CCEA GCSE CHEMISTRY

CHEMISTRY



EXAM QUESTION PACK

UNIT C1 HIGHER TIER GCH12 PAPERS

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016

GCSE Chemistry

Unit 1

Higher Tier

[GCH12]

GCH12

WEDNESDAY 15 JUNE, AFTERNOON

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen.**
Answer **all five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Questions **2(d)** and **3(a)(iii)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

10001

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1 **(a)** The following equations represent reactions of Group 1 and Group 7 elements.

Reaction A: sodium + water → sodium hydroxide + hydrogen

Reaction B: potassium + fluorine → potassium fluoride

Reaction C: sodium bromide + chlorine → sodium chloride + bromine

Reaction D: potassium iodide + bromine → potassium bromide + iodine

(i) In Reaction A the sodium floats on the surface of the water, gets smaller and eventually disappears leaving a colourless solution. State three other observations you would make.

1. _____

2. _____

3. _____

[3]

(ii) In Reaction B, a potassium atom becomes a potassium ion. Write a half equation for this reaction.

_____ [2]

(iii) Write a balanced symbol equation for Reaction C.

_____ [3]

(iv) In Reaction C chlorine gas is bubbled into a solution of sodium bromide. State the colour change observed in the solution.

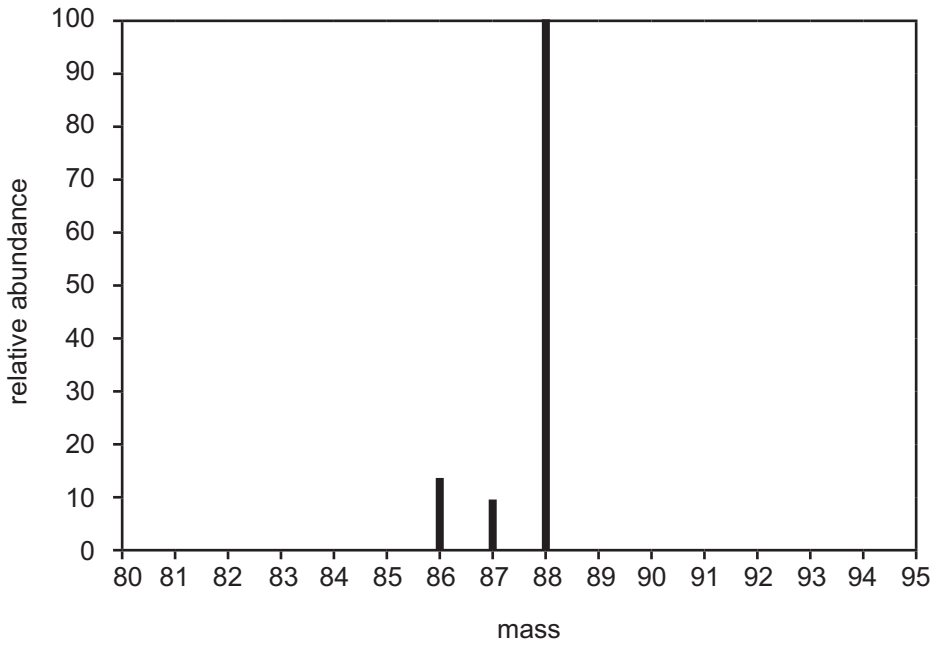
From _____ to _____ [2]

(v) In Reaction D a bromine molecule becomes bromide ions. Write a half equation for this reaction.

_____ [3]

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(b) The diagram below shows part of a mass spectrum of a sample of a Group 2 element. Each peak in the spectrum represents an isotope of this element.



(i) Based on the mass spectrum above, how many isotopes of the element are present in the sample?

_____ [1]

(ii) What is the mass of the isotope with the greatest relative abundance?

_____ [1]

(iii) Suggest the identity of the Group 2 element using your Data Leaflet.

_____ [1]

(iv) Suggest one advantage of using mass spectrometry to analyse elements.

_____

_____ [1]

[Turn over

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2 Drugs containing metal compounds may be used to treat different medical conditions.

(a) An excess of hydrochloric acid in the stomach can cause indigestion. Antacid tablets containing calcium carbonate can be taken to relieve the symptoms of indigestion.

(i) State the observations made when an antacid tablet containing calcium carbonate is dropped into a beaker of dilute hydrochloric acid.

_____

_____

_____

_____ [3]

(ii) Write a balanced symbol equation for the reaction between calcium carbonate and hydrochloric acid.

_____ [3]

(b) Other brands of antacid tablets contain aluminium hydroxide.

(i) Write the formula of aluminium hydroxide.

_____ [1]

(ii) State the colour of aluminium hydroxide.

_____ [1]

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(iii) Aluminium hydroxide reacts with hydrochloric acid to form a solution containing aluminium ions. Describe a chemical test for aluminium ions and state the result for a positive test. Comment on the validity of the test.

[5]

(c) Other metal ions can be detected using flame tests. Complete the table below.

Metal ion	Flame colour
Na^+	
	Brick red
Ba^{2+}	

[3]

[Turn over

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20GCH1205

(d) People who suffer from anaemia are often prescribed iron supplements. The supplements contain iron(II) sulfate.

Describe in detail how a solid iron supplement may be tested to confirm the presence of iron(II) ions and sulfate ions.

Your answer should include:

- The chemical test for iron(II) ions and the expected result
- The balanced ionic equation for the test for iron(II) ions
- The chemical test for sulfate ions and the expected result
- The balanced ionic equation for the sulfate ion test.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[9]

3 The Shard in London is 309 metres high and is currently the tallest building in the European Union. It is the fifty-ninth tallest building in the world.



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(a) In the construction of the Shard, 12 000 tonnes of steel were used. Steel is an alloy of carbon and iron. One form of carbon is graphite.

(i) What is meant by the term alloy?

_____

_____ [2]

(ii) Graphite and iron have different types of bonding and structure. Complete the table below to state the type of bonding and structure for graphite and for iron.

	Type of bonding	**Type of structure**
Graphite		
Iron		

[4]

[Turn over

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(iii) Describe, in detail, the bonding and structure of graphite and iron.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

10001

[6]

[Turn over

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(b) There are 11 468 panels of glass in the Shard, enough to cover eight football pitches. The glass is made from silicon dioxide, sodium oxide, calcium oxide and small amounts of other compounds.

(i) What type of bonding is found in silicon dioxide?

_____ [1]

(ii) What type of bonding is found in calcium oxide?

_____ [1]

(iii) Using full electronic configurations, draw **dot and cross** diagrams to show how atoms of sodium combine with atoms of oxygen to form sodium oxide. Include the charge on each ion.

[6]

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(c) The glass used in the Shard is 'low iron glass' which is very clear. Any iron(II) oxide impurity in the glass would produce a tint.

(i) Iron(II) oxide contains the iron(II) ion. Complete the table below by giving the formula of the iron(II) ion and the number of protons, neutrons and electrons present in this ion.

Formula of ion	Mass Number	Number of protons	Number of electrons	Number of neutrons
	56			

[4]

(ii) What is meant by the term ion?

_____

_____ [1]

[Turn over

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(d) The Shard uses energy saving methods to generate heat and so its carbon dioxide emissions are reduced.

Draw a **dot and cross** diagram to show the bonding in a carbon dioxide molecule. Show outer shell electrons only.

[3]

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4 The solubility of substances varies with temperature.

(a) What is meant by the term solubility?

_____

_____

_____

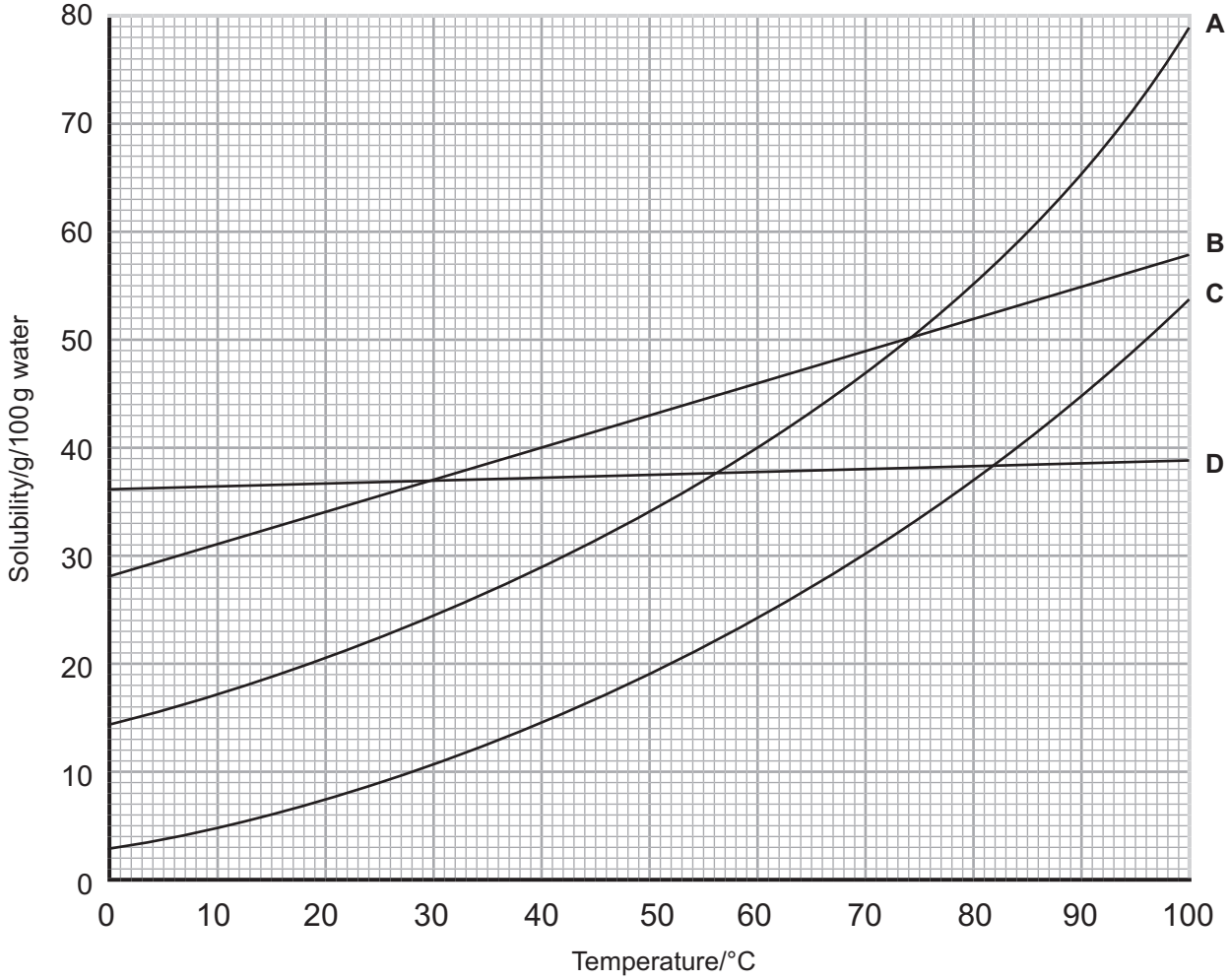
_____ [4]

[Turn over



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(b) The graph below shows the solubility curves for four different substances, A, B, C and D.



(i) Which substance (A, B, C or D) is most soluble at 10 °C?

_____ [1]

(ii) At what temperature do substances A and D have the same solubility?

_____ [1]

(iii) At what temperature would 3 g of substance C saturate 10 g of water?

Temperature _____ °C [1]

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(iv) Different masses of substances A, B, C and D were added to different masses of water as shown in the table below.

Mixture	Substance	Mass of substance (g)	Mass of water (g)	Temperature (°C)
1	A	5	10	70
2	B	180	500	40
3	C	2.0	25	10
4	D	80	250	30

Which mixtures (1–4) are saturated solutions?

_____ [2]

(v) On cooling a saturated solution of B containing 50 g of water from 60 °C to a lower temperature, 6 g of solid were deposited. Determine the temperature to which the solution was cooled.
Show all your working out.

Temperature _____ °C [4]

[Turn over

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5 Magnesium compounds have many important and wide-ranging uses. Magnesium nitrate is used as a fertiliser and is also present in many cosmetics including hair conditioner.

(a) On heating, magnesium nitrate breaks down according to the equation below:

$$2Mg(NO_3)_2(s) \rightarrow 2MgO(s) + 4NO_2(g) + O_2(g)$$

(i) What term is used to describe a reaction in which a substance breaks down when heated?

_____ [2]

(ii) Calculate the mass of nitrogen dioxide, NO_2, produced when 4.44 g of magnesium nitrate are heated.

(Relative atomic masses: N = 14; O = 16; Mg = 24)

Mass of nitrogen dioxide _____ g [5]

[Turn over

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(b) Magnesium chloride has healing effects on a wide range of diseases. The hydrated form of the salt has the formula $MgCl_2.nH_2O$.

(Relative atomic masses: H = 1; O = 16; Mg = 24; Cl = 35.5)

The following results were obtained in an experiment to determine the value of n in the formula.

Mass of empty crucible = 13.87 g
Mass of crucible and hydrated magnesium chloride = 15.90 g
Mass of crucible and anhydrous magnesium chloride = 14.82 g

(i) Calculate the mass of water of crystallisation lost.

Mass of water _____ g [1]

(ii) Calculate the number of moles of water of crystallisation lost.

Moles of water _____ [1]

(iii) Calculate the mass of the anhydrous magnesium chloride.

Mass of anhydrous magnesium chloride = _____ g [1]

(iv) Calculate the number of moles of anhydrous magnesium chloride.

