



Centre Number

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Candidate Number

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General Certificate of Secondary Education  
2018–2019

# Single Award Science: Chemistry

Unit 2



Higher Tier

[GSA22]

\*GSA22\*

**THURSDAY 28 FEBRUARY 2019, 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 **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.

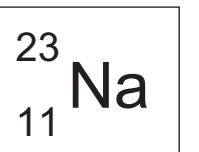
Quality of written communication will be assessed in Question 3(a).

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:

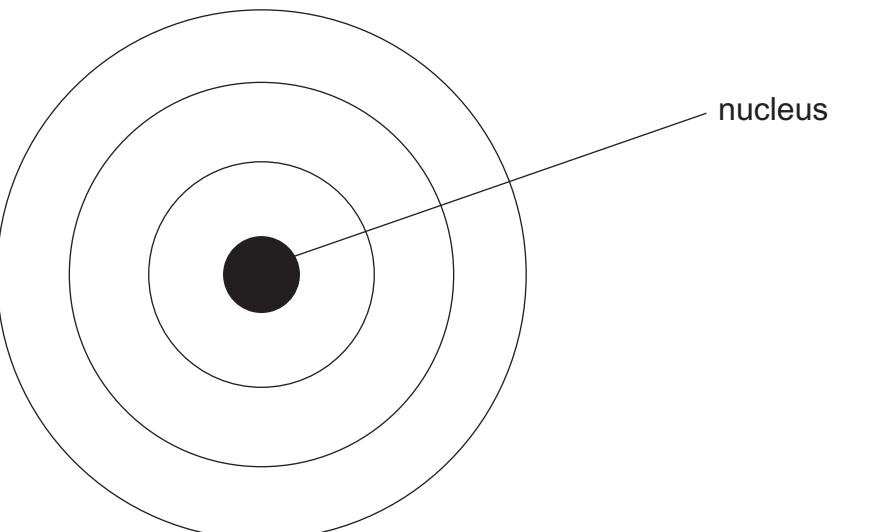


(a) (i) Complete the table below to give the numbers of protons and neutrons in a sodium atom.

Particle	Number
electron	11
proton	
neutron	

[2]

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



[1]



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

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[1]

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

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[1]

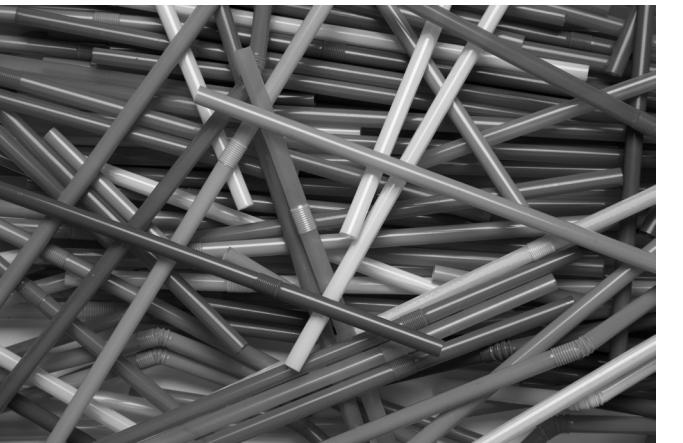
[Turn over

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\*20GSA2203\*

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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\*20GSA2204\*

(b) Plastic straws are non-biodegradable.

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

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[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.

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[2]

[Turn over

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

1

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(b) The forensic scientist also collected some hair and fibre samples from the crime scene.

Name the piece of apparatus he will need to use to be able to compare the hair and fibres to the suspect's hair and fibres.

---

[1]

(c) Fingerprints are also useful to a forensic scientist.

Name **two** types of fingerprints.

