



Rewarding Learning

General Certificate of Secondary Education
2016

Centre Number

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Candidate Number

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GCSE Chemistry

Unit 1

Higher Tier



[GCH12]

GCH12

WEDNESDAY 15 JUNE, AFTERNOON

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages.

Complete in blue or black ink only. **Do not write with a gel pen.**

Answer **all five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Questions **2(d)** and **3(a)(iii)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

10001



20GCH1201

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

Reaction A: sodium + water \rightarrow sodium hydroxide + hydrogen

Reaction B: potassium + fluorine \rightarrow potassium fluoride

Reaction C: sodium bromide + chlorine \rightarrow sodium chloride + bromine

Reaction D: potassium iodide + bromine \rightarrow potassium bromide + iodine

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

1. _____

2. _____

3. _____

[3]

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

_____ [2]

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

_____ [3]

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

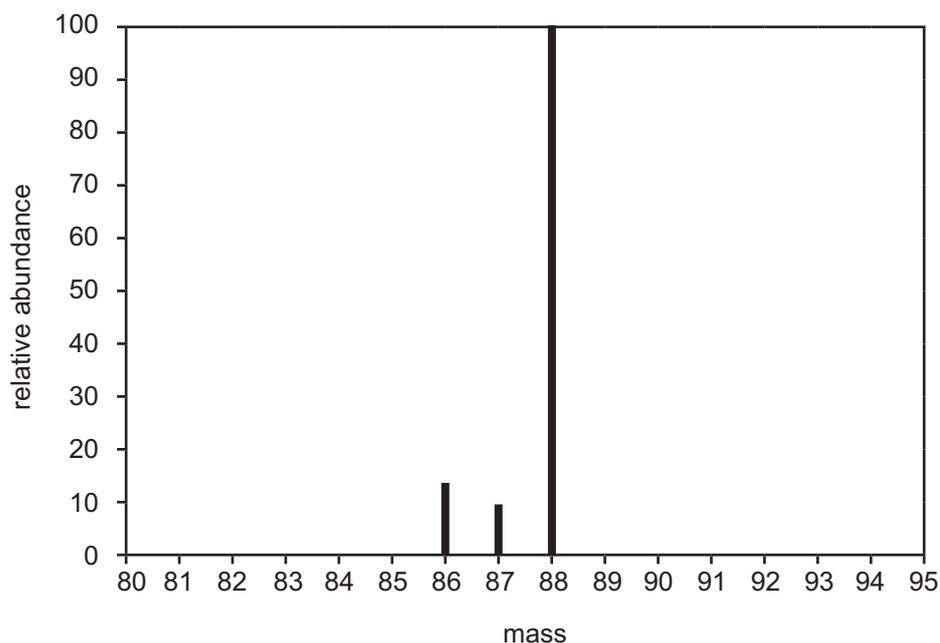
From _____ to _____ [2]

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

_____ [3]



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



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

_____ [1]

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

_____ [1]

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

_____ [1]

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

_____ [1]

[Turn over



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

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

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

[3]

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

[3]

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

(i) Write the formula of aluminium hydroxide.

[1]

(ii) State the colour of aluminium hydroxide.

[1]



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



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

- (i) What is meant by the term alloy?

[2]

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

	Type of bonding	Type of structure
Graphite		
Iron		

[4]

[Turn over





[6]

10001

[Turn over



20GCH1209

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

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

_____ [1]

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

_____ [1]

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

[6]



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

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

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

[4]

(ii) What is meant by the term ion?

[1]



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

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

[3]