Moles of anhydrous magnesium chloride = _____ [1]

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(v) Using your answer to parts **(ii)** and **(iv)**, calculate the value of n in $MgCl_2.nH_2O$.

n = _____ [1]

(c) Magnesium chloride is produced when magnesium hydroxide reacts with dilute hydrochloric acid. The balanced symbol equation for this reaction is shown below:

$$Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$$

A pharmaceutical company needs to produce 0.475 tonnes of magnesium chloride for use in the manufacture of health supplements. Calculate the mass of hydrochloric acid, in kg, required to produce 0.475 tonnes of magnesium chloride. (1 tonne = 1000 kg)

Mass of hydrochloric acid = _____ kg [5]

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Question Number	Marks
1	
2	
3	
4	
5	
Total Marks	

Examiner Number

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SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble

Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

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DATA LEAFLET

For the use of candidates taking
Science: Chemistry,
Science: Double Award
or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations.

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Solubility of Common Salts 4

gcse
science
chemistry
double award
single award

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THE PERIODIC TABLE OF ELEMENTS

Group

1	2											3	4	5	6	7	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La* Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac† Actinium 89	261 Rf Rutherfordium 104	262 Db Dubnium 105	263 Sg Seaborgium 106	262 Bh Bohrium 107	265 Hs Hassium 108	266 Mt Meitnerium 109	269 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112						

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	245 Bk Berkelium 97	251 Cf Californium 98	254 Es Einsteinium 99	253 Fm Fermium 100	256 Md Mendelevium 101	254 No Nobelium 102	257 Lr Lawrencium 103

* 58 – 71 Lanthanum series
† 90 – 103 Actinium series

a / b x
a = relative atomic mass (approx)
x = atomic symbol
b = atomic number

Rewarding Learning

General Certificate of Secondary Education
2016

GCSE Chemistry

Unit 1

Higher Tier

[GCH12]

WEDNESDAY 15 JUNE, AFTERNOON

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in Marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive Marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of any particular question and be prepared to award full marks for a response which as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

						AVAILABLE MARKS
1	(a)	(i)	moves about releases heat fizzes or hisses or gas produced melts to form a silvery ball	[1] [1] [1] [1]	max [3]	
		(ii)	$K \rightarrow K^+ + e^-$ [1] for $K \rightarrow K^+$ [1] for e^- placed correctly with + or – as appropriate		[2]	
		(iii)	$2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$ [1] for correct formulae of reactants [1] for correct formulae of products [1] for correct balancing		[3]	
		(iv)	colourless [1] to orange [1]		[2]	
		(v)	$Br_2 + 2e^- \rightarrow 2Br^-$ [1] for Br_2 and Br^- [1] for e^- placed correctly with + or – as appropriate [1] for correct balancing		[3]	
	(b)	(i)	3		[1]	
		(ii)	88		[1]	
		(iii)	strontium		[1]	
		(iv)	small sample/identification of elements/fast		[1]	17

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AVAILABLE MARKS

2 **(a)** **(i)** bubbles/fizzing/gas produced [1]
tablet disappears [1]
heat released [1]
colourless solution forms [1] max [3]

(ii) $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$
correct formulae of reactants [1]
correct formulae of products [1]
correct balancing [1] [3]

(b) **(i)** $Al(OH)_3$ [1]

(ii) white [1]

(iii) add sodium hydroxide (solution) [1]
white precipitate [1]
add excess sodium hydroxide (solution) [1]
precipitate redissolves [1]
Zn^{2+}/zinc ions give the same result [1] [5]

(c)

Metal ion	Flame colour
Na^+	**(golden) yellow/orange** [1]
Ca^{2+} [1]	Brick red
Ba^{2+}	**(apple) green** [1]

[3]

(d) **Indicative content**

- dissolve supplement in water [1]
- add sodium hydroxide [1] (solution)
- green precipitate confirms presence of iron(II) ions [1]
- $Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$ [3]
- add barium chloride [1] (solution)
- white precipitate confirms presence of sulfate ions [1]
- $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ [2]

Response	Mark
Candidates must use appropriate specialist terms to explain fully how to test for the presence of iron(II) ions and sulfate ions (using 8–10 points of indicative content). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[7]–[9]
Candidates must use appropriate specialist terms to explain how to test for the presence of iron(II) ions and/or sulfate ions (using 5–7 points of indicative content). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[4]–[6]
Candidates partially describe the test for the presence of iron(II) ions and sulfate ions (using 2–4 points of indicative content). They use limited spelling, punctuation and grammar and they make little use of specialist terms. The form and style are of a limited standard.	[1]–[3]
Response not worthy of credit	[0]

[9]

25

AVAILABLE MARKS

3 (a) (i) mixture [1]
of two or more elements at least one of which is a metal [1] [2]

(ii)

	Type of bonding	Type of structure
Graphite	covalent [1]	giant [1]
Iron	metallic [1]	metallic [1]

[4]

(iii) Indicative content

Graphite

- Layers (of carbon atoms) [1]
- Carbon atoms bonded to three others [1]
- Weak forces (of attraction) between the layers [1]
- One electron free per carbon/delocalised electrons (between layers) [1]
- Hexagonal (arrangement of carbon atoms) [1]

Iron

- Regular arrangement/lattice/layers [1]
- Positive ions [1]
- (Sea of) delocalised electrons [1]
- Attraction between positive ions and delocalised electrons [1]

Response	Mark
Candidates must use appropriate specialist terms to explain fully the structures of graphite and iron (using 7–9 points of indicative content). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some appropriate specialist terms to explain structure of graphite and iron (using 4–6 points of indicative content). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates explain briefly and partially the structures of graphite and iron (using 2–3 points of indicative content). They use limited spelling, punctuation and grammar and they have made little use of specialist terms. The form and style are of a limited standard.	[1]–[2]
Response not worthy of credit	[0]

[6]

(b) (i) covalent [1]

(ii) ionic [1]

(iii) (Sodium atom) 2,8,1 (oxygen atom) 2,6 [1]
Two sodium atoms, 1 oxygen atom [1]
(Sodium ion) 2,8 [1] (oxide ion) 2,8 must be dot and cross [1]
Na^+ [1] O^{2-} [1] [6]
Electronic configurations must be **drawn**

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				AVAILABLE MARKS

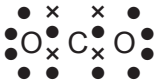
(c) **(i)**

Formula of ion	Number of protons	Number of electrons	Number of neutrons
Fe^{2+} [1]	26 [1]	24 [1]	30 [1]

[4]

(ii) a charged particle formed when an atom gains or loses electrons [1]

(d)



2 bonded pairs of electrons between C and each of the O atoms [1]
2 lone pairs of electrons on each oxygen [1]
dot and cross mark depends on first mark [1] [1] [3] 28
(if correct number of electrons shown)

4 **(a)** Mass [1] of solid required to saturate [1] 100 g of water [1]
at a particular temperature [1] [4]

(b) **(i)** D [1]

(ii) 56 (±1) (°C) [1]

(iii) 70 (±1) (°C) [1]

(iv) 1 [1]
3 [1] [2]

(v) solubility at 60 °C = 46 [1] g/100g water
12 [1] g per 100 g deposited
46 –12 = 34 [1] g
Temperature = 20 [1] °C
all solubilities ±1 [4] 13

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					AVAILABLE MARKS
5	**(a)**	**(i)**	thermal [1] decomposition [1]	[2]	
		(ii)	moles of magnesium nitrate = $\frac{4.44}{148\,[1]}$ = 0.03 [1] ratio $Mg(NO_3)_2 : NO_2$ = 2:4/moles of NO_2 = 0.06 [1] mass of NO_2 = 0.06 × 46 [1] = 2.76 [1] g	[5]	
	(b)	**(i)**	(15.90 – 14.82) = 1.08 (g)	[1]	
		(ii)	$\frac{1.08}{18}$ = 0.06 [1]	[1]	
		(iii)	(14.82 – 13.87) = 0.95 (g)	[1]	
		(iv)	$\frac{0.95}{95}$ = 0.01 [1]	[1]	
		(v)	(0.01:0.06) n = 6 [1]	[1]	
	(c)		mass of magnesium chloride = 475000 [1] g moles of magnesium chloride = 5000 [1] ratio $Mg(OH)_2 : HCl$ = 1:2/moles of HCl = 10000 [1] mass of HCl = 10000 × 36.5 = 365000 [1] g mass of HCl = 365 [1] kg	[5]	17
				Total	**100**

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2015

GCSE Chemistry

Unit 1

Higher Tier

[GCH12]

GCH12

TUESDAY 9 JUNE, AFTERNOON

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9372

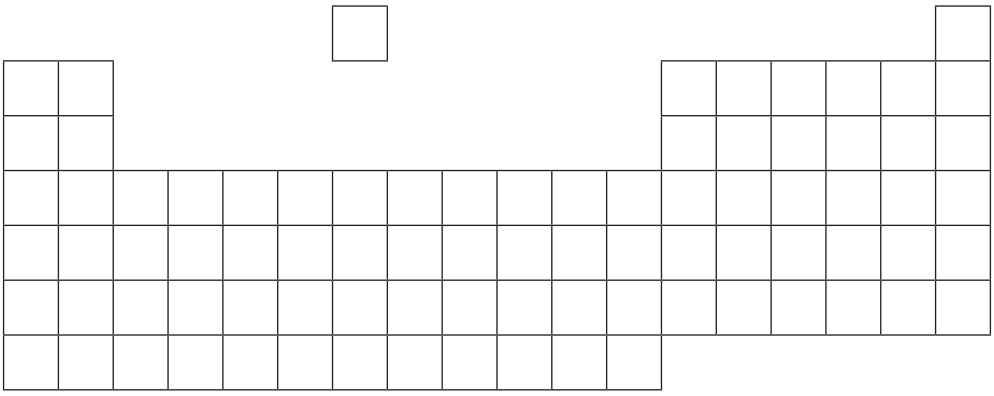
1 The Periodic Table has been developed over many years by several scientists. Each scientist produced a Periodic Table with different characteristics and this eventually led to the Periodic Table we use today.

(a) Complete the table below by adding the name of the scientist.

Characteristic of the Periodic Table	Name of Scientist
Law of octaves	
Spaces for undiscovered elements	

[2]

(b) The diagram below is an outline of the modern Periodic Table.



Using the letters **A–D** show the position of the following elements on the outline of the Periodic Table above. Place each letter in the appropriate box on the outline.

A a gas which burns with a pop

B the least reactive alkali metal

C the element in Period 3 and Group 2

D a metal which is a liquid at room temperature

[4]

(c) The table below shows six elements and the electronic configuration of their atoms. The elements are represented by the letters **P–U** (these are not symbols of the elements).

Element	Electronic configuration
P	2,6
Q	2,8,1
R	2,8,2
S	2,8,7
T	2,8,8
U	2,8,8,1

Using the letters **P–U**, identify the following elements. Each letter may be used once, more than once or not at all.

(i) Two elements in the same Group _____ and _____

(ii) An element in Period 2 _____

(iii) A noble gas _____

(iv) An alkaline earth metal _____

[4]

(d) The halogens are found in Group 7 of the Periodic Table. All of the halogens react with sodium.

(i) Write a balanced symbol equation for the reaction of sodium with chlorine.

_____ [3]

(ii) Sodium reacts vigorously with chlorine.

Name a halogen which reacts even more vigorously with sodium.

_____ [1]

[Turn over

(e) The halogens chlorine, bromine and iodine, were added to solutions of different halide ions. The results are recorded in the table below.

Halogen	Solution of halide ion		
	Sodium chloride	**Sodium bromide**	**Sodium iodide**
Chlorine		orange solution produced	brown solution produced
Bromine	no reaction		brown solution produced
Iodine	no reaction	no reaction	

(i) Explain why there is no reaction between sodium chloride and bromine.

_____

_____

_____ [1]

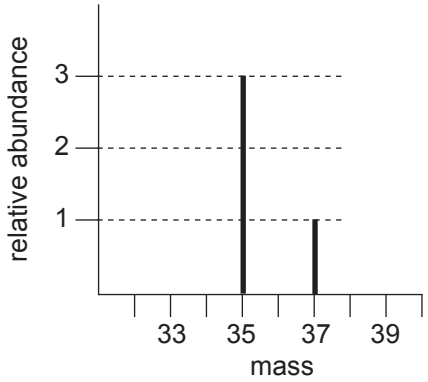
(ii) Write a balanced symbol equation for the reaction between sodium bromide and chlorine.

_____ [3]

(iii) State the name for the type of reaction in **(e)(ii)**.

_____ [1]

(f) A sample of chlorine atoms was analysed in a mass spectrometer. The mass spectrum obtained is shown below.



Use data from the mass spectrum to calculate the relative atomic mass of chlorine. **You must show your working out.**

Relative atomic mass = _____ [3]

[Turn over

2 **(a)** The following balanced symbol equations show reactions of some acids:

Reaction A $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

Reaction B $CuO + 2HCl \rightarrow CuCl_2 + H_2O$

Reaction C $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$

Reaction D $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$

Reaction E $KOH + HCl \rightarrow KCl + H_2O$

In the following questions where a **name** is required, a chemical formula will not be accepted.

(i) **Name** a weak alkali from the equations above.

_____ [1]

(ii) **Name** a salt of a transition metal from the equations above.

_____ [1]

(iii) Describe a chemical test for the gas produced in **Reaction C**. Include observations for a positive test.

_____

_____

_____ [3]

(iv) **Name** the salt produced in **Reaction D**.

_____ [1]

(v) Reaction E is an example of a neutralisation reaction. Write an **ionic** equation, including state symbols, for **Reaction E**.

_____ [3]

(b) Excess copper(II) carbonate is added to dilute nitric acid to form copper(II) nitrate solution. The reaction is exothermic.

(i) Write a balanced symbol equation for the reaction of copper(II) carbonate with nitric acid.

_____ [3]

(ii) What colour is the solution formed in this reaction?

_____ [1]

(iii) Name the separation technique used to remove the excess copper(II) carbonate from the solution.

_____ [1]

(iv) Describe how you would confirm experimentally that the reaction is exothermic.

_____

_____

_____

_____ [2]

[Turn over

(c) Many cation and anion tests rely on the formation of a precipitate.

