CCEA GCSE CHEMISTRY

CHEMISTRY



EXAM QUESTION PACK

UNIT C1 FOUNDATION TIER GCH11 PAPERS

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016

GCSE Chemistry

Unit 1

Foundation Tier

GCH11

[GCH11]

WEDNESDAY 15 JUNE, AFTERNOON

TIME

1 hour 15 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 80.
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 **3(a)(ii)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

10000

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1 Group 1 and 2 elements show a variety of physical and chemical properties.

(a) The picture below shows a Group 1 element reacting with water. A lilac flame is observed.



© E. R. Degginger / Science Photo Library

(i) State four **other** observations for this reaction.

1. _____

2. _____

3. _____

4. _____ [4]

(ii) Name the Group 1 element which is reacting with water.

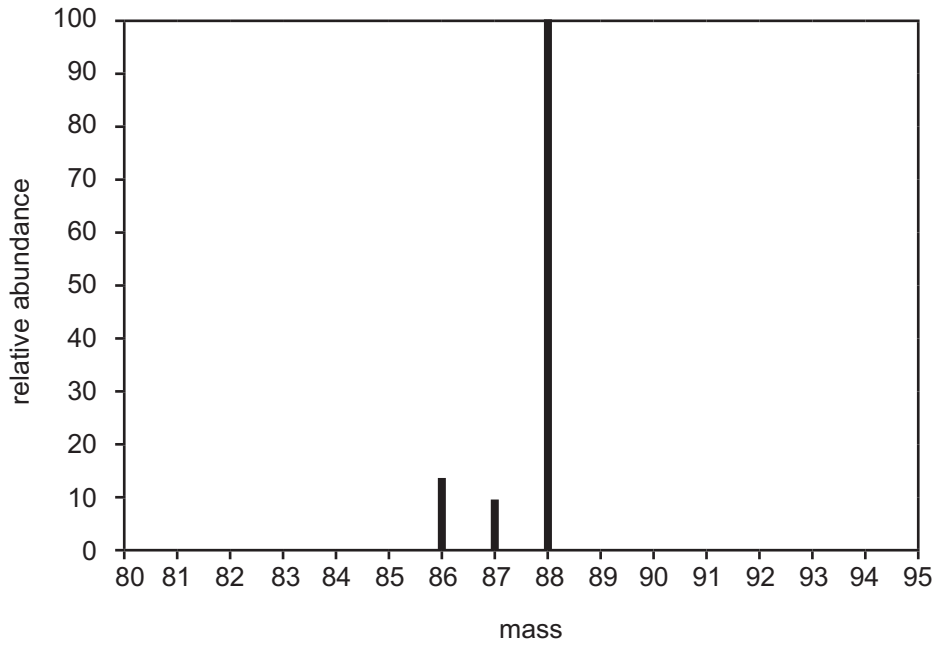
_____ [1]

(iii) Name the **two** products of the reaction of this Group 1 element with water.

_____

_____ [2]

(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) What is meant by the term isotope?

_____

_____ [2]

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

_____ [1]

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

_____ [1]

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

_____ [1]

[Turn over

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

_____

_____ [1]

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2 Solutions may be classified as acidic, alkaline or neutral using the pH scale.

(a) (i) Name an indicator which may be used to find the pH value of a solution.

_____ [1]

(ii) Complete the following table.

Name of Compound	Formula	pH value
	H_2SO_4	
Water	H_2O	
	CH_3COOH	3

[4]

(b) Hydrochloric acid reacts with zinc metal to produce a salt and hydrogen gas.

(i) Name the salt produced in this reaction.

_____ [1]

(ii) Describe the chemical test for hydrogen gas and state the result for a positive test.

_____

_____

_____

_____ [2]

[Turn over

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(c) An excess of hydrochloric acid can build up in the stomach and 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]

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

(i) Write the formula of aluminium hydroxide.

_____ [1]

(ii) State the colour of aluminium hydroxide.

_____ [1]

(iii) Describe what is observed when sodium hydroxide solution is added until it is in excess to a solution containing aluminium ions.

_____

_____

_____

_____

_____

_____ [3]

[Turn over

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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.



© chrisdorney / iStock / Thinkstock

(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]

[Turn over

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(ii) Describe the bonding and structure of graphite. In your answer include:

- the name of the type of bonding,
- the name of the type of structure,
- a description of the structure of graphite.

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

10000

[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, including iron(II) oxide.

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

_____ [1]

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

_____ [1]

(iii) Using full electronic configurations, draw **dot and cross** diagrams to show how atoms of calcium combine with atoms of oxygen to form calcium 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) What is the formula of iron(II) oxide?

_____ [1]

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

Atom or ion	Atomic number	Mass number	Number of protons	Number of electrons	Number of neutrons
Fe	26	56			
Fe^{2+}	26	56			

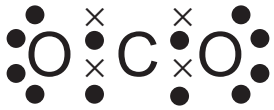
[3]

[Turn over

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

A **dot and cross** diagram for the bonding in carbon dioxide is shown below.



(i) What is the formula for carbon dioxide?

_____ [1]

(ii) What type of bonding is found in carbon dioxide?

_____ [1]

(iii) Draw a circle around a lone pair in the dot and cross diagram for carbon dioxide.

[1]

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4 The solubility of substances varies with temperature.

(a) What is meant by the term solubility?

_____

_____

_____

_____ [4]

(b) The table below shows the formulae of some compounds.

$Cu(OH)_2$	$(NH_4)_2SO_4$	KOH	$CaCO_3$

(i) Complete the table below by writing the formulae of the compounds under the headings **soluble** or **insoluble** in water. You may find your Data Leaflet useful in answering this question.

Soluble	Insoluble

[2]

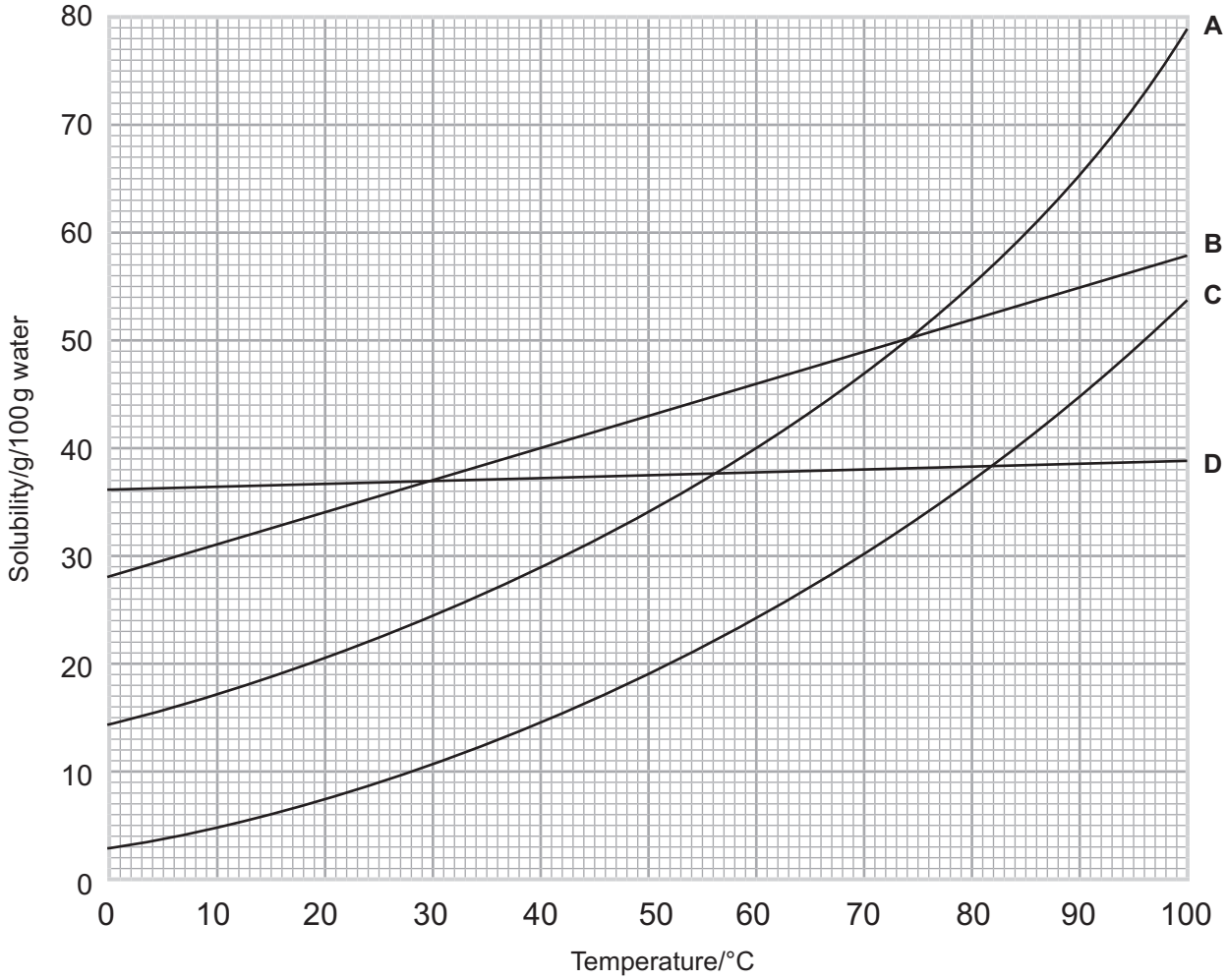
(ii) State the name of $(NH_4)_2SO_4$.

