) Using the information in the diagram state why an atom of carbon is neutral. [1]

.....

(b) (i) Calculate the relative molecular mass (M_r) of methane, CH_4. [2]

$A_r(H) = 1$ $A_r(C) = 12$

$M_r(CH_4)$ = ...

(ii) Calculate the percentage (%) by mass of carbon in a molecule of methane. [2]

Percentage by mass = ... %

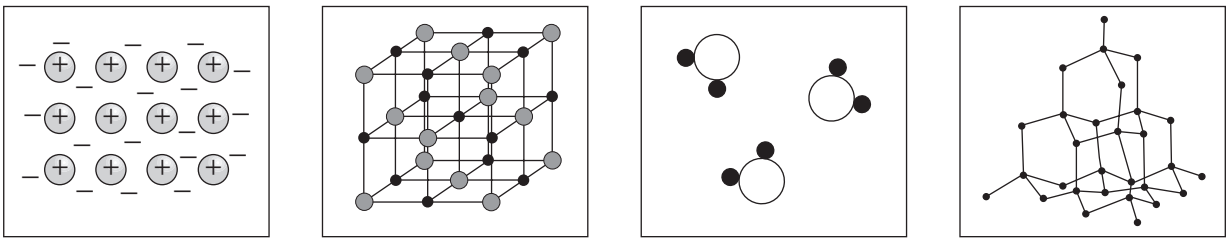
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2. *(a)* The following diagrams show the structures of some substances.



A **B** **C** **D**

Give the **letter** of the substance which

(i) conducts electricity as a solid, ... [1]

(ii) has the lowest boiling point, ... [1]

(iii) contains ionic bonds. ..... [1]

(b) The box below contains some observations describing the results of different chemical tests.

cream precipitate	**yellow flame**	**yellow precipitate**
lilac flame	**white precipitate**	**white flame**

The chemical name for table salt is sodium chloride.

Choose from the box the observation made when

(i) a flame test is carried out on a sample of solid table salt, [1]

.....

(ii) silver nitrate solution is added to a solution of table salt. [1]

.....

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3. Smart materials are becoming widely used in everyday life.

The diagrams below show uses of two different types of smart material.

Beach sandals



With UV light



No UV light

Mug



Empty



With hot water

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

(a) Beach sandals [2]

Type of smart material .....

Unusual property .....

.....

(b) Mug [2]

Type of smart material .....

Unusual property .....

.....

4

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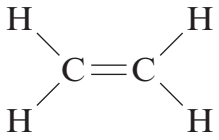
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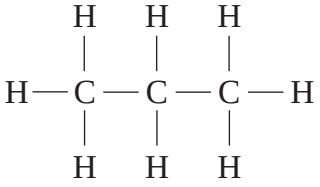
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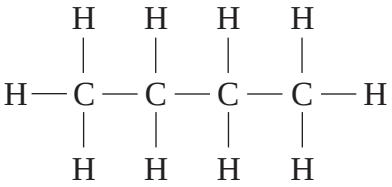
4. *(a)* The diagrams below show the structural formulae of some hydrocarbons.



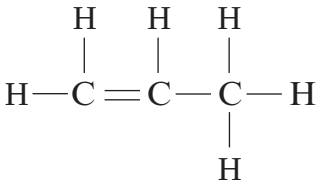
A



B



C



D

(i) Give the **letters** of the two hydrocarbons which are alkenes. [1]

..... and .....

(ii) Give the **letter** of the hydrocarbon which is represented by the molecular formula C_3H_6. [1]

.....

(b) An alkane contains two carbon atoms and six hydrogen atoms.
Draw its **structural** formula. [1]

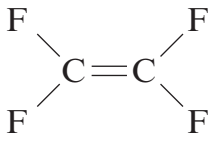
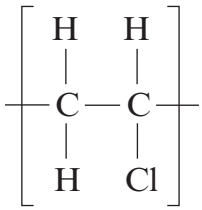
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(c) The table below shows some information about monomers and the polymers that can be made from them.

Complete the table. [2]

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

4472 010007

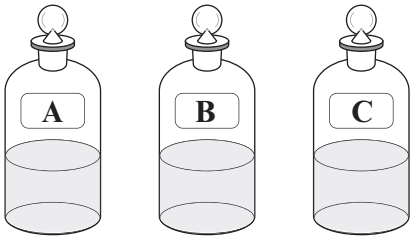
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5. *(a)* A water company has provided your class with three samples of water from different parts of Wales. The water company is asking for the hardness of the water samples to be investigated.



Water samples

Describe an experiment you would carry out to show which sample is the hardest.

You are provided with soap solution and basic laboratory equipment.

Include in your answer

- the ways in which you will make the experiment a fair test,
- how you will know which sample is the hardest. [5]

.....

.....

.....

.....

.....

.....

.....

.....

(b) The box below contains some statements about hard water.

forms limescale when heated	**reduces heart disease**
strengthens bones and teeth	**forms a scum with soap**
wastes soap	**tastes better**

Choose **one** statement which

(i) gives a health benefit, ... [1]

(ii) describes why hard water causes problems in boilers and water pipes,

..... [1]

(iii) is an opinion and not a scientific fact. ..... [1]

8

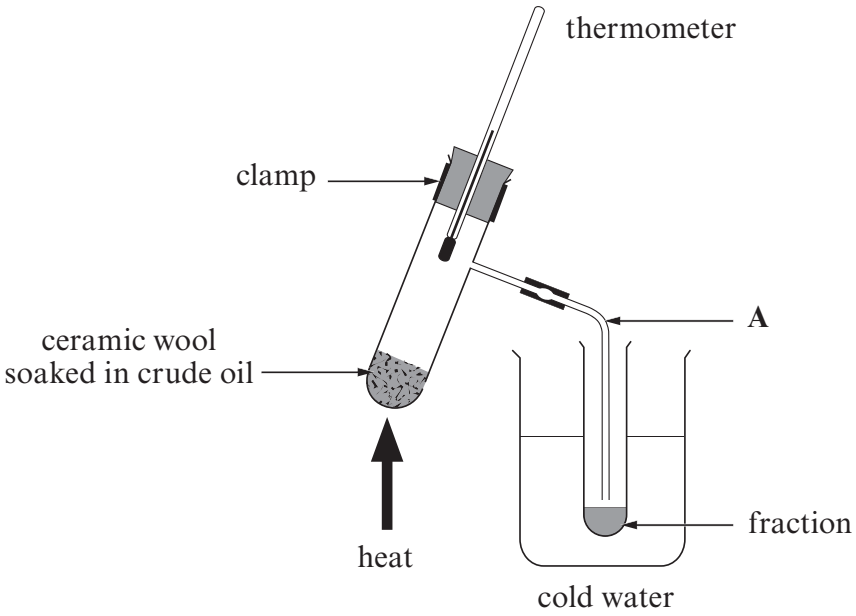
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6. The diagram below shows the laboratory apparatus that can be used to separate crude oil into more useful chemicals.

Crude oil is gently heated and the first fraction is collected over the range from room temperature to 100 °C. When the temperature reaches 100 °C the collection tube is changed.
Three more fractions are collected over the temperature ranges 100-150 °C, 150-200 °C and 200-250 °C.