(i) What is meant by the term cation?

_____ [1]

(ii) Describe the chemical tests used to positively identify:

- the cation
- the anion

present in a sample of **solid** magnesium iodide.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [6]

3 Magnesium and chlorine react together to form the ionic compound magnesium chloride.

(a) Name and describe the type of bonding in **magnesium**.

Name: _____

Description _____

_____

_____

_____

_____

_____ [3]

(b) (i) Write the formula for magnesium chloride.

_____ [1]

[Turn over

(ii) Using **dot and cross** diagrams explain how magnesium chloride is formed from atoms of magnesium and chlorine.
Include the charge on each ion.

[6]

(c) (i) Magnesium chloride is a white crystalline solid at room temperature. State two other physical properties of magnesium chloride.

1. _____

_____

2. _____

_____ [2]

(ii) Name one other compound with similar bonding and physical properties to magnesium chloride.

_____ [1]

(d) Chlorine also bonds with hydrogen to form the compound hydrogen chloride.

Draw a **dot and cross** diagram to show the bonding in hydrogen chloride and **label a lone pair of electrons**. Your diagrams should only show outer shell electrons.

[3]

[Turn over

(e) The melting point of hydrogen chloride is −114 °C. The melting point of magnesium chloride is 714 °C. Explain in detail why the melting point of hydrogen chloride is much lower than that of magnesium chloride.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

4 The solubility of solids such as ammonium dichromate and ammonium chloride varies with temperature.

(a) (i) What is meant by the term solubility?

_____

_____

_____

_____

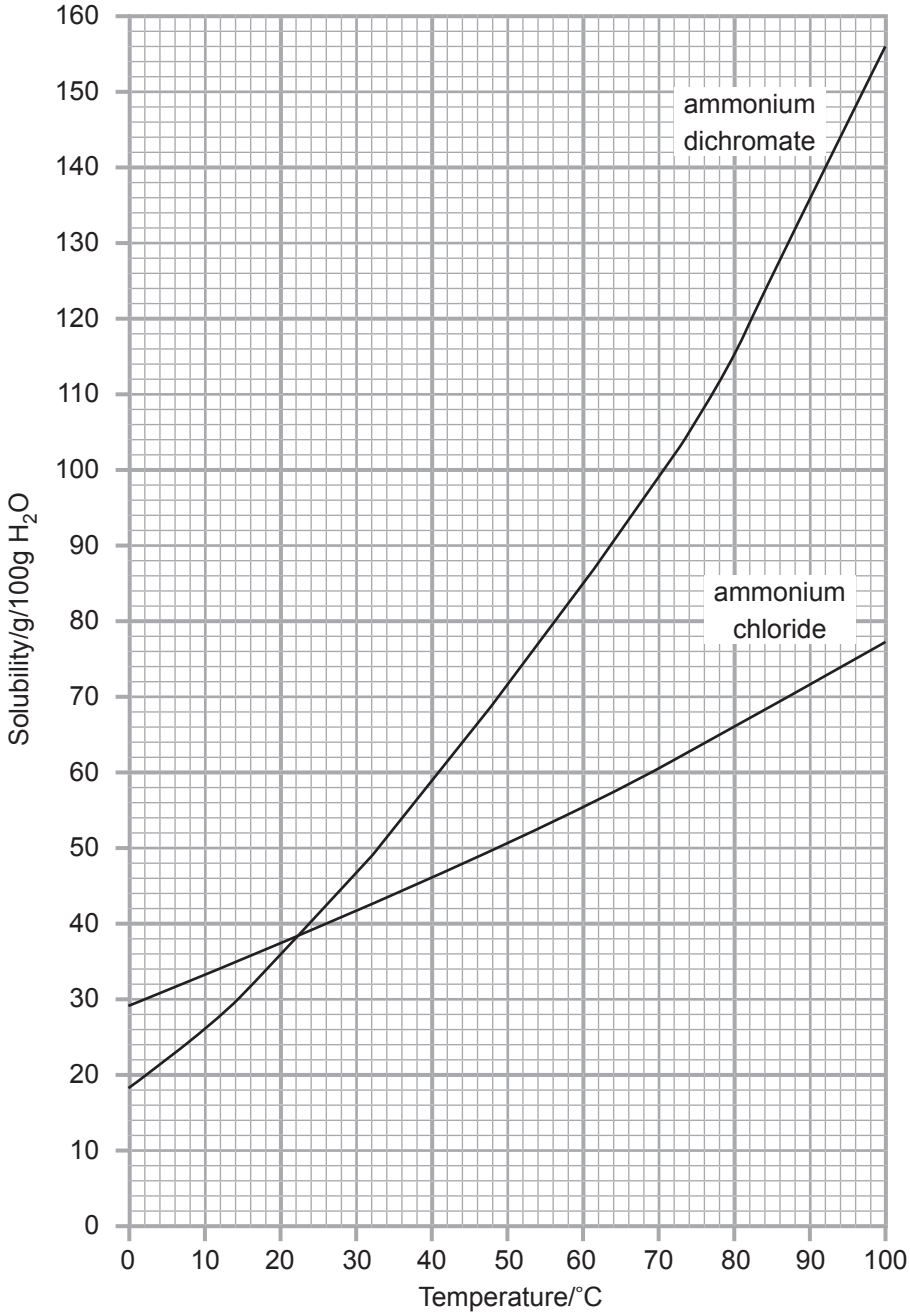
_____ [4]

(ii) Write the formula for ammonium dichromate.

_____ [1]

[Turn over

The graph below shows the solubility curves for ammonium dichromate and ammonium chloride. **Use the graph to answer parts (b) and (c).**



9372

(b) (i) At what temperature does ammonium chloride have a solubility of 55g/100g H_2O?

_____ [1]

(ii) At what temperature do both salts have the same solubility?

_____ [1]

(iii) Why does the *x*-axis not go below 0 °C or above 100 °C?

_____

_____ [1]

(c) A concentrated solution of ammonium dichromate at 60 °C which is **not saturated** contains 30 g of ammonium dichromate dissolved in 50 g of water.

The concentrated solution was cooled from 60 °C to 20 °C. Calculate the mass of solid that crystallises out of solution.

Mass of solid = _____ g [3]

[Turn over

5 Tooth whitening is not a modern invention. Ancient Romans used urine and goats' milk to whiten their teeth. A chemical called urea which is present in the urine bleaches teeth.

(a) Urea contains 20.00 % carbon, 6.66 % hydrogen, 46.67 % nitrogen and 26.67 % oxygen. Determine the empirical formula of urea.

(Relative atomic masses: H=1; C=12; N=14; O=16)

Empirical formula = _____ [5]

(b) Today, most teeth whitening kits contain the chemical carbamide peroxide which breaks down in the mouth into urea and hydrogen peroxide. During the bleaching process the hydrogen peroxide decomposes to produce water and oxygen.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

Calculate the mass of oxygen produced from 5.1 g of hydrogen peroxide.

(Relative atomic masses: H = 1; O = 16)

Mass of oxygen = _____ [5]

[Turn over

(c) Some whitening toothpastes contain hydrated silica, $SiO_2.2H_2O$, which acts as an abrasive to remove stains and polish teeth.

(i) Hydrated silica contains water of crystallisation. What is meant by the term water of crystallisation?

_____

_____

_____ [2]

(ii) Calculate the percentage of water of crystallisation present in hydrated silica.
(Relative atomic masses: H = 1; O = 16; Si = 28)

Percentage of water = _____ % [3]

(iii) Silica has a structure similar to diamond. Name this type of structure.

_____ [1]

(iv) Hydrated aluminium oxide, $Al_2O_3.nH_2O$, may be used as an alternative abrasive.

To determine the degree of hydration in hydrated aluminium oxide 3.12 g of hydrated aluminium oxide were heated to constant mass. 2.04 g of anhydrous aluminium oxide remained.

Find the value of n in $Al_2O_3.nH_2O$.
(Relative atomic masses: H = 1; O = 16; Al = 27)

n = _____ [6]

THIS IS THE END OF THE QUESTION PAPER

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For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2015

GCSE Chemistry

Unit 1

Higher Tier

[GCH12]

TUESDAY 9 JUNE, AFTERNOON

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in Marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive Marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of any particular question and be prepared to award full marks for a response which as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

1 **(a)**

Characteristic of the Scientist's Periodic Table	Name of Scientist
Law of octaves	Newlands [1]
Spaces for undiscovered elements	Mendeleev [1]

[2]

(b) A in hydrogen position [1]
B in lithium position [1]
C in magnesium position [1]
D in mercury position [1] [4]

(c) Q and U [1] both needed
P [1]
T [1]
R [1] [4]

(d) **(i)** $2Na + Cl_2 \rightarrow 2NaCl$
correct formulae of reactants [1]
correct formula of product [1]
correct balancing [1] [3]

(ii) fluorine [1]

(e) **(i)** bromine is less reactive than chlorine [1]

(ii) $2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$
correct formulae of reactants [1]
correct formulae of products [1]
correct balancing [1] [3]

(iii) displacement (accept redox) [1]

(f) $\frac{(35 \times 3) + (37 \times 1)\,[1]}{4\,[1]} = 35.5\,[1]$ [3]

AVAILABLE MARKS

22

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AVAILABLE MARKS

2 **(a)** **(i)** ammonia (Do not accept NH_3) [1]

(ii) copper(II) chloride (accept copper chloride)
Do not accept $CuCl_2$ [1]

(iii) limewater [1], changes from colourless [1] to milky [1] [3]

(iv) ammonium sulfate (Do not accept $(NH_4)_2SO_4$) [1]

(v) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
correct formulae of reactants [1]
correct formula of product [1]
correct state symbols [1] [3]

(b) **(i)** $CuCO_3 + 2HNO_3 \rightarrow Cu(NO_3)_2 + CO_2 + H_2O$
correct formulae of reactants [1]
correct formulae of products [1]
correct balancing [1] [3]

(ii) blue [1]

(iii) filtration [1]

(iv) thermometer/temperature probe/measure temperature change/
measure initial and final temperature [1]
increase in temperature [1] [2]

(c) **(i)** positive ion [1]

(ii) **Indicative Content**

- make a solution of the solid
- add sodium hydroxide (solution)
- white precipitate
- add excess sodium hydroxide (solution)
- precipitate does not redissolve confirms magnesium ions present
- add silver nitrate (solution to fresh sample of solution)
- yellow precipitate confirms iodide ions present

Response	Mark
Candidates must use appropriate specialist terms to explain fully the process of confirming the presence of both ions (6–7 points of indicative content). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates must use appropriate specialist terms to explain fully the process of confirming the presence of the ions (using 3–5 points of indicative content). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates explain briefly and partially the process of confirming the presence of the ions (using at least 2 points of indicative content). They use limited spelling, punctuation and grammar and they have made little use of specialist terms. The form and style are of limited standard.	[1]–[2]
Response not worthy of credit	[0]

[6]

23

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AVAILABLE MARKS

3 **(a)** Metallic [1] bonding
positive ions and delocalised electrons [1]
attraction between these [1] dependent on second mark [3]

(b) **(i)** $MgCl_2$ [1]

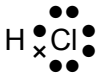
(ii) Correct electronic configuration of magnesium atom
drawn as (2,8,)2 [1]
Correct electronic configuration of two chlorine atoms
drawn as (2,8,)7 [1]

Correct electronic configuration of magnesium ion
drawn as (2,8,) [1]
Correct electronic configuration of two chloride ions
drawn as (2,8,)8
shown as dot and cross [1]

Correct charge on magnesium ion $^{2+}$ [1]
Correct charge on chloride ion $^{-}$ [1] [6]

(c) **(i)** any **two** from the following points:
- conducts electricity when molten or in solution
- soluble in water
- brittle
- high melting point/high boiling point [2]

(ii) any correct ionic compound [1]

(d) 

correct sharing of electrons as dot and cross between H and Cl [1]
all other electrons correct [1]
correct label for a lone pair of electrons [1] [3]

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(e) Indicative content

- HCl weak van der Waals forces
- between the molecules
- HCl = little energy required to break (forces)
- $MgCl_2$ = strong bonds
- ionic bonds
- $MgCl_2$ = substantial energy required to break the bonds

Response	Mark
Candidates must use appropriate specialist terms to explain fully the structure and bonding in both compounds (5–6 points of indicative content). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates must use appropriate specialist terms to explain fully the structure and bonding in both compounds (using 3–4 points of indicative content). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates explain briefly and partially the structure and bonding in these compounds (using at least 2 points of indicative content). They use limited spelling, punctuation and grammar and they have made little use of specialist terms. The form and style are of limited standard.	[1]–[2]
Response not worthy of credit	[0]

[6] 22

4 (a) (i) mass (of solute) [1]
which will saturate [1]
100 **g** of water [1]
at a particular temperature [1]
in the context of a definition
allow **maximum** for the idea of **saturate** [4]

(ii) $(NH_4)_2Cr_2O_7$ [1]

(b) (i) 59 (°C) ±1 [1]

(ii) 22 (°C) ±1 [1]

(iii) water freezes at 0 °C and boils at 100 °C [1]

(c) solubility at 20 °C = 36 [1]/100 g of water (allow ±1)
in 50 g of water = 18 [1] g
mass which crystallises = 30 – 18 = 12 [1] g [3] 11

