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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2018–2019

Single Award Science: Chemistry

Unit 2
Higher Tier

ML

[GSA22]

THURSDAY 28 FEBRUARY 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 **nine** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 60.
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(a)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included for your use.

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1 Sodium is a Group 1 metal. It is represented by the following symbol:

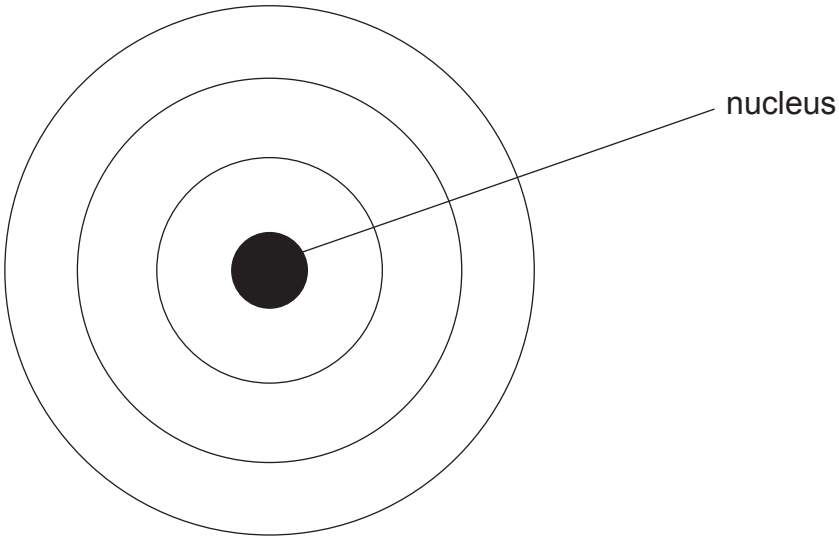
$$^{23}_{11}Na$$

(a) (i) Complete the table below to give the numbers of protons and neutrons in a sodium atom.

Particle	Number
electron	11
proton	
neutron	

[2]

(ii) Complete the diagram below to show the electronic structure of a sodium atom.



[1]

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(iii) Describe how a sodium **ion** is formed.

_____

_____ [1]

(b) Potassium is also a Group 1 metal. Explain why sodium and potassium have similar reactions.

_____

_____ [1]

[Turn over

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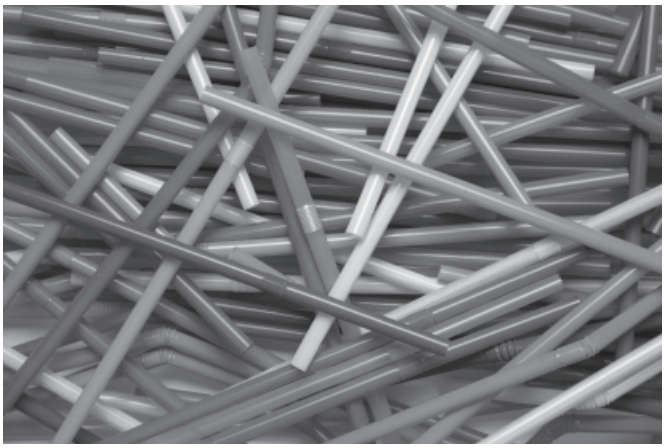
2 The following article about plastic straws is from a local newspaper.



© Victor De Schwanberg / Science Photo Library

A consultation on banning disposable plastic products will launch later this year in an effort to cut the amount of waste that ends up in rivers and oceans, entangling and endangering aquatic life.

Around 8.5 billion plastic straws are thrown away each year, with one million birds and over 100,000 sea mammals dying every year from eating and getting tangled in plastic waste. A straw may only be used for 20 minutes but it will last as waste for over 200 years.

Last year, on average, 437 items of rubbish were found per 100 m of beach in Northern Ireland and 82% of this was made of plastic.

Adapted from 'Northern Ireland should follow lead of England in banning plastic straws: MLA',
© Belfast Telegraph, Adrian Rutherford, April 20 2018

(a) From the information above suggest **two** reasons why the use of plastic straws should be banned.

1. _____

2. _____ [2]

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(b) Plastic straws are non-biodegradable.

Give **one** disadvantage of disposing of plastic straws in a landfill site.

_____

_____

_____ [1]

(c) Combustion of hydrocarbon fuels is a major source of pollution. During the combustion of these fuels carbon dioxide is produced.

Describe fully how increasing carbon dioxide levels affect the Earth.

_____

_____

_____

_____ [2]

[Turn over

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3 **(a)** A forensic scientist collected some paint fragments from the scene of a car accident. He also had a paint sample from a suspect's car.

Explain how the scientist would carry out a flame test to prove that both paint samples contain calcium ions.

Your answer should include:
- one safety precaution
- the flame colour for calcium ions.