(a) Name the **physical** property that allows the different fractions to be separated.

..... [1]

(b) The fractions are collected as liquids in test tubes. Name the physical process taking place at **A**. [1]

.....

(c) State why the thermometer bulb is positioned near the opening of the side arm. [1]

.....

(d) Give the name of the industrial process used to separate crude oil into fractions. [1]

.....

4

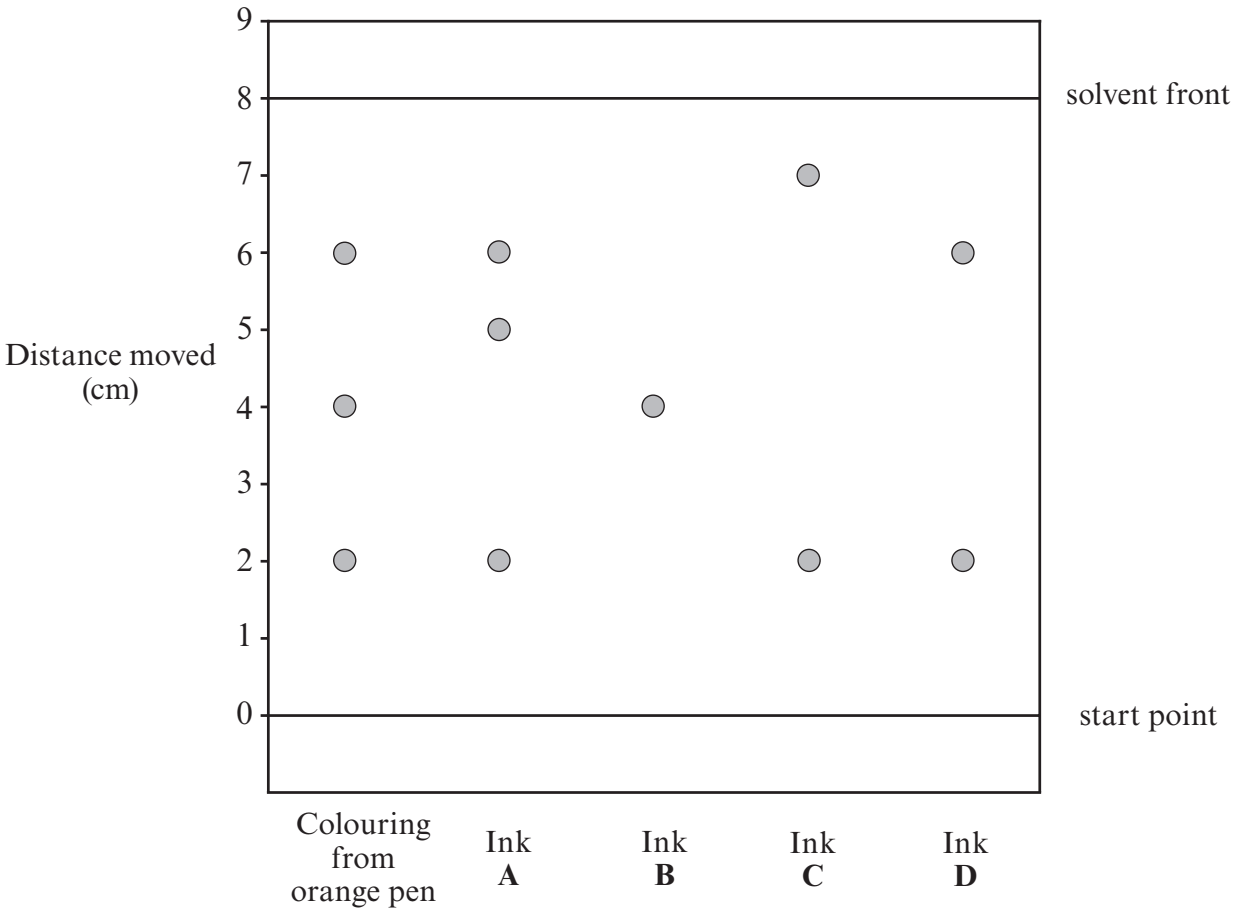
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7. The chromatogram of an orange felt-tipped pen was compared with various orange inks **A**, **B**, **C** and **D**. The results are shown below.



(a) Give the **letters** of the two inks that are mixed to make the orange felt-tipped pen. [1]

..... and .....

(b) Give the **letter** of the ink which contains the most soluble substance. [1]

.....

(c) The R_f value of a substance can be used to identify that substance.
The R_f value is given by the formula below.

$$R_f = \frac{\text{distance moved by the substance}}{\text{distance moved by the solvent front}}$$

Calculate the R_f value of the substance in ink **B**. [2]

R_f = ...

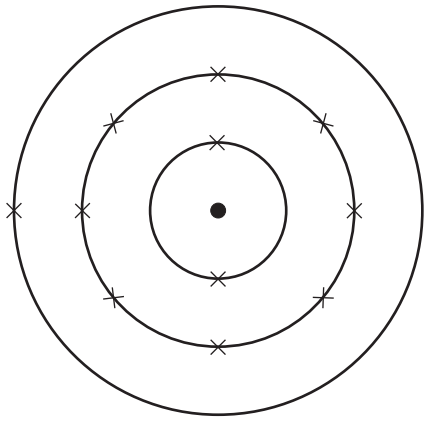
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8. *(a)* The diagram below shows the electronic structure of an element in the Periodic Table.



Using × to represent an electron, draw a similar diagram to show the electronic structure of the element which

(i) lies directly **below** this one in the Periodic Table, [1]

(ii) lies directly to the **right** of this one in the Periodic Table. [1]

(b) Carbon has two different types of atom which are represented by $^{12}_{6}C$ and $^{13}_{6}C$.

Give the term used for different types of atom of the same element. [1]

.....

3

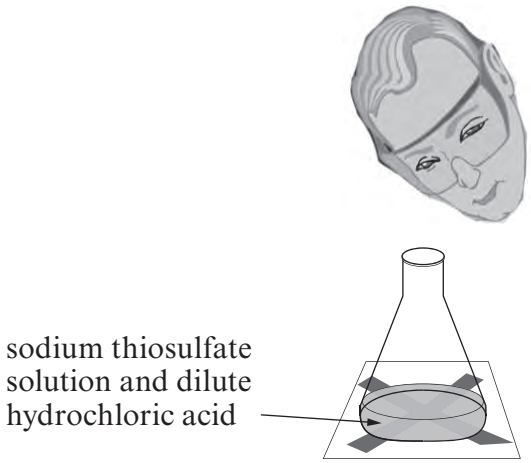
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9. Sodium thiosulfate solution reacts with dilute hydrochloric acid forming a yellow precipitate. This reaction can be investigated using the 'disappearing cross' experiment. The yellow precipitate formed during the reaction causes a cross marked on a piece of white paper to disappear (see diagram below). The time taken for this to happen can be measured.



10 cm^3 of dilute hydrochloric acid was added separately to 50 cm^3 sodium thiosulfate solutions of five different concentrations. The results are shown below.