AVAILABLE MARKS

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				AVAILABLE MARKS
5	**(a)**	moles of C = $\frac{20.00}{12}$ = 1.66 [1] moles of H = $\frac{6.66}{1}$ = 6.66 [1] moles of N = $\frac{46.67}{14}$ = 3.33 [1] moles of O = $\frac{26.67}{16}$ = 1.66 [1] empirical formula is CH_4N_2O [1]	[5]	
	(b)	moles H_2O_2 = $\frac{5.1}{34\,[1]}$ = 0.15 [1] moles of O_2 = $\frac{0.15}{2}$ = 0.075 [1] mass of O_2 = 0.075 × 32 [1] = 2.4 [1] g	[5]	
	(c) **(i)**	contains water **chemically bonded** into the crystal structure contains water in the crystal structure [1]	[2]	
	(ii)	$\frac{2 \times 18\,[1]}{96\,[1]}$ × 100 = 37.5 [1] %	[3]	
	(iii)	giant covalent/macromolecular	[1]	
	(iv)	Moles of Al_2O_3 = $\frac{2.04}{102\,[1]}$ = 0.02 [1] Mass of H_2O = 3.12 – 2.04 = 1.08 [1] g Moles of H_2O = $\frac{1.08}{18\,[1]}$ = 0.06 [1] n = 3 [1]	[6]	22
			Total	**100**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2014

GCSE Chemistry

Unit 1

Higher Tier

[GCH12]

GCH12

TUESDAY 10 JUNE, AFTERNOON

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided. Do not write outside the box, around each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen.**
Answer **all five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Questions **1(d)** and **2(b)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

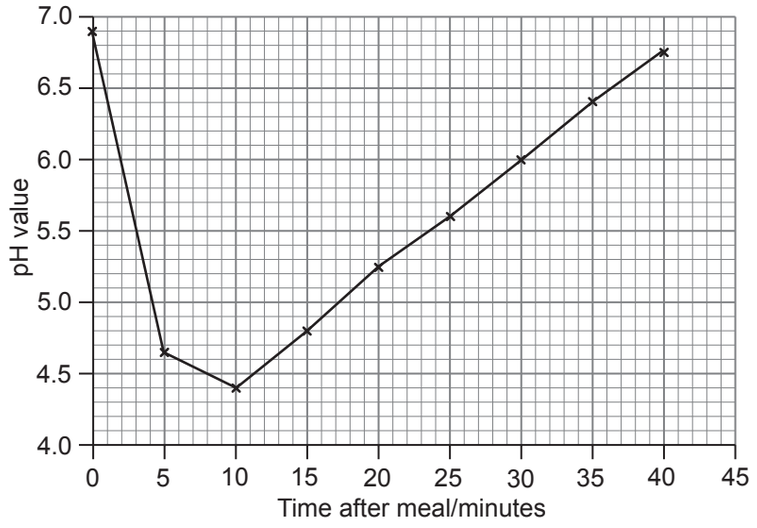
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Examiner Only	
Marks	Remark

1 **(a)** In an experiment a sample of human saliva was removed from the mouth every five minutes after a meal and the pH values were determined. The graph below shows how the pH values of the saliva changed.



(i) How were the pH values of the saliva determined in this experiment?

_____ [1]

(ii) A sample of saliva was tested with phenolphthalein indicator 30 minutes after the meal. State the colour observed when the saliva was tested with phenolphthalein.

_____ [1]

(iii) When the pH in the mouth is 5.5 or less tooth decay occurs. Use the graph to find the time after the meal at which teeth would start to decay.

_____ [1]

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Examiner Only	
Marks	Remark

(b) In the stomach food is digested by the action of hydrochloric acid. Hydrochloric acid is a strong acid. Excess stomach acid can cause a burning sensation called indigestion which is treated using antacid tablets to neutralise some of the acid.

(i) Explain what is meant by the term **strong** acid.

_____

_____

_____ [1]

(ii) Write an ionic equation for neutralisation. Include state symbols.

_____ [3]

(iii) Calcium carbonate is often present in antacid tablets. Write a balanced symbol equation for the reaction of hydrochloric acid with calcium carbonate.

_____ [3]

(iv) Describe a chemical test for the gas produced during the reaction between calcium carbonate and hydrochloric acid. State what you would observe for a positive test.

_____

_____

_____

_____

_____ [3]

[Turn over

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(c) The digested food from the stomach is passed into the small intestine. Sodium chloride is a salt which is absorbed in the small intestine.

Examiner Only	
Marks	Remark

(i) What is meant by the term salt?

_____

_____

_____

_____ [3]

(ii) Describe how you would test the salt to prove that it contained chloride ions.

_____

_____

_____

_____ [3]

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(d) Hydrochloric acid reacts with calcium hydroxide solution and with solid calcium. **Compare and contrast** the reaction of hydrochloric acid and calcium hydroxide solution with the reaction of hydrochloric acid and solid calcium. In your answer you must include:

- the **names** of all products for each reaction
- the observations for each reaction.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

Examiner Only	
Marks	Remark
Total Question 1	

[Turn over

Examiner Only	
Marks	Remark

2 **(a)** The elements in Group 1 of the Periodic Table are very reactive metals.

(i) Complete the following table.

Group number	Name of group	Number of electrons in the outer shell of an atom
1		

[2]

(ii) State the trend in reactivity in Group 1.

_____

_____ [1]

(iii) What would be observed when a piece of potassium is added to cold water?

_____

_____

_____

_____ [3]

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(b) During the reaction of potassium with water a potassium atom forms a potassium ion.

Compare a potassium atom with a potassium ion in terms of:

- electronic configurations
- the half equation for the formation of a potassium ion from a potassium atom
- relative stability (include an explanation).

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [6]

(c) Elements and compounds may be detected using modern instrumental analysis. Name **two** methods of modern instrumental analysis.

1. _____

2. _____ [2]

Examiner Only	
Marks	Remark
Total Question 2	

[Turn over

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Examiner Only	
Marks	Remark

3 **(a)** The photograph below shows “Seizure”, an artwork by Roger Hiorns which won the Turner Prize in 2009. An apartment was made watertight and filled with hot **saturated** copper(II) sulfate solution. The solution was allowed to cool and crystallise leaving the walls, floor and ceiling covered in **hydrated** copper(II) sulfate crystals.

An image of an apartment with the walls, floor and ceiling covered in hydrated copper(II) sulphate crystals has been removed due to copyright restrictions

(i) What is meant by the term hydrated?

_____

_____ [1]

(ii) What colour is hydrated copper(II) sulfate?

_____ [1]

(iii) What is meant by a saturated solution?

_____

_____ [1]

[Turn over

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(b) The table below shows values for the solubility of copper(II) sulfate.

Temperature (°C)	0	20	40	60	80	100
Solubility (g/100 g water)	14	20	28	40	56	77

(i) Explain what is meant by the term solubility.

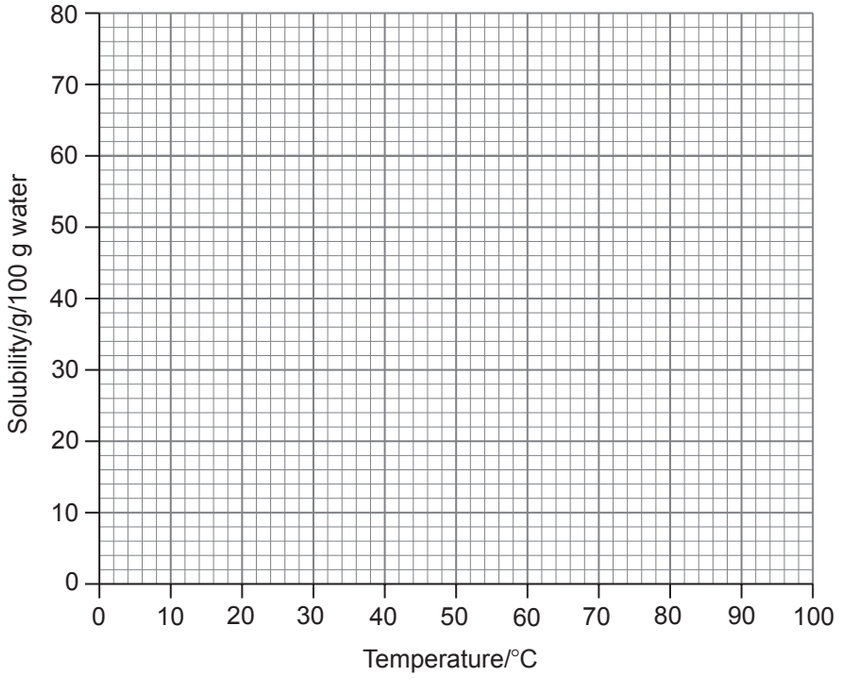
_____

_____

_____

_____ [4]

(ii) Use the data in the table to plot a solubility curve for copper(II) sulfate on the axes below.



[3]

Examiner Only

Marks	Remark

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(c) Use the graph in **(b)(ii)** to answer the following questions.

(i) What is the maximum mass of copper(II) sulfate which will dissolve in 10 g of water at 70 °C?

Mass of copper(II) sulfate = _____ g [2]

(ii) Calculate the mass of copper(II) sulfate which will crystallise out of solution if a saturated solution of copper(II) sulfate containing 200 g of water is cooled from 75 °C to 45 °C.

Mass of copper(II) sulfate = _____ g [4]

Examiner Only	
Marks	Remark
Total Question 3	

[Turn over

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Examiner Only	
Marks	Remark

4 Many scientists have contributed to the development of theories concerning the structure of the atom. The work of these scientists has led to the structural model of the atom we use today.

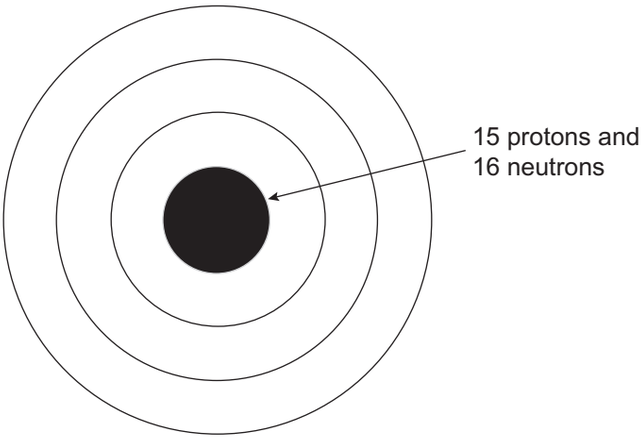
(a) Describe the differences between the "Plum Pudding" model of the atom and the model of the atom we use today.

[4]

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Examiner Only	
Marks	Remark

(b) The diagram below represents an atom of an element. The electrons are missing from the diagram.



(i) State the atomic number of this element.

_____ [1]

(ii) State the mass number of this element.

_____ [1]

(iii) Name the part of the atom in which the protons and neutrons are found.

_____ [1]

(iv) Complete the diagram above to show the electronic configuration of the atom, using × to represent an electron. [1]

[Turn over

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(c) The table below shows some information for several atoms and simple ions. Complete the table.

Atom/Ion	Number of protons	Electronic configuration
	7	2, 5
O^{2-}		
Al^{3+}		
	12	2, 8

[6]

(d) Substances have different types of bonding and structure. A variety of substances is shown in the table below.

aluminium	carbon dioxide	diamond
graphite	iron	lithium oxide
potassium sulfide	iodine	water

Using ONLY the substances in the table, answer the following questions.

(i) Name one substance in which the bonding is ionic.

_____ [1]

(ii) Name one substance in which the bonding is metallic.

_____ [1]

(iii) Name one substance in which the structure is described as giant covalent.

_____ [1]

Examiner Only	
Marks	Remark

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(iv) Name one substance in which van der Waals forces of attraction exist.

_____ [1]

(v) Which substance has the lowest melting point?

_____ [1]

(vi) Name one substance which will conduct electricity at room temperature.

_____ [1]

(e) Diamond is an allotrope of which element?

_____ [1]

(f) Ammonia gas is a covalent compound formed from the reaction between hydrogen and nitrogen.

(i) Draw a **dot and cross** diagram to show the bonding in a molecule of nitrogen.
You should show outer shell electrons only.

[3]

Examiner Only	
Marks	Remark

(ii) Write a balanced symbol equation for the formation of ammonia from hydrogen and nitrogen.

_____ [3]

(iii) Draw a **dot and cross** diagram to show the bonding in a molecule of ammonia.
You should show outer shell electrons only.

[3]

Examiner Only	
Marks	Remark
Total Question 4	

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Examiner Only	
Marks	Remark

5 Potassium permanganate, $KMnO_4$, dissolves in water to form a purple solution. The solution can be used to counteract the lethal effects of strychnine, $C_{21}H_{22}N_2O_2$.

(a) Strychnine, $C_{21}H_{22}N_2O_2$, is a compound.

(i) Write the empirical formula for strychnine.

_____ [1]

(ii) The masses of all atoms are compared relative to the mass of one isotope of a particular element. Name the element and state the mass of the isotope.

Element: _____

Mass: _____ [2]

(iii) A bottle of strychnine would show the following symbol.



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What do you understand by this symbol?

_____ [1]

[Turn over

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(b) A sample of potassium permanganate, $KMnO_4$, was heated to constant mass in a crucible and the following reaction occurred:

$$2KMnO_4(s) \rightarrow K_2MnO_4(s) + MnO_2(s) + O_2(g)$$

(i) Draw a labelled diagram of the assembled apparatus used to heat the sample of solid potassium permanganate in a crucible.

[3]

(ii) 5.53 g of potassium permanganate were used in this experiment. Calculate the mass of oxygen, O_2, which forms.

Relative atomic masses: O = 16; K = 39; Mn = 55

Mass of O_2 _____ g [5]

Examiner Only	
Marks	Remark

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(iii) Explain why the mass of the solid sample decreases during heating.

_____

_____

_____ [2]

(iv) Calculate the total mass of solid which remains in the crucible after heating the sample of $KMnO_4$ to constant mass.

