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General Certificate of Secondary Education 2017

### **GCSE Chemistry**

Unit 1

**Higher Tier** 



[GCH12]

\*GCH12\*

#### **WEDNESDAY 14 JUNE, MORNING**

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 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 4(c) and 5(b).

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



1	(a)	Gro	up 1 of the Periodic Table is a group of reactive metals.	
		(i)	By what name are the Group 1 metals known?	[1]
		(ii)	A piece of sodium metal is cut with a knife. Describe the appearance of the metal when it is freshly cut and a few minutes after it is cut.	
				[2]
		(iii)	Write the symbol for the least reactive element in Group 1.	[1]
	(b)	An a	atom of an element has the electronic configuration 2,8,5.  In which group of the Periodic Table is this element found?	
				[1]
		(ii)	In which period of the Periodic Table is this element found?	[1]

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(c)				f unreactive non-metals.	
	(i)	By what name are	the elements of Gr	oup 0 known?	
	(ii)	Explain why the ele	ements of Group 0	are unreactive.	
(d)	The	elements in Group	7 are reactive non	-metals.	
	(i)	The physical proper below. Complete the	·	7 elements are shown in the ta	able
		Element	Colour	Physical state at room temperature	
		Chlorine		Gas	
		lodine	Dark grey		
	(ii)	State the trend in r	eactivity on descer	nding Group 7.	
(e)	(i)	•		chlorine is added to a solution ange observed in the solution.	of
		From	t	0	
	(ii)	Write a half equation molecules.	on to represent the	conversion of iodide ions to iod	dine
					[Turn

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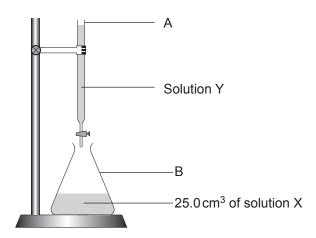
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2 (a) In an experiment a student slowly added solution Y in 0.5 cm<sup>3</sup> portions to 25.0 cm<sup>3</sup> of a solution X and swirled the mixture. The apparatus for the experiment is shown below.



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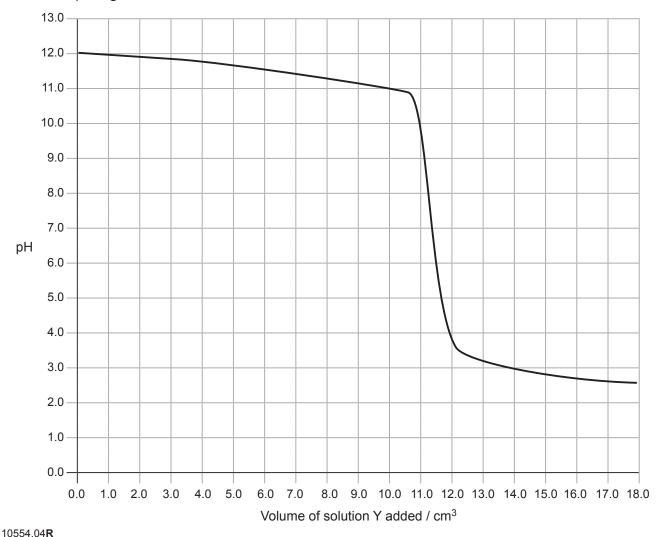
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The pH after each addition of solution Y was measured and recorded. A graph of pH against volume of solution Y added was drawn.



(i)	Name the piece of apparatus labelled A.	<sub>-</sub> [1]
(ii)	Name the piece of apparatus labelled B.	<sub>-</sub> [1]
(iii)	Suggest how the pH of the solution was measured.	
		[1]
(iv)	Why was the flask swirled after each addition of 0.5 cm <sup>3</sup> of solution Y?	<sub>-</sub> [1]
(v)	Use the graph to explain if solution X is an acidic, alkaline or neutral solution.	
		[2]
(vi)	Use the graph to describe how the pH of the mixture in the conical flask changes as solution Y is slowly added until 14.0 cm <sup>3</sup> have been added.	
		[2]
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(1	<ul><li>Write an ionic equation for the neutralisation reaction which occurs between solution X and solution Y.</li></ul>	veen
		_ [2]
(1	viii) What volume of solution Y is needed to react with solution X to form a neutral solution?	
		_ [1]

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- **(b)** Solution Z contains a mixture of two compounds. The mixture was tested to identify the cations and anions present in the mixture.
  - (i) Complete the table to give the expected observations.