Concentration of sodium thiosulfate solution (g/dm^3)	Time for cross to disappear (s)			
	1	2	3	Mean
8	37	38	39	38
16	20	17	17	18
24	10	8	12	10
32	10	7	7	8
40	3	7	8	6

(a) State which concentration gave the most repeatable set of reaction times. Give the reason for your choice. [2]

Concentration ..... g/dm^3

Reason .....

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(b) Apart from taking more readings, suggest **one** way to improve the repeatability of the readings. [1]

.....

(c) Apart from the volumes of both reactants and the concentration of the acid, name the **most** important factor which must be kept the same during each experiment. [1]

.....

(d) State and explain, using particle theory, your conclusion from the investigation. [3]

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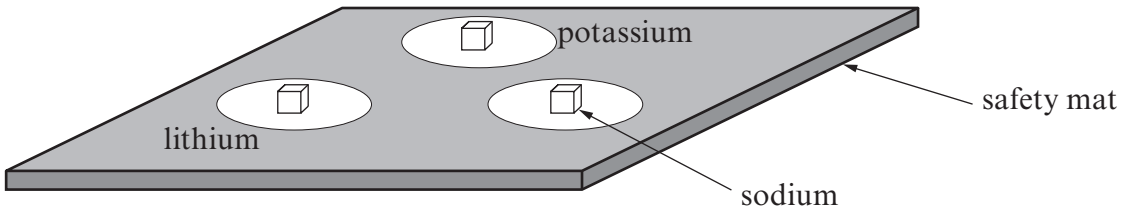
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10. *(a)* Freshly cut pieces of lithium, potassium and sodium are left exposed to the atmosphere.



(i) Describe how the appearance of all the metals will change. [1]

.....

(ii) Describe how the reactions will differ. [1]

.....

(b) **A**, **B** and **C** represent the Group 7 elements bromine, chlorine and iodine, but not necessarily in that order. The table below shows the results observed when **A**, **B** and **C** react with hot iron wool.

Group 7 element	Reaction with hot iron wool
A	After a few seconds the iron wool glows. An orange solid is formed.
B	After a few minutes of constant heating the iron wool glows a little. A red-brown solid is formed.
C	The iron wool burns instantly glowing brightly. An orange solid is formed.

(i) Use the above results to identify the Group 7 elements **A**, **B** and **C** and give a reason for your choice. [3]

A ..... **B** ..... **C** .....

Reason .....

.....

(ii) Chlorine reacts with iron forming iron(III) chloride.

Write a balanced **symbol** equation for the reaction between chlorine and iron. [3]

..... + ... ⟶ .....

8

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11. Describe the treatment of the public water supply.

Include in your answer the three main stages in the purification process and the reason why each one is required. [6 QWC]

.....

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6

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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^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

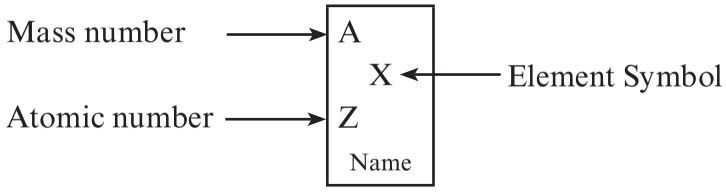
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PERIODIC TABLE OF ELEMENTS

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 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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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY (NEW)

JANUARY 2013

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the year examination in GCSE SUBJECT. 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 (NEW)	1
C2 (NEW)	17

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)	(i)		1	neutron and proton ***both needed, either order***			
			(ii)		1	number of protons equals the number of electrons / 6 protons and 6 electrons present		number of positives = number of negatives	reference to neutrons
		(b)	(i)		2	12 + 4 (1) = 16 (1) ***If no working shown, award 2 marks for correct answer only (cao)*** ***Consequential marking – follow through (ft)***			
			(ii)		2	12/16 × 100 (1) = 75 (1) ***If no working show , award 2 marks for cao*** ***Consequential marking – ft***			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)	(i)		1	**A**			
			(ii)		1	**C**			
			(iii)		1	**B**			
		(b)	(i)		1	yellow **flame**	orange flame	yellow	
			(ii)		1	white **precipitate**		white	

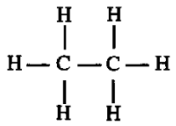
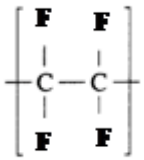
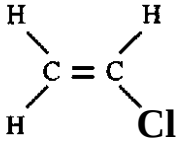
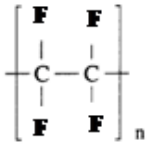
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)			2	photochromic (1) changes colour with changes in light (intensity) / in light (and dark) / u.v. (light) (1)		appearance changes	
		(b)			2	thermochromic (1) changes colour with changes in temperature / when hot (and cold) / when exposed to heat (1)	changes colour at a certain temperature	reference to pattern appearing	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)	(i)		1	**A** and **D** ***both needed, either order***		breathing	
			(ii)		1	**D**			
		(b)			1				
		(c)			2	 (1)  (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)			5	**Method 1** • equal volumes of water sample/ actual volume given *e.g. 20cm^3* • add equal volume of soap solution/ actual volume *e.g. 5cm^3* • shake same number of times / shake equally • measure height of lather – *could be implied in final point* • hardest water forms least froth (accept converse) (1) mark per point **Method 2** • equal volumes of water sample/ actual volume given *e.g. 20cm^3* add 1 cm^{3}of soap solution at a time • shake the same number of times (after adding each 1 cm^3 soap sol.) • record volume of soap sol. to obtain permanent lather – *could be implied in final point* • hardest water needs most soap solution (accept converse) (1) mark per point			
		(b)	(i)		1	reduces heart disease / strengthens bones and teeth			tastes better
			(ii)		1	forms limescale (when heated)			
			(iii)		1	tastes better			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)			1	boiling point	size of chain / molecular mass/ density	boiling	melting point
		(b)			1	condensation / condensing / condenses			
		(c)			1	takes the temperature of the fraction / takes the temperature of the vapour			
		(d)			1	fractional distillation		distillation / fractionation	fractionating distillation

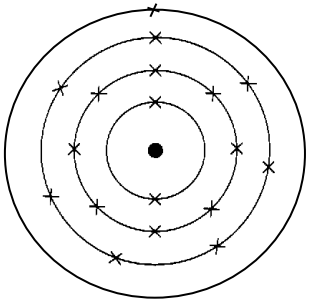
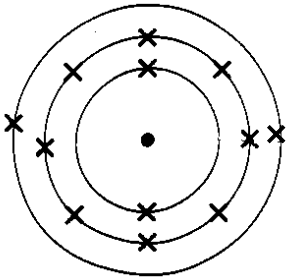
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7		(a)			1	**B** and **D** ***Both needed, either order***			
		(b)			1	**C**			
		(c)			2	4/8 (1) = 0.5 (1) ***If no working shown, award 2 marks cao*** ***Consequential marking only if one of 4 or 8 are correct – ft***			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	1	(a)	(i)		1		2.8.8.1		
			(ii)		1		2.8.2 correct diagram of calcium structure / 2.8.8.2 [element to right of (a)(i) above rather than to right of original element drawn]		
		(b)			1	isotope			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	2	(a)			2	Concentration: 8 (g/dm^3) (1) Reason: experiment times close together / reaction times close together / little variation between times (1)	only 2 seconds variation between reaction times		
		(b)			1	use a light sensor / use a datalogger / same person recording the reaction times / same person adds the acid and starts the stopwatch / same person watches X disappear		use a computer	
		(c)			1	temperature		heat	catalyst
		(d)			3	• the **higher the concentration**, the **faster the rate** the higher the concentration the shorter the reaction time (1) • the higher the concentration the **more particles** are present (1) • the more particles the **greater the chance of collision** the more particles present more collisions per second the more particles present more collisions in a given time (1)		more collisions	reference to increased energy