Mass of solid remaining _____ g [1]

THIS IS THE END OF THE QUESTION PAPER

Examiner Only	
Marks	Remark
Total Question 5	

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Question Number	**Marks**
1	
2	
3	
4	
5	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2014

GCSE Chemistry

Unit 1

Higher Tier

[GCH12]

TUESDAY 10 JUNE, AFTERNOON

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in Marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive Marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of any particular question and be prepared to award full marks for a response which as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

AVAILABLE MARKS

1 **(a)** **(i)** using a pH meter/limited range pH paper [1]

(ii) colourless [1]

(iii) 3 (minutes) [1]

(b) **(i)** completely ionised in water/solution allow has a pH of 0–2 [1]

(ii) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
[1] for correct formulae of reactants including charges
[1] for correct formula of product
[1] for correct state symbols (3rd mark dependent on 1st 2 marks) [3]

(iii) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$
[1] for correct formulae of reactants
[1] for correct formulae of products
[1] for correct balancing (3rd mark dependent on 1st 2 marks) [3]

(iv) limewater [1] allow calcium hydroxide (solution)
changes from colourless [1] to milky [1] [3]

(c) **(i)** (a compound/substance) formed when (some or all of) the hydrogen ions [1] in an acid [1] are replaced with metal ions (other positive ions/ammonium ions) [1]
allow – formed when an acid reacts with base/carbonate/alkali or formed in a neutralisation reaction max [1] [3]

(ii) make a solution of the solid [1]
add silver nitrate solution [1]
white ppte [1] [3]

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(d) Indicative content

- calcium chloride formed in both
- water is other product in reaction of calcium hydroxide with hydrochloric acid
- hydrogen is other product in reaction of calcium with hydrochloric acid
- observations for calcium hydroxide and hydrochloric acid – test tube gets warm/heat (released)/solution remains colourless (any incorrect extra observation loses this mark)
- observations for calcium and hydrochloric acid – any **two** from:
  - bubbles/effervescence/gas produced
  - test tube gets warm/heat (released)
  - solid disappears
  - colourless solution formed

Response	**Mark**
Candidates must use appropriate specialist terms throughout to fully compare and contrast these two reactions (using 5–6 points of indicative content). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some appropriate specialist terms to compare and contrast these two reactions (using 3–4 points of indicative content). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates briefly and partially compare and contrast these two reactions (using 1–2 points of indicative content). They use limited spelling, punctuation and grammar and they have made little use of specialist terms. The form and style are of a limited standard.	[1]–[2]
Response not worthy of credit	[0]

[6]

AVAILABLE MARKS

25

AVAILABLE MARKS

2 (a) (i)

Group number	Name of group	Number of electrons in the outer shell of an atom
1	alkali metals [1]	1 [1]

[2]

(ii) reactivity increases going down the group [1]

(iii) Any **three** from:
- floats/on surface
- moves around
- fizzing
- lilac flame
- metal disappears
- colourless solution forms
- heat released
- crackles/small explosion/sparks [3]

(b) Indicative content
- 2,8,8,1 for K atom
- 2,8,8 for K^+
- $K \rightarrow K^+ + e^-$ [2] $K \rightarrow K^+$ [1] electron mark dependent on 1st mark
- K^+ full outer shell/has a noble gas configuration
- K^+ more stable (than K)/idea of relative stability

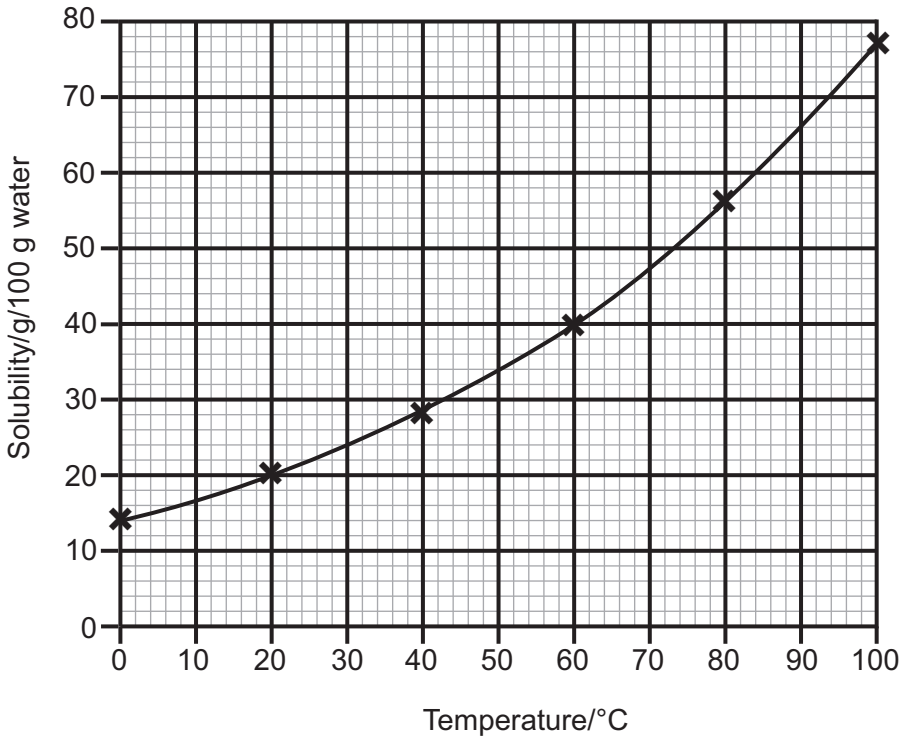
Response	Mark
Candidates must use appropriate specialist terms throughout to compare a potassium atom and a potassium ion (using 5–6 points of indicative content). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some appropriate specialist terms to compare a potassium atom and a potassium ion (using 3–4 points of indicative content). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates briefly and partially compare a potassium atom and a potassium ion (using 1–2 points of indicative content). They use limited spelling, punctuation and grammar and they have made little use of specialist terms. The form and style are of a limited standard.	[1]–[2]
Response not worthy of credit	[0]

[6]

(c) Mass Spectrometry [1]
High Performance Liquid Chromatography/HPLC [1] [2]

14

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					AVAILABLE MARKS
3	(a)	(i)	**contains** water of crystallisation	[1]	
		(ii)	blue	[1]	
		(iii)	no more solute **will dissolve**/no more solid will dissolve	[1]	
	(b)	(i)	mass [1] which will saturate [1] 100 g of water [1] at a particular temperature [1] allow maximum for idea of saturate	[4]	
		(ii)	 5–6 points plotted correctly = [2] 3–4 points plotted correctly = [1] 1–2 points plotted correctly = [0] smooth curve [1]	[3]	
	(c)	(i)	solubility at 70 °C = 47 [1] g/100 g water allow ± 2 in 10 g of water = 4.7 [1] g apply consequential marking from graph	[2]	
		(ii)	solubility at 75 °C = 52 [1] g/100 g water allow ± 2 solubility at 45 °C = 31 [1] g/100 g water allow ± 2 difference in solubility = 52 – 31 = 21 [1] for 200 g 21 × 2 = 42 [1] g apply consequential marking from graph	[4]	16

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AVAILABLE MARKS

4 **(a)** plum pudding = positive sphere [1] with electrons embedded in it [1]
today's model = nucleus containing protons and neutrons [1]
electrons (orbiting) in shells/energy levels/orbits/electrons orbiting around the nucleus [1] [4]

(b) **(i)** 15 [1]

(ii) 31 [1]

(iii) nucleus [1]

(iv) diagram showing 2,8,5 [1]

(c)

Atom/Ion	Number of protons	Electronic configuration
N [1]	7	2,5
O^{2-}	8 [1]	2,8 [1]
Al^{3+}	13 [1]	2,8 [1]
Mg^{2+} [1]	12	2,8

[6]

(d) **(i)** potassium sulfide/lithium oxide [1]

(ii) aluminium/iron [1]

(iii) graphite/diamond [1]

(iv) carbon dioxide/iodine/water allow graphite [1]

(v) carbon dioxide [1]

(vi) aluminium/graphite/iron [1]

(e) carbon [1]

(f) **(i)** [1] for correct sharing of electrons (3 bonded pairs)
[1] for correct number of electrons and e^- in a lone pair
[1] for correct bonding diagram not shown as × and •
each mark dependent on the one before [3]

(ii) $N_2 + 3H_2 \rightarrow 2NH_3$
[1] for correct formulae of reactants
[1] for correct formula of product
[1] for correct balancing [3]

(iii) [1] for correct sharing of electrons
[1] for correct number of e^-/N e^- as a lone pair
[1] for a correct bonding diagram not shown as × and •
each mark dependent on the one before [3]

30

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					AVAILABLE MARKS
5	**(a)**	**(i)**	$C_{21}H_{22}N_2O_2$	[1]	
		(ii)	element = carbon [1] mass = 12 [1]	[2]	
		(iii)	toxic/poisonous	[1]	
	(b)	**(i)**	Bunsen burner/HEAT in correct position [1] tripod and pipeclay triangle [1] crucible without lid [1] No labels = [0]	[3]	
		(ii)	$\frac{5.53}{158\ [1]} = 0.035$ [1] moles of $KMnO_4$ moles of $O_2 = \frac{0.035}{2} = 0.0175$ [1] mass of $O_2 = 0.0175 \times 32$ [1] = 0.56 [1] g	[5]	
		(iii)	oxygen/gas [1] released (to the surroundings) [1] 2nd mark dependent on first	[2]	
		(iv)	5.53 – 0.56 = 4.97	[1]	15
				Total	**100**

Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2013

Science: Chemistry

Unit C1

Higher Tier

[GCH12]

GCH12

MONDAY 10 JUNE, AFTERNOON

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided. Do not write outside the box, around each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen**.
Answer **all six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is **100**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in question **2(b)(iii)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

7950

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1 (a) The Periodic Table below shows some elements.

							H									He
Li													N	O		Ne
Na											Al		P	S		Ar
K							Fe			Cu					Br	
Rb															I	

USE ONLY THE ELEMENTS SHOWN ABOVE TO ANSWER THE FOLLOWING QUESTIONS.

Examiner Only	
Marks	Remark

(i) Name one non-metal which is a solid at room temperature and pressure.

_____ [1]

(ii) Write the symbol for an element which is a liquid at room temperature and pressure.

_____ [1]

(iii) Name one diatomic element.

_____ [1]

(iv) Name one element which is a colourless gas at room temperature and pressure.

_____ [1]

(v) Name one transition metal.

_____ [1]

(vi) Name the most reactive element in Group 1.

_____ [1]

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(vii) Name the element which has atoms with an electronic configuration 2, 8, 8.

_____ [1]

(viii) Name one element which sublimes on heating.

_____ [1]

(b) The element chlorine is found in Group 7 of the Periodic Table.

(i) What name is given to Group 7 of the Periodic Table?

_____ [1]

(ii) What is the colour and physical state of chlorine at room temperature and pressure?

Colour: _____

State: _____ [2]

(iii) Explain why chlorine should be used in a fume cupboard.

_____ [1]

(c) Chlorine reacts with solutions containing iodide ions.

(i) Write a balanced symbol equation for the reaction between chlorine and potassium iodide.

_____ [3]

(ii) What would be observed when chlorine gas is bubbled into a solution of potassium iodide?

_____

_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 1	

[Turn over

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Examiner Only	
Marks	Remark

2 Ski resorts use artificial snow to supplement natural snow. Artificial snow is made by forcing water and pressurised air through a snow cannon into cold air. The water droplets crystallise to form artificial snow.



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(a) Water contains the elements hydrogen and oxygen.

(i) Complete the table below to give information about atoms of hydrogen and oxygen.

Atom	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
$^{1}_{1}H$					
$^{16}_{8}O$					

[2]

(ii) Use a **dot and cross diagram** to show the bonding in water (H_2O). (Show only outer shell electrons.)

[3]

(iii) Artificial snow production works most effectively if the water used contains calcium ions, Ca^{2+}.

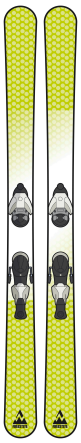
Draw a labelled diagram of a calcium ion stating the number of each subatomic particle present and showing the position of each particle. (Calcium atomic number = 20; mass number = 40)

[3]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(b) Skis were originally made from wood. Modern skis are often made of layers of graphite with steel edges to help the skis turn easily.



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(i) Steel is an alloy. What is meant by the term alloy?

_____

_____

_____ [2]

(ii) Graphite is one of the allotropes of carbon. What are allotropes?

_____

_____ [2]

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(iii) Three physical properties of graphite are shown in the table below. Explain these three physical properties of graphite in terms of structure and bonding.

Physical properties of graphite
High melting point
Soft
Good conductor of electricity

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

Examiner Only	
Marks	Remark

[Turn over

(c) Instead of steel, aluminium can be used on the edges of skis to make them lighter. The bonding within aluminium metal is metallic bonding.

(i) What is metallic bonding?

_____

_____

_____

_____ [2]

(ii) Explain why metals such as aluminium are malleable.

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 2	

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Examiner Only	
Marks	Remark

3 **(a)** Limestone, $CaCO_3$, is used as a building material and in the production of lime.

When heated strongly calcium carbonate breaks down to produce lime and carbon dioxide gas as shown in the following equation.

$$CaCO_3 \rightarrow CaO + CO_2$$

(i) What name is given to this type of reaction?

_____ [2]

(ii) Calculate the maximum mass of calcium oxide produced when 600 g of calcium carbonate are heated strongly.

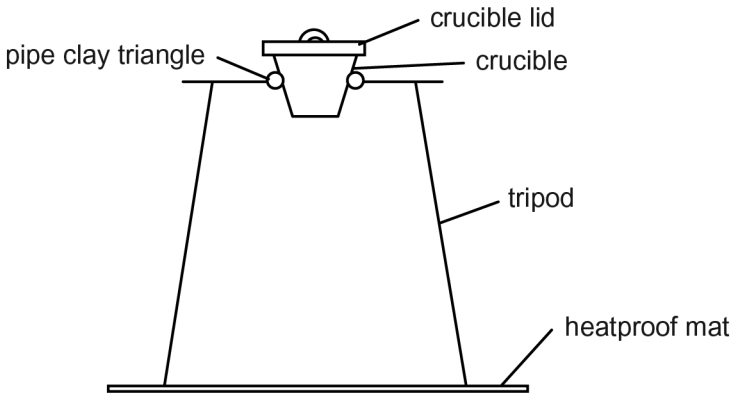
(Relative atomic masses: C = 12; O = 16; Ca = 40)

_____ g [5]

[Turn over

Examiner Only	
Marks	Remark

(b) The metal titanium reacts with oxygen to form an oxide of titanium. In an experiment to determine the formula of the oxide, a sample of titanium metal was heated in a crucible with a tightly fitting lid. During heating the lid was lifted from time to time.