Test	Observation	Deduction
1. flame test		sodium ions present
(i) add 1 cm <sup>3</sup> of sodium hydroxide solution     (ii) add excess sodium hydroxide solution		zinc ions present
3. add some barium chloride solution		sulfate ions present
4. add some silver nitrate solution		chloride ions present

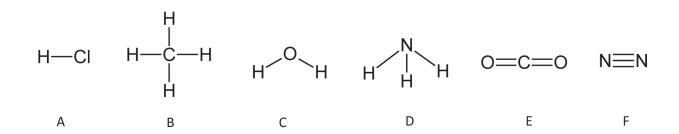
(ii)	Write an ionic equation for the reaction which occurred in test 4.	
		[2]
(iii)	Write the formulae of two different compounds which could be present in solution Z.	
		[2]

[Turn over

[5]



**3** (a) Some covalent substances are shown below. They are labelled A, B, C, D, E and F.



- (i) Which letter (A, B, C, D, E or F) represents methane? [1]
- (ii) Which letter (A, B, C, D, E or F) represents ammonia? [1]
- (iii) Which letter (A, B, C, D, E or F) represents a diatomic element? \_\_\_\_\_ [1]
- (iv) Write the chemical formula of D. \_\_\_\_\_\_[1]
- (v) Draw dot and cross diagrams to show the bonding in C and E. Only outer shell electrons should be shown.

C

[2]

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	[3
vii)What is a covalent bond?	
	[2
viii)Substance A can be formed from the reaction between hydrogen a chlorine. Write a balanced symbol equation for the reaction.	nd [3
x) Substance D reacts with substance A to form ammonium chloride. formula for ammonium chloride.	
	[1
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**(b)** When atoms form ions they lose or gain electrons.

The table below shows some information about six different ions. Complete the table.

lon	Atomic number	Mass number	Number of protons	Number of electrons	Number of neutrons
Mg <sup>2+</sup>	12	24	12	10	12
O <sup>2-</sup>	8				8
	19	39		18	
			30	28	35
Sc <sup>3+</sup>		45	21		
	53	127		54	

[6]

[3]

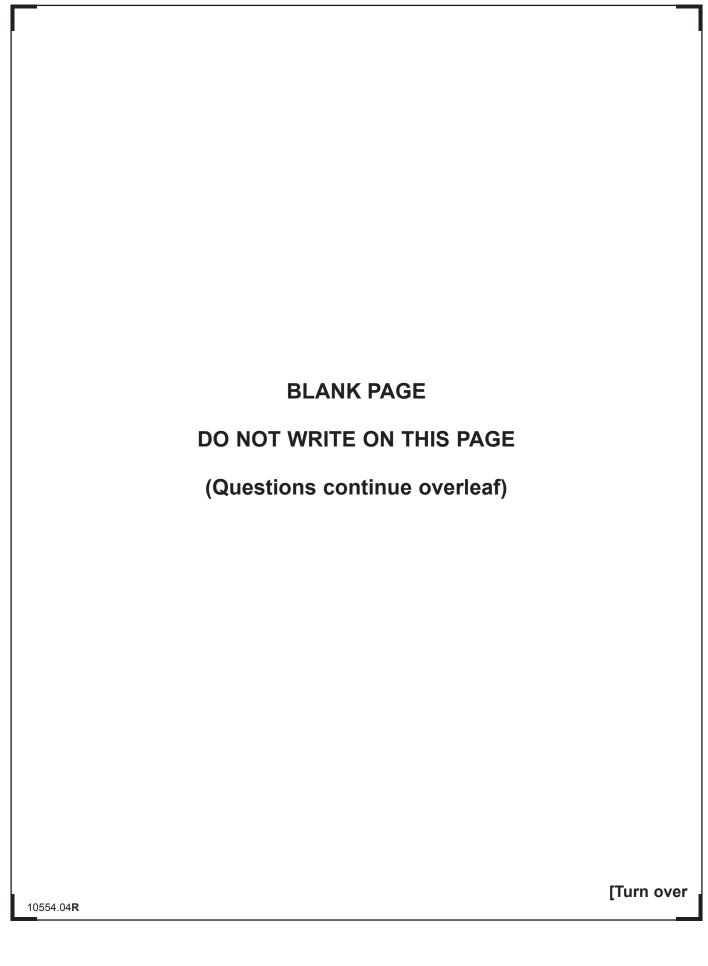
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(c) I	Mg <sup>2+</sup>	and C	) <sup>2–</sup> ions	are	attracted	to	each	other	and	form	а	compound.
-------	------------------	-------	----------------------	-----	-----------	----	------	-------	-----	------	---	-----------

(1)	Name the compound.	
		[1

(ii)	Explain why this compound has a high melting point and conducts electricity when molten.