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
10	3	(a)	(i)		1	tarnish / lose their shiny appearance	go dull / less shiny	grey / forms an oxide / corrodes	reference to rust
			(ii)		1	they react at different speeds / potassium reacts the quickest / lithium reacts the slowest / the speed at which the change occurs	reactivity increases down the group		
		(b)	(i)		3	**A** = bromine / Br_2 / Br **B** = iodine / I_2 / I **C** = chlorine / Cl_2 / Cl all correct (2) any one correct (1) Reason: reactivity decreases down the group (1)	chlorine most reactive, iodine least		
			(ii)		3	Reactants: Fe Cl_2 (1) Product: $FeCl_3$ (1) Balancing: 2:3:2 (1) ***Reactants and products must be correct before balancing mark can be awarded***	multiples of 2 and 3 e.g. 4:6:4		

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Question Number			
FT	HT	Mark	
11	4	6	**Indicative content:** Reference to sedimentation, filtration and chlorination together with the reason for each process e.g. sedimentation / settling tank: removal of large insoluble particles filtration / filter bed: removal of small insoluble particles removal of bacteria / germs / micro-organisms chlorination: kills remaining bacteria / germs / micro-organisms **5 – 6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3 – 4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1 – 2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)			3	All points plotted correctly ±½ square (2) All but one point plotted correctly (1) Suitable line – judgement by eye (1) ***Consequential marking – ft***			
		(b)			1	67 ± 1 ***Consequential marking – ft***			
		(c)			2	60 °C = 40 24 °C = 22 both needed for (1) 18 (1) ***Consequential marking – ft***			

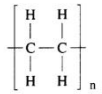
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)			3	**Two** discrete diagrams needed: - diagram 1 showing transfer of electrons - diagram 2 showing ions Diagram 1 Calcium atom loses 2 electrons (1) Two fluorine atoms gain 1 electron each (1) Diagram 2 Ca^{2+} and 2 × F^- ions formed (1) *octet of electrons around F^- **not** needed* *discrete pair of ions needed for this mark*			
		(b)			2	**three** shared pairs of electrons (P-F's) (1) **octets of electrons** around P and all three Fs (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)	(i)		3	**A** bromine / Br_2 (1) **B** ethane / C_2H_6 / structural formula (1) **C** polyethene / polythene (1)		Br 	
			(ii)		1	addition			additional
			(iii)	I	1	Reason: **weak bonds** between chains / molecules / chains not linked together ***Accept labelled diagram***	forces = bonds	layers	
				II	1	thermoplastic	thermosoftening		
		(b)			3	**mass/A_r** 0.96/12 and 0.2/1 (1) = 0.08 = 0.2 **ratio** 1 2.5 (1) **formula** C_2H_5 (1) ***Consequential marking – ft***	C_4H_{10}		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)	(i)		2	Any **two** for (1) each • All the water samples are hard / become softer • **X** is not softened by boiling / **X** is permanently hard • **Y** and **Z** are softened by boiling / **Y and Z are** temporary hard			
			(ii)		2	Any **two** for (1) each • Ca^{2+} (and Mg^{2+}) present / **X** has the highest Ca^{2+} / Mg^{2+} content • **X** has the highest sulfate (ion) content • **Y** and **Z** contain high hydrogencarbonate (ion) content		reference to only Mg^{2+} **X** is the hardest	
		(b)	(i)		2	**Ca^{2+}/Mg^{2+}** (in hard water) ions (1) **exchanged** with **Na^{+}** ions(in resin) / **swapped** with **Na^{+}** ions (in resin) (1)	replace	reference to 'displace'	'react with'
			(ii)		1	Any **one** for (1) • resin needs regular replenishing / regeneration (with Na^{+} ions) • disposal of waste water (after regeneration) / Na^{+} ions pollute water • iron fouling • bacteria contamination • chlorine contamination	Na^{+} ions could be bad for heart	cost of process cost of sodium solution for regeneration	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9				3	$M_r(NaHCO_3) = 84$ $M_r(Na_2CO_3) = 106$ } both needed (1) **2**(84) ⟶ **1**(106) 2:1 ratio (1) 168 106 84 53 8.4 ⟶ **5.3** (1) **cao (3)**	Moles approach $M_r(NaHCO_3)= 84$ $Mr(Na_2CO_3) = 106$ } (1) 8.4/84 = 0.1 **2** ⟶ **1** 2:1 ratio (1) 0.1 **0.05** 0.05 × 106 = **5.3** (1)		

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Question Number			
FT	HT	Mark	
	10	6	**Indicative content:** For diamond **and** graphite – reference made to bonding, structure and properties related to uses Diamond Bonding: uniform covalent / strong covalent bonds throughout / each carbon atom joined to four others Structure: giant molecular / covalent Properties and uses: hard – drill bits transparent /sparkly – jewellery Graphite Bonding: strong bonds within layers and weak bonds between layers / carbon atoms / each joined to three others Structure: giant molecular / covalent in layers Properties and uses: soft – pencils electrical conductor – electrodes **5 – 6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3 – 4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1 – 2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

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New GCSE

4472/01

ADDITIONAL SCIENCE
FOUNDATION TIER
CHEMISTRY 2

A.M. MONDAY, 21 May 2012

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**4**	
2	**9**	
3	**6**	
4	**10**	
5	**7**	
6	**6**	
7	**6**	
8	**6**	
9	**6**	
Total	**60**	

4472 010001

ADDITIONAL MATERIALS

In addition to this paper you will need 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.

Assessment will take into account the quality of written communication (QWC) used in your answer to question 7.

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.