The following results were obtained:

Mass of crucible	18.34 g
Mass of crucible + titanium metal	19.36 g
Mass of crucible + oxide	20.04 g

(i) Suggest why it was necessary to lift the crucible lid during heating.

_____

_____ [1]

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(ii) Use the results of the experiment to determine the empirical formula for the oxide of titanium.

(Relative atomic masses: O = 16; Ti = 48)

Empirical formula _____ [6]

Examiner Only	
Marks	Remark
Total Question 3	

[Turn over

4 Acids and alkalis react together to form a salt and water.

Examiner Only	
Marks	Remark

(a) The following experiment was carried out to determine if the reaction between hydrochloric acid and sodium hydroxide was exothermic.

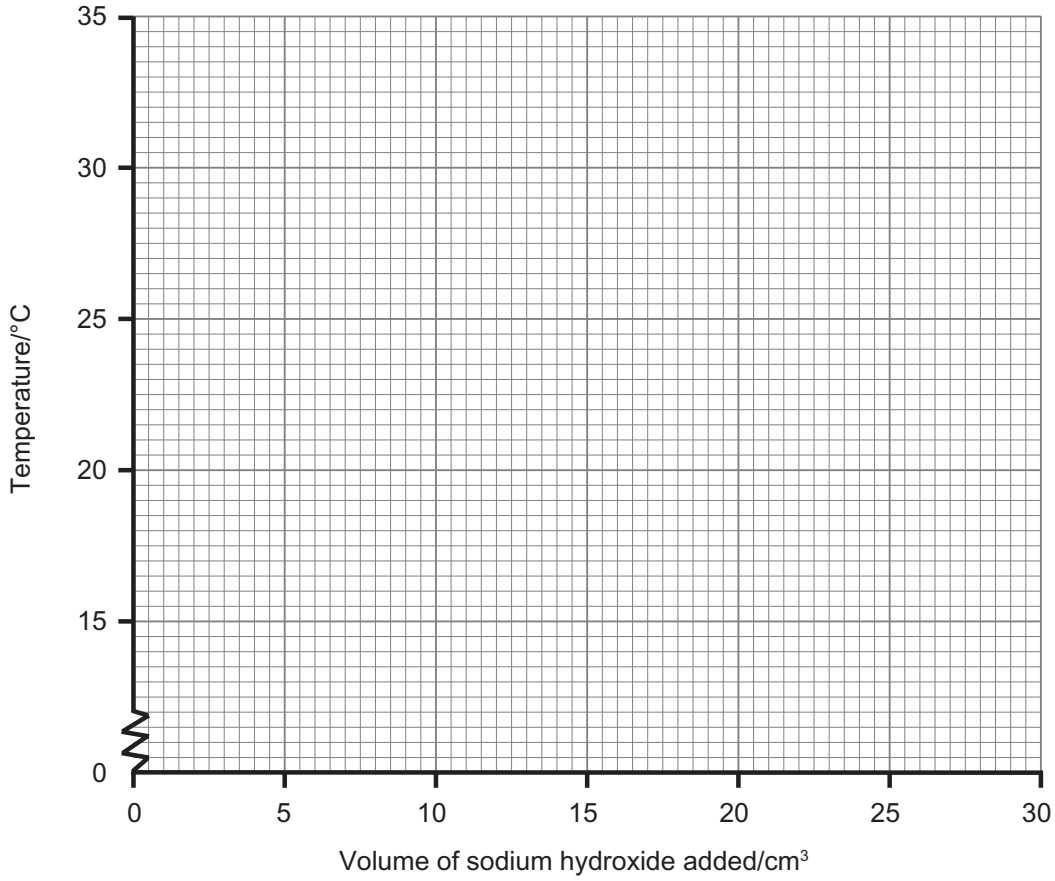
- 25 cm^3 of 1.0 mol/dm^3 hydrochloric acid were measured out and placed in a polystyrene cup.
- The temperature of the hydrochloric acid was recorded.
- 25 cm^3 of 1.0 mol/dm^3 sodium hydroxide solution were then added gradually in 5 cm^3 portions to the hydrochloric acid, stirring after each addition.

The temperature of the reaction mixture was recorded and the results are shown in the table below.

Volume of sodium hydroxide added/cm^3	0	5	10	15	20	25
Temperature of reaction mixture/°C	20.5	21.5	22.5	23.5	25.5	28.0

(i) On the axes opposite, plot a graph of temperature against volume of sodium hydroxide added using the results in the table above.

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[3]

(ii) How does your graph prove that this reaction is exothermic?

_____

_____ [1]

(iii) Apart from exothermic, what other term is used to describe the type of reaction between an acid and an alkali?

_____ [1]

(iv) Write a balanced symbol equation for the reaction between sodium hydroxide and hydrochloric acid.

_____ [2]

Examiner Only	
Marks	Remark

[Turn over

(b) The salt potassium sulfate is widely used as a fertiliser and in the manufacture of glass.

(i) Describe the steps which should be taken to prepare pure, dry crystals of potassium sulfate from the reaction between sulfuric acid and potassium hydroxide solution using a named indicator.

[6]

Examiner Only	
Marks	Remark

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(ii) Write a balanced symbol equation for the reaction between potassium hydroxide and sulfuric acid.

_____ [3]

Examiner Only	
Marks	Remark
Total Question 4	

[Turn over

Examiner Only	
Marks	Remark

5 **(a)** A student used the following method to find the solubility of potassium nitrate at room temperature (20 °C).

Place 25 g of deionised water in a beaker and add solid potassium nitrate while stirring until no more will dissolve. Filter the mixture. Place the filtrate in an evaporating basin and heat using a Bunsen burner until all of the water has been removed. Measure the mass of solid obtained.

(i) What is meant by the term solubility?

_____

_____

_____

_____ [4]

(ii) Suggest why the mixture was filtered.

_____

_____ [1]

(iii) Draw a labelled diagram of the assembled apparatus used to heat the filtrate.

[3]

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(b) The table below shows the solubility values of potassium nitrate between 0 °C and 100 °C.

Temperature/°C	0	20	40	60	80	100
Solubility of potassium nitrate (g/100 g water)	13.5	31.5	62.5	108	168	245

(i) 72 g of potassium nitrate were added to 100 g of water at 40 °C. After stirring, the solution was saturated and some potassium nitrate remained undissolved. Calculate the mass of potassium nitrate which did not dissolve.

Mass of potassium nitrate _____ g [2]

(ii) Calculate the mass of potassium nitrate which would crystallise if a saturated solution containing 500 g of water is cooled from 60 °C to 40 °C.
You should show all your working out clearly.

Mass of potassium nitrate _____ g [4]

Examiner Only	
Marks	Remark
Total Question 5	

[Turn over

Examiner Only	
Marks	Remark

6 Hydrochloric acid, hydrobromic acid and hydroiodic acid each contain a Group 7 ion.

(a) (i) Name the two ions present in hydrochloric acid.

_____

_____ [2]

(ii) These three acids are all **strong acids**. Describe how you would experimentally determine which of these acids is the strongest.

_____

_____

_____

_____ [2]

(b) (i) In an experiment to determine which Group 7 ion was present in each of the acids, a few drops of silver nitrate solution were added to a sample of the acid solution. Complete the table below to show the results of these tests.

	Hydrochloric acid	**Hydrobromic acid**	**Hydroiodic acid**
Observation on addition of a few drops of silver nitrate solution.			

[4]

(ii) Write a balanced **ionic** equation for the reaction of hydrochloric acid with silver nitrate solution.

_____ [2]

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(c) Hydrochloric acid reacts with bases to form salts such as sodium chloride and zinc chloride. An antiseptic mouthwash is thought to contain both of these salts.



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(i) Describe how you would confirm that the mouthwash contained sodium ions.

_____

_____

_____

_____ [2]

(ii) Describe how you would experimentally confirm that the mouthwash contained zinc ions. In your answer, refer to the validity of your test.

_____

_____

_____

_____

_____

_____ [5]

Examiner Only	
Marks	Remark
Total Question 6	

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Question Number	**Marks**
1	
2	
3	
4	
5	
6	
QWC	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2013

Science: Chemistry

Unit C1

Higher Tier

[GCH12]

MONDAY 10 JUNE, AFTERNOON

MARK SCHEME

STEMUP.CO.UK

General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

					AVAILABLE MARKS
1	(a)	(i)	phosphorus/sulfur/iodine	[1]	
		(ii)	Br	[1]	
		(iii)	hydrogen/nitrogen/oxygen/bromine/iodine	[1]	
		(iv)	hydrogen/nitrogen/oxygen/helium/neon/argon	[1]	
		(v)	iron/copper	[1]	
		(vi)	rubidium	[1]	
		(vii)	argon	[1]	
		(viii)	iodine	[1]	
	(b)	(i)	halogens	[1]	
		(ii)	yellow-green [1] gas [1]	[2]	
		(iii)	toxic	[1]	
	(c)	(i)	$Cl_2 + 2KI \rightarrow 2KCl + I_2$ [1] for correct formulae of reactants [1] for correct formulae of products [1] for correct balancing	[3]	
		(ii)	colourless solution [1] changes to brown [1] grey solid formed [1] Any **two**	[2]	17

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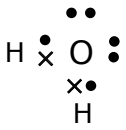
AVAILABLE MARKS

2 (a) (i)

Atom	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
$^{1}_{1}H$	1	1	1	0	1
$^{16}_{8}O$	8	16	8	8	8

[1] for each row [2]

(ii)



correct sharing of electrons in water [1]
correct number of electrons in total [1]
dot and cross diagram [1] [3]
second and third marks dependent on first

(iii) 20 protons in nucleus [1]
20 neutrons in nucleus [1]
EC drawn 2,8,8 [1] [3]

(b) (i) **mixture** of two or more **elements** [1]
at least one of which is a metal [1] [2]

(ii) different structures/forms of the same element [1]
in the same state [1]
second mark dependent on first [2]

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(iii) Indicative content

High melting point:
- strong bonds between (carbon) atoms/in the layers [1]
- indication that these bonds are covalent [1]
- **substantial** energy/heat required to break bonds [1]

Soft:
- layers can slide (off/over each other) [1]
- as there are weak forces of attraction between the layers [1]

Conduct electricity:
- delocalised electrons/free electrons [1]
- can move and carry the charge [1]

Response	**Mark**
Candidates must use appropriate specialist terms to explain fully the physical properties of graphite using a structural model (**using 6–7** points of indicative content). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some appropriate specialist terms to explain the physical properties of graphite using a structural model (**using 3–5** points of indicative content). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates explain briefly and partially the physical properties of graphite using a structural model (using **at least 2** points of indicative content). They use limited spelling, punctuation and grammar and they have made little use of specialist terms. The form and style are of a limited standard.	[1]–[2]
Response not worthy of credit	[0]

[6]

(c) (i) attraction
between positive ions and delocalised electrons [2] [2]

(ii) layers/(of positive ions) can slide [1]
idea that (metallic) bond is not disrupted [1] [2]

22

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					AVAILABLE MARKS
3	(a)	(i)	thermal [1] decomposition [1]	[2]	
		(ii)	moles of calcium carbonate = $\frac{600}{100}$ [1] = 6 [1]		
			mole ratio $CaCO_3$: CaO = 1:1/moles of calcium oxide = 6 [1]		
			mass of calcium oxide = 6 × 56 [1] = 336 = 336 g [1]	[5]	
	(b)	(i)	to allow air to enter the crucible/to ensure all of the metal reacted	[1]	
		(ii)	(19.36 – 18.34 =) **1.02 g** [1] (1.02/48 =) **0.02125** [1] (20.04 – 19.36 =) **0.680** [1] (0.68/16 =) **0.0425** [1] **ratio = 1:2** [1] empirical formula = TiO_2 [1]	[6]	14

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					AVAILABLE MARKS
4	**(a)**	**(i)**	5–6 points correct [2] 3–4 points correct [1] 1–2 points correct [0] curve [1]	[3]	
		(ii)	there is a temperature increase	[1]	
		(iii)	neutralisation	[1]	
		(iv)	$NaOH + HCl \rightarrow NaCl + H_2O$ [1] for correct formulae of reactants [1] for correct formulae of products	[2]	
	(b)	**(i)**	• place a measured volume of alkali/KOH into a **conical flask**/ **pipette** alkali/KOH into a **conical flask**/place 25 cm^3 of alkali/ KOH into a conical flask [1] • add phenolphthalein [1] • add sulfuric acid from burette [1] • colour changes from pink to colourless [1] • note volume of sulfuric acid added **and** repeat without indicator [1] (**alternative**: add charcoal, **heat** and filter) • **heat to** reduce volume/**heat** to concentrate the solution [1] • allow to cool and crystallise [1] • (filter to remove crystals and) dry between filter paper/in a desiccator/low temperature oven [1] Accept same method with alkali in burette and acid in conical flask Colour change is ∴ colourless to pink Maximum [6]	[6]	
		(ii)	$2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$ [1] for correct formulae of reactants [1] for correct formulae of products [1] for correct balancing	[3]	16

AVAILABLE MARKS

5 **(a)** **(i)** mass of solute [1] **or** maximum [1]
which will saturate [1] mass of solute which dissolves in [1]
100 g of water [1] 100 g of water [1]
at a particular temperature [1] at a particular temperature [1]
in the context of a definition [4]

(ii) to remove the solid (which did not dissolve) [1]

(iii) marks are awarded for recognisable pieces of equipment correctly **labelled** and **assembled** to suit the experiment
evaporating basin [1]
evaporating basin on gauze on tripod [1]
Bunsen burner below gauze/heat and arrow below gauze [1] [3]

(b) **(i)** mass of potassium nitrate which would dissolve = 62.5 [1] g
mass of potassium nitrate which remains = 72 – 62.5 = 9.5 [1] g [2]

(ii) solubility at 60°C = 108 [1] g/100 g water
solubility at 40°C = 62.5 [1] g/100g water
difference in solubility = 108 – 62.5 = 45.5 [1] g
solid which crystallises from 500 g water = 45.5 × 5 = 227.5 [1] [4] 14

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				AVAILABLE MARKS
6	**(a)**	**(i)**	hydrogen [1] (ion) chlor**ide** [1] (ion) [2]	
		(ii)	pH meter [1] lowest pH is the strongest [1] [2]	
	(b)	**(i)**		

	Hydrochloric acid	**Hydrobromic acid**	**Hydroiodic acid**
Observation on adding a few drops of silver nitrate solution.	white ppt	cream ppt	yellow ppt

[1] for each correct colour
[1] for ppt in all 3 boxes [4]

(ii) $Ag^+ + Cl^- \rightarrow AgCl$
[1] for correct formulae of reactants ions including charges
[1] for correct formula of product [2]

(c) **(i)** flame test [1]
yellow [1] flame indicates sodium (ions) present [2]

(ii) add sodium hydroxide (solution) [1]
white ppt [1]
add excess (sodium hydroxide solution) [1]
ppt dissolves/colourless solution formed [1]
validity – aluminium ions give the same result [1] [5] 17

Total **100**

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New Specification

Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012

Science: Chemistry

Unit C1

Higher Tier

[GCH12]

GCH12

TUESDAY 12 JUNE, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all seven** questions.

