Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2019–2020

Double Award Science: Chemistry

Unit C1

Higher Tier

[GDW22]

GDW22

THURSDAY 7 NOVEMBER 2019, MORNING

TIME

1 hour.

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 eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
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 **2(c)**.
A Data Leaflet, which includes a Periodic Table of the elements is provided.

12676

1 The Periodic Table contains metals and non-metals.

(a) The symbols of the elements in Group 3 of the Periodic Table are shown below with some of their atomic numbers.

Symbol	Atomic number
B	
Al	13
Ga	31
In	
Tl	81

(i) Complete the table by filling in the missing atomic numbers. [1]

(ii) What is meant by the term atomic number?

_____

_____ [1]

(iii) Name the non-metal in Group 3.

_____ [1]

(b) An isotope of gallium, atomic number 31, has 38 neutrons.

(i) What is the mass number of this isotope of gallium?

_____ [1]

(ii) How many electrons are present in a Ga^{3+} ion?

_____ [1]

(c) Complete the table below giving information about **ions** of different elements.

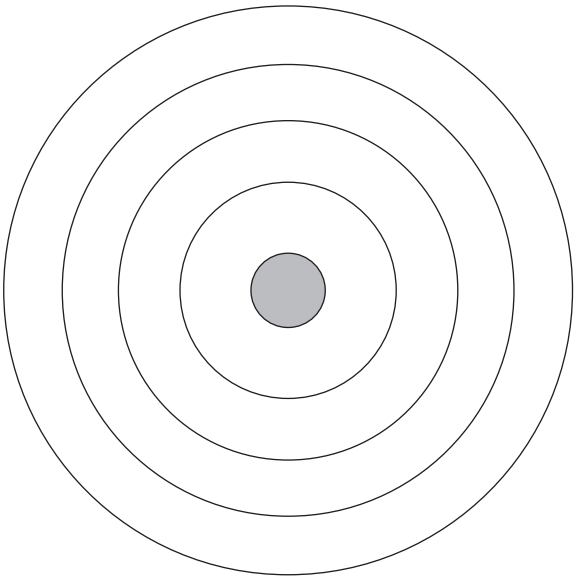
Ion	Number of protons	Number of electrons	Number of neutrons	Atomic number	Mass number
Al^{3+}		10		13	27
	8	10	8	8	
Br^{-}	35		46		81

[3]

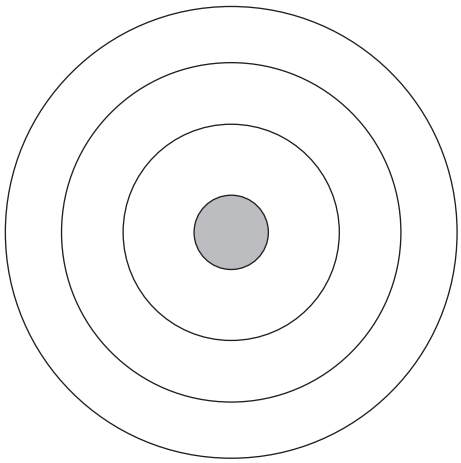
[Turn over

2 Calcium reacts with chlorine to form calcium chloride.

(a) Complete the diagrams below to show the arrangement of all of the electrons in an atom of calcium and in an atom of chlorine.



atom of calcium



atom of chlorine

[2]

(b) A flame test can be used to identify the calcium ion in calcium chloride. Complete the passage below about this flame test by **circling the correct answers**.

A nichrome wire is cleaned by dipping it in

water
concentrated hydrochloric acid
dilute hydrochloric acid

and is then dipped in calcium chloride.

A Bunsen burner is adjusted to give a

blue
yellow
orange

flame.

When the nichrome wire is now placed in the Bunsen burner flame it should produce a

crimson
lilac
brick red

colour. [3]

[Turn over

(c) The electronic configuration of a sodium atom is 2,8,1. The electronic configuration of an oxygen atom is 2,6.

Describe in words:

- how the electronic configurations of both atoms change in order to form sodium oxide including the charges of the ions formed and the formula of the compound.
- at least two physical properties you would expect sodium oxide to have.

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

How the electronic configurations of both atoms change in order to form sodium oxide including the charges of the ions formed and the formula of the compound.