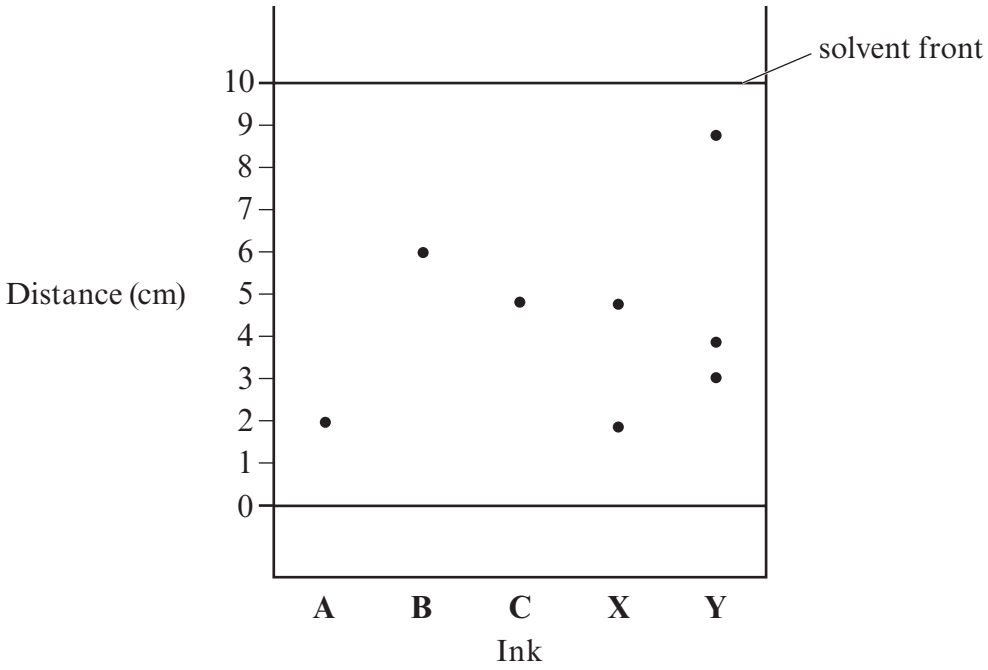
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Answer **all** *questions.*

1. James and Lucy were investigating colours in ink. They were given three pure substances, **A**, **B** and **C**, and two mixtures **X** and **Y**.

They carried out a paper chromatography experiment.
The chromatogram produced is shown in the diagram below.



(a) (i) Which substances were found in mixture **X**? [1]

.....

(ii) What did the experiment tell them about mixture **Y**? [1]

.....

.....

(b) The R_f value of a substance can be used to identify that substance.
The R_f value is given by the formula

$$R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent front}}$$

Calculate the R_f value for **B**. [2]

.....

.....

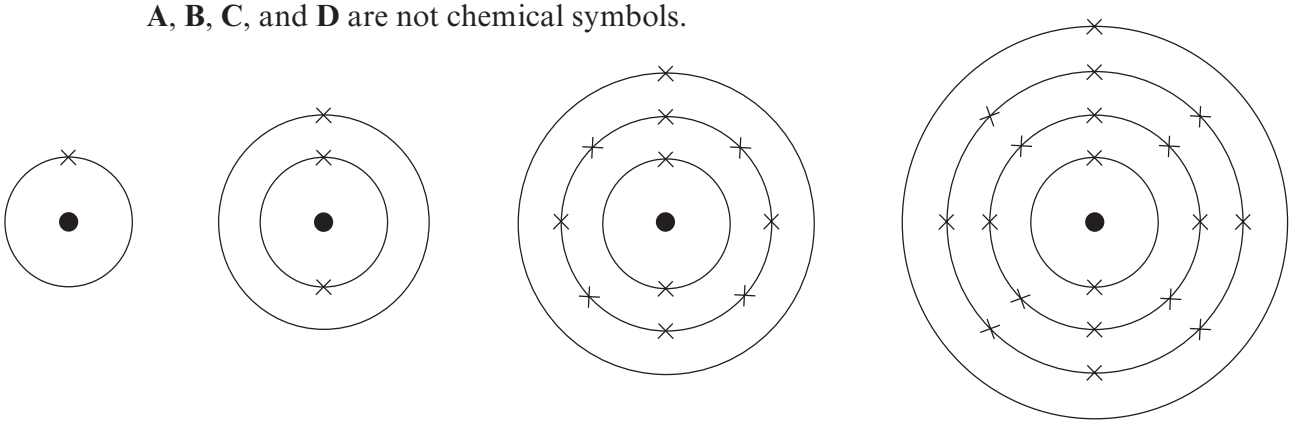
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2. *(a)* The following diagrams represent four atoms, **A**, **B**, **C** and **D**.

A, **B**, **C**, and **D** are not chemical symbols.



A **B** **C** **D**

(i) Give the electronic structure of **C**. ..... [1]

(ii) Give the atomic number of **B**. ..... [1]

(iii) State which period of the Periodic Table element **D** belongs to. [1]

.....

(iv) Which of the above diagrams represents an atom of potassium? [1]

.....

(v) Name the particle found in the nucleus of **all** atoms. [1]

.....

(b) (i) Calculate the relative molecular mass (M_r) of calcium carbonate, $CaCO_3$.

$A_r(Ca) = 40$ $A_r(C) = 12$ $A_r(O) = 16$ [2]

.....

.....

(ii) Calculate the percentage by mass of calcium in calcium carbonate. [2]

.....

.....

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3. *(a)* The table below shows some properties of five substances.

Substance	Melting point (°C)	Electrical conductivity	Density (g/cm^3)	Structure
carbon dioxide	–78	poor	0.002	simple covalent
copper	1083	good	8.92	metallic
graphite	3730	good	2.25	giant covalent
nitrogen	–210	poor	0.00013	
sodium chloride	801	good when molten or dissolved in water	2.17	giant ionic

(i) Name the substance with the **lowest** melting point in the table.

..... [1]

(ii) Complete the table by giving the structure of nitrogen. [1]

(iii) Name a substance from the table which is a non-metallic element. [1]

.....

(b) Give **two** reasons why copper is used to make saucepan bases. [2]

1. .....

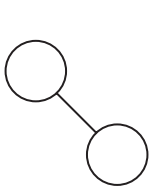
2. .....

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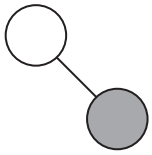
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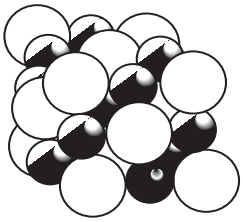
(c) Give the letter of the diagram below that represents the structure of sodium chloride. [1]



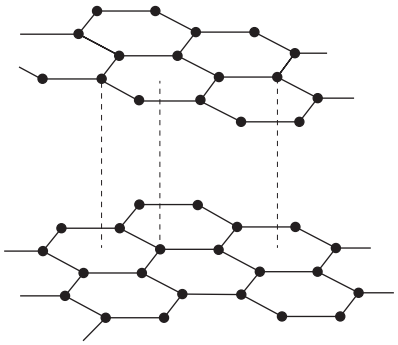
A



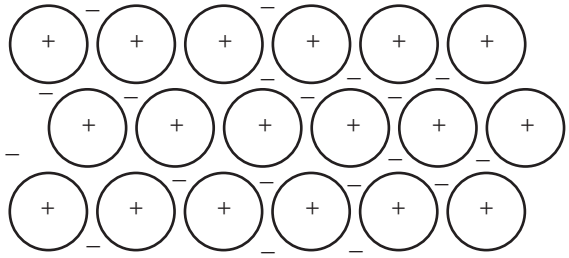
B



C



D



E

..... represents the structure of sodium chloride.

