Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2018–2019

Double Award Science: Chemistry

Unit C1
Higher Tier

ML

[GDW22]

THURSDAY 16 MAY 2019, MORNING

TIME

1 hour, plus your additional time allowance.

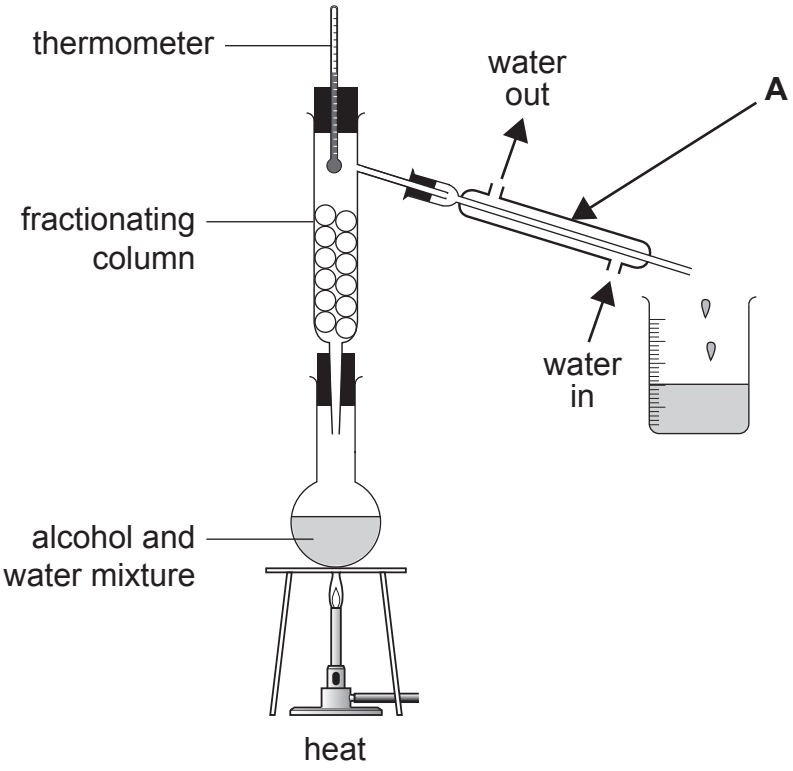
INSTRUCTIONS TO CANDIDATES

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 **6**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

1 Look at the diagram below.
It shows the apparatus that can be used in the laboratory to obtain a **pure** sample of **ethanol** from a mixture of ethanol and water.



(a) (i) What is the **full** name of this separation process?

_____ [1]

(ii) What is the name of the piece of apparatus labelled **A**?

_____ [1]

(iii) Why is water flowing through **A**?

_____

_____ [1]

(b) **(i)** Why can the sample of ethanol obtained from this process be described as pure?

_____ [1]

(ii) Which piece of apparatus in the diagram can be used to prove that the sample of ethanol collected is pure?

_____ [1]

[Turn over

2 **(a)** **(i)** The table below gives information about atomic structures.
Complete the table by filling in the blank spaces.

atom	atomic number	mass number	electronic configuration
A	6	12	2,4
B		14	2,5
C	6	14	
D	14	28	
E		24	2,8,2

[4]

(ii) Which two atoms **A**, **B**, **C**, **D** or **E** are isotopes?

_____ and _____ [1]

(b) Silicon has three naturally occurring isotopes.

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

Show your working out.

Mass number	Relative abundance
28	93%
29	5%
30	2%

_____ [2]

[Turn over

3 Nanoparticles are used in healthcare, sports equipment, clothing and in sun creams.

(a) What is the size of nanoparticles? Circle the correct answer.

0 – 1 nm **1 – 10 nm** **10 – 100 nm** **1 – 100 nm**

[1]

(b) The table below gives some uses of nanoparticles and the properties they provide to the products.