At least two physical properties you would expect sodium oxide to have.

[6]

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(Questions continue overleaf)

3 Copper(II) sulfate solution may be prepared by reacting copper(II) carbonate with sulfuric acid.

(a) Write a balanced symbol equation for this reaction.

_____ [2]

(b) Using **only** the words given in the list below, answer the questions which follow. Each word may be used once, more than once or not at all.

colourless	**black**	**blue**	**green**
orange	**purple**	**red**	**white**

What colour is copper(II) carbonate?

_____

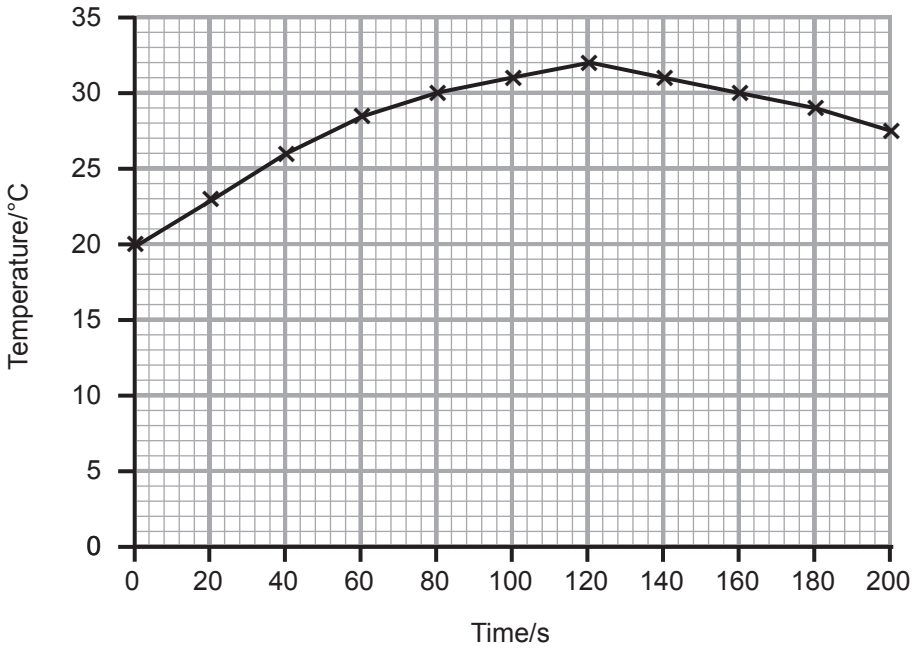
What colour is sulfuric acid?

_____

What colour is copper(II) sulfate solution?

_____ [3]

(c) A sample of copper(II) carbonate was added to 25 cm^3 of sulfuric acid and the temperature was recorded every 20 seconds. The results were plotted on the axes below.



(i) What was the temperature at the start of the reaction?

_____

What was the highest temperature recorded during the reaction?

_____

Calculate the maximum temperature change observed.

_____ [3]

(ii) Suggest why the temperature started to fall after 120 seconds.

