



Rewarding Learning

General Certificate of Secondary Education
2022

Centre Number

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Candidate Number

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GCSE Chemistry

Unit 1

Higher Tier



[GCM12]

GCM12

FRIDAY 27 MAY, MORNING

TIME

1 hour 15 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 six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 80.

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 **3(b)(i)**.

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

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20GCM1201

(b) Potassium reacts with water. The potassium floats and moves on the surface. It melts to form a silvery ball, burns with a flame and eventually disappears, leaving a colourless solution.

(i) Apart from wearing safety glasses, state two safety precautions which should be taken when adding potassium to water.

1. _____

2. _____

_____ [2]

(ii) Explain why potassium floats on water.

_____ [1]

(iii) Explain why potassium melts during the reaction.

_____ [1]

(iv) What colour is the flame observed?

_____ [1]

(v) Explain, in terms of electrons, why the reaction of sodium with water is less vigorous than the reaction of potassium with water.

_____ [3]

[Turn over



2 Many elements, including neon, exist as isotopes.

(a) (i) What is meant by the term isotopes?

[2]

(ii) The percentage abundance of the isotopes of neon are shown below.

Isotope	Percentage abundance /%
^{20}Ne	90.1
^{21}Ne	0.3
^{22}Ne	9.6

Calculate the relative atomic mass of neon. Give your answer to 1 decimal place.

relative atomic mass = _____ [2]



- (iii) The radius of a neon atom is 45 000 times larger than the radius of its nucleus. The nuclear radius is 3.50×10^{-15} m. Calculate the atomic radius in nanometres (nm).
(1 nm = 1×10^{-9} m)

atomic radius = _____ nm [2]

- (b) The table below contains information about some atoms and simple ions of elements.

Complete the table.

Atom/ion	Atomic number	Mass number	Number of neutrons	Number of protons	Electronic configuration
H			1	1	1
K ⁺	19	39			
	13		14		2, 8
			20	17	2, 8, 7
O ²⁻		18		8	

[5]

[Turn over



3 Salts may be prepared by reacting metals or metal compounds with acids. Many salts are hydrated.

(a) The word equations below show the formation of some salts.

Equation 1: potassium hydroxide + hydrochloric acid \rightarrow **substance A** + water

Equation 2: **substance B** + nitric acid \rightarrow copper(II) nitrate + water + carbon dioxide

Equation 3: zinc oxide + **substance C** \rightarrow zinc sulfate + water

(i) Name **substances A, B and C**.

A _____

B _____

C _____ [3]

(ii) Write the formula of copper(II) nitrate.

_____ [1]

(iii) What is meant by the term hydrated?

_____ [1]



4 (a) Chlorine reacts with magnesium to form the ionic compound magnesium chloride.

(i) Draw a dot and cross diagram to show how atoms of magnesium react with atoms of chlorine to form magnesium chloride. Include the charges of the ions formed.

[6]

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(ii) The bonding in magnesium chloride is ionic. What is meant by ionic bonding?

[1]

(b) Chlorine may react with nitrogen or ammonia to form nitrogen trichloride. Nitrogen, ammonia and chlorine are gases at room temperature.

(i) Complete the table below.

Molecule	Total number of electrons in one molecule	Total number of electrons in covalent bonds in one molecule	Number of lone pairs of electrons in one molecule
Cl ₂	34		
N ₂			2
NH ₃		6	

[3]

(ii) Suggest a formula for nitrogen trichloride.

[1]

(iii) Explain why nitrogen is a gas at room temperature.

[2]

[Turn over



(c) Chlorine also reacts with methane and with water.