4	Sal	ts are ionic compounds which form during reactions of acids.	
	(a)	Sodium sulfate is a salt which may be prepared by reacting sodium hydroxide with sulfuric acid. Write a balanced symbol equation for this reaction.	
			[3]
	(b)	Copper(II) sulfate is a salt which may be prepared by reacting copper(II) oxide with sulfuric acid. Write a balanced symbol equation for this reaction.	<b>:</b>
			[2]

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(c)	Describe, giving experimental details, how you would prepare <b>solutions</b> of
	<ul> <li>sodium sulfate, from the reaction of sodium hydroxide solution and sulfuric acid</li> </ul>
	<ul> <li>copper(II) sulfate, from the reaction of solid copper(II) oxide and sulfuric acid.</li> </ul>
	In this question you will be assessed on your written communication skills including the use of specialist terms.
	[6]
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(d)		prepare pure crystals of copper(II) sulfate, a copper(II) sulfate solution was porated to half volume and allowed to cool and crystallise.
	(i)	Why is the solution not evaporated to dryness?  [1]
	(ii)	Why do crystals form as the solution is cooled?
		[1]
	(iii)	State <b>two</b> methods of drying the crystals.
		[2]
(e)		determine the solubility of copper(II) sulfate in water at 20°C a saturated ition of copper(II) sulfate was evaporated to dryness.
	The	following results were obtained:
	mas	es of evaporating basin = 21.45g es of evaporating basin and saturated solution = 38.45g es of evaporating basin and copper(II) sulfate after heating = 25.95g
	the	culate the mass of copper(II) sulfate after heating and the mass of water in solution. Use these values to calculate the solubility of copper(II) sulfate in 00 g at 20°C.
		Solubility g/100 g water [3]
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**5 (a)** The following table shows details of three different calcium compounds. Complete the table.

(Relative atomic masses: H = 1; C = 12; O = 16; Ca = 40)

Substance	Mass	Relative formula mass	Moles
Ca(OH) <sub>2</sub>	0.185 g		
Ca(HCO <sub>3</sub> ) <sub>2</sub>	kg		20
(C <sub>17</sub> H <sub>35</sub> COO) <sub>2</sub> Ca	g		1.5

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(b)	Explain, giving experimental detail, how you would determine the mass of water of crystallisation present in a sample of hydrated calcium chloride. Include details of any mass measurements you would make and the equipment you would use.	
	In this question you will be assessed on your written communication skills including the use of specialist scientific terms.	
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(c) Calculate the loss in mass when all of the water of crystallisation is removed from 1.095 g of hydrated calcium chloride,  $CaCl_2.6H_2O$ .

(Relative atomic masses: H = 1; O = 16; CI = 35.5; Ca = 40)

$$\mathsf{CaCl}_2.\mathsf{6H}_2\mathsf{O} \to \mathsf{CaCl}_2 + \mathsf{6H}_2\mathsf{O}$$

(d) Calculate the percentage of water of crystallisation, by mass, in hydrated calcium chloride, CaCl<sub>2</sub>.6H<sub>2</sub>O.

(Relative atomic masses: H = 1; O = 16; CI = 35.5; Ca = 40)



#### THIS IS THE END OF THE QUESTION PAPER

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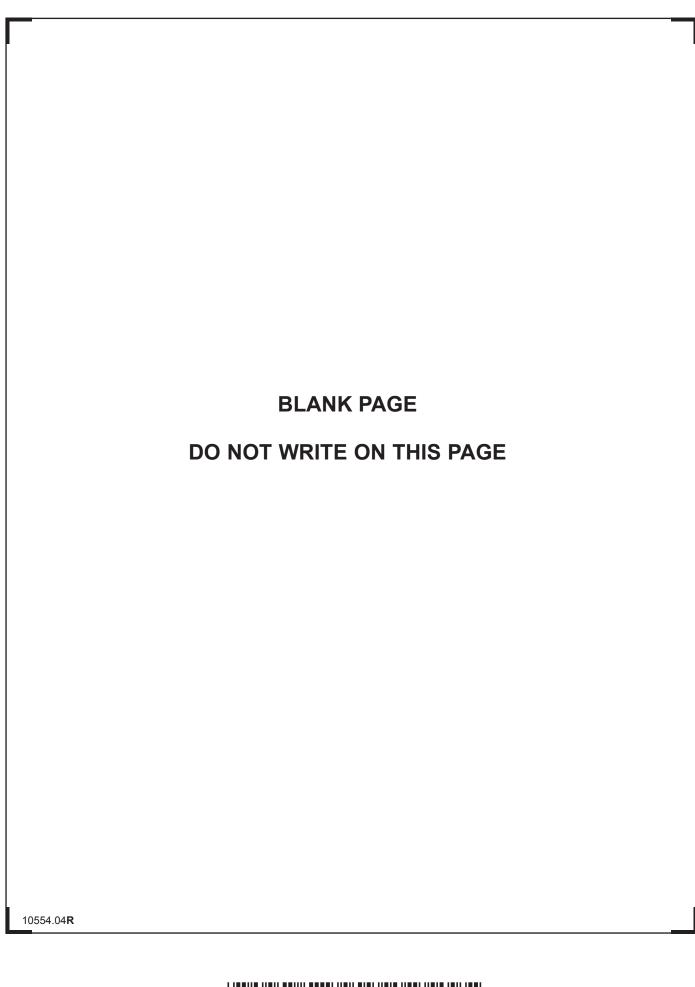
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Total Marks