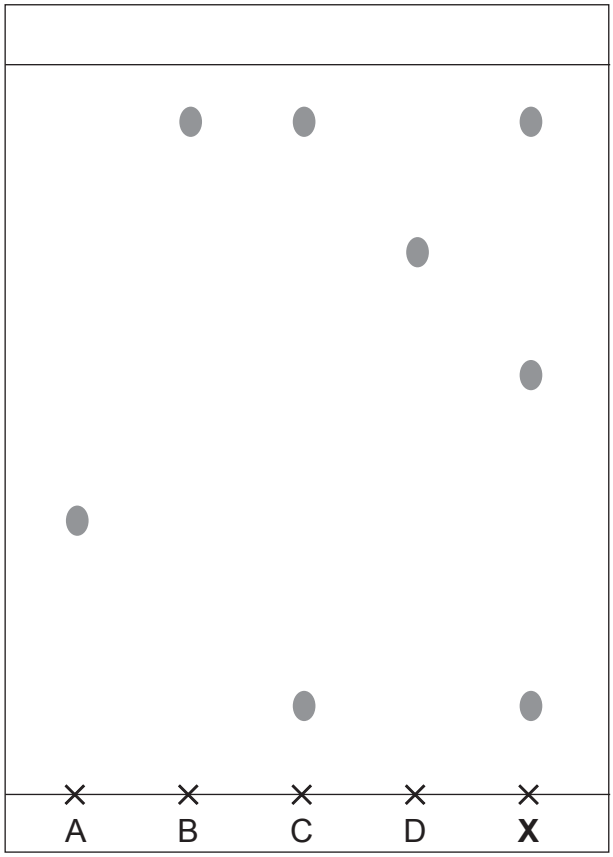
_____

_____ [1]

[Turn over

4 Many food substances contain coloured dyes which can be separated using paper chromatography.

(a) **X** is a dye that contains a banned substance and is not safe to use in food. A, B, C and D are four other dyes. The results of a chromatography experiment are shown below.



Explain fully which of the dye(s) (A, B, C, D) may **not** be safe to use in food, based on these results and on what you have been told about dye **X**.

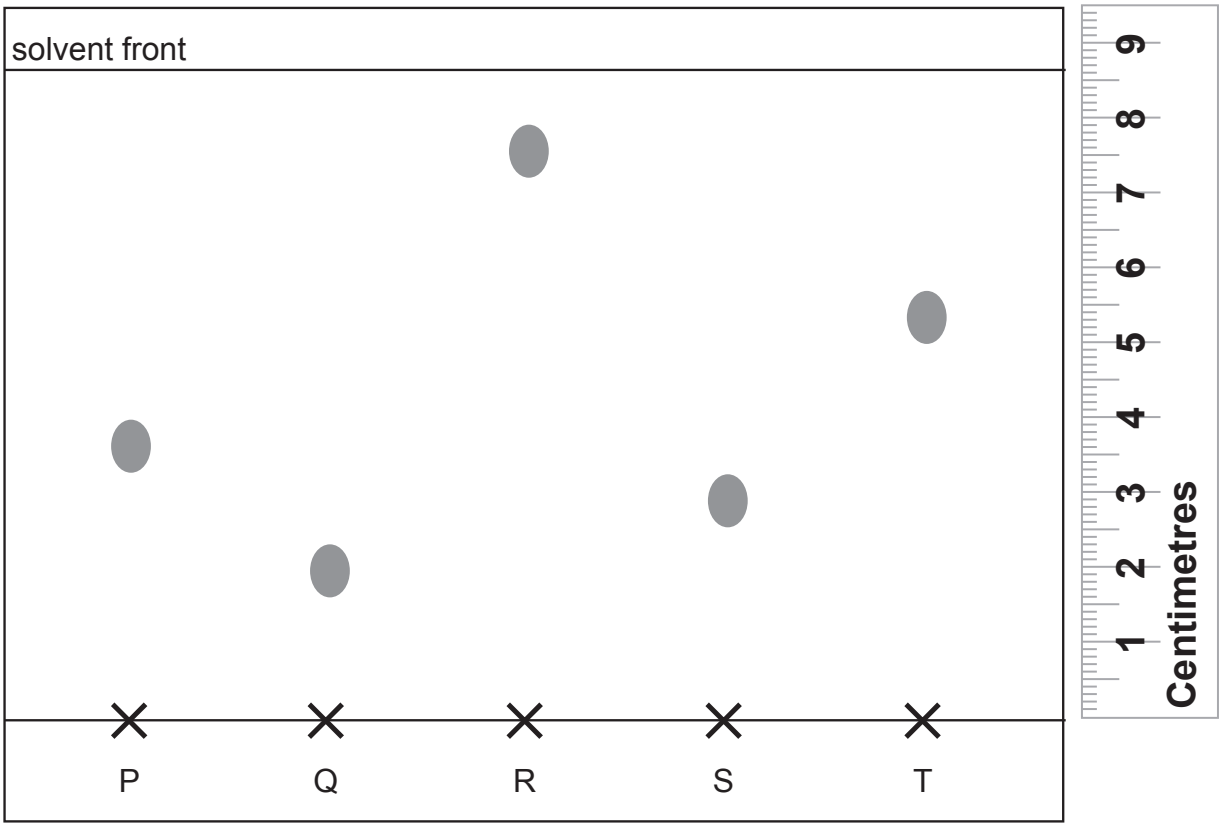
_____

_____

_____

_____ [2]

(b) The chromatogram below shows the results of an investigation using five food colourings P, Q, R, S and T.