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

[6]

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(b) The forensic scientist collected some hair and fibre from a crime scene.

The forensic scientist will need to compare these hair and fibre samples with a suspect's hair and fibre samples.

Name the apparatus the forensic scientist will need to use.

_____ [1]

(c) Fingerprints are also useful to a forensic scientist.
Name **two** types of fingerprints.

_____ and _____ [1]

[Turn over

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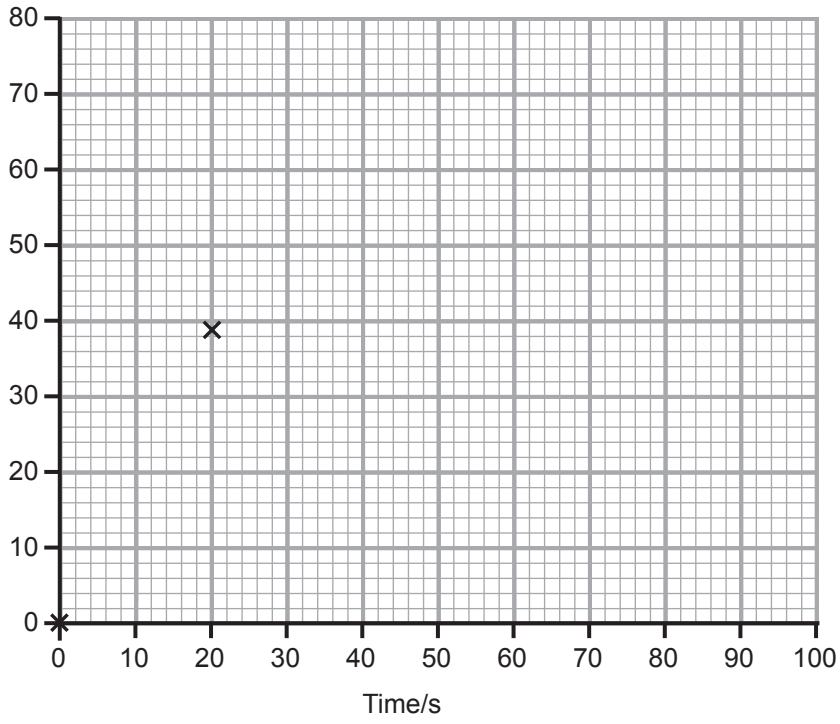
4 **(a)** A student reacted magnesium ribbon with dilute hydrochloric acid and measured the volume of gas produced over 100 seconds. The results are shown below.

Volume of gas/cm^3	0	39	58	70	77	77
Time/s	0	20	40	60	80	100

(i) On the grid below add the correct label to the y-axis. [1]

(ii) Draw a line graph for these results on the grid below. The first two points have been plotted for you.



[3]

(iii) Describe fully the trend shown by these results.

_____

_____ [2]

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(iv) Use the equation:

$$\textbf{rate of reaction} = \frac{\textbf{volume of gas}}{\textbf{time}}$$

to calculate the rate of reaction in the first 40 seconds.

_____ cm^3/s [1]

(b) The rate of reaction can be changed by varying the reaction conditions.

(i) Use collision theory to explain how the rate of a reaction is increased by using a higher temperature.

_____

_____

_____

_____

_____

_____ [3]

(ii) State two other changes to reaction conditions that will **increase** the rate of a reaction.

1. _____

2. _____ [2]

[Turn over

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5 The table below gives the melting and boiling points of some compounds.

Compound	Melting point/°C	Boiling point/°C
sodium chloride	801	1465
water	0	100
ethanol	–130	78
sodium carbonate	851	1600
methane	–183	–162

(a) What is meant by the term **melting point**?

_____

_____ [1]

(b) Use information from the table to answer the following questions.

(i) Which compound has the lowest melting point?

_____ [1]

(ii) Which compound is a gas at room temperature (22 °C)?

_____ [1]

(iii) Which state (solid, liquid or gas) is ethanol at a temperature of 100 °C? Explain your answer.

_____

_____ [2]

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(c) Some compounds can change directly from a solid to a gas. What name is given to this change of state?