_____ [1]

[Turn over

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(c) 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) Which substance (A, B, C or D) is least soluble at 90 °C?

_____ [1]

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

_____ [1]

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

Temperature _____ °C [1]

[Turn over

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5 Seawater contains a range of dissolved salts.

(a) (i) Complete the table below for some of the salts present in seawater.

Name of Salt	Formula	Relative Formula Mass
	$MgCl_2$	
Sodium sulfate	Na_2SO_4	

[3]

(ii) The most abundant salt present in seawater is sodium chloride, NaCl.
Calculate the number of moles of sodium chloride in 29.25 kg.

(Relative atomic masses: Na = 23; Cl = 35.5)

Moles of NaCl = _____ [3]

(iii) Sodium chloride may be obtained by reacting sodium hydroxide with hydrochloric acid.
Write a balanced symbol equation for this reaction.

_____ [2]

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(b) Magnesium chloride has healing effects on a wide range of diseases. The hydrated form of magnesium chloride contains water of crystallisation and has the formula $MgCl_2.6H_2O$.

(i) What is meant by the term water of crystallisation?

_____

_____ [1]

(ii) Calculate the relative formula mass of hydrated magnesium chloride, $MgCl_2.6H_2O$.

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

Relative formula mass = _____ [1]

(iii) Use the value calculated in **(b)(ii)** to find the percentage of water of crystallisation in hydrated magnesium chloride.

Percentage of water = _____ % [2]

[Turn over

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(iv) Describe how water of crystallisation may be removed from hydrated salts and how you would ensure that all of the water of crystallisation has been removed.

_____

_____

_____ [2]

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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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29 Clarendon Road, Clarendon Dock, Belfast BT1 3BG
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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.

Contents **Page**

Periodic Table of the Elements 2–3
Symbols of Selected Ions 4
Solubility of Common Salts 4

gcse
science
chemistry
double award
single award

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THE PERIODIC TABLE OF ELEMENTS

Group

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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						

* 58 – 71 Lanthanum series																	
† 90 – 103 Actinium series																	
a / b x = relative atomic mass (approx), x = atomic symbol, b = atomic number																	
	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			

Rewarding Learning

General Certificate of Secondary Education
2016

GCSE Chemistry

Unit 1

Foundation Tier

[GCH11]

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 is 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)	any **four** from: floats [1] moves about [1] releases heat [1] fizzes or hisses or gas produced [1] crackle/small explosion/disappears [1] colourless solution remains [1] melts to form a silvery ball [1]	max [4]	
		(ii)	potassium	[1]	
		(iii)	potassium hydroxide [1] hydrogen [1]	[2]	
	(b)	(i)	(isotopes are atoms which have) same atomic number/same number of protons [1] different mass number/different number of neutrons [1]	[2]	
		(ii)	3	[1]	
		(iii)	88	[1]	
		(iv)	strontium	[1]	
		(v)	small sample/identification of elements/fast	[1]	13

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2 **(a)** **(i)** Universal Indicator [1]

(ii)

Solution	Formula	pH value
sulfuric acid [1]	H_2SO_4	0–2 [1]
water	H_2O	7 [1]
ethanoic acid [1]	CH_3COOH	3

[4]

(b) **(i)** zinc chloride [1]

(ii) apply a lighted splint [1] pop [1] [2]

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

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

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

(ii) white [1]

(iii) white [1] precipitate [1]
redissolves in excess [1] [3]

AVAILABLE MARKS

19

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AVAILABLE MARKS

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

(ii) **Indicative content**

- covalent bonding [1]
- macromolecular/giant [1] covalent
- layers (of carbon atoms) [1]
- carbon atoms bonded to three others [1]
- hexagonal (arrangement of carbon atoms) [1]
- weak forces (of attraction) between the layers [1]
- one electron unbonded per carbon atom/delocalised electrons (between layers) [1]

Response	Mark
Candidates must use appropriate specialist terms to explain fully the structures of graphite (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 structure of graphite (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 partially explain the structures of graphite (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]

(b) (i) covalent [1]

(ii) ionic [1]

(iii) (calcium atom) 2,8,8,2 [1] (oxygen atom) 2,6 [1]
(calcium ion) 2,8,8 [1] (oxide ion) 2,8 [1]
Ca^{2+} [1] O^{2-} [1] [6]
Electronic configurations must be **drawn**

(c) (i) FeO [1]

(ii)

Atom or ion	Atomic number	Mass number	Number of protons	Number of electrons	Number of neutrons
			26	26	30
			26	24	30

[1] per column [3]

(d) (i) CO_2 [1]

(ii) covalent [1]

(iii) any lone pair of electrons labelled [1]

23

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			AVAILABLE MARKS
4	**(a)**	solubility is the mass [1] of solute required to saturate [1] 100 g of water [1] at a particular temperature [1] allow maximum for saturate [4]	
	(b)	**(i)**	

Soluble	Insoluble
KOH	$Cu(OH)_2$
$(NH_4)_2SO_4$	$CaCO_3$

Each error or missing [–1] until zero [2]

(ii) ammonium sulfate [1]

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

(ii) D [1]

(iii) 56 (±1) (°C) [1]

(iv) 70 (±1) (°C) [1] 11

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					AVAILABLE MARKS
5	(a)	(i)			

Name of Salt	Formula	Relative Formula Mass
magnesium chloride [1]	$MgCl_2$	95 [1]
sodium sulfate	Na_2SO_4	142 [1]

[3]

(ii) 29 250 g [1]

$\frac{29250}{58.5\ [1]}$ = 500 [1] mol [3]

(iii) $NaOH + HCl \rightarrow NaCl + H_2O$ [2]

(b) **(i)** water which is chemically bonded in the crystal structure [1]

(ii) 203 [1]

(iii) 108 [1] /203 × 100 = 53.2 [1] [2]

(iv) heat [1] to constant mass [1] [2] 14

Total **80**

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Centre Number

Candidate Number

General Certificate of Secondary Education
2015

GCSE Chemistry

Unit 1

Foundation Tier

GCH11

[GCH11]
TUESDAY 9 JUNE, AFTERNOON

TIME

1 hour 15 minutes.

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Quality of written communication will be assessed in Question **2(c)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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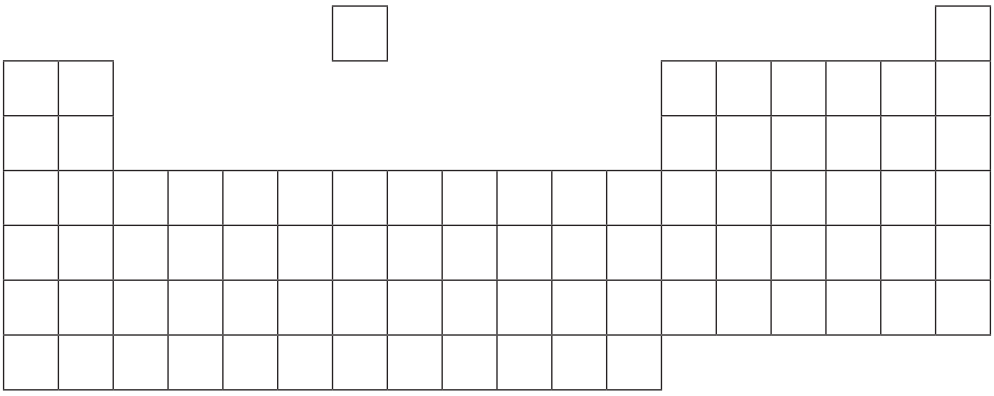
1 The Periodic Table has been developed over many years by several scientists. Each scientist produced a Periodic Table with different characteristics and this eventually led to the Periodic Table we use today.