Use the ruler shown in the diagram above to help calculate the R_f value for **T**. Give your answer to 2 decimal places.

Show your working out.

R_f = _____ [3]

[Turn over

5 This question is about the alkali metals and their reactions.

(a) Potassium is a soft metal that can be cut with a knife. It reacts vigorously with water.

(i) Complete the table below which is part of a risk assessment for adding potassium to water.

Risk	Safety precaution
	Use tweezers to lift a piece of potassium
Corrosive solution splashing out	

[2]

(ii) Complete and balance the symbol equation for the reaction of potassium with water. Include state symbols for all reactants and products.

K + H_2O → [3]

(iii) Write a half equation for the formation of a potassium ion from a potassium atom.

_____ [1]

(b) The alkali metals get more reactive as you move down the Group.
Explain this trend.

_____

_____

_____

_____

_____ [3]

(c) The alkali metals react vigorously with water. Explain why this Group of elements show similar reactions with water.

_____

_____

_____

_____ [2]

[Turn over

6 Potassium reacts with sulfur according to the balanced symbol equation:

$$2K(s) + S(s) \longrightarrow K_2S(s)$$

(a) **Name** the product in this reaction.

_____ [1]

(b) 1.17 g of potassium are reacted with excess sulfur.
(Relative atomic masses: S = 32; K = 39)

(i) Calculate the number of moles in 1.17 g of potassium.

_____ [1]

(ii) Using the balanced symbol equation, calculate the number of moles of K_2S formed.

_____ [1]

(iii) Calculate the mass, in grams, of K_2S formed.

_____ g [2]

(iv) 1.32 g of K_2S were formed when this reaction was carried out. Calculate the percentage yield using your answer to **part (b)(iii)** opposite.

percentage yield = _____ % [2]

(v) Suggest one reason why the percentage yield of K_2S was not 100 %.

_____

_____ [1]

[Turn over

7 **(a)** Some properties of five substances (A, B, C, D, E) are given in the table below.

Substance	Melting point /°C	Boiling point /°C	Conduction of electricity as a solid	Conduction of electricity as liquid
A	801	1465	No	Yes
B	–39	357	Yes	Yes
C	1085	2562	Yes	Yes
D	–102	–34	No	No
E	1710	2950	No	No

(i) Which substance (A, B, C, D or E) is a liquid at room temperature (20 °C)?

_____ [1]

(ii) Which substance (A, B, C, D or E) is most likely to have a molecular covalent structure?

_____ [1]

(iii) Which substance (A, B, C, D or E) is most likely to be an ionic compound?

_____ [1]

(iv) Which substance (A, B, C, D or E) is most likely to be copper? Explain your answer.

_____

_____

_____ [3]

(b) Zinc is a typical metal.

(i) Draw a labelled diagram to show the structure of a metal such as zinc.

[4]

(ii) Explain why metals such as zinc are malleable.

_____

_____

_____ [2]

[Turn over

8 The table below gives information about some reactions of the halogens with solutions of halides.

halogen	with lithium chloride solution	with lithium bromide solution	with lithium iodide solution
bromine	no reaction		colourless to dark brown
iodine	no reaction	no reaction	
chlorine		colourless to orange	

(a) (i) Complete the table by filling in the last box in the bottom row. [1]

(ii) If sodium fluoride solution had also been available, which, if any, of the halogens would have reacted with it?

_____ [1]

(b) When bromine is mixed with lithium iodide solution a displacement reaction occurs.

(i) Write a balanced symbol equation for the reaction of bromine with lithium iodide.

_____ [3]

(ii) In this displacement reaction which substance is being displaced?

_____ [1]

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For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
Total Marks	

Examiner Number

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
Butanoate	$C_3H_7COO^-$
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Propanoate	$C_2H_5COO^-$
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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Rewarding Learning

New Specification

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Data Leaflet

Including the Periodic Table of the Elements

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

gcse examinations

chemistry

For first teaching from September 2017

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	98 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	266 Sg Seaborgium 106	264 Bh Bohrium 107	277 Hs Hassium 108	268 Mt Meitnerium 109	271 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112						

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 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
X
b

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