Property / Use	strong	better UV protection	light	antibacterial/ removes odours	transparent
golf clubs	✓		✓		
socks				✓	
sun creams		✓			✓

The nanoparticles in socks are made of silver. The nanoparticles in sun creams are made of zinc oxide and titanium dioxide.
Zinc oxide is a white material that gives good protection from UV rays.
Titanium dioxide is used to reduce the white colour and it makes sun creams less visible.

Use the information given to answer the following questions.

(i) Give the name of a transition metal mentioned in the passage.

_____ [1]

(ii) Which nanoparticle is used to reduce the smell of sweaty feet?

_____ [1]

(iii) What are the advantages of using nanomaterials in golf clubs?

_____ and _____ [1]

(iv) Which chemical compound gives good protection from UV light?

_____ [1]

(v) Which chemical substance makes the sun creams more transparent?

_____ [1]

(c) The nanoparticles in sun cream may have a 'harmful effect on the environment'. Give **one** other risk associated with the use of nanoparticles in sun cream.

_____

_____ [1]

[Turn over

4 Magnesium fluoride is an ionic compound.

(a) (i) What is the chemical formula of magnesium fluoride?

_____ [1]

(ii) Explain fully what happens to the electronic configuration **of the magnesium atom** when it forms an ionic bond with fluorine atoms.

_____

_____ [2]

(iii) Explain what happens to the electronic configuration **of the fluorine atom** when it becomes a fluoride ion.

_____

_____ [2]

(b) In each of the tables below there are three statements, but only **one** is correct. Put a tick (✓) beside the correct statement in each table.

(i)

table 1	Tick (✓)
ionic bonds are typical of metal compounds	
ionic bonds are typical of metals	
ionic bonds are typical of non-metal compounds	

[1]

(ii)

table 2	Tick (✓)
most ionic compounds are insoluble in water	
many molecular covalent substances are insoluble in water	
most molecular covalent substances have high melting points	

[1]

(iii)

table 3	Tick (✓)
diatomic means two atoms ionically bonded in a compound	
diatomic means two or more atoms chemically combined	
diatomic means two atoms covalently bonded in a molecule	

[1]

(c) In the spaces below draw dot and cross diagrams to show how covalent bonding occurs in ammonia, NH_3.

Your diagrams should show:

- the electronic structures of both of the atoms – show **all** electrons
- the electronic arrangement in an ammonia molecule – only outer electrons are needed
- a label showing a **lone pair** of electrons in the ammonia molecule.

hydrogen atom nitrogen atom

[2]

ammonia molecule

[3]

[Turn over

(d) Draw a dot and cross diagram to show how covalent bonding occurs in carbon dioxide and label any multiple bonds. Only the outer electrons need to be shown.

[3]

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(Questions continue overleaf)

5 **(a)** This question is about relative formula masses, moles and percentage of an element by mass in a compound.

Calculate the relative formula mass of the following compounds:
(relative atomic masses: H = 1, N = 14, C = 12, O = 16, S = 32)

(i) sulfuric acid H_2SO_4

_____ [1]

(ii) ammonium carbonate $(NH_4)_2CO_3$

_____ [1]

(b) Iron(II) sulfate, $FeSO_4$, (relative formula mass 152) is an essential body mineral. It helps keep our red blood cells healthy.

Calculate, to one decimal place, the percentage by mass of iron in iron(II) sulfate.

_____ [3]

(c) The relative formula mass of glucose $C_6H_{12}O_6$ is 180.

(i) Calculate the number of moles in 45 g of glucose.

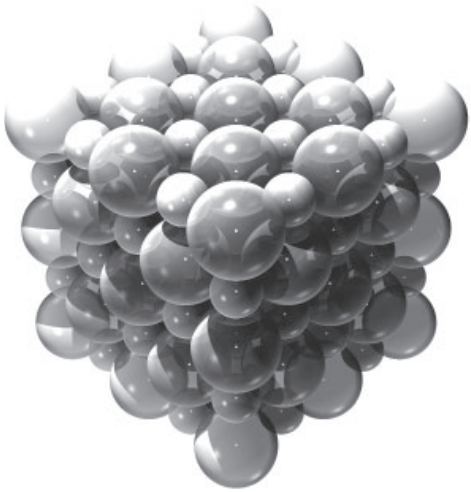
_____ [1]

(ii) What is the percentage composition of carbon, by mass, in a glucose molecule?
Circle the correct answer.