4472 010005

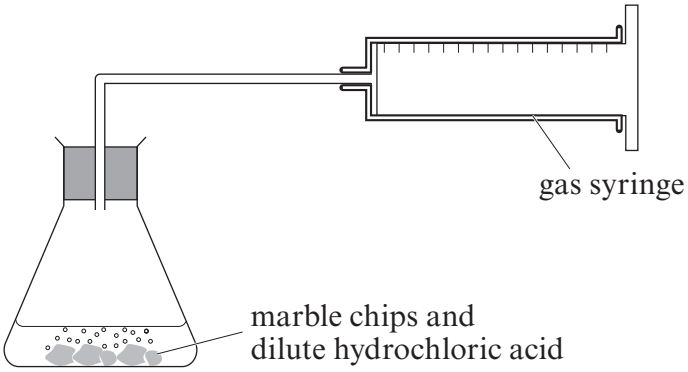
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4. Marble chips are made of calcium carbonate and react with dilute hydrochloric acid to give off carbon dioxide.

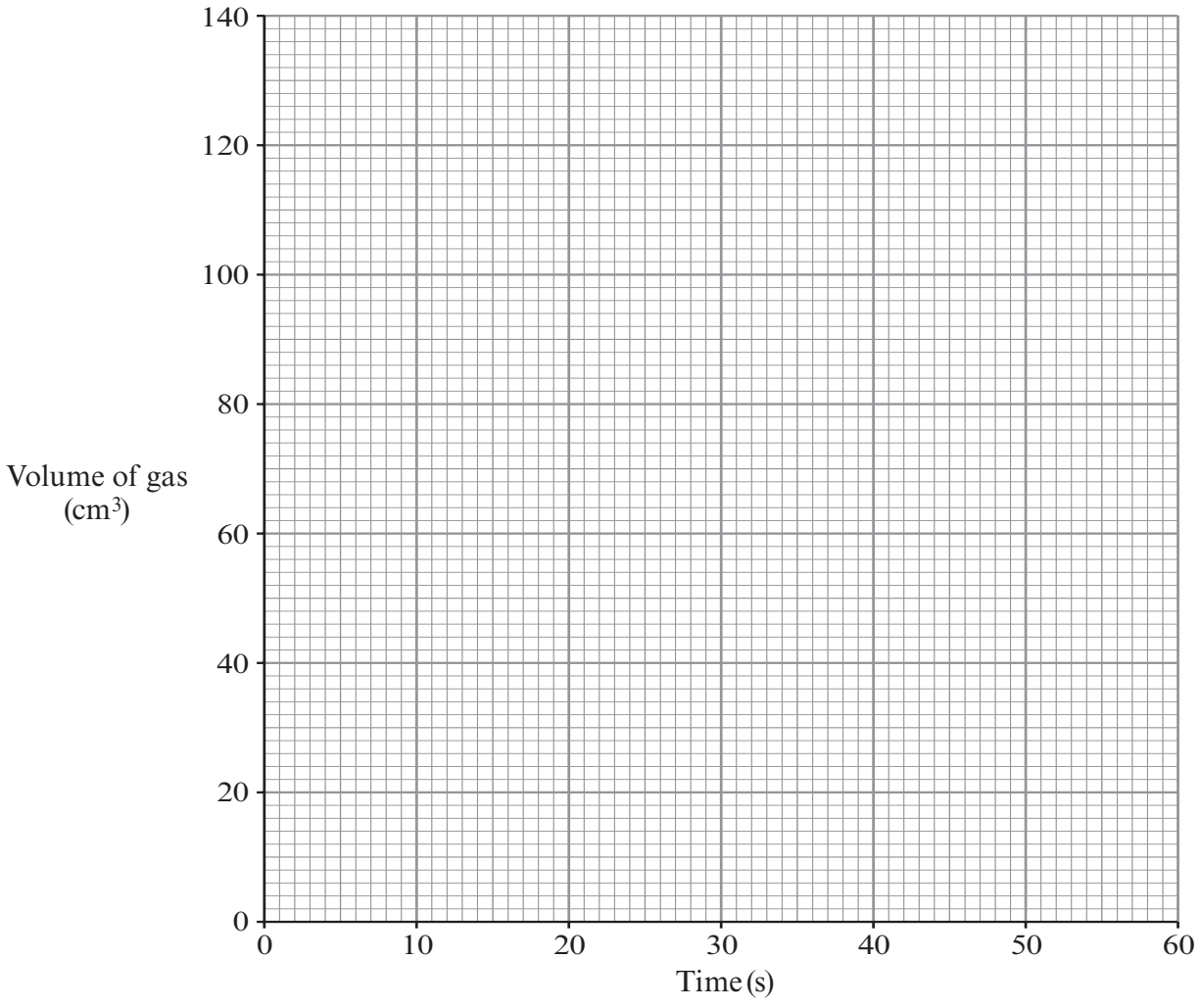
Excess marble chips and 100 cm^3 of hydrochloric acid were placed in the flask in the apparatus shown below.



The volume of gas given off was measured every 10 seconds and recorded in the table below.

Time (s)	0	10	20	30	40	50	60
Volume of gas (cm^3)	0	52	80	92	114	120	120

(a) (i) Plot the results from the table on the grid below and draw a smooth curve of best fit. [3]



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(ii) Find the time taken for the reaction to finish and state how you reached your answer. [2]

.....

.....

(iii) Complete the following statement by placing a tick (✓) in the box next to the correct answer.
Using the **graph**, give the reason for your choice.

The reaction is proceeding at its fastest rate from [2]

0-10 s	☐
10-20 s	☐
20-30 s	☐
30-40 s	☐
40-50 s	☐
50-60 s	☐

Reason .....

.....

(b) State **two** ways in which this reaction could be made to go faster. [2]

1. .....

.....

2. .....

.....

(c) If the acid had been in *excess*, instead of the marble chips, state **one** different observation that would have been made at the end of the experiment. [1]

.....

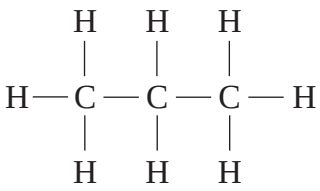
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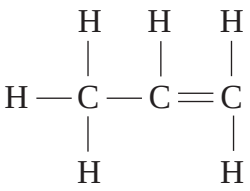
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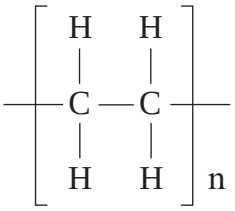
5. The following diagrams show the structural formulae of four organic compounds, **A**, **B**, **C** and **D**.



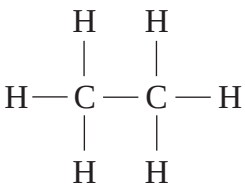
A



B



C



D

(a) (i) Give the **molecular** formula of **B**. ..... [1]

(ii) State which of the above compounds is an alkene. [1]

.....

(iii) State which of the above is a polymer. ..... [1]

(b) Draw the **structural** formula for butane, C_4H_{10}. [1]

(c) You have been given two plastics (polymers) – PVC and melamine. PVC is a thermoplastic and melamine is a thermoset. You are asked to carry out a simple test on both plastics in order to identify them. State what you would do and give the expected result for both. [3]

.....

.....

.....

.....