(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 the 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]

[Turn over

(d) Iron and sulfur are two elements found in the Periodic Table.

(i) Describe the appearance of sulfur.

_____

_____ [2]

(ii) Describe how you would practically separate a mixture of iron and sulfur.

_____

_____

_____

_____

_____ [2]

(iii) **Name** the compound formed when iron reacts with sulfur.

_____ [1]

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 $Na_2CO_3 + 2HNO_3 \rightarrow 2NaNO_3 + CO_2 + H_2O$

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

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

(i) **Name** a base from the equations above.

_____ [1]

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

_____ [1]

(iii) Write a word equation for **Reaction A**.

_____ [2]

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

_____

_____

_____ [3]

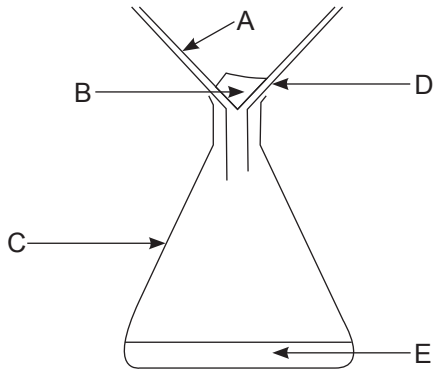
[Turn over

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

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

_____ [3]

(ii) Excess copper(II) carbonate is removed using the following apparatus.



Use the labels in the box below to identify A to E from the diagram.

beaker	condenser	conical flask
distillate	filter funnel	filter paper
filtrate	residue	separating funnel

A _____

B _____

C _____

D _____

E _____ [5]

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

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]

[Turn over

3 **(a)** Whitening toothpastes contain hydrogen peroxide which bleaches teeth.

(i) During the bleaching process the hydrogen peroxide decomposes to produce water and oxygen. Balance the equation for this reaction below.

$$H_2O_2 \rightarrow \quad H_2O + \quad O_2$$

[1]

(ii) The molecular formula of hydrogen peroxide is H_2O_2. What is its empirical formula?

_____ [1]

(b) The table below shows the chemical formula and relative formula mass of other chemicals which can be present in whitening toothpastes.

Substance	Chemical Formula	Relative Formula Mass
Sodium fluoride		
Sodium hydrogen carbonate		84
Hydrated silica	$SiO_2.2H_2O$	
Sodium lauryl sulfate	$CH_3(CH_2)_{11}SO_4Na$	

(i) Complete the table. [5]

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

_____

_____

_____ [2]

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

Percentage of water = _____ % [2]

(iv) How many different types of atoms are present in sodium lauryl sulfate?

_____ [1]

[Turn over

(c) Hydrated aluminium oxide may also be present in whitening toothpastes. In an experiment, hydrated aluminium oxide was heated to remove all of the water of crystallisation.

When 3.12 g of hydrated aluminium oxide were heated, 2.04 g of anhydrous aluminium oxide (Al_2O_3) remained.

(Relative atomic masses: H = 1; O = 16; Al = 27)

(i) Calculate the mass of water in 3.12 g of hydrated aluminium oxide.

_____ g [1]

(ii) Calculate the number of moles of water in 3.12 g of hydrated aluminium oxide.

_____ mol [2]

(iii) Calculate the number of moles of anhydrous aluminium oxide.

_____ mol [2]

4 Many substances are very soluble in water and are said to have high solubility.

(a) What is meant by the term solubility?

_____

_____

_____

_____

_____ [4]

(b) Use your Data Leaflet to determine if the substances given in the table below are soluble or insoluble in water. Place one tick (✓) in each row. The first substance has been completed for you.

Substance	Soluble	Insoluble
Sodium chloride	✓	
Lead sulfate		
Potassium carbonate		
Ammonium nitrate		
Calcium carbonate		

[4]

[Turn over

(c) The table below shows how the solubility of some solids and some gases varies with temperature.

Temperature (°C) / Substance	20	30	40	50	60
Sodium chloride	35.9	36.1	36.4	36.7	37.0
Potassium iodide	144	153	162	169	176
Oxygen	0.0043	0.0036	0.0031	0.0027	0.0023
Carbon dioxide	0.150	0.125	0.059	0.055	0.052

Use the information in the table to answer the following questions.

(i) Name the gases from the table above.

_____ [1]

(ii) State the effect of increasing temperature on the solubility of a gas.

_____ [1]

(iii) State the effect of increasing temperature on the solubility of a solid.

_____ [1]

(iv) Which substance has the lowest solubility at 40 °C?

_____ [1]

(v) Which substance is most soluble at 20 °C?

_____ [1]

5 The symbol for the element magnesium as it appears in the Periodic Table is shown below:

$$^{24}_{12}\mathrm{Mg}$$

(a) (i) The atomic number of magnesium is 12. Explain what you understand by the term atomic number.

_____

_____ [1]

(ii) The mass number of magnesium is 24. Explain what you understand by the term mass number.

_____

_____

_____ [1]

(iii) Complete the table below to give information about the particles present in the nucleus of a magnesium atom.

Name of particle	Relative Mass	Relative Charge
	1	0
		+1

[2]

[Turn over

(b) Magnesium and chlorine react together to form the ionic compound magnesium chloride.

(i) Write the formula for magnesium chloride.

_____ [1]

(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]

(iii) Magnesium chloride is a white crystalline solid at room temperature with a melting point of 714 °C. State two other physical properties of magnesium chloride.

1. _____

_____

2. _____

_____ [2]

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

_____ [1]

THIS IS THE END OF THE QUESTION PAPER

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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
2015

GCSE Chemistry

Unit 1

Foundation Tier

[GCH11]

TUESDAY 9 JUNE, AFTERNOON

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction

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AVAILABLE MARKS

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 required
P [1]
T [1]
R [1] [4]

(d) **(i)** yellow [1] solid [1] [2]

(ii) magnet [1]
iron attracted to magnet [1] [2]

(iii) iron sul**fide** [1] 15

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AVAILABLE MARKS

2 **(a)** **(i)** copper(II) oxide (accept copper oxide)/potassium hydroxide [1]
Do not accept CuO/KOH

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

(iii) magnesium + sulfuric acid → magnesium sulfate + hydrogen
correct names of reactants as displayed in a word equation [1]
correct names of products as displayed in a word equation [1] [2]

(iv) limewater [1] changes from colourless [1] to milky [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) A = filter paper [1]
B = residue [1]
C = conical flask [1]
D = filter funnel [1]
E = filtrate [1] [5]

(c) **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]

21

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AVAILABLE MARKS

3 **(a)** **(i)** $2H_2O_2 \rightarrow 2H_2O + O_2$
correct balancing [1]

(ii) HO [1]

(b) **(i)**

Substance	Chemical Formula	Relative Formula Mass
Sodium fluoride	NaF [1]	42 [1]
Sodium hydrogen carbonate	$NaHCO_3$ [1]	84
Hydrated silica	$SiO_2.2H_2O$	96 [1]
Sodium lauryl sulfate	$CH_3(CH_2)_{11}SO_4Na$	288 [1]

[5]

(ii) contains water in the crystal/structure [1]
water chemically bonded [1] [2]

(iii) $\frac{2 \times 18\,[1]}{96} \times 100 = 37.5\,[1]\,\%$ [2]

(iv) 5 [1]

(c) **(i)** (3.12 g – 2.04 g) = 1.08 [1] g [1]

(ii) $\frac{1.08}{18\ [1]} = 0.06$ [1] mol [2]

(iii) $\frac{2.04}{102\ [1]} = 0.02$ [1] mol [2]

17

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AVAILABLE MARKS

4 **(a)** 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]

(b)

Substance	Soluble	Insoluble
Sodium chloride	✓	
Lead sulfate		✓ [1]
Potassium carbonate	✓ [1]	
Ammonium nitrate	✓ [1]	
Calcium carbonate		✓ [1]

[4]

(c) **(i)** oxygen and carbon dioxide [1]

(ii) solubiliity decreases (as temperature increases) [1]

(iii) solubiliity increases (as temperature increases) [1]

(iv) oxygen [1]

