



Rewarding Learning

General Certificate of Secondary Education  
2016

Centre Number

--	--	--	--	--

Candidate Number

--	--	--	--	--

# 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.

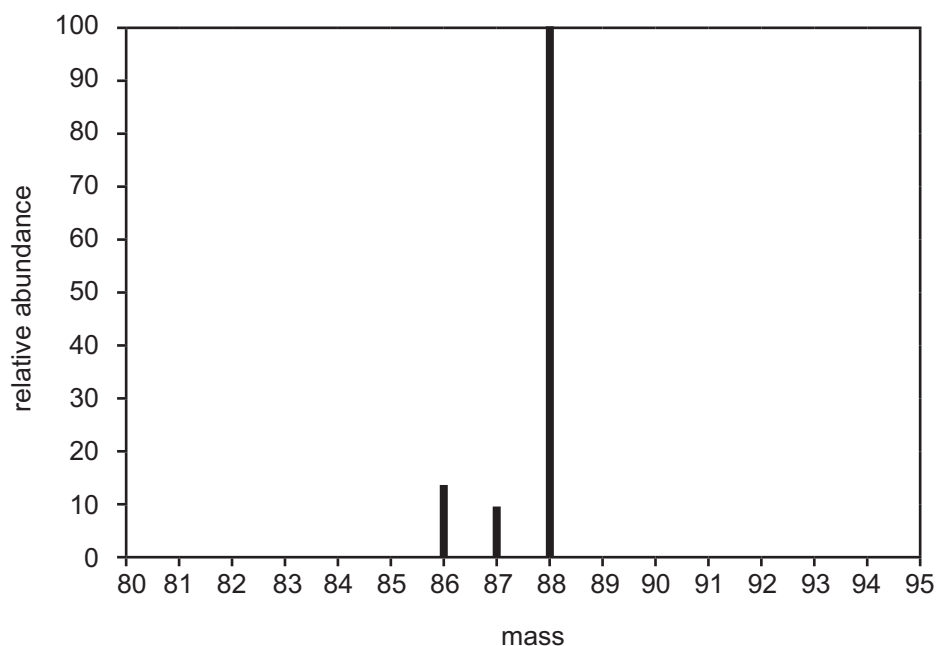
From \_\_\_\_\_ to \_\_\_\_\_ [2]

(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]



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

---



---



---



---



---



---



---



---



---



---



---

[5]

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

Metal ion	Flame colour
Na <sup>+</sup>	
	Brick red
Ba <sup>2+</sup>	

[3]

[Turn over



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

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

Your answer should include:

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

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

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

[9]



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



© 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) 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



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

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

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

10001



\*20GCH1208\*







---

---

---

---

---

---

---

---

---

---

[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]

10001



\*20GCH1210\*

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

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

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

[4]

(ii) What is meant by the term ion?

---

---

[1]

[Turn over



(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]

10001



\*20GCH1212\*

4 The solubility of substances varies with temperature.

(a) What is meant by the term solubility?

---

---

---

---

[4]