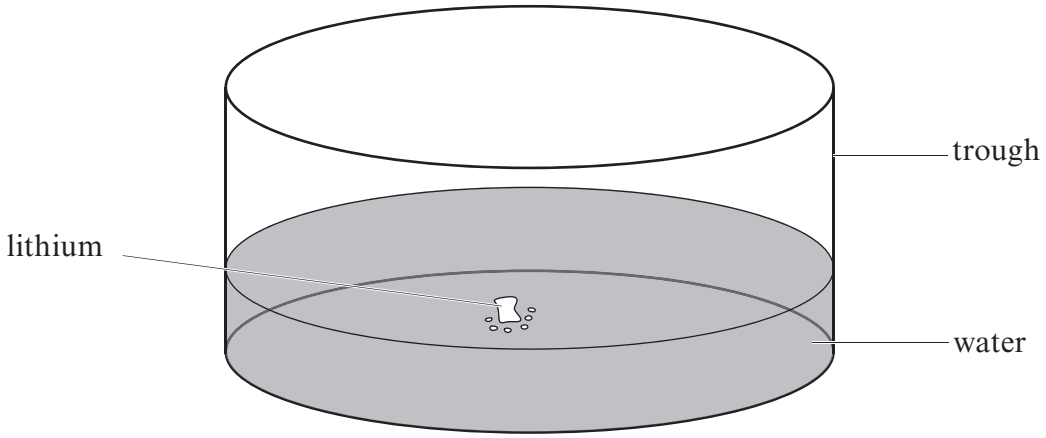
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6. This question is about the reactions of Group 1 metals.

The following diagram shows how lithium reacts with water.



(a) Apart from wearing goggles, give **one** safety precaution taken when carrying out this experiment. [1]

.....

(b) Complete the following **word** equation for the reaction that takes place. [2]

lithium + water ⟶ ..... + ...

(c) Name the **least** reactive metal in Group 1. [1]

.....

(d) Describe what differences you would have observed if potassium had been added to the water in the trough instead of lithium. [2]

.....

.....

.....

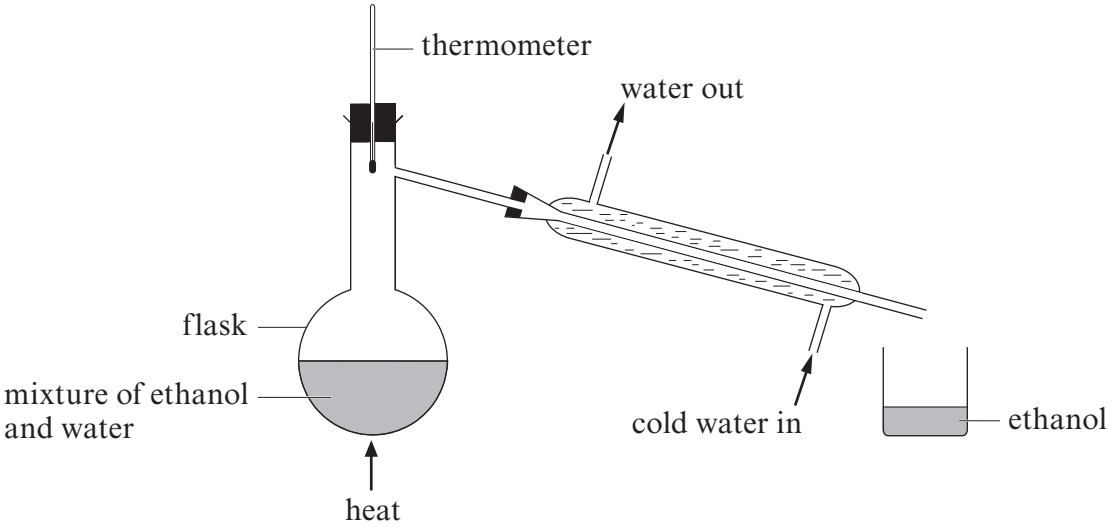
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Turn over.

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7. A mixture of ethanol and water can be separated by distillation.

A diagram of the apparatus which can be used is shown below.



Describe what happens during the process and explain how this method of separation works. [6 QWC]

.....

.....

.....

.....

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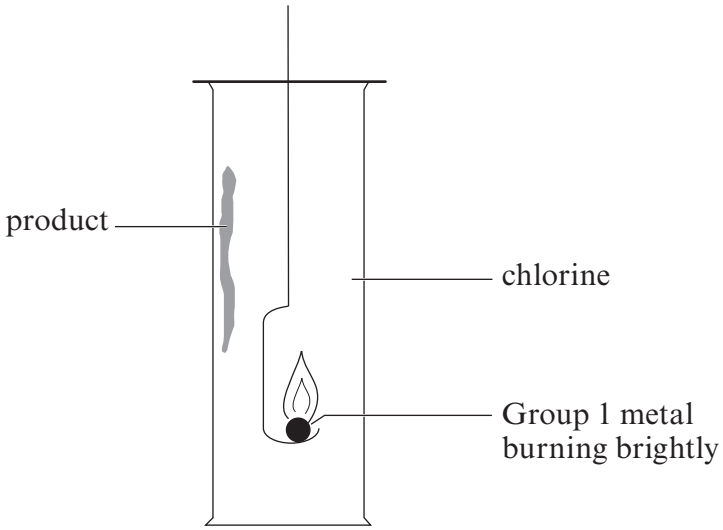
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8. Group 1 metals react vigorously when heated and lowered into a gas jar of chlorine, Cl_2, as shown in the diagram below.



(a) When a flame test was carried out on the product of such a reaction a yellow flame was seen. Identify the Group 1 metal that was used. [1]

.....

(b) Give the balanced **symbol** equation for the reaction. [3]

..... + ... ⟶ .....

(c) Describe how you would test for chloride ions in a solution of the product, giving the expected observation. [2]

.....

.....

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Turn over.

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9. The following table contains information about the numbers of particles contained within atoms and ions **A-F**.

A, **B**, **C**, **D**, **E** and **F** are **not** chemical symbols.

	A	**B**	**C**	**D**	**E**	**F**
Number of electrons	8	10	9	10	10	11
Number of neutrons	10	10	10	10	12	12
Number of protons	8	8	9	10	10	11

(a) State the group and period of the Periodic Table to which **A** belongs. [1]

Group ..... *Period* .....

(b) (i) Choose the letter **A-F** which represents an ion. [1]

.....

(ii) Give the charge of this ion. ..... [1]

(c) Give the letter **A-F** which represents an atom/ion with a mass number of 20. [1]

.....

(d) Choose the letters **A-F** which represent isotopes and give the reason for your choice. [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^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

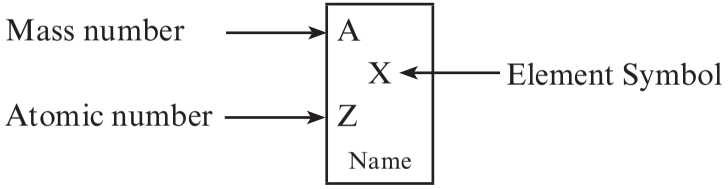
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PERIODIC TABLE OF ELEMENTS

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 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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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

SUMMER 2012

INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2012 examination in GCSE SCIENCE-CHEMISTRY. 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.

