



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.

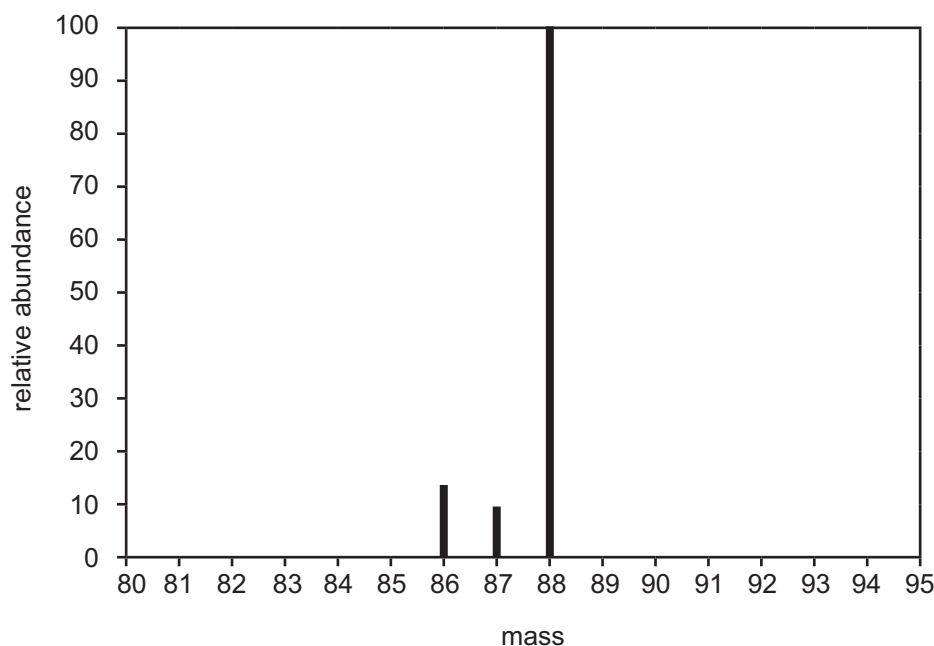
From \_\_\_\_\_ to \_\_\_\_\_ [2]

- (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.

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[3]

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

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[3]

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

**(i)** Write the formula of aluminium hydroxide.

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[1]

**(ii)** State the colour of aluminium hydroxide.

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[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.

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[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.**

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[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?

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[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.**

[illegible]

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[6]

[Turn over

10001



\*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?

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[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]



4 The solubility of substances varies with temperature.

(a) What is meant by the term solubility?

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[4]

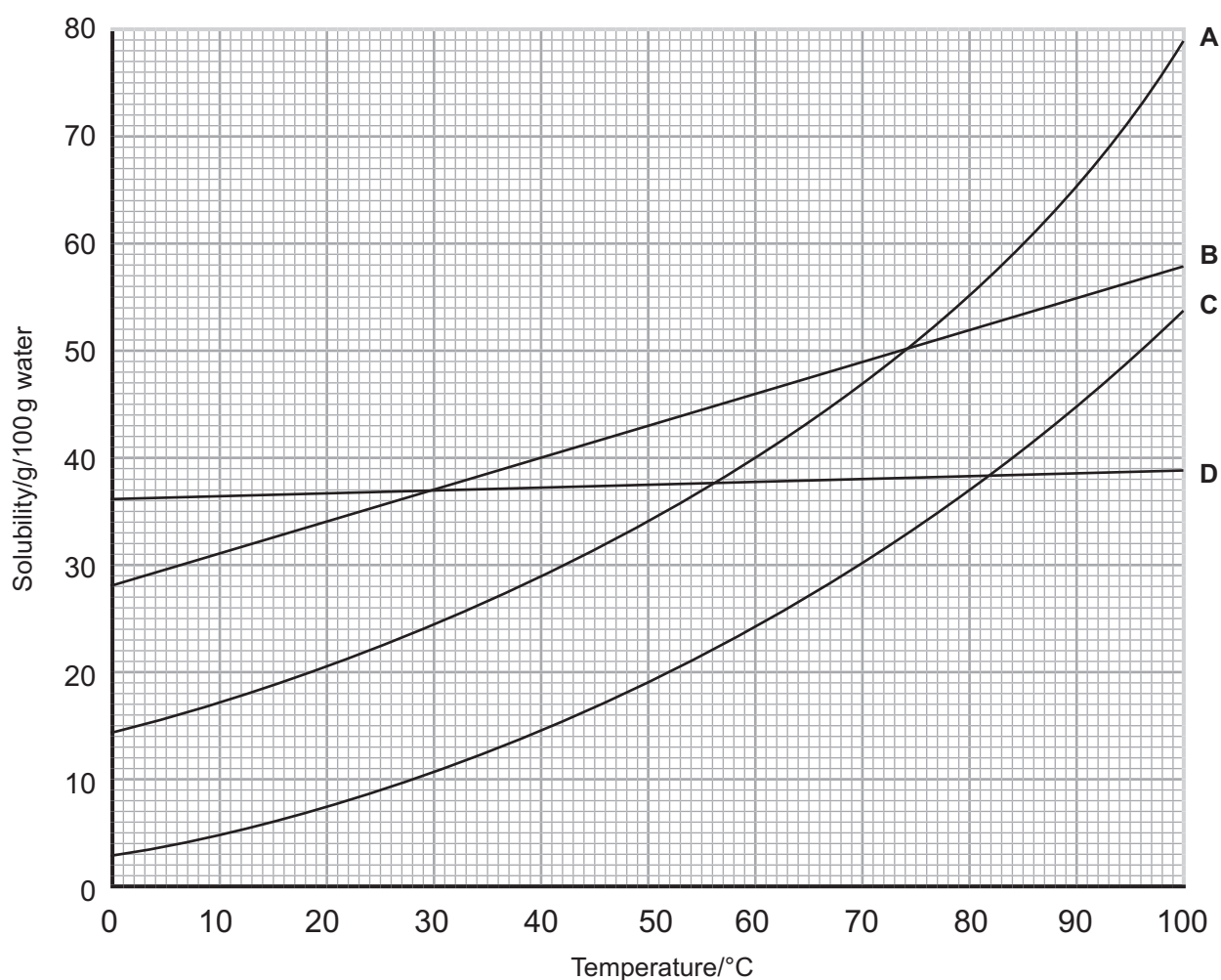
[Turn over]

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\*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]



- (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,  $\text{NO}_2$ , 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:  $\text{H} = 1$ ;  $\text{O} = 16$ ;  $\text{Mg} = 24$ ;  $\text{Cl} = 35.5$ )

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.

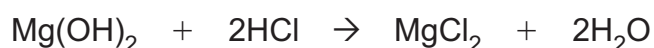
Moles of anhydrous magnesium chloride = \_\_\_\_\_ [1]



- (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]



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For Examiner's use only	
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	$\text{NH}_4^+$
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

Rewarding Learning

Group

1

2

3

4

5

6

7

0

1

H

Hydrogen

1

7

Li

Lithium

3

9

Be

Beryllium

4

23

Na

Sodium

11

24

Mg

Magnesium

12

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<sup>\*</sup>

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<sup>†</sup>

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