



Rewarding Learning

General Certificate of Secondary Education
2019–2020

Centre Number

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Candidate Number

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Double Award Science: Chemistry

Unit C1

Higher Tier



[GDW22]

GDW22

THURSDAY 27 FEBRUARY 2020, 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 5.

A Data Leaflet, which includes a Periodic Table of the elements is provided.



- 1 The table below shows the percentage by mass of three elements in fertilisers X, Y and Z. Each of these fertilisers contains a mixture of compounds.

Fertiliser	%N	%P	%K
X	6	24	24
Y	8	32	16
Z	24	24	16

- (a) (i) Fertilisers X and Y can be used to help the growth of tomatoes. Fertiliser Z does not help the growth of tomatoes.

Use the information in the table to help you suggest a reason why fertiliser Z does not help the growth of tomatoes.

_____ [1]

- (ii) Explain fully why the fertilisers X, Y and Z can be described as formulations.

_____ [3]



- (b) Some materials produce new properties when their particle size is reduced. These smaller particles are called nanoparticles. Zinc oxide and titanium oxide nanoparticles are used in sun creams.

Give two advantages of using nanoparticles in sun creams.

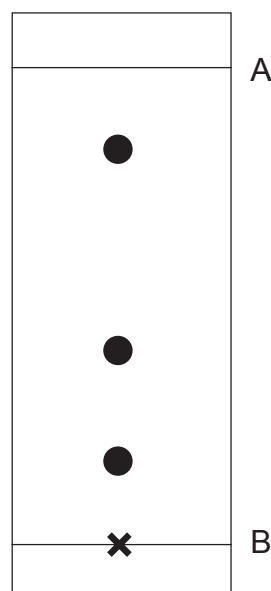
1. _____
2. _____ [2]

- (c) The diagram below shows the results of a chromatography experiment to separate a mixture of dyes. A and B are pencil lines on the chromatography paper.

- (i) Label A and B. [2]

A = _____

B = _____



- (ii) Explain fully how chromatography separates a mixture of dyes.

_____ [2]

[Turn over



2 Atoms and ions are made up of protons, electrons and neutrons.

(a) Complete the table below, which gives information about some atoms and ions.

Atom or ion	Mass number	Number of protons	Number of electrons	Number of neutrons
C		6		7
Br ⁻	79		36	
Ga ³⁺	70	31		

[4]

(b) Magnesium has three naturally occurring isotopes.

Use the information in the table below to calculate the relative atomic mass of magnesium to **two decimal places**.

Show your working out.

Mass number	Relative abundance
24	79%
25	10%
26	11%

[2]





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(Questions continue overleaf)



- 3 (a) The table below gives some information about metal compounds and their reactions with acids to produce ionic salts.
Complete the table by filling in the blank spaces.

Metal compound	Acid	Name of salt	Formula of salt	Formula of cation in salt	Formula of anion in salt
aluminium oxide	hydrochloric acid		AlCl_3		
	nitric acid	copper(II) nitrate			NO_3^-
potassium hydroxide			KCl		Cl^-
sodium carbonate		sodium sulfate		Na^+	

[4]

- (b) Write a balanced symbol equation for the reaction of magnesium with nitric acid.

_____ [3]



- (c) A student was given four beakers each containing 250 cm³ of dilute sulfuric acid. The acid concentrations were:

beaker A	0.5 mol/dm ³	beaker B	1.0 mol/dm ³
beaker C	1.5 mol/dm ³	beaker D	2.0 mol/dm ³

Which one of the following statements about the pH of the solutions is true?
Put a tick (✓) in the box beside the correct statement.

Statement	Tick (✓) if correct
It is impossible to know which solution has the lowest pH	
The acid in beaker A has the lowest pH	
The acid in beaker D has the lowest pH	
The acids in all four beakers have the same pH	

[1]

- (d) A dilute solution of sodium hydroxide was prepared.

- (i) Sodium hydroxide is an example of a strong alkali. What is meant by the term **strong alkali**?

[2]

- (ii) What is meant by the term **dilute solution**?