(v) potassium iodide [1] 13

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5 **(a)** **(i)** number of protons [1]

(ii) total number of protons and neutrons [1]

(iii)

Particle	Relative Mass	Relative Charge
neutron [1]	1	0
proton [1]	1 [1]	+1

3 correct = [2]
2 correct = [1]
1 correct = [0] [2]

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

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

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

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

(iii) any **two** from the following points:
- conducts **electricity** when molten or in solution
- soluble in water
- brittle [2]

(iv) any correct ionic compound [1]

Total

AVAILABLE MARKS

14

80

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2014

GCSE Chemistry

Unit 1

Foundation Tier

[GCH11]

GCH11

TUESDAY 10 JUNE, AFTERNOON

TIME

1 hour 15 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 80.
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 **1(d)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

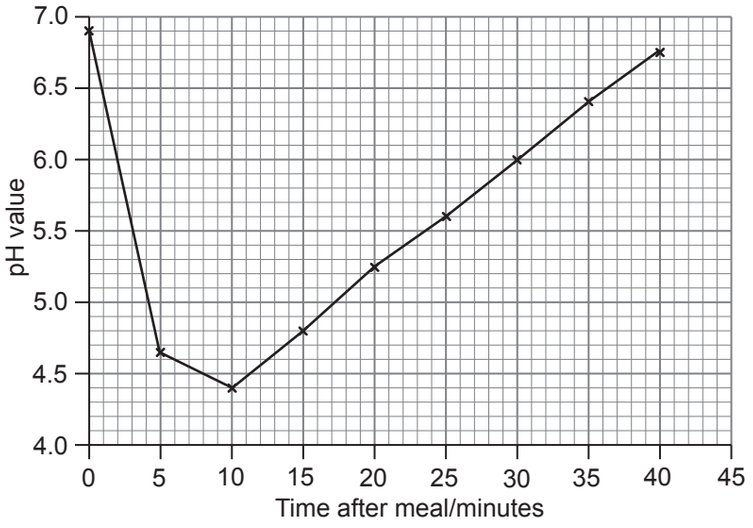
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Examiner Only	
Marks	Remark

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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(b) In the stomach food is digested by the action of hydrochloric acid. Hydrochloric acid has a pH value between 0 and 2. Excess stomach acid can cause a burning sensation called indigestion which is treated using antacid tablets to neutralise some of the acid.

Examiner Only	
Marks	Remark

(i) Explain why hydrochloric acid is a strong acid.

_____

_____

_____ [1]

(ii) Calcium carbonate is often present in antacid tablets. It reacts with hydrochloric acid to produce carbon dioxide gas. Describe a chemical test for carbon dioxide. State what you would observe for a positive test.

_____

_____

_____

_____

_____ [3]

(iii) Write a balanced symbol equation for the reaction of hydrochloric acid with calcium carbonate.

_____ [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. Some tests were carried out to prove that a salt is sodium chloride. Complete the table below.

Test	Result for a positive test
1. Flame test	
2. Add 5 drops of silver nitrate solution to a solution of the salt.	

[1]

[2]

Examiner Only	
Marks	Remark

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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

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Examiner Only	
Marks	Remark

2 The modern Periodic Table contains over 100 elements.

(a) At room temperature and pressure most of these elements are solids, a few are gases and two are liquids.

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

_____ [1]

(ii) Name two elements which exist as gases at room temperature and pressure.

1. _____

2. _____ [2]

(b) On heating, the element iodine undergoes sublimation.

(i) Explain what you understand by sublimation.

_____

_____ [1]

(ii) What would be observed when a sample of iodine is heated?

_____

_____ [2]

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

Examiner Only	
Marks	Remark

(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]

(iv) Complete the word equation below for the reaction between potassium and water.

potassium + water → _____ + _____

[2]

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

1. _____

2. _____ [2]

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.

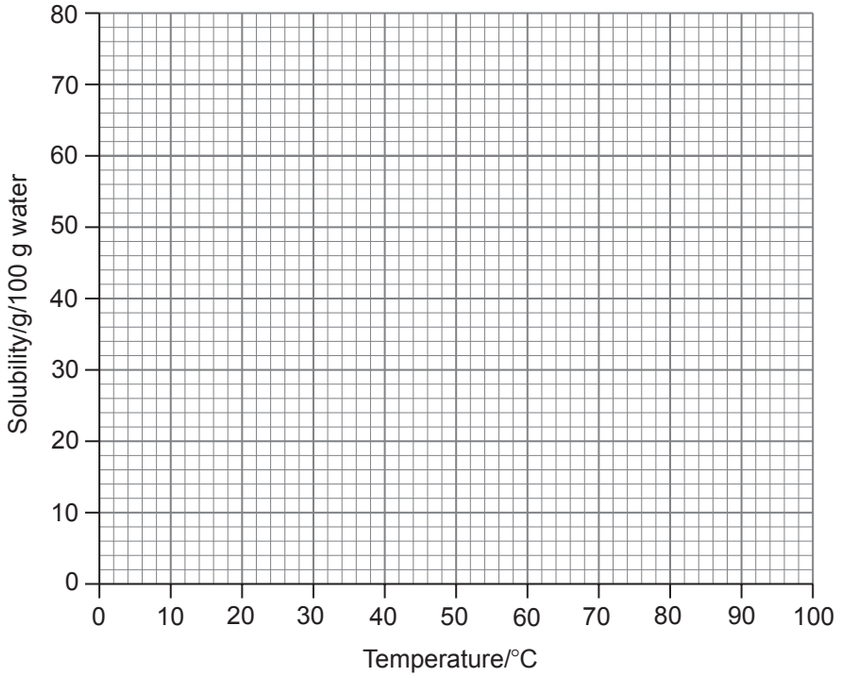
_____

_____

_____

_____ [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 solubility of copper(II) sulfate at 50 °C?

Solubility of copper(II) sulfate = _____ g/100 g water [1]

(ii) Calculate the mass of copper(II) sulfate which will saturate 10 g of water at 30 °C.

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

(iii) At what temperature will 60 g of copper(II) sulfate saturate 100 g of water?

Temperature = _____ °C [1]

(iv) A sample of 10 g of copper(II) sulfate is added to a saturated solution of copper(II) sulfate in 100 g of water at 60 °C. What mass from the 10 g sample of copper(II) sulfate would dissolve?

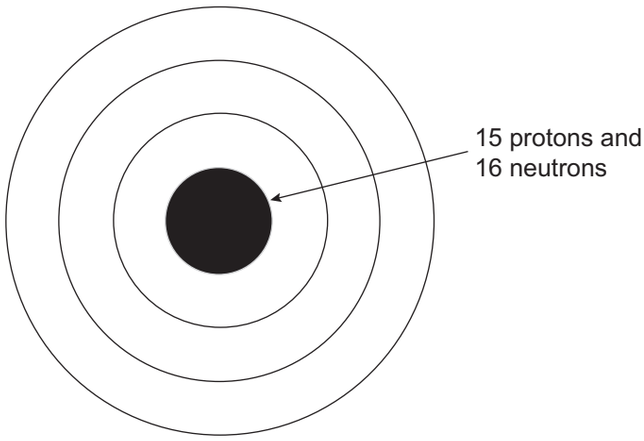
_____ [1]

Examiner Only	
Marks	Remark
Total Question 3	

[Turn over

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4 The diagram below represents an atom of an element. The electrons are missing from the diagram.



(a) (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]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

(b) The atoms of the Group 8 elements have a full outer shell of electrons.

(i) What name is given to Group 8 of the Periodic Table?

_____ [1]

(ii) Complete the table below for some Group 8 elements.

Name of element	Electronic configuration of an atom of the element
	2, 8
	2
argon	

[3]

(c) The box below contains examples of chemical symbols and formulae.

CO_2	NO_3^-	S^{2-}
SO_4^{2-}	Br_2	Ne
O^{2-}	S	O_2

From the box above select the formula or symbol for:

(i) a diatomic molecule _____ [1]

(ii) a molecular ion _____ [1]

(iii) the sulfide ion _____ [1]

[Turn over

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(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 structure is described as giant covalent.

_____ [1]

(iii) Which substance has the lowest melting point?

_____ [1]

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

_____ [1]

(e) Diamond is an allotrope of which element?

_____ [1]

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, $C_{21}H_{22}N_2O_2$.

Relative atomic masses: H = 1; C = 12; N = 14; O = 16; K = 39; Mn = 55

(a) Calculate the relative formula mass (RFM) of potassium permanganate and strychnine.