_____ [1]

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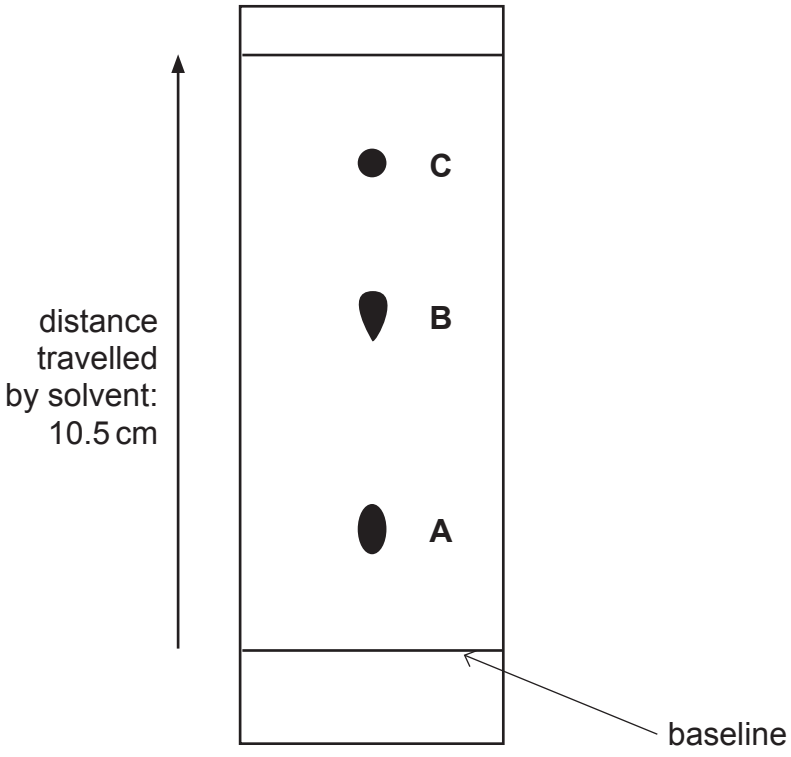
6 The chromatogram below shows 3 dyes that have been separated from black ink using chromatography. The dyes can be identified using R_f values.



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Dye **A** travelled 2.8 cm, dye **B** travelled 6.2 cm and dye **C** travelled 8.6 cm from the baseline.

(a) Use the formula:

$$R_f = \frac{\textbf{distance travelled by dye}}{\textbf{distance travelled by solvent}}$$

to calculate the R_f value for dye **B**. Give your answer to 1 decimal place.

(Show your working out.)

_____ [3]

(b) **(i)** Which dye (**A**, **B** or **C**) is the most soluble?

_____ [1]

(ii) Complete the following sentence.

In chromatography the paper is described as the stationary phase and the solvent is described as the _____ phase. [1]

(iii) What solvent could be used to separate black ink?

_____ [1]

[Turn over

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7 Some aluminium and calcium compounds can be used to treat indigestion.

(a) **(i)** Complete the table below to give the number of atoms of each element in aluminium carbonate, $Al_2(CO_3)_3$.

Element	Numbers of atoms
Aluminium	
Carbon	3
Oxygen	

[2]

(ii) How many atoms in total are represented by the formula $Ca(HCO_3)_2$?

_____ [1]

(b) The stomach contains hydrochloric acid, which can react with calcium carbonate.

(i) Balance the symbol equation for this reaction.

$$HCl + CaCO_3 \longrightarrow CaCl_2 + H_2O + CO_2$$

[1]

(ii) What is the name given to this **type** of reaction?

_____ [1]

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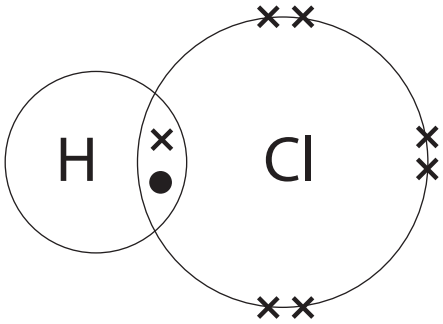
8 Below is a diagram of a molecule of hydrogen chloride showing only the outer electrons.



(a) Name the type of bonding in hydrogen chloride **and** describe, in terms of electrons, how this bond is formed.

_____

_____

_____

_____

_____

_____ [3]

(b) How many lone pairs of electrons does a molecule of hydrogen chloride have?

_____ [1]

(c) Name another molecule that has the same type of bonding as hydrogen chloride.

_____ [1]

[Turn over

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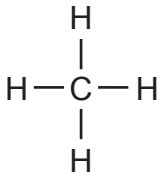
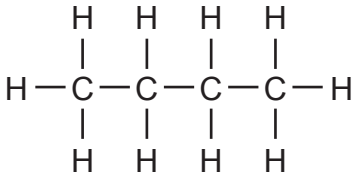
9 Alkanes and alkenes can be described as hydrocarbons.

(a) Complete the table below about some hydrocarbons.

Hydrocarbon	Molecular formula	Structural formula
	CH_4	
ethene	C_2H_4	
butane		

[3]

(b) Propane (C_3H_8) can be used as a fuel. Write a balanced symbol equation for the complete combustion of propane.

_____ [3]

(c) Alkenes can be used to make polymers.

Explain fully what is meant by the term **polymerisation**.

_____

_____ [2]

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Question Number	Marks
1	
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9	
Total Marks	

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	$C_3H_7COO^-$
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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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

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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