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#### SYMBOLS OF SELECTED IONS

#### **Positive ions**

Name	Symbol
Ammonium	NH <sub>4</sub>
Chromium(III)	Cr <sup>3+</sup>
Copper(II)	Cu <sup>2+</sup>
Iron(II)	Fe <sup>2+</sup>
Iron(III)	Fe <sup>3+</sup>
Lead(II)	Pb <sup>2+</sup>
Silver	Ag <sup>+</sup>
Zinc	Zn <sup>2+</sup>

#### **Negative ions**

Name	Symbol
Carbonate	CO <sub>3</sub> <sup>2-</sup>
Dichromate	Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup>
Ethanoate	CH₃COO¯
Hydrogen carbonate	HCO₃
Hydroxide	OH <sup>-</sup>
Methanoate	HCOO <sup>-</sup>
Nitrate	NO <sub>3</sub>
Sulfate	SO <sub>4</sub> <sup>2-</sup>
Sulfite	SO <sub>3</sub> <sup>2-</sup>

#### 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

#### **Insoluble**

Most carbonates

**EXCEPT** 

sodium, potassium and ammonium carbonates

Calcium sulfate is slightly soluble

Most hydroxides

**EXCEPT** 

sodium, potassium and ammonium hydroxides

Most oxides

**EXCEPT** 

sodium, potassium and calcium oxides which react with water













COUNCIL FOR THE CURRICULUM EXAMINATIONS AND ASSESSMENT 29 Clarendon Road, Clarendon Dock, Belfast BT1 3BG













### 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	<b>Page</b>
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

4	<b>N</b>
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1		
	H	
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1	2						Hydrogen <b>1</b>					3	4	5	6	7	Helium 2
7 Lithium 3	9 Be Beryllium											Boron 5	Carbon	14 N Nitrogen 7	16 Oxygen 8	19 F Fluorine 9	Neon 10
Na Sodium	Mg Magnesium 12											Aluminium 13	28 Si Silicon 14	Phosphorus	32 Sulfur 16	35.5 Chlorine 17	40 Ar Argon 18
39	40	45	48	51	52	55	56	59	59	64	65	70	73	75	79	80	84
Potassium 19	Calcium 20	Sc Scandium 21	Ti Titanium 22	Vanadium 23	Cr Chromium 24	Mn Manganese 25	Fe Iron 26	Cobalt 27	Nickel 28	Cu Copper 29	Zn zinc 30	Gallium 31	Germanium 32	As Arsenic 33	Se Selenium 34	Bromine 35	Krypton 36
Rb Rubidium 37	Strontium 38	Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 TC Technetium 43		Rhodium	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 <b>Sn</b> 50	Sb Antimony 51	Tellurium 52	127       lodine   53	131 <b>Xe</b> Xenon 54
133 CS Caesium	Barium	139 La*	178 <b>Hf</b>	181 Ta	184 W Tungsten	186 Re Rhenium	190 Os Osmium	192 Ir Iridium	195 Pt Platinum	197 Au Gold	Hg Mercury	204 TI Thallium	Pb	Bi Bismuth	Polonium	210 At Astatine	Radon
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
223	226	227	261	262	263	262	265	266	269	272	285						

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

Ra

Radium

Fr

Francium

a = relative atomic mass b X (approx)

89

 $Ac^{\dagger}$ 

Actinium Rutherfordium

104

Db Dubnium

Sg Seaborgium 106

Bh

Bohrium

107

Hs

Hassium

108

109

x = atomic symbol

b = atomic number

	140	141	144	147	150	152	157	159	162	165	167	169	173	175
	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dv	Но	Er	Tm	Yb	Lu
	Cerium <b>58</b>	Praseodymium <b>59</b>	Neodymium	Promethium		Europium	Gadolinium	Terbium <b>65</b>	Dysprosium <b>66</b>	Holmium	Erbium <b>68</b>	Thulium <b>69</b>	Ytterbium <b>70</b>	Lutetium <b>71</b>
3	232	231	238	237	242	243	247	245	251	254	253	256	254	257
	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
	Thorium <b>90</b>	Protactinium		Neptunium <b>93</b>		Americium <b>95</b>	Curium <b>96</b>	Berkelium <b>97</b>	Californium <b>98</b>	Einsteinium <b>99</b>	Fermium <b>100</b>	Mendelevium <b>101</b>		Lawrencium <b>103</b>

Mt Ds Rg Cn
Meitnerium Darmstadtium Roentgenium Copernicium