C2

Foundation Tier

Q.1	Mark	Answer	Accept	Neutral answer	Do not accept
a i	1	A and C (both needed)			
ii	1	Y contains three substances /Y does not contain A,B or C			
b	2	$\frac{6}{10}$ (1) = 0.6 (1)			

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Q.2	Mark	Answer	Accept	Neutral answer	Do not accept
a i	1	2.8.1			
ii	1	3			
iii	1	4			
iv	1	D			
v	1	proton			
b i	2	40 + 12 + 3(16) (1) = 100 (2) - two marks for correct answer			
ii	2	$\frac{40}{100}$ x 100 (1) = 40 (2) - two marks for correct answer	consequential marking		

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Q.3	Mark	Answer	Accept	Neutral answer	Do not accept
a i	1	nitrogen	N_2	N	
ii	1	simple covalent	simple molecular	covalent	
iii	1	nitrogen/graphite	N_2/C	N	
b	2	high melting point/good conductor of heat/malleable – any two for 1 mark each		good conductor	
c	1	C			

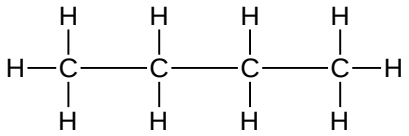
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Q.4	Mark	Answer	Accept	Neutral answer	Do not accept
a i	3	all seven points plotted correctly (2) one error (1) two or more errors (0) smooth curve going through the reliable points (not 92-30) (1)			
ii	2	49 (from graph) (1) graph levels/reaches 120 or highest volume of gas (1)			
iii	2	between 0 and 10 (1) steepest slope/most gas given off in 10 seconds (1)			
b	2	using powdered calcium carbonate/increasing the temperature/increasing the concentration of the acid – any two for one mark each		catalyst	more acid
c	1	no solid left at the end of the experiment/all the solid used up	increase in the volume of gas given off		acid left at the end of the experiment

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Q.5	Mark	Answer	Accept	Neutral answer	Do not accept
a i ii iii	1 1 1	C_3H_6 B C			
b	1				
c	3	heat/ (1) PVC would melt/soften/loose shape (1) melamine no change/char (1) **or** warm/place in hot water(1) PVC would soften/ loose shape (1) melamine no change(1)		burn	

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Q.6	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	screen/tongs/small piece of lithium/large volume of water – any one			laboratory coat
b	2	lithium hydroxide (1) hydrogen (1)	LiOH (1) H_2 (1)	H	
c	1	lithium (1)	Li		
d	2	burns/lilac flame spits (more) melts moves faster fizzes more – any two for 2 marks	disappears quicker	dissolves quicker	

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Q.7	Mark	
	6	**Indicative content:** Description – heating the mixture in the flask to produce hot vapours. In the condenser the water enters at the lower end of the condenser and leaves at the higher point. The hot vapours from the flask then enter the condenser where they then cool, condense and runs down into the beaker as liquid. Explanation - since the boiling point of ethanol is lower than that of water the vapours will initially contain mainly ethanol and will therefore enter the condenser/beaker first. **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Q.8	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	sodium	Na		
b	3	$Na + Cl_2$ (1) NaCl (1) correct balancing (1)	consequential marking		
c	2	add silver nitrate solution (1) white precipitate/solid formed (1)			

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Q.9	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	6 and 2 – both needed			
b i ii	1 1	**B** 2-	oxide/O^{2-} O^{2-}	oxygen/O	
c	1	**D**	neon/Ne		
d	2	**D** and **E** – both needed (1) same number of protons but a different number of neutrons / same element but a different number of neutrons (1)			

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C2

Higher Tier

Q.1	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	prevent the metals from reacting with air/oxygen/moisture			
b i	1	screen/tongs/small piece of lithium/large volume of water – any one			laboratory coat
ii	1	lithium hydroxide (1) hydrogen (1)	LiOH (1) H_2 (1)	H	
iii	1	lithium (1)	Li		
iv	2	burns/lilac flame spits (more) melts moves faster fizzes more – any two for 2 marks	disappears quicker	dissolves quicker	

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Q.2	Mark	
	6	**Indicative content:** Description – heating the mixture in the flask to produce hot vapours. In the condenser the water enters at the lower end of the condenser and leaves at the higher point. The hot vapours from the flask then enter the condenser where they then cool, condense and runs down into the beaker as liquid. Explanation – since the boiling point of ethanol is lower than that of water the vapours will initially contain mainly ethanol and will therefore enter the condenser/beaker first. **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Q.3	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	sodium	Na		
b	3	$Na + Cl_2$ (1) NaCl (1) correct balancing (1)	consequential marking		
c	2	add silver nitrate solution (1) white precipitate/solid formed (1)			

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Q.4	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	9			
b	1	6 and 2 – both needed			
c i ii	1 1	**B** 2-	oxide/O^{2-} O^{2-}	oxygen/O	
d	1	**D**	neon/Ne		
e	2	**D** and **E** – both needed (1) same number of protons but a different number of neutrons / same element but a different number of neutrons (1)			

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Q5	Mark	Answer	Accept	Neutral answer	Do not accept
a i ii	1 2	ionic melt/dissolve (in water) (1) allow the ions to move (1)			
b	2	4 electrons between C and both O atoms (1) 8 electrons around both O atoms (1)			
c	3	simple and giant covalent (1) weak bonds between carbon dioxide molecules (1) strong bonds throughout diamond (1)			

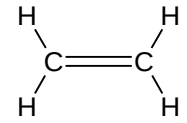
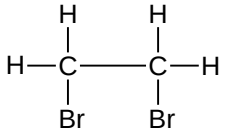
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Q.6	Mark	Answer	Accept	Neutral answer	Do not accept
a	1	smooth curve by eye starting at 290 and becoming flat at 287.6			
b	1	release/loss of gas			
c	1	prevent the loss of water vapour/moisture			
d	2	curve to the left of graph (1) levelling off at 287.6 (1)			
e	2	2.4 (1) amount of carbon dioxide released depends on the mass of calcium carbonate since the acid is in excess (1)			

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Q7	Mark	Answer	Accept	Neutral answer	Do not accept
a	2	bromine becoming colourless/it decolourises (1) addition (1)			
b	2	 (1)  (1)			
c	1	ethane	C_2H_6		

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Q.8	Mark	
	6	**Indicative content:** Hard water does not lather easily with soap whereas soft water does. Calcium or magnesium compounds dissolved in water makes it hard. Hardness in water can be removed by boiling/distillation, adding washing soda and by passing through an ion-exchange column or a detailed account of one method. **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Q9	Mark	Answer	Accept	Neutral answer	Do not accept
a	3	mass of oxygen = 0.16 mass of magnesium = 0.48 (1) Mg O 0.48 0.16 (1) 24 16 0.02 0.01 Mg_2O (1)			
b	2	some magnesium had not reacted (1) some product lost during the burning (1)	lid not opened enough white smoke given off Mg reacted with nitrogen Mg might have oxidised before expt		
c	3	M_r(MgO) = 24 + 16 = 40 (1) 2(24) g Mg …… 2(40)g MgO (1) 48……..80 0.48 ……0.8 (1) or 2 mols of Mg gives 2 mols of MgO (1) 0.02 ……0.02 Mass of MgO = 0.02 × 40 = 0.8 (1) - correct answer 3 marks			

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