(i) Potassium permanganate

RFM _____ [1]

(ii) Strychnine

RFM _____ [1]

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

(i) Using the formula explain why strychnine is a compound.

_____

_____

_____ [2]

(ii) Write the empirical formula for strychnine.

_____ [1]

[Turn over

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Examiner Only	
Marks	Remark

(iii) 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]

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



© Crown copyright

What do you understand by this symbol?

_____ [1]

(c) 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) 0.035 moles of potassium permanganate were used in this experiment. Calculate the mass of potassium permanganate used.

Mass of $KMnO_4$ _____ g [1]

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

_____

_____

_____ [2]

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

[3]

THIS IS THE END OF THE QUESTION PAPER

Examiner Only	
Marks	Remark
Total Question 5	

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

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2014

GCSE Chemistry

Unit 1

Foundation Tier

[GCH11]

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AVAILABLE MARKS

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

(ii) colourless [1]

(iii) 3 (minutes) [1]

(b) **(i)** pH in the range of a strong acid
accept completely ionised **in water/solution** [1]

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

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

(c)

Test	Result for a positive test
1. Flame test	(golden) yellow
2. Add 5 drops of silver nitrate solution to a solution of the salt.	white [1] ppt [1]

[1]

[2]

(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) (any incorrect extra observation loses this mark) allow solution **remains** colourless
- 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]

19

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2 **(a)** **(i)** Hg [1]

(ii) Any **two** from:
- helium
- neon
- argon
- krypton
- xenon
- radon
- hydrogen
- nitrogen
- oxygen
- fluorine
- chlorine

[2]

(b) **(i)** (a change in state) from solid to gas [1]

(ii) black/(dark) grey solid [1] produces purple/violet/vapour/gas [1] [2]

(c) **(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

[3]

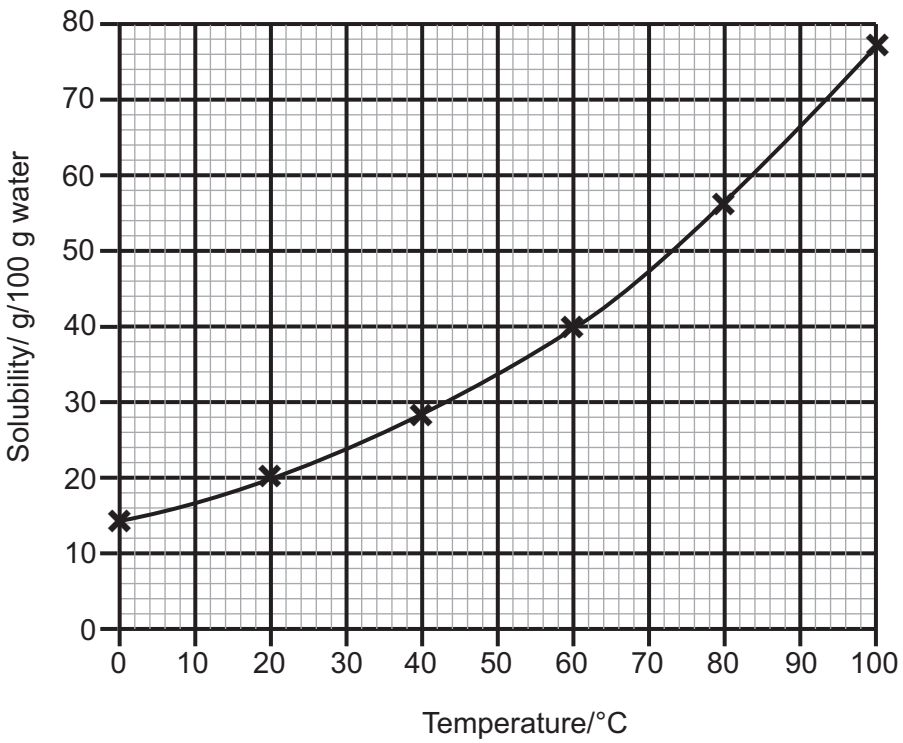
(iv) potassium hydroxide + hydrogen
[1] [1] [2]

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

16

AVAILABLE MARKS

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					AVAILABLE MARKS
3	(a)	(i)	**contains** water of crystallisation	[1]	
		(ii)	blue	[1]	
		(iii)	no more solute/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)	34 [1] g/100 g water; allow ± 2 Apply consequential marking from graph	[1]	
		(ii)	solubility at 30 °C = 24 [1] g/100 g water allow ± 2 in 10 g of water 2.4 [1] g would saturate Apply consequential marking from graph	[2]	
		(iii)	85 [1] °C allow ± 2	[1]	
		(iv)	0/zero [1] g	[1]	15

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4 **(a)** **(i)** 15 [1]

(ii) 31 [1]

(iii) nucleus [1]

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

(b) **(i)** Noble gases [1]

(ii)

Name of element	Electronic configuration of an atom of the element
neon [1]	2, 8
helium [1]	2
argon	**2, 8, 8** [1]

[3]

(c) **(i)** Br_2/O_2 [1]

(ii) NO_3^- **or** SO_4^{2-} [1]

(iii) S^{2-} [1]

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

(ii) graphite/diamond [1]

(iii) carbon dioxide [1]

(iv) aluminium/graphite/iron [1]

(e) carbon [1]

16

AVAILABLE MARKS

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					AVAILABLE MARKS
5	**(a)**	**(i)**	158	[1]	
		(ii)	334	[1]	
	(b)	**(i)**	strychnine has four elements/more than two elements [1] chemically combined [1]	[2]	
		(ii)	$C_{21}H_{22}N_2O_2$	[1]	
		(iii)	element = carbon [1] mass = 12 [1]	[2]	
		(iv)	toxic/poisonous	[1]	
	(c)	**(i)**	0.035 × 158 = 5.53 [1] g	[1]	
		(ii)	oxygen/gas [1] released to the surroundings [1] second mark dependent on first	[2]	
		(iii)	Bunsen burner/HEAT in correct position [1] tripod and pipeclay triangle [1] crucible without lid [1] No labels = [0]	[3]	14
				Total	**80**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2013

Science: Chemistry

Unit C1

Foundation Tier

[GCH11]

GCH11

MONDAY 10 JUNE, AFTERNOON

TIME

1 hour 15 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 **80**.
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)(iv)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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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) Name one diatomic element.

_____ [1]

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

_____ [1]

(iv) Name one transition metal.

_____ [1]

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

_____ [1]

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

_____ [1]

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(vii) Name one element which sublimes on heating.

_____ [1]

(b) The element chlorine reacts with all Group 1 elements. Chlorine is found in Group 7 of the Periodic Table.

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

Colour: _____

State: _____ [2]

(ii) Name the compound formed when lithium reacts with chlorine.

_____ [1]

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

_____ [1]

(iv) Potassium reacts with chlorine according to the word equation:

potassium + chlorine $\longrightarrow$ potassium chloride

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

_____ [3]

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

_____ [1]

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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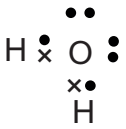
(a) Water contains the elements hydrogen and oxygen.

(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) A dot and cross diagram showing the bonding in water is given below.



On the diagram above use an arrow to label the following features:
Label a covalent bond, A
Label a lone pair of electrons, B. [2]

(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]

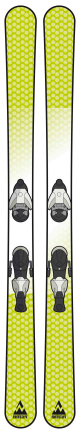
Examiner Only

Marks	Remark

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(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.

Examiner Only	
Marks	Remark



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

_____

_____

_____ [2]

(ii) Instead of steel, aluminium can be used on the edges of skis to make a very lightweight ski. State one other use of aluminium.

_____ [1]

(iii) Graphite is one of the allotropes of carbon. Name another allotrope of carbon.

_____ [1]

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(iv) 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
Total Question 2	

[Turn over

Examiner Only	
Marks	Remark

3 Metal compounds are widely used in agriculture, in medicine and as catalysts.

(Relative atomic masses: H = 1; C = 12; N = 14; O = 16; S = 32; Cl = 35.5; Cu = 64)

(a) Complete the table below which gives information on some copper(II) compounds.