\_\_\_\_\_ and \_\_\_\_\_

[1]

[Turn over

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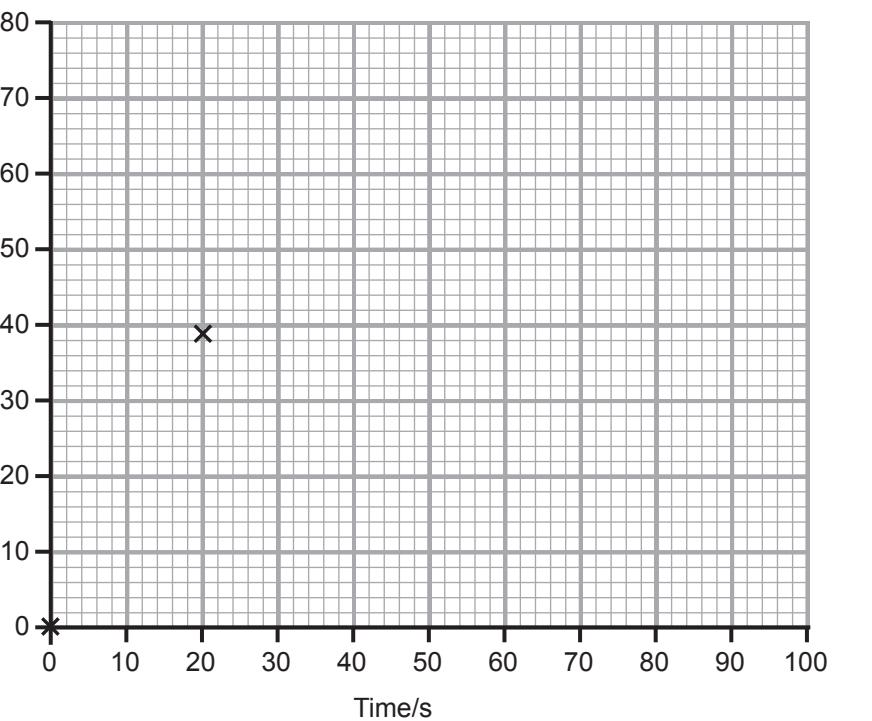
4 (a) A student reacted magnesium ribbon with dilute hydrochloric acid and measured the volume of gas produced over 100 seconds. The results are shown below.

<b>Volume of gas/cm<sup>3</sup></b>	0	39	58	70	77	77
<b>Time/s</b>	0	20	40	60	80	100

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

[1]

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



[3]

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

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[2]



**(iv) Use the equati**

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

to calculate the rate of reaction in the first 40 seconds

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\_\_\_\_\_ cm<sup>3</sup>/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.

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

1. \_\_\_\_\_

2. \_\_\_\_\_ [2]

Turn over



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**?

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[1]

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

(i) Which compound has the lowest melting point?

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[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.

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[2]



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

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[1]

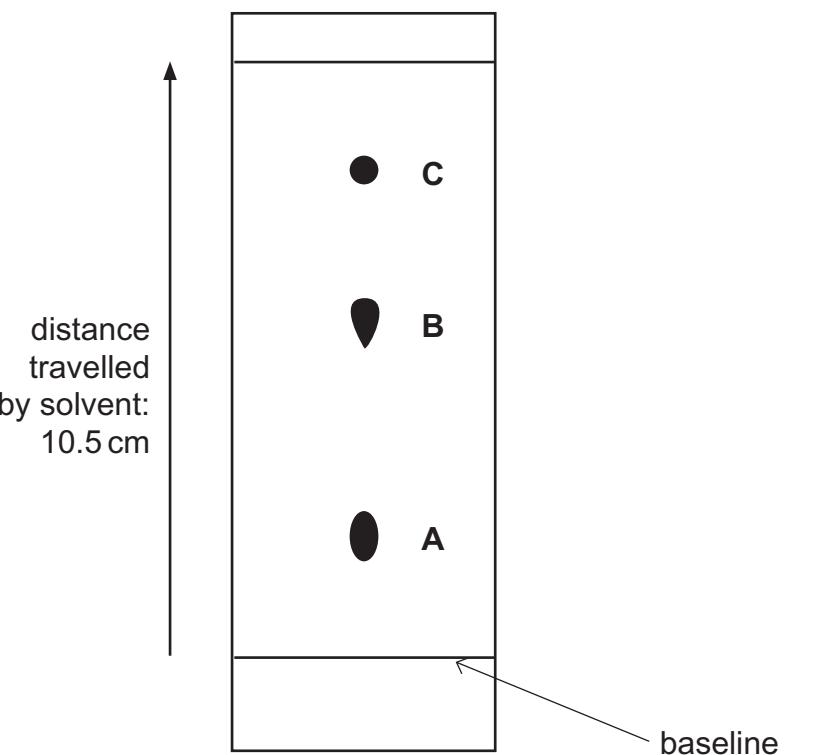
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\*20GSA2211\*

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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\*20GSA2212\*

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:

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

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) Suggest a suitable solvent that can 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,  $\text{Al}_2(\text{CO}_3)_3$ .