INFORMATION FOR CANDIDATES

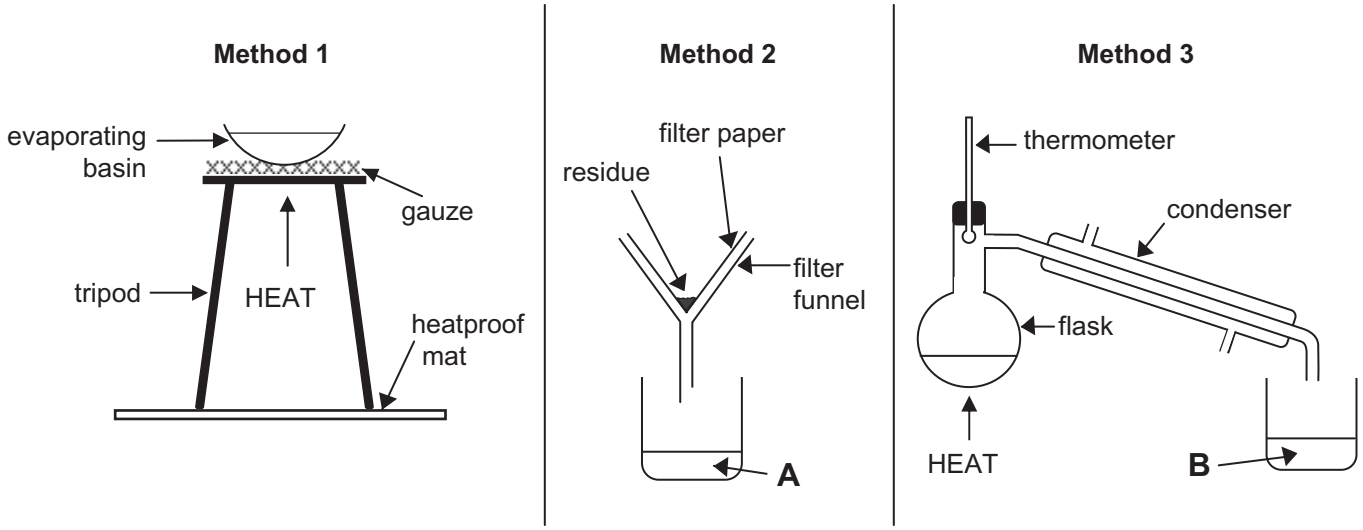
The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in questions **3(c)** and **5(a)(i)**.
A Data Leaflet which includes a Periodic Table of the Elements is provided.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
Total Marks	

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1 Mixtures may be separated in the laboratory in many different ways.

(a) Three different methods of separating mixtures are shown below.



(i) Which method (**1, 2 or 3**) would be most suitable for obtaining water from salt solution?

_____ [1]

(ii) Which method would be most suitable for removing sand from a mixture of sand and water?

_____ [1]

(iii) Explain fully why Method 2 would **not** be suitable to separate copper(II) sulfate from copper(II) sulfate solution.

_____

_____ [1]

(iv) What general term is used for liquid **A** collected in Method 2 and liquid **B** collected in Method 3?

A _____

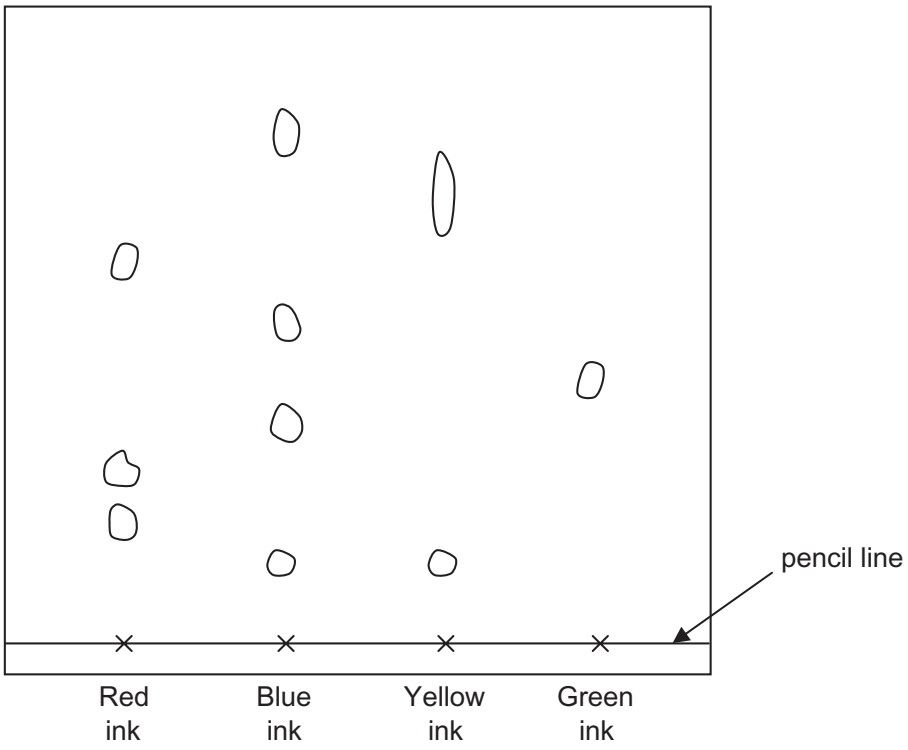
B _____ [2]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

(b) A student analyses four different inks using paper chromatography. The inks are spotted along a pencil line. The chromatography paper is placed in a solvent and the coloured components in the inks separate out. The resulting chromatogram is shown below.



(i) Which ink contains four different components?

_____ [1]

(ii) Which ink contains the most soluble component?

_____ [1]

(iii) Which **two** inks contain one common component?

_____ [1]

(iv) What do you understand by the term solvent?

_____

_____ [1]

(v) Which ink is a pure substance?

_____ [1]

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Examiner Only	
Marks	Remark

2 **(a)** Non-metallic elements form compounds with each other by bonding covalently.

(i) Explain what you understand by a single covalent bond.

_____

_____ [2]

(ii) Draw a **dot and cross diagram** to show the covalent bonding in hydrogen chloride, HCl.

[3]

(iii) Name the weak forces of attraction that exist between simple covalent molecules like hydrogen chloride.

_____ [1]

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(b) The table below gives some of the properties of the Period 3 element magnesium and one of its compounds, magnesium chloride.

Property	Magnesium (Mg)	Magnesium chloride ($MgCl_2$)
melting point	649 °C	714 °C
solubility in water		soluble
electrical conductivity when solid	conducts	does not conduct
electrical conductivity when molten	conducts	conducts
electrical conductivity when dissolved in water		conducts

(i) Explain why magnesium has a high melting point.

_____

_____

_____ [2]

(ii) What type of structure does magnesium chloride have? Use evidence from the table to explain your answer.

Structure: _____

Explanation: _____

_____

_____

_____ [3]

(iii) Explain why magnesium chloride conducts electricity when molten.

_____

_____

_____ [2]

Examiner Only

Marks	Remark

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3 In the Periodic Table, elements with similar properties appear in the same group. Some of the groups in the Periodic Table have names.

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn						

(a) Complete the table below by inserting the correct name for each group and state the number of electrons in the outer shell of atoms of elements in this group.

Group number	Name of group	Number of electrons in outer shell of atom
1		
2		

[4]

(b) When Group 1 elements react, the atom forms an ion. For example when potassium reacts with chlorine, potassium ions are formed from potassium atoms.

(i) Using electronic configurations, compare the stability of a potassium atom with that of a potassium ion.

electronic configuration of potassium atom _____

electronic configuration of potassium ion _____

_____

_____

_____

_____ [3]

(ii) Write a balanced symbol equation for the reaction of potassium with chlorine.

_____ [3]

Examiner Only	
Marks	Remark

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(c) The table below shows information about the reactions of Group 2 elements with water.

Element	Reactivity with water	Name of products on reaction with water
Beryllium	No reaction	No products
Magnesium	Reacts very slowly with cold water	Magnesium hydroxide and hydrogen
Calcium	Reacts moderately with cold water	Calcium hydroxide and hydrogen
Strontium	Reacts rapidly with cold water	Strontium hydroxide and hydrogen
Barium	Reacts very rapidly with cold water	Barium hydroxide and hydrogen

Use the information in the table and your own knowledge of Group 1 elements to compare and contrast the reactions of Group 1 and Group 2 elements with water.

In your answer compare:
- the products formed;
- the reactivity of the Group 1 elements compared to the Group 2 elements; and
- the trend in reactivity down both groups.

In this question, you will be assessed on using your written communication skills including the use of specialist science terms.

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

[6]

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Examiner Only	
Marks	Remark

4 Bath crystals are a mixture of water soluble solids which are added to bathwater for health benefits. Bath crystals contain Epsom salts (hydrated magnesium sulfate) which relax muscles, reduce inflammation and help muscle function.

'An image of a packet of Epsom Salts has been removed'

(a) Magnesium sulfate crystals are prepared in the laboratory by reacting magnesium carbonate with sulfuric acid, as shown in the equation below.

$$MgCO_3 + H_2SO_4 \rightarrow MgSO_4 + H_2O + CO_2$$

(Relative atomic masses: C = 12; O = 16; Mg = 24; S = 32)

(i) What is the maximum mass of magnesium sulfate which could be formed when 2.1 g of magnesium carbonate are reacted with sulfuric acid?

Mass of magnesium sulfate: _____ g [5]

(ii) A student carried out this experiment and only obtained 1.8 g of magnesium sulfate. Calculate the percentage yield.

Percentage yield: _____ % [2]

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(iii) Suggest why the percentage yield is not 100% in this reaction.

Examiner Only

Marks	Remark

_____

_____ [1]

(b) To find out the number of moles of water of crystallisation, a student heated some hydrated magnesium sulfate in a crucible and recorded the results in the table below.

(Relative atomic masses: H = 1; O = 16; Mg = 24; S = 32)

mass of empty crucible	12.73 g
mass of crucible + hydrated magnesium sulfate	13.96 g
mass of crucible after heating for 5 minutes	13.56 g
mass of crucible after heating for 10 minutes	13.33 g
mass of crucible after heating for 15 minutes	13.33 g

(i) Explain why the student weighed the crucible and its contents several times during the heating process.

_____

_____ [1]

(ii) Calculate the mass of water of crystallisation lost.

_____ g [1]

(iii) Calculate the number of moles of water of crystallisation lost.

_____ [2]

(iv) Calculate the mass of the anhydrous magnesium sulfate.

Examiner Only

Marks	Remark

_____ g [1]

(v) Calculate the number of moles of anhydrous magnesium sulfate.

_____ [1]

(vi) Using your answers to parts **(iii)** and **(v)**, calculate the number of moles of water of crystallisation contained in one mole of hydrated magnesium sulfate.

_____ [2]

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5 Calcium chloride is a salt and a common food additive. It is usually labelled as E509 and is found in a wide variety of foods including chocolate.

'An image of a Cadbury Crunchie bar has been removed'

(a) Calcium chloride solution may be prepared from solid calcium carbonate and dilute hydrochloric acid.

(i) Describe fully how a solution of calcium chloride may be prepared from solid calcium carbonate and dilute hydrochloric acid.

In this question, you will be assessed on using your written communication skills including the use of specialist science terms.

[6]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(ii) Write a balanced symbol equation for the reaction between calcium carbonate and hydrochloric acid.

_____ [3]

(iii) Describe the process of obtaining pure, dry crystals of hydrated calcium chloride from a solution of calcium chloride.

_____

_____

_____

_____

_____

_____

_____

_____ [3]

(b) Calcium chloride may also be prepared by neutralising calcium hydroxide solution with dilute hydrochloric acid. 25.0 cm^3 of calcium hydroxide solution is placed in a conical flask with phenolphthalein indicator and hydrochloric acid is added.

(i) Write an **ionic equation** for the neutralisation reaction. Include state symbols.

_____ [3]

(ii) State the colour change of the indicator in this preparation.

From _____ to _____ [2]

(iii) What common name is used for calcium hydroxide solution?

_____ [1]

(iv) Name the piece of apparatus used to add the hydrochloric acid to the conical flask.

