New Specification

Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2017–2018

Double Award Science: Chemistry

Unit C1
Higher Tier

ML

[GDW22]

THURSDAY 17 MAY 2018, 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 ten** 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 **4(b)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

1 Transition elements form ions with different charges.

(a) Iron can form iron(II) oxide and iron(III) oxide.
Which one of the following statements would you expect to be correct?
Put a tick in the correct box.

Both these oxides of iron are white solids ☐

Both these oxides of iron are coloured solids ☐

One of the oxides is a white solid and the other is a coloured solid ☐

[1]

(b) **(i)** Describe how you would carry out a flame test to identify the copper(II) ions in copper(II) chloride powder.

____

____

____

____

____

____ [4]

(ii) What is the flame colour for copper(II) ions?

____ [1]

11666.04 **ML**

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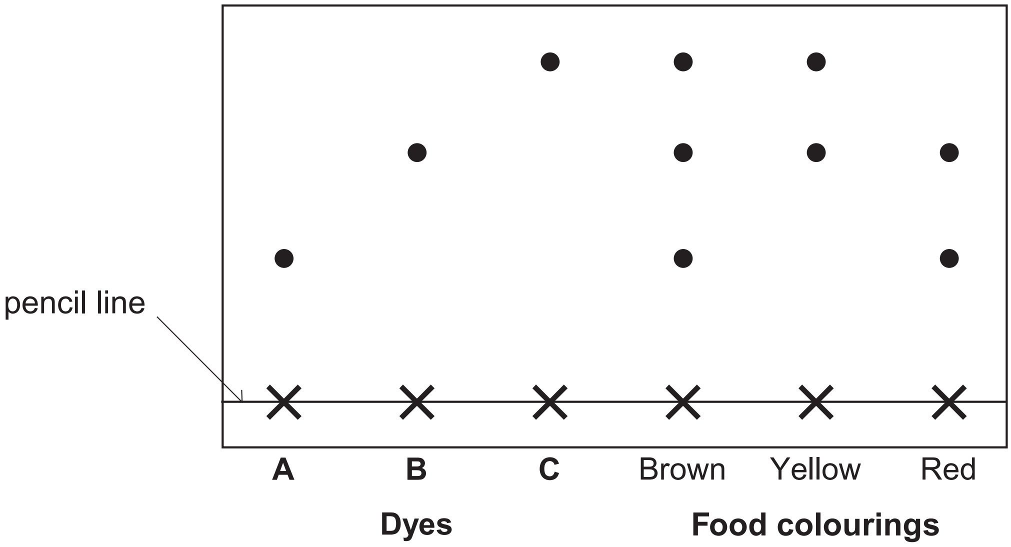
(Questions continue overleaf)

[Turn over

2 Look at the diagram below. It shows the results of a paper chromatography experiment, using water as a solvent, to find out which dyes (**A**, **B** or **C**) were present in brown, yellow and red food colourings.



(a) **(i)** What is the **stationary phase** in paper chromatography?

____ [1]

(ii) How can you tell that none of the food colourings are pure substances?

____

____ [1]

(iii) Which dye (**A**, **B** or **C**) is the **least** soluble in the solvent used? Give a reason for your answer.