Element	Numbers of atoms
Aluminium	
Carbon	3
Oxygen	

[2]

(ii) How many atoms in total are represented by the formula  $\text{Ca}(\text{HCO}_3)_2$ ?

\_\_\_\_\_ [1]

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

(i) Balance the symbol equation for this reaction.



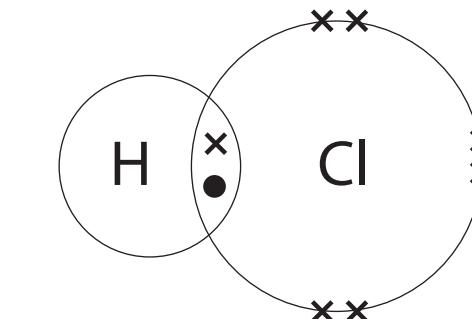
[1]

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

\_\_\_\_\_ [1]



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

[11]

Turn over



9 Alkanes and alkenes can be described as hydrocarbons.

(a) Complete the table below about some hydrocarbons.

Hydrocarbon	Molecular formula	Structural formula
	$\text{CH}_4$	$  \begin{array}{c}  \text{H} \\    \\  \text{H} - \text{C} - \text{H} \\    \\  \text{H}  \end{array}  $
ethene	$\text{C}_2\text{H}_4$	
butane		$  \begin{array}{c}  \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\    \quad   \quad   \quad   \\  \text{H} - \text{C} - \text{C} - \text{C} - \text{C} - \text{H} \\    \quad   \quad   \quad   \\  \text{H} \quad \text{H} \quad \text{H} \quad \text{H}  \end{array}  $

[3]

(b) Propane ( $\text{C}_3\text{H}_8$ ) 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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<b>For Examiner's use only</b>	
<b>Question Number</b>	<b>Marks</b>
1	
2	
3	
4	
5	
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8	
9	

<b>Total Marks</b>	
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Examiner Number

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## SYMBOLS OF SELECTED IONS

## Positive ions

Name	Symbol
Ammonium	$\text{NH}_4^+$
Chromium(III)	$\text{Cr}^{3+}$
Copper(II)	$\text{Cu}^{2+}$
Iron(II)	$\text{Fe}^{2+}$
Iron(III)	$\text{Fe}^{3+}$
Lead(II)	$\text{Pb}^{2+}$
Silver	$\text{Ag}^+$
Zinc	$\text{Zn}^{2+}$

## Negative ions

Name	Symbol
Butanoate	$\text{C}_3\text{H}_7\text{COO}^-$
Carbonate	$\text{CO}_3^{2-}$
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	$\text{CH}_3\text{COO}^-$
Hydrogencarbonate	$\text{HCO}_3^-$
Hydroxide	$\text{OH}^-$
Methanoate	$\text{HCOO}^-$
Nitrate	$\text{NO}_3^-$
Propanoate	$\text{C}_2\text{H}_5\text{COO}^-$
Sulfate	$\text{SO}_4^{2-}$
Sulfite	$\text{SO}_3^{2-}$

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

New  
SpecificationData Leaflet  
Including the Periodic Table of the ElementsFor 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

# THE PERIODIC TABLE OF ELEMENTS

## Group

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

**a** = relative atomic mass  
(approx)

**a** = relative atomic mass  
(approx)  
**X** = atomic symbol  
**b** = atomic number

140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	145 <b>Pm</b> Promethium 61	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	159 <b>Tb</b> Terbium 65	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71
232 <b>Th</b> Thorium 90	231 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	237 <b>Np</b> Neptunium 93	242 <b>Pu</b> Plutonium 94	243 <b>Am</b> Americium 95	247 <b>Cm</b> Curium 96	245 <b>Bk</b> Berkelium 97	251 <b>Cf</b> Californium 98	254 <b>Es</b> Einsteinium 99	253 <b>Fm</b> Fermium 100	256 <b>Md</b> Mendelevium 101	254 <b>No</b> Nobelium 102	257 <b>Lr</b> Lawrencium 103