Copper compound	Formula	Colour	Relative Formula Mass
Hydrated copper(II) chloride	$CuCl_2.2H_2O$	blue-green	
Copper(II) oxide	CuO		
Copper(II) nitrate		blue	

[5]

(b) Copper(II) sulfate may be prepared by reacting copper(II) carbonate with sulfuric acid. The equation for the reaction is as follows:

$$CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + CO_2 + H_2O$$

4.65 g of copper(II) carbonate were added to a solution of sulfuric acid. The reaction produced 0.02 moles of copper(II) sulfate, $CuSO_4$.

(i) Calculate the number of moles present in 4.65 g of copper(II) carbonate.

Moles of copper(II) carbonate _____ [2]

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(ii) How would you know when the reaction was complete?

_____

_____ [1]

(iii) Calculate the mass of copper(II) sulfate, $CuSO_4$, present in 0.02 moles.

Mass of copper(II) sulfate _____ [2]

(c) A metal ore with the formula XO_2 was isolated from the Earth's crust and found to have a relative formula mass of 80. Determine the relative atomic mass and identity of metal X.

You may find your Data Leaflet useful in answering this question.

Relative atomic mass of X _____

Identity of metal X _____ [2]

Examiner Only	
Marks	Remark
Total Question 3	

[Turn over

Examiner Only	
Marks	Remark

4 **(a)** The pH values of four solutions were determined by adding universal indicator and comparing the final colour to the colour chart.

(i) Complete the table below.

Solution	Colour in universal indicator	pH
Deionised water	Green	
Milk		6
Washing soda		12
Sulfuric acid	Red	

[4]

(ii) Select from the table above an example of each of the following:

A weak acid _____

A strong alkali _____ [2]

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

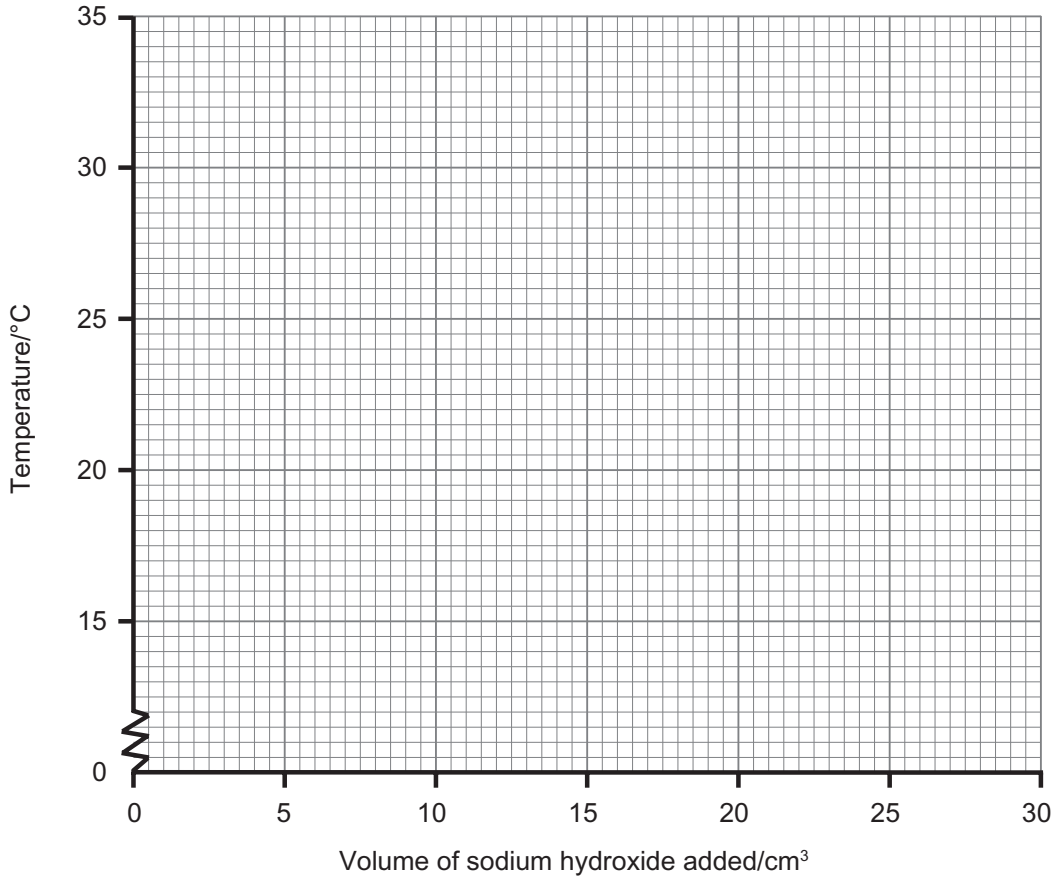
- 25 cm^3 of 1.0 mol/dm^3 hydrochloric acid were measured out and placed in a polystyrene cup.
- The temperature of the hydrochloric acid was recorded.
- 25 cm^3 of 1.0 mol/dm^3 sodium hydroxide solution were then added gradually in 5 cm^3 portions to the hydrochloric acid, stirring after each addition.

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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) Use the results in the table to plot a graph of temperature against volume of sodium hydroxide added.



[3]

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

_____

_____ [1]

Examiner Only

Marks	Remark

[Turn over

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(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
Total Question 4	

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(Questions continue overleaf)

[Turn over

5 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.

(a) What is meant by the term solubility?

_____

_____

_____

_____ [4]

(b) Suggest why the mixture was filtered.

_____

_____ [1]

(c) Draw a labelled diagram of the assembled apparatus used to filter the mixture.

[3]

Examiner Only	
Marks	Remark

(d) The student obtained 7.1 g of potassium nitrate. Calculate the solubility of potassium nitrate at 20 °C.

Examiner Only	
Marks	Remark

_____ g/100 g water [1]

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 ion present in all acid solutions.

_____ [1]

(ii) Complete the table to give the colour observed when hydrochloric acid is tested with red and blue litmus paper.

	Hydrochloric acid
Colour of red litmus paper	
Colour of blue litmus paper	

[2]

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

_____

_____

_____ [2]

(b) 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 each 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]

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(c) Each of the acids reacts with bases to produce salts.

(i) To identify the metal ion present in a salt a flame test can be carried out. Complete the table below to give the flame colour for each of the metal ions listed.

Metal ion	Flame colour
Potassium	
Calcium	
Copper	

[3]

(ii) The metal ion in a salt can also be identified using sodium hydroxide solution. Use the results in the table below to identify the metal ion present in salt A and salt B.

Salt	Observation on adding a few drops of sodium hydroxide solution	Observation on adding an excess of sodium hydroxide solution
A	Blue precipitate	Blue precipitate remains
B	White precipitate	White precipitate remains

Metal ion in salt A _____

Metal ion in salt B _____ [2]

THIS IS THE END OF THE QUESTION PAPER

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

Foundation Tier

[GCH11]

MONDAY 10 JUNE, AFTERNOON

MARK SCHEME

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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)	hydrogen/nitrogen/oxygen/bromine/iodine	[1]	
		(iii)	hydrogen/nitrogen/oxygen/helium/neon/argon	[1]	
		(iv)	iron/copper	[1]	
		(v)	rubidium	[1]	
		(vi)	argon	[1]	
		(vii)	iodine	[1]	
	(b)	(i)	yellow-green [1] gas [1]	[2]	
		(ii)	lithium chlor**ide**	[1]	
		(iii)	(chlorine is) toxic	[1]	
		(iv)	$2K + Cl_2 \rightarrow 2KCl$ [1] for correct formulae of reactants [1] for correct formula of product [1] for correct balancing	[3]	
		(v)	halogens	[1]	15

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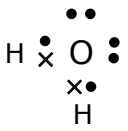
AVAILABLE MARKS

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)



either shared pair of electrons labelled as A [1]
either lone pair of electrons labelled as B [1] [2]

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

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AVAILABLE MARKS

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

(ii) overhead electrical cables/aircraft alloys [1]

(iii) diamond [1]

(iv) **Indicative content**

High melting point:
- strong bond between (carbon) atoms/in the layers [1]
- idea that these bonds are covalent [1]
- a lot of 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] 17

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3 (a)

AVAILABLE MARKS

Copper compound	Formula	Colour	Relative Formula Mass
Hydrated copper(II) chloride	$CuCl_2.2H_2O$	blue	171 [1]
Copper(II) oxide	CuO	black [1]	80 [1]
Copper(II) nitrate	$Cu(NO_3)_2$ [1]	blue	188 [1]

[5]

(b) (i) RFM of $CuCO_3$ = 124 [1]

$\left(\frac{4.65}{124} = \right)$ 0.0375 [1] [2]