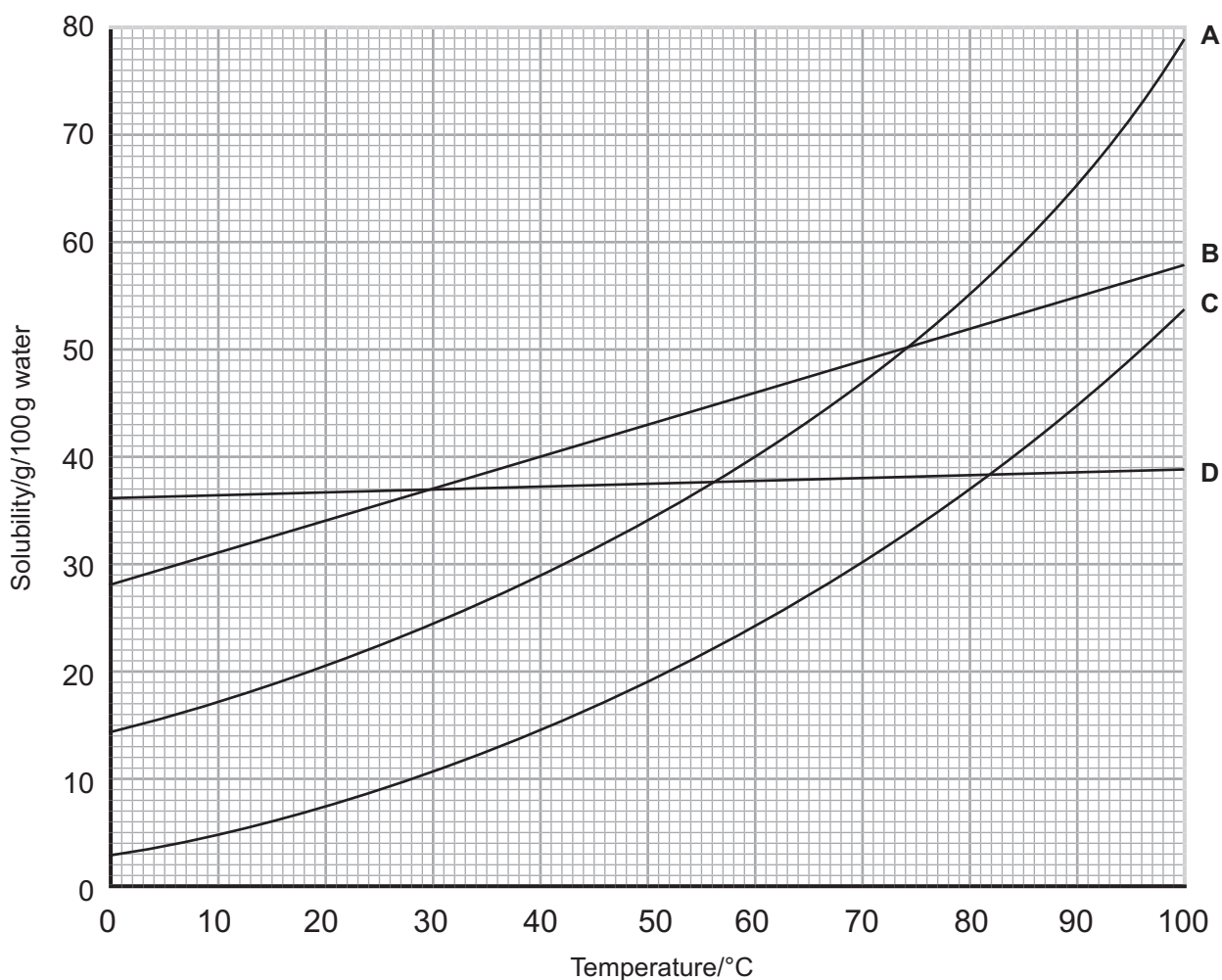
10001

[Turn over



\*20GCH1213\*

(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



**BLANK PAGE**  
**DO NOT WRITE ON THIS PAGE**

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,  $\text{NO}_2$ , 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.

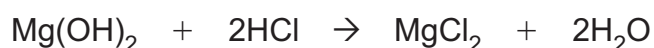
Moles of anhydrous magnesium chloride = \_\_\_\_\_ [1]



- (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]



**DO NOT WRITE ON THIS PAGE**

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

<b>Total Marks</b>	
--------------------	--

Examiner Number

Permission to reproduce all copyright material has been applied for.  
In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA will be happy to rectify any omissions of acknowledgement in future if notified.

204265



\*20GCH1220\*

## SYMBOLS OF SELECTED IONS

### Positive ions

Name	Symbol
Ammonium	$\text{NH}_4^+$
Chromium(III)	$\text{Cr}^{3+}$
Copper(II)	$\text{Cu}^{2+}$
Iron(II)	$\text{Fe}^{2+}$
Iron(III)	$\text{Fe}^{3+}$
Lead(II)	$\text{Pb}^{2+}$
Silver	$\text{Ag}^+$
Zinc	$\text{Zn}^{2+}$

### Negative ions

Name	Symbol
Carbonate	$\text{CO}_3^{2-}$
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	$\text{CH}_3\text{COO}^-$
Hydrogen carbonate	$\text{HCO}_3^-$
Hydroxide	$\text{OH}^-$
Methanoate	$\text{HCOO}^-$
Nitrate	$\text{NO}_3^-$
Sulfate	$\text{SO}_4^{2-}$
Sulfite	$\text{SO}_3^{2-}$

## 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

# gcse . Science

## chemistry double award single award



# THE PERIODIC TABLE OF ELEMENTS

## Group

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

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

<b>a</b>	x
<b>b</b>	

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

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