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20GCH1212

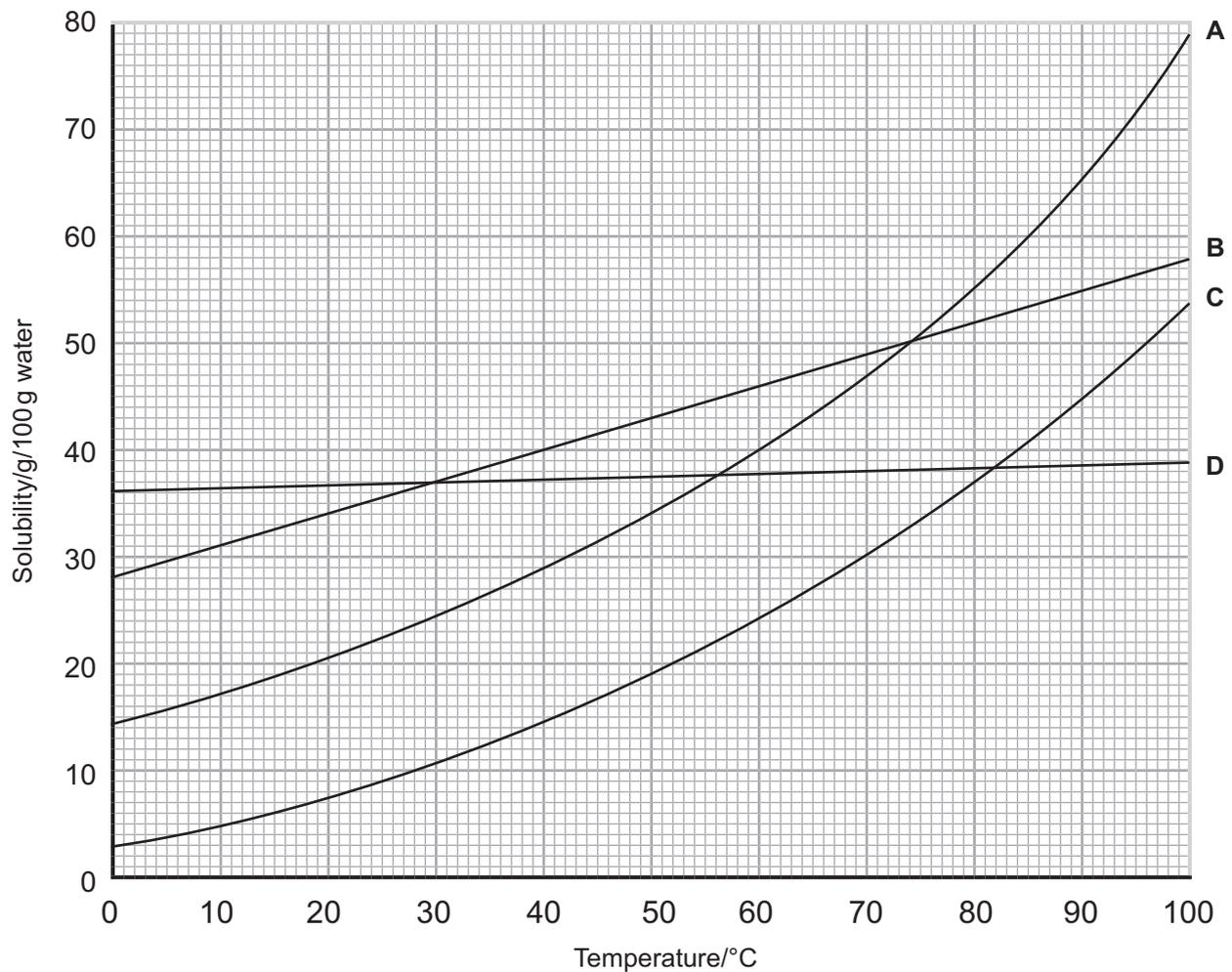
4 The solubility of substances varies with temperature.

(a) What is meant by the term solubility?

[4]



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



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

_____ [1]

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

_____ [1]

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

Temperature _____ °C [1]

10001



20GCH1214

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

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

Which mixtures (1–4) are saturated solutions?

_____ [2]

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

Temperature _____ °C [4]

[Turn over



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10001



20GCH1216



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

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



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

_____ [2]

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

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

Mass of nitrogen dioxide _____ g [5]

[Turn over



- (b) Magnesium chloride has healing effects on a wide range of diseases. The hydrated form of the salt has the formula $\text{MgCl}_2 \cdot n\text{H}_2\text{O}$.

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

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

Mass of empty crucible = 13.87 g

Mass of crucible and hydrated magnesium chloride = 15.90 g

Mass of crucible and anhydrous magnesium chloride = 14.82 g

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

Mass of water _____ g [1]

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

Moles of water _____ [1]

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

Mass of anhydrous magnesium chloride = _____ g [1]

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

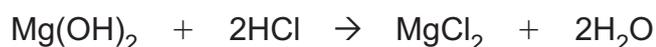
Moles of anhydrous magnesium chloride = _____ [1]



- (v) Using your answer to parts (ii) and (iv), calculate the value of n in $\text{MgCl}_2 \cdot n\text{H}_2\text{O}$.

n = _____ [1]

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



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

Mass of hydrochloric acid = _____ kg [5]

10001



20GCH1219

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Question Number	Marks
1	
2	
3	
4	
5	

Total Marks	
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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	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	HCOO^-
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

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.

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

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

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chemistry double award single award



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																	

* 58 – 71 Lanthanum series

† 90 – 103 Actinium series

$\begin{matrix} a \\ b \end{matrix} x$

 a = 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 Mendeleevium 101	254 No Nobelium 102	257 Lr Lawrencium 103