(ii) no more bubbles/gas given off [1]

(iii) RFM of $CuSO_4$ = 160 [1]

$(0.02 \times 160 =)$ 3.2 [1] g [2]

(c) RAM of X = 48 [1]

X is titanium/Ti [1] [2] 12

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AVAILABLE MARKS

4 (a) (i)

Solution	Colour in universal indicator	pH
Deionised water	Green	7 [1]
Milk	Yellow [1]	6
Washing soda	Blue/Purple [1]	12
Sulfuric acid	Red	any value between 0 and 2 [1]

[4]

(ii) weak acid: milk [1]
strong alkali: washing soda [1] [2]

(b) (i) 5/6 points correct [2]
3/4 points correct [1]
1/2 points correct [0]
curve/best fit line [1] [3]

(ii) idea of 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]

13

5	**(a)**	mass of solute [1] which will saturate [1] 100 g of water [1] at a particular temperature [1] in the context of a definition [4]	**or**	maximum [1] mass of solute which dissolves in [1] 100 g of water [1] at a particular temperature [1]
	(b)	to remove the solid (which did not dissolve) [1]		
	(c)	marks are awarded for recognisable pieces of equipment correctly labelled and assembled to suit the experiment filter funnel [1] filter paper [1] suitable container [1] to collect filtrate [3]		
	(d)	$(7.1 \times 4 =) 28.4$ (g/100 g water) [1]		

AVAILABLE MARKS

9

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6 **(a)** **(i)** hydrogen [1] ion [1]

(ii)

	Hydrochloric acid
Colour of red litmus paper	red [1]
Colour of blue litmus paper	red [1]

[2]

(iii) pH meter [1]
lowest reading is the strongest [1] [2]

(b)

	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 at all 3 tests [4]

(c) **(i)**

Metal ion	**Flame colour**
Potassium	lilac [1]
Calcium	red [1]
Copper	blue-green [1]

[3]

(ii) A copper/copper(II)/Cu^{2+} [1]
B magnesium/Mg^{2+} [1] [2]

Total

AVAILABLE MARKS

14

80

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New Specification

Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012

Science: Chemistry

Unit C1

Foundation Tier

[GCH11]

GCH11

TUESDAY 12 JUNE, MORNING

TIME

1 hour 15 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 six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is **80**.
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.

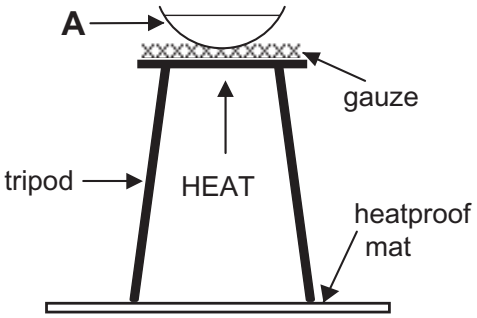
For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
Total Marks	

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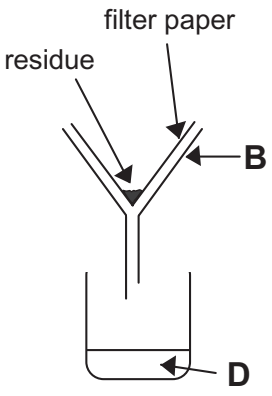
1 Mixtures may be separated in the laboratory in many different ways.

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

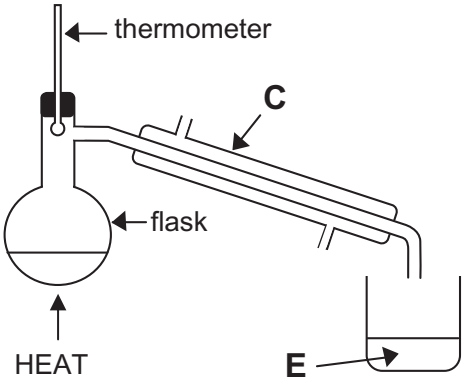
Method 1



Method 2



Method 3



(i) Name the pieces of apparatus labelled **A**, **B** and **C**.

A _____

B _____

C _____ [3]

(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 **D** collected in Method 2 and liquid **E** collected in Method 3?

D _____

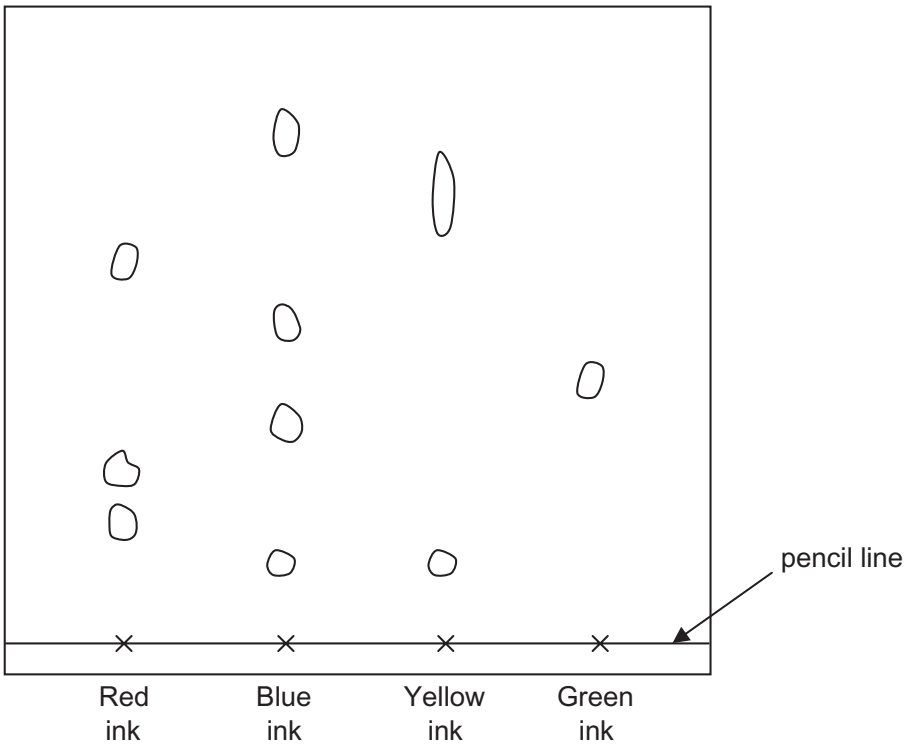
E _____ [2]

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]

Examiner Only	
Marks	Remark

2 The non-metals oxygen and chlorine can form compounds with most metallic elements and also with some other non-metallic elements.

(a) Magnesium metal reacts with oxygen gas to form the ionic compound magnesium oxide.

(i) Complete the table below to show the electronic configuration of magnesium and oxygen before and after bonding.

	magnesium	**oxygen**
Electronic configuration before bonding		
Electronic configuration after bonding		

[4]

(ii) State the charge of a magnesium ion and an oxide ion.

Magnesium ion _____

Oxide ion _____ [2]

(iii) Magnesium oxide has a melting point of 2852 °C. Explain why magnesium oxide has a very high melting point.

_____

_____

_____ [2]

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(b) 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]

Examiner Only	
Marks	Remark

3 **(a)** A new element was added to the Periodic Table on February 19, 2010. It was officially named Copernicium, after a famous scientist and astronomer called Nicolaus Copernicus, and it was given the chemical symbol Cn. The position of Copernicium in the Periodic Table is shown below.

							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**						

(i) What is meant by the term element?

_____

_____ [1]

(ii) In which period of the Periodic Table is Copernicium (Cn) found?

_____ [1]

(iii) From your knowledge of the Periodic Table, state if Copernicium is a metal or non-metal.

_____ [1]

Examiner Only	
Marks	Remark

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(b) In the Periodic Table elements with similar properties appear in the same group. Some of the groups in the Periodic Table have names.

(i) 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]

(ii) Potassium belongs to Group 1 of the Periodic Table. State how potassium should be stored.

_____ [1]

(iii) Before demonstrating the reaction of potassium with water, a risk assessment must be carried out. State **two** safety precautions, apart from wearing safety glasses, which must be included in the risk assessment for reacting potassium with water.

1. _____

_____

2. _____

_____ [2]

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.

'An image of a packet of bath crystals has been removed'

(a) (i) Some of the solids present in bath crystals are shown in the table below.

Complete the table.