_____ [1]

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(c) A solution of 0.015 mol/dm^3 hydrochloric acid was tested using a pH meter, red and blue litmus and universal indicator paper. The results are given below.

Test	Result
pH meter	1.82
red litmus	red
blue litmus	red
universal indicator paper	red

(i) Explain how the result with universal indicator may be converted into a pH value.

_____

_____ [1]

(ii) Explain why the result with red litmus is not conclusive for the presence of an acid.

_____

_____ [1]

(iii) Based on the results in the table, select **two** pieces of evidence which would suggest that hydrochloric acid is a strong acid. Explain your answer.

_____

_____

_____

_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

6 A **mixture** of two ionic compounds was analysed to determine the ions present in the mixture. The two ionic compounds have the **same anion**. The results of the tests are given in the table below.

	Description of test	Observations
Test 1	A flame test was carried out on a solid sample of the mixture	yellow flame
Test 2	A sample of the mixture was dissolved in deionised water and sodium hydroxide solution was added	white precipitate which redissolves in excess sodium hydroxide solution
Test 3	A sample of the mixture was dissolved in deionised water and barium chloride solution was added	white precipitate

(a) Describe how a flame test is carried out.

_____

_____

_____

_____

_____

_____ [3]

(b) Use the information in the table to answer the questions which follow.

Examiner Only

Marks	Remark

(i) Using the evidence from Test 1, name the cation which is present in the mixture.

_____ [1]

(ii) Using the evidence from Test 2, name **two** other cations which may be present in the mixture.

1. _____

2. _____ [2]

(iii) Using the evidence from Test 3, write the formula of the anion which is present in the mixture.

_____ [1]

(iv) Suggest the names of **two** compounds which may be present in the mixture.

1. _____

2. _____ [2]

(v) Write an **ionic equation** for the formation of the white precipitate in Test 3.

_____ [2]

Examiner Only	
Marks	Remark

7 Some chemical compounds such as potassium chloride dissolve very well in water and are said to have a high solubility.

(a) Explain what is meant by the term solubility.

_____

_____

_____

_____

_____ [4]

(b) A student carried out a series of experiments to determine the solubility of potassium chloride over a range of temperatures. The results were plotted on a graph and the solubility curve is shown opposite.

(i) Which temperature value should the student repeat?

_____ [1]

(ii) If a saturated solution of potassium chloride containing 50 g of water is cooled from 70 °C to 20 °C, what mass of solid crystallises out of the solution?

Mass of solid _____ g [4]

(c) A factory situated beside a river takes water from the river and uses it as a coolant. The warm water is returned to the river and causes thermal pollution.

What effect does this thermal pollution have on the dissolved oxygen gas content of the river and on the aquatic life of the river?

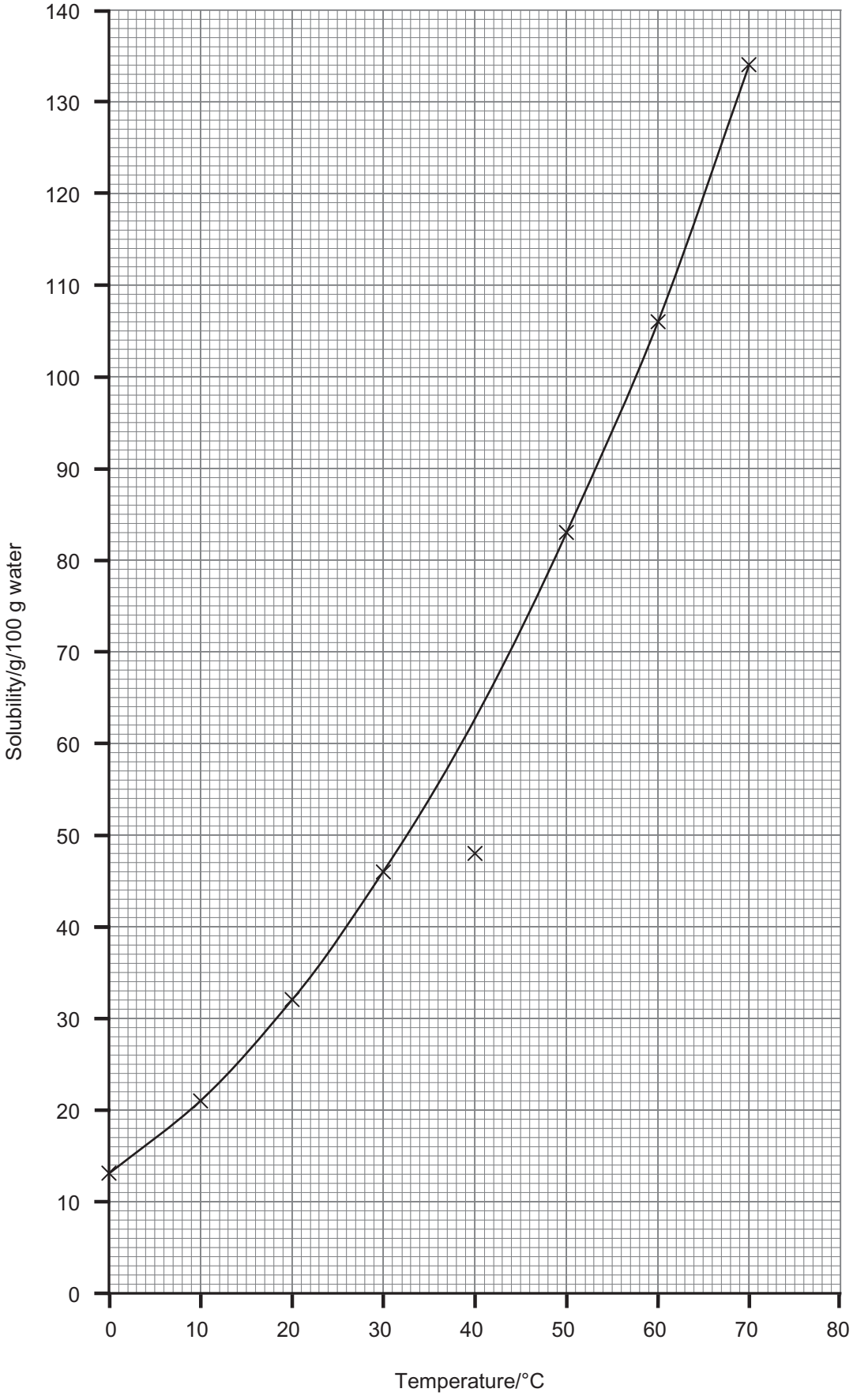
_____

_____

_____

_____ [2]

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THIS IS THE END OF THE QUESTION PAPER

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112039

New Specification

Rewarding Learning

General Certificate of Secondary Education
2012

Science: Chemistry

Unit C1

Higher Tier

[GCH12]

TUESDAY 12 JUNE, MORNING

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in Marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive Marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of any particular question and be prepared to award full marks for a response which as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

Section A

AVAILABLE MARKS

1 **(a)** **(i)** Method 3/distillation [1]

(ii) Method 2/filtration/filtering [1]

(iii) idea that copper sulfate is soluble [1]

(iv) **A** = filtrate [1]
B = distillate [1] [2]

(b) **(i)** blue (ink) [1]

(ii) blue (ink) [1]

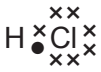
(iii) yellow and blue (inks) [1]

(iv) liquid in which the solute/dyes/components dissolve [1]

(v) green (ink) [1] 10

2 **(a)** **(i)** sharing of electrons [1]
idea of a pair of electrons [1] (2nd mark dependent on first) [2]

(ii)



[1] for shared pair shown as × and ●
[1] for 1 electron in outer shell of H atom
[1] for 7 electrons in outer shell of Cl atom [3]
second and third marks only awarded if first mark awarded for correct sharing of electrons
Award 2 marks for correct bonding diagram if not dot and cross

(iii) Van der Waals forces [1]

(b) **(i)** strong bonds [1]
substantial **energy** required to break [1] [2]

(ii) structure: ionic lattice/giant ionic [1]
evidence: conducts electricity when in solution or when molten [1]
high melting point/soluble in water [1] [3]

(iii) ions [1]
(are free to) move and carry charge [1] [2] 13

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AVAILABLE MARKS

3 **(a)**

Group number	Name of group	Number of electrons in outer shell of atom
1	alkali metals [1]	1 [1]
2	alkaline earth metals [1]	2 [1]

[4]

(b) **(i)** electronic configuration of K 2, 8, 8, 1 [1]
electronic configuration of K^+ 2, 8, 8 [1]
The K^+ ion is more stable because it has a full outer shell [1] [3]

(ii) $2K + Cl_2 \rightarrow 2KCl$
[1] for correct formulae of reactants
[1] for correct formula of product
[1] for correct balancing (only awarded if all formulae are correct) [3]

(c) Indicative content

- both groups give same products with water
- hydrogen and (metal) hydroxide
- Group 1 are more reactive (with water) than Group 2
- all of the Group 1 elements react/not all Group 2 react/Be is the **only** one which does not react
- idea that both groups have same trend in reactivity down group
- statement of trend in reactivity

Accept alternative appropriate responses

Response	Mark
Candidates must use appropriate specialist terms throughout to compare and contrast the reaction of Group 1 elements with water with the reaction of Group 2 elements with water (at least 5 points from above). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some appropriate specialist terms to compare and contrast the reaction of Group 1 elements with water with the reaction of Group 2 elements with water (at least 3 points from above). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates attempt to compare and contrast the reaction of Group 1 elements with water with the reaction of Group 2 elements with water (at least 1 point from above). They use limited spelling, punctuation and grammar and they have made little use of specialist terms. The form and style are of a limited standard.	[1]–[2]
Response not worthy of credit	[0]

[6]

16

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				AVAILABLE MARKS
4	(a)	(i)	RFM of $MgCO_3$ = 84 [1] moles of $MgCO_3$ = $\frac{2.1}{84}$ = 0.025 [1] 1:1 so moles of $MgSO_4$ = 0.025 [1] RFM of $MgSO_4$ = 120 [1] mass of $MgSO_4$ = 0.025 × 120 = 3 [1] g [5]	
		(ii)	% = $\frac{1.8}{3}$ ×100 [1] = 60 [1] % [2]	
		(iii)	any **one** from: loss by mechanical transfer loss when fizzing loss by filtration incorrect measurements side reactions reaction not complete [1]	
	(b)	(i)	heat to constant mass/to ensure **all** the water (of crystallisation) had been removed [1]	
		(ii)	13.96 – 13.33 = 0.63 [1] g [1]	
		(iii)	RFM of water = 18 [1] moles of water = $\frac{0.63}{18}$ = 0.035 [1] [2]	
		(iv)	13.33 – 12.73 = 0.6 (g) [1]	
		(v)	0.6/120 = 0.005 [1]	
		(vi)	0.005 : 0.035 [1] 1 : 7/moles of water of crystallisation = 7 [1] [2]	16

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AVAILABLE MARKS

5 (a) (i) Indicative content

- place hydrochloric acid in a suitable container
- add calcium carbonate
- stir/swirl/heat/warm
- until no further reaction occurs/no more reacts/no more fizzing/**excess** solid remaining
- filter (the reaction mixture)
- remove excess calcium carbonate/ filtrate is calcium chloride solution

Accept alternative appropriate responses

Response	**Mark**
Candidates must use appropriate specialist terms throughout to discuss fully the preparation of a solution of calcium chloride from calcium carbonate and hydrochloric acid in a logical sequence ([5]–[6]). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some appropriate specialist terms to discuss the preparation of a solution of calcium chloride from calcium carbonate and hydrochloric acid in a logical sequence ([3]–[4]). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates describe the preparation of a solution of calcium chloride from calcium carbonate and hydrochloric acid which may not be in a logical sequence ([1]–[2]). They use limited spelling, punctuation and grammar and form and style are of a limited standard.	[1]–[2]
Response not worthy of credit.	[0]

[6]

(ii) $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$
[1] for correct formulae of reactants
[1] for correct formulae of products
[1] for correct balancing (only awarded if all formulae correct) [3]

(iii) heat to concentrate/to half volume [1]
allow to (cool and) crystallise [1]
filter the crystals [1]
dry between two sheets of filter paper/in a desiccator/in a low temperature oven [1] maximum [3]

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				AVAILABLE MARKS
(b)	**(i)**	$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ [1] for correct formulae of reactants [1] for correct formula of product [1] for correct state symbols	[3]	
	(ii)	pink [1] to colourless [1] award [1] if wrong way round	[2]	
	(iii)	limewater	[1]	
	(iv)	burette	[1]	
(c)	**(i)**	compare to a colour chart	[1]	
	(ii)	red litmus is red with neutral solutions	[1]	
	(iii)	pH metre/pH = 1.82 and a pH range of 0–2 means a strong acid [1] red with universal indicator red indicates a strong acid [1]	[2]	23
6	**(a)**	nichrome wire/flame test rod [1] dipped in conc HCl/deionised water **and** dip wire/rod into solid sample [1] into Bunsen flame and observe the colour [1]	[3]	
	(b)	**(i)** sodium	[1]	
		(ii) aluminium [1] zinc [1]	[2]	
		(iii) SO_4^{2-}	[1]	
		(iv) any **two** from: sodium sulfate zinc sulfate aluminium sulfate	[2]	
		(v) $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ [1] for correct formulae of reactants [1] for correct formula of product	[2]	11

				AVAILABLE MARKS
7	**(a)**	mass [1] of solute which will saturate [1] 100 g of water [1] at a given temperature [1] allow idea of **maximum which dissolves** for saturate	[4]	
	(b) **(i)**	40 (°C)	[1]	
	(ii)	solubility at 70 °C = 134 [1] (g/100 g water) solubility at 20 °C = 32 [1] (g/100g water) 134 – 32 = 102 [1] g $\frac{102}{2}$ = 51 [1] g	[4]	
	(c)	dissolved oxygen content decreases [1] aquatic life dies [1]	[2]	11
			Total	**100**

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