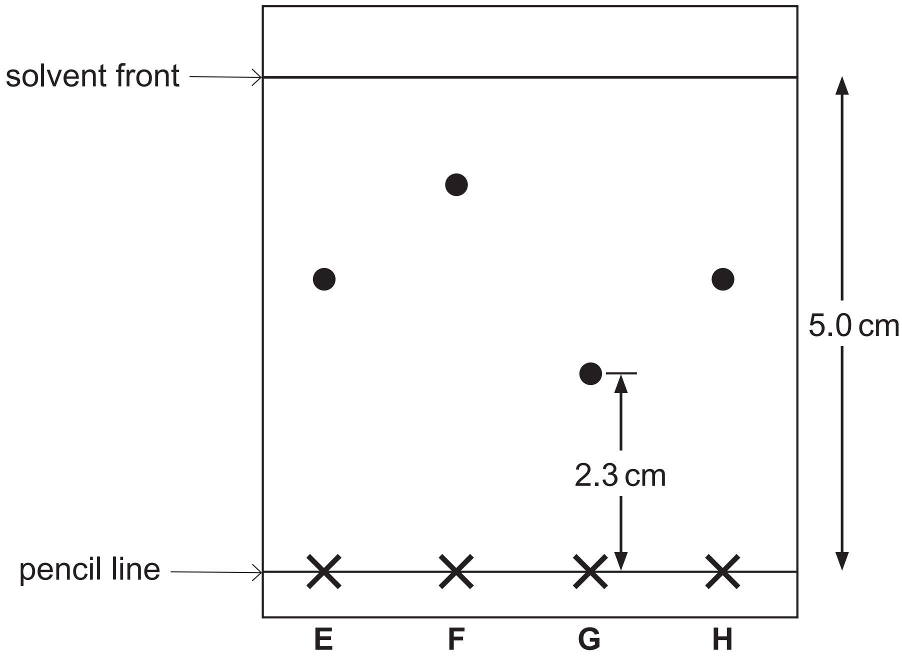
Dye: ____

Reason: ____

____ [2]

11666.04 **ML**

(b) Four green dyes (E, F, G and H) were investigated using chromatography. The chromatogram is shown below:



The dyes can be identified by calculating the R_f value for a particular solvent.

Calculate the R_f value for dye **G**.

Show your working out.

R_f value: ________________ [2]

[Turn over

11666.04 **ML**

3 Read the article below which is about nanoparticles in sun creams. Answer the questions that follow.

Today many sun creams use nanoparticles. These sun creams are very good at absorbing ultraviolet radiation which can be harmful to the skin.
Due to their particle size, these sun creams spread more easily, and cover the skin better, which also saves money because less is needed. They are also transparent, unlike the more traditional sun creams which are white.

Nanoparticles of titanium oxide are used in some sun creams. Normal sized particles of titanium oxide are also used.
It is thought that nanoparticles can pass through the skin and travel more easily around the body than normal sized particles. It is possible that nanoparticles could be toxic to some types of cells such as skin, bone, brain and liver cells.

(a) How many atoms are in a typical nanoparticle?

Circle the correct answer.

a few   a few hundred   a few million   a few billion

[1]

(b) Give three advantages of using sun creams which contain nanoparticles.
Do not write about the cost.

1. ______________________________

2. ______________________________

3. ______________________________ [3]

(c) Sun creams that contain nanoparticles may be a risk to the body. Why?

____

______________________________ [2]

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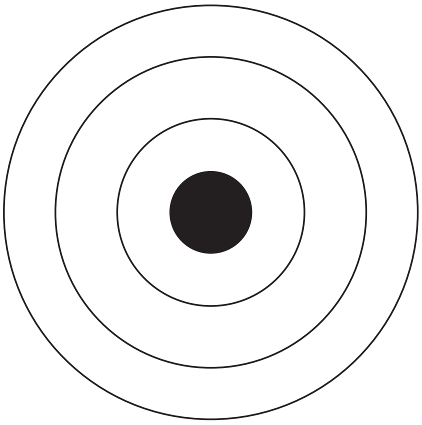
(Questions continue overleaf)

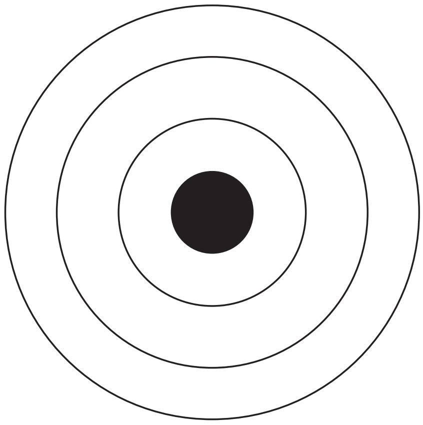
[Turn over

4 Sodium reacts with sulfur to form a compound called sodium sulfide.

(a) Complete the diagrams below to show the electronic structures of:



a sodium **atom**



a sulfur **atom**

[2]

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

1. Describe how the electronic structures of both the sodium atom and the sulfur atom change in order to form sodium sulfide. Your answer should include the charges on the ions formed, and the formula of the compound produced.

2. Describe at least two physical properties you would expect sodium sulfide to have.

[6]

5 This question is about covalent bonding.

(a) Complete the three sentences below by filling in the missing words:

Covalent bonding is typical of ____________________ elements and compounds.