(Relative atomic masses: O = 16; Na = 23; P = 31)

Solid	Formula	Relative formula mass
sodium hexametaphosphate	$Na_6P_6O_{18}$	
sodium chloride		58.5

[2]

(ii) The molecular formula of sodium hexametaphosphate is shown in the table. What is the empirical formula of sodium hexametaphosphate?

_____ [1]

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(b) Bath crystals also contain Epsom salts (hydrated magnesium sulfate) which relax muscles, reduce inflammation and help muscle function.

Examiner Only	
Marks	Remark

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

0.05 moles of magnesium sulfate crystals were prepared in the laboratory by reacting 6.3 g of 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) Calculate the mass of magnesium sulfate present in 0.05 moles of magnesium sulfate.

_____ g [2]

(ii) Calculate the number of moles present in 6.3 g of magnesium carbonate, $MgCO_3$.

_____ [2]

(c) Epsom salts contain water of crystallisation and have the formula $MgSO_4.7H_2O$.

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

(i) What is meant by the term water of crystallisation?

_____

_____ [2]

(ii) Calculate the relative formula mass of Epsom salts $MgSO_4.7H_2O$.

_____ [1]

(iii) Use the value calculated in **(c)(ii)** to find the percentage of water of crystallisation in Epsom salts.

_____ % [2]

Examiner Only	
Marks	Remark

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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

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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. Calcium hydroxide solution is an alkali.

(i) What do you understand by the term alkali?

_____ [1]

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

_____ [3]

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

_____ [1]

(iv) Name the gas which can be detected using calcium hydroxide solution.

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

(a) 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) Describe how the solubility of potassium chloride varies with temperature.

_____

_____ [1]

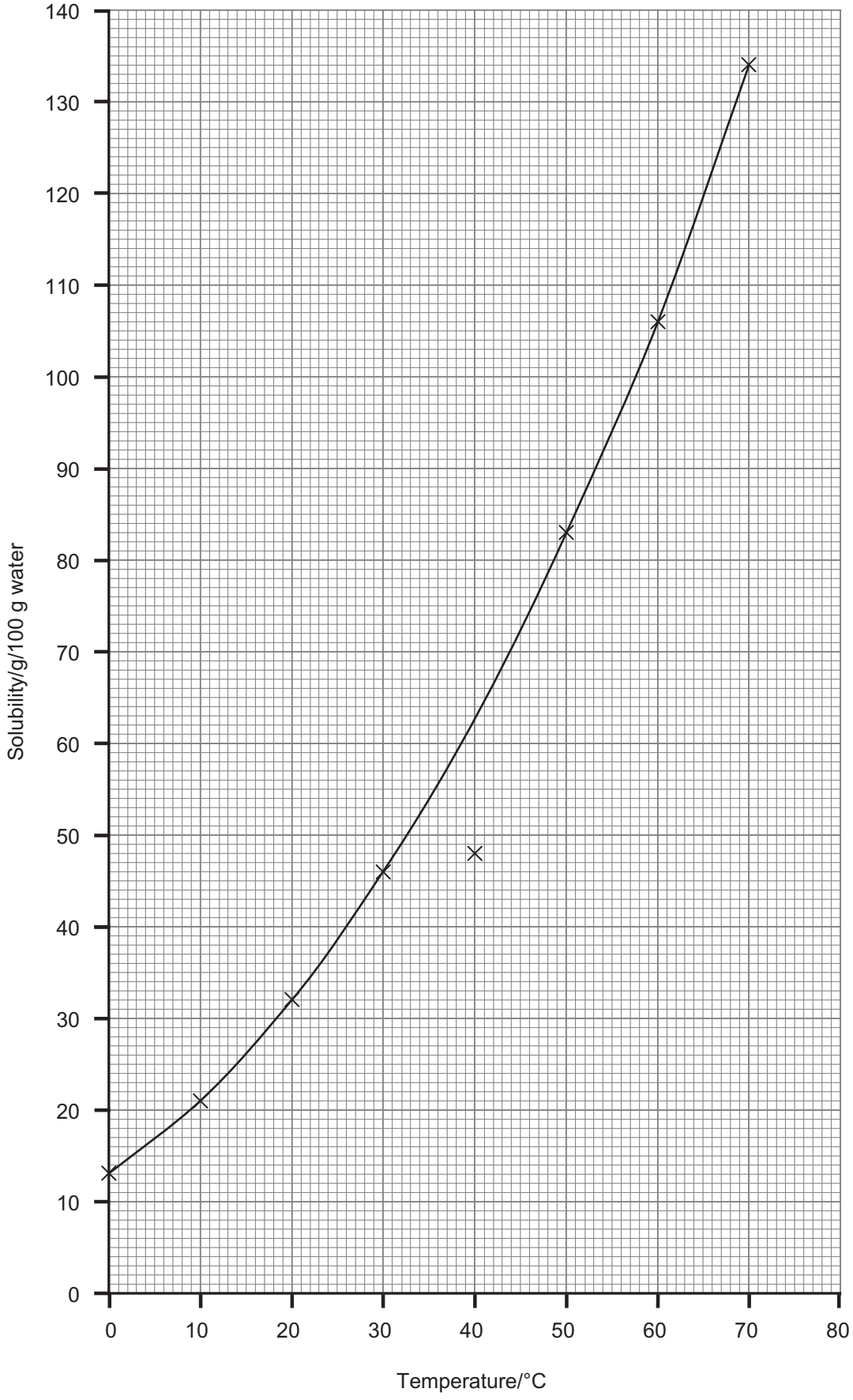
(ii) Which temperature value should the student repeat?

_____ [1]

(iii) From the graph determine the solubility of potassium chloride at 55 °C.

_____ [1]

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THIS IS THE END OF THE QUESTION PAPER

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2012

Science: Chemistry

Unit C1

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[GCH11]

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 is 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.

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					AVAILABLE MARKS
1	(a)	(i)	**A** = evaporating basin/dish [1] **B** = filter funnel [1] **C** = (Liebig) condenser [1]	[3]	
		(ii)	Method 2/filtration/filtering	[1]	
		(iii)	copper sulfate is soluble	[1]	
		(iv)	**D** = filtrate [1] **E** = distillate [1]	[2]	
	(b)	(i)	blue (ink)	[1]	
		(ii)	blue (ink)	[1]	
		(iii)	yellow and blue (inks)	[1]	10

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2 (a) (i)

	magnesium	oxygen
Electronic configuration before bonding	2,8,2 [1]	2,6 [1]
Electronic configuration after bonding	2,8 [1]	2,8 [1]

[4]

(ii) magnesium ion: 2+ [1]
oxide ion: 2– [1] [2]

(iii) strong bonds [1]
substantial energy required to break [1] [2]

(b) (i) sharing of electrons [1]
idea of a pair of electrons [1] [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

AVAILABLE MARKS

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AVAILABLE MARKS

3 **(a)** **(i)** a substance which consists of only one type of atom [1]

(ii) 7 [1]

(iii) metal [1]

(b) **(i)**

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]

(ii) under oil [1]

(iii) small piece of potassium [1]
safety screen [1]
tongs for lifting potassium [1] maximum [2]

(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)
- 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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4 **(a)** **(i)**

Solid	Formula	Relative formula mass
sodium hexametaphosphate	$Na_6P_6O_{18}$	612 [1]
sodium chloride	NaCl [1]	58.5

[2]

(ii) $NaPO_3$ [1]

(b) **(i)** RFM $MgSO_4$ = 120 [1]
0.05 × 120 = 6 [1] g [2]

(ii) RFM $MgCO_3$ = 84 [1]

number of moles $= \frac{6.3}{84} = 0.075$ [1] [2]

(c) **(i)** water which is (chemically) bonded [1]
into the crystal structure [1] [2]

(ii) 246 [1]

(iii) % water $= \frac{126\ [1]}{246} \times 100 = 51.2$ [1] % [2]

AVAILABLE MARKS

12

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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 points). 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 points). 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 points). 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]

				AVAILABLE MARKS
(b)	**(i)**	soluble base	[1]	
	(ii)	$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$ [1] for correct formulae of reactants [1] for correct formulae of products [1] for correct balancing (only awarded if all formulae correct)	[3]	
	(iii)	limewater	[1]	
	(iv)	carbon dioxide/CO_2	[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]	22

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				AVAILABLE MARKS
6	**(a)**	mass of solute [1] 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)** as temperature increases, solubility increases	[1]	
		(ii) 40 (°C)	[1]	
		(iii) 94 [1] g/100 g water	[1]	7
			Total	**80**