Draw dot and cross diagrams to show the bonding in a methane molecule and in a water molecule.

methane

water

[2]





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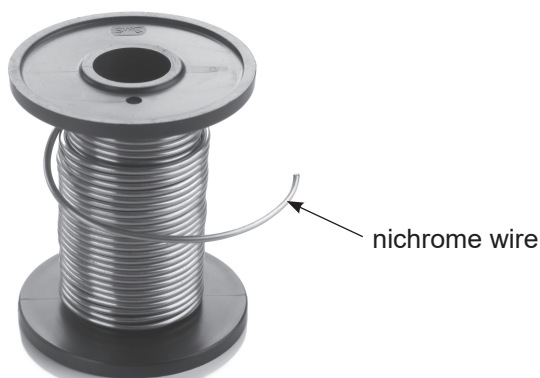
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20GCM1211

5 Metal ions may be identified using flame tests and precipitation reactions.

(a) Nichrome is an alloy of nickel and chromium often used to carry out flame tests on metal compounds. Nichrome is harder than nickel.



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(i) What is meant by the term alloy?

[3]

(ii) Explain, in terms of structure, why nichrome is harder than nickel.

[2]



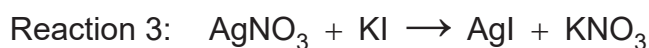
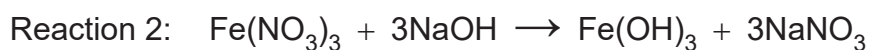
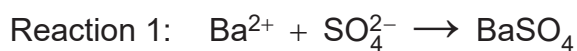
(iii) Complete the table to give the flame test colour or the formula of the metal ion present.

Flame test colour	Metal ion present
brick red	
	Li^+
yellow/orange	

[3]



(b) The equations below represent precipitation reactions which occur when testing for ions.



(i) What is a precipitate?

_____ [1]

(ii) For each reaction, state the colour of the precipitate formed.

Reaction 1: _____

Reaction 2: _____

Reaction 3: _____ [3]

(iii) Rewrite the equation for Reaction 1 to include state symbols.

_____ [1]

(iv) Write an ionic equation for Reaction 2.

_____ [3]

(v) Name the precipitate in Reaction 3.

_____ [1]





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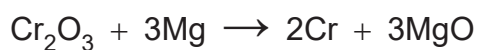
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20GCM1215

6 Chromium forms a variety of compounds including chromium(III) oxide, hydrated chromium(III) nitrate and potassium dichromate.

(a) Chromium(III) oxide reacts with magnesium according to the equation:



1.9 kg of chromium(III) oxide are allowed to react with 1.2 kg of magnesium.

(i) Calculate the number of moles of chromium(III) oxide present in 1.9 kg.

moles = _____ [1]

(ii) Calculate the number of moles of magnesium present in 1.2 kg of magnesium.

moles = _____ [1]

(iii) State which reactant is the limiting reactant.

_____ [1]



(iv) Calculate the mass of chromium formed in grams.

mass = _____ g [2]

(b) 10.0 g of hydrated chromium(III) nitrate, $\text{Cr}(\text{NO}_3)_3 \cdot x\text{H}_2\text{O}$ were heated to constant mass. 5.95 g of anhydrous chromium(III) nitrate remained.

Determine the value of x in $\text{Cr}(\text{NO}_3)_3 \cdot x\text{H}_2\text{O}$.

x = _____ [4]

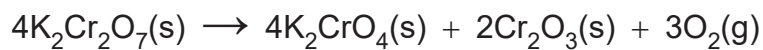
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20GCM1217

- (c) Potassium dichromate, $K_2Cr_2O_7$, decomposes on strong heating as shown in the equation below.



Calculate the loss in mass when 1.47 g of potassium dichromate are heated to constant mass.

loss in mass = _____ g [3]

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20GCM1219

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Question Number	Marks
1	
2	
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5	
6	

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
Butanoate	$\text{C}_3\text{H}_7\text{COO}^-$
Carbonate	CO_3^{2-}
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	HCOO^-
Nitrate	NO_3^-
Propanoate	$\text{C}_2\text{H}_5\text{COO}^-$
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}



Data Leaflet

Including the Periodic Table of the Elements

For the use of candidates taking
 Science: Chemistry,
 Science: Double Award
 or Science: Single Award

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

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

THE PERIODIC TABLE OF ELEMENTS

Group

												1 H Hydrogen 1						4 He Helium 2	
		1	2											3	4	5	6	7	0
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								

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



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

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