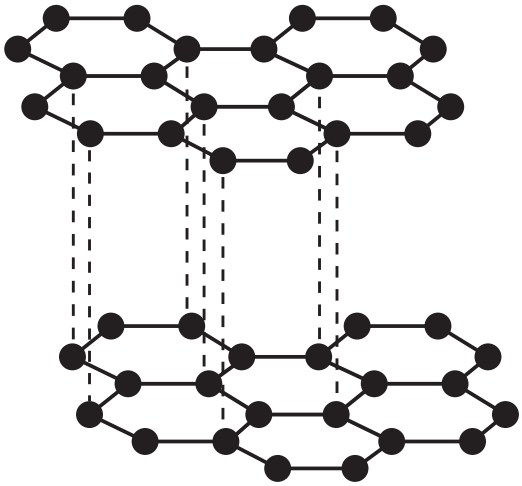
6% **15%** **25%** **33%** **40%** **50%**

[1]

6 The diagrams below show two giant structures.



structure A



structure B

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

For **each** of these structures A and B:

- predict the physical properties you would expect them to have with respect to melting points, solubility in water and electrical conductivity.
- name the type of bonding you would expect.
- name a substance which could be represented by the structure
  and
  for structure B **only** give a use for a substance with that structure.

Structure A

Structure B

[6]

[Turn over

7 **(a)** The symbol equations below describe some reactions of dilute acids used in the laboratory.

$$HNO_3 + \textbf{alkali A} \longrightarrow KNO_3 + H_2O$$

$$H_2SO_4 + \textbf{base B} \longrightarrow CuSO_4 + H_2O$$

Give the **names** and **formulae** for:

alkali A: name _____ formula _____ [2]

base B: name _____ formula _____ [2]

(b) What is the difference between an alkali and a base?

_____

_____ [1]

(c) Both of the reactions in part (a) involve neutralisation.
Write an ionic equation, including state symbols, for a neutralisation reaction.

_____ [3]

(d) **(i)** Nitric acid is described as a **strong** acid.
Complete the equation to show the ions formed when nitric acid is dissolved in water.

$HNO_3 \longrightarrow$ [1]

(ii) How would you describe the extent to which a strong acid is ionised in water?
Circle the correct answer

About 50% **100%** **1%** **a random %**

[1]

(iii) The symbol equation below shows the reaction of nitric acid with zinc metal.

$$2HNO_3 + Zn \longrightarrow Zn(NO_3)_2 + H_2$$

(Relative atomic masses H = 1, N = 14, O = 16, Zn = 65)

Calculate the number of grams of zinc that would be needed to produce 37.8 g of zinc nitrate.

Show your working out.

_____ [3]

[Turn over

8 The table below gives some information about the noble gases.

noble gas	symbol	relative atomic mass	boiling point/ °C
helium	He	4	–269
neon	Ne	20	–246
argon	Ar	40	–186
krypton	Kr	84	–153
xenon	Xe	131	–108
radon	Rn	222	

(a) What is the trend in boiling points for the noble gases?

_____

_____ [2]

(b) Why does the number of electrons in the outer shell of each atom have nothing to do with this trend?

_____ [1]

(c) What colour is helium?

_____ [1]

(d) **(i)** Calculate the average change in boiling point from one element to the next as you move down the group.

Show your working out.

_____ [3]

(ii) Use your answer to predict the boiling point for radon.

_____ [1]

(e) Give one physical property, other than low boiling point, of the noble gases.

_____ [1]

THIS IS THE END OF THE QUESTION PAPER

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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

Rewarding Learning

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