[1]

[Turn over]



- 4 (a) Sodium chloride has an ionic structure. It has a high melting point and it conducts electricity when molten but not when solid.
Explain why:

1. sodium chloride has a high melting point

2. sodium chloride conducts electricity when molten but not when solid

[3]

- (b) Oxygen has a molecular covalent structure.
Explain why oxygen has a very low melting point and boiling point.

[2]



5 Outline the chemistry of the Group 7 elements.

Your answer should include:

- A description of the colour and physical state at room temperature of chlorine, bromine and iodine
- What is observed if iodine is heated in a boiling tube
- A description of the test for chlorine

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

A description of the colour and physical state at room temperature of chlorine, bromine and iodine:

What is observed if iodine is heated in a boiling tube:

A description of the test for chlorine:

[6]

[Turn over



6 Barium, a Group 2 metal, forms a variety of compounds.

- (a) Calculate the relative formula masses of Ba(OH)_2 and BaSO_4 .
(Relative atomic masses: H = 1; O = 16; S = 32; Ba = 137)



[2]

- (b) The relative formula mass (M_r) of barium nitrate, $\text{Ba(NO}_3)_2$, is 261.

- (i) Calculate the mass, in grams, present in 0.02 moles of $\text{Ba(NO}_3)_2$.

g [1]



- (ii) Calculate the number of moles in 14.0 g of $\text{Ba}(\text{NO}_3)_2$.
Give your answer to 3 decimal places.

_____ [1]

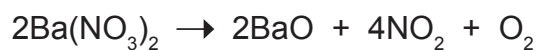
- (c) Calculate the percentage by mass of chlorine in barium chloride BaCl_2 (relative formula mass 208). Give your answer to 1 decimal place.
(Relative atomic masses: Cl = 35.5; Ba = 137)

_____ % [2]

[Turn over]



- (d) Barium nitrate, $\text{Ba}(\text{NO}_3)_2$ decomposes on heating according to the equation below:



The relative formula masses of the reactants and products are given in the table below.

Substance	Relative formula mass (M_r)
$\text{Ba}(\text{NO}_3)_2$	261
BaO	153
NO_2	46
O_2	32

17.00 g of barium nitrate were decomposed by heating.

- (i) Use the equation for the reaction and the relative formula masses in the table to calculate the theoretical yield of NO_2 produced.
Give your answer to 2 decimal places.

theoretical yield = _____ g [3]



- (ii) In an actual experiment, after heating for 3 minutes, 3.95 g of NO_2 were obtained. Calculate the percentage yield.
Give your answer to 1 decimal place.

percentage yield = _____ % [2]



7 The electronic configurations of several atoms are shown in the table below.

Atom	Electronic configuration
Mg	2, 8, 2
Cl	2, 8, 7
H	1
S	2, 8, 6
N	2, 5
K	
	2, 6

(a) Complete the table.

[2]

(b) Using the electronic configurations in the table above, explain how magnesium atoms and chlorine atoms react to form the ionic compound magnesium chloride.

[4]



- (c) Using the electronic configurations in the table opposite, draw a dot and cross diagram of a hydrogen sulfide molecule, H_2S . Show outer shell electrons only. Label a lone pair of electrons on the diagram.

[3]

- (d) Using the electronic configurations in the table opposite, draw a dot and cross diagram of a nitrogen molecule, N_2 . Show outer shell electrons only.

[2]

[Turn over]



8 Group 1 and Group 7 elements are highly reactive.

- (a) The image below shows a piece of freshly cut sodium metal. The surface quickly tarnishes.



© Turtle Rock Scientific / Science Photo Library

What is observed when sodium metal tarnishes?

What causes sodium to tarnish?

How can sodium be stored to prevent further tarnishing?

[3]



(b) Chlorine gas is bubbled through potassium bromide solution for several minutes. The solution changes colour during the reaction.

(i) Describe the colour change in the solution during the reaction.

from _____ to _____. [2]

(ii) Write a balanced symbol equation for the reaction which occurs when chlorine gas is bubbled through potassium bromide solution.

_____ [3]

(iii) Write a half equation to show how chloride ions are formed from a chlorine molecule during this reaction.

_____ [2]

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For Examiner's
use only

Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	

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

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

gcse examinations chemistry

Group

1	H	Hydrogen	1
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† 90 – 103 Actinium series

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