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.

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24GCH1101

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.

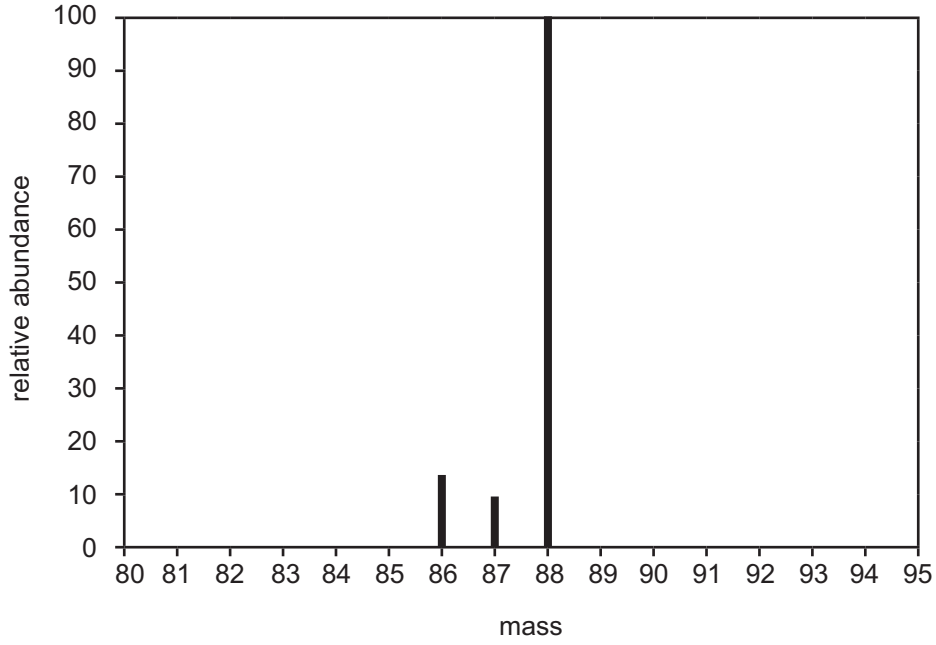
_____ [1]

(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

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

_____

_____ [1]

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

(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]

(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]

(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.

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[6]

[Turn over

(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]

(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.

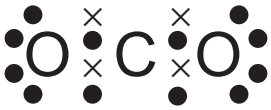
Atom or ion	Atomic number	Mass number	Number of protons	Number of electrons	Number of neutrons
Fe	26	56			
Fe^{2+}	26	56			

[3]

[Turn over

(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]

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**

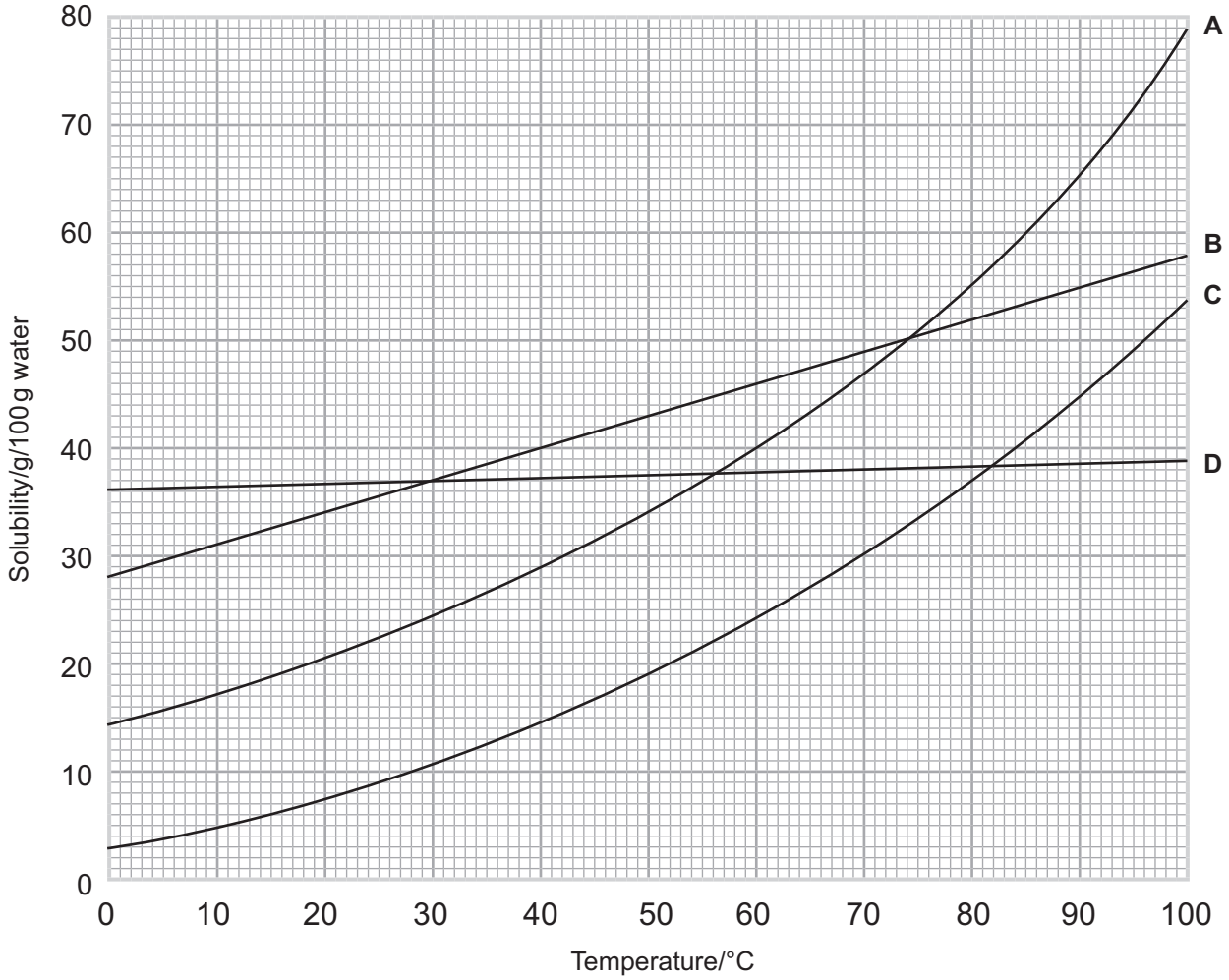
[2]

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

_____ [1]

[Turn over

(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

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]

(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

(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	
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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
✆ +44 (0)28 9026 1200 +44 (0)28 9026 1234 +44 (0)28 9024 2063 info@ccea.org.uk www.ccea.org.uk
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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

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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