Covalent bonds are strong and ____________________ amounts

of ____________________ are needed to break them.

Forces between covalent molecules are ____________________ and are

called ____________________ forces. [5]

(b) Draw a dot and cross diagram to show the bonding in carbon dioxide, CO_2.
Show the outer electrons only.

[3]

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(Questions continue overleaf)

6 This question is about relative formula masses, moles and the percentage of an element by mass in a compound.

(a) Complete the sentence below to define the term **relative atomic mass**.

The relative atomic mass (A_r) of an atom is the ______________________________

____

____

____ [3]

(b) Calculate the relative formula mass of each of the following substances.
(relative atomic masses: C = 12, N = 14, O = 16, Mg = 24, Ca = 40)

(i) calcium carbonate, $CaCO_3$

______________ [1]

(ii) magnesium nitrate, $Mg(NO_3)_2$

______________ [1]

(c) The relative formula mass of ethane, C_2H_6, is 30.

(i) Calculate the number of moles in 150 g of ethane.

_______________ g [1]

(ii) Calculate the percentage of carbon, by mass, in ethane, C_2H_6.

Show your working out.

_______________ [3]

[Turn over

7 **(a)** Look at the table below. It gives information about the salts formed when three bases react with acids. Complete the table by filling in all the gaps.

Base	Acid	Formula of cation in salt	Formula of anion in salt	Formula of salt produced
calcium hydroxide	hydrochloric acid		Cl^-	$CaCl_2$
	sulfuric acid	Cu^{2+}		$CuSO_4$
sodium hydroxide	nitric acid	Na^+	NO_3^-	

[2]

(b) A word equation is given below:

sodium hydroxide + hydrochloric acid ⟶ sodium chloride + water

Use this equation to help write an **ionic** equation to show the formation of sodium chloride.

______________________________ [2]

(c) What happens to the pH of an acidic solution if the concentration of the hydrogen ions increases?

______________________________ [1]

(d) A strong acid like nitric acid (HNO_3) is completely ionised in water.
What does this mean?
You may use words and/or an equation in your answer.

____

____

______________________________ [2]

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(Questions continue overleaf)

[Turn over

8 Look at the table below. It gives information about the physical properties of four substances (A, B, C and D). Use the information to help you answer the questions which follow.

Substance	**Melting point/ °C**	**Boiling point/ °C**	**Electrical conductivity when solid**	**Electrical conductivity when molten**
A	808	1465	poor	good
B	3650	4200	good	good
C	660	2500	good	good
D	–182	–161	poor	poor

(a) Which substance (A, B, C or D) has a molecular covalent structure? Explain your choice.

Substance with a molecular covalent structure: ______________________________

Explanation: ______________________________

______________________________ [2]

(b) Which substance (A, B, C or D) is made up of oppositely charged ions in a giant lattice structure? Explain your choice.

Substance made up of oppositely charged ions in a giant lattice structure:

____

Explanation: ______________________________

______________________________ [2]

(c) Which substance (A, B, C or D) could be graphite? Explain your choice.

Substance which could be graphite: ______________________

Explanation: ____

____ [2]

(d) Which substance (A, B, C or D) is a metal with a relatively low melting point? Explain your choice.

Substance which is a metal: ______________________

Explanation: ____

____ [2]

9 Gallium is an element with atoms that have different mass numbers.

(a) Use the information in the table to calculate the relative atomic mass of gallium to one decimal place.

Show your working out.

Mass Number	Abundance
69	60%
71	40%

Answer ________________ [2]

(b) Explain, in terms of atomic structure, why some atoms of gallium are heavier than others.

____

____ [2]

10 (a) When chlorine gas is bubbled into sodium iodide solution, it causes a chemical reaction which results in a colour change in the solution.

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

____ [3]

(ii) Describe the colour change in the solution.

The colour changes from ________________ to ________________ [2]

(iii) What is displaced in the reaction between chlorine and sodium iodide?

____ [1]

(b) When bromine is added to sodium iodide solution a similar reaction occurs to the reaction of chlorine with sodium iodide solution.

Explain why **chlorine** and **bromine** react in similar ways.

____

____

____ [2]

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	
9	
10	

Total Marks	

Examiner Number

11666.04 **ML**

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