



*Rewarding Learning*

General Certificate of Secondary Education  
2022–2023

Centre Number

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Candidate Number

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# Single Award Science: Chemistry

Unit 2

Foundation Tier



[GSA21]

\*GSA21\*

**MONDAY 22 MAY, 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 **8(a)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included for your use.



1 Three different types of fingerprint patterns are shown below.

(a) Using lines, match each pattern to the type of fingerprint.

Pattern



Fingerprint type

arch

loop

whorl

[2]

(b) Scientists can dust fingerprints with a powder to make them more visible.  
Name the powder that is used on a **white** surface.

[1]

(c) What name is given to the branch of science that is used to help fight crime?

Circle your answer.

nano

organic

forensic

[1]



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**(Questions continue overleaf)**

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**[Turn over**



\*20GSA2103\*

2 The table below gives the pH value of some household substances.

Substance	pH value
milk	6
baking soda	9
vinegar	3
oven cleaner	13
battery acid	1
orange juice	4
washing powder	10
water	7

(a) Name an indicator that could be used to find the pH values of these substances.

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

(b) Which substance named in the table is the:

(i) strongest alkali? \_\_\_\_\_ [1]

(ii) weakest acid? \_\_\_\_\_ [1]

(c) Complete the following sentence about water.

Water has a pH of 7 and is described as a \_\_\_\_\_ substance. [1]



(d) The hazard symbol shown below is found on a container of battery acid.



(i) What name is given to this hazard symbol?

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




(ii) Give **one** reason why symbols are used rather than words.

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

[Turn over



- 3 Given below are three different materials that garden furniture could be made from.

		
plastic	wood	iron

- (a) Plastic is a synthetic material. What is meant by the term **synthetic**?

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

The table below gives some properties of each material.

Material	Plastic	Wood	Iron
Properties	Low density, easily coloured, insulator, flexible, weather resistant, non-biodegradable.	Medium density, attractive, insulator, strong, weather resistant if painted, biodegradable.	High density, decorative, conductor, strong, can rust, non-biodegradable.

- (b) Use information from the table and your knowledge to answer the following questions.

- (i) Give **two** reasons why some people prefer furniture made from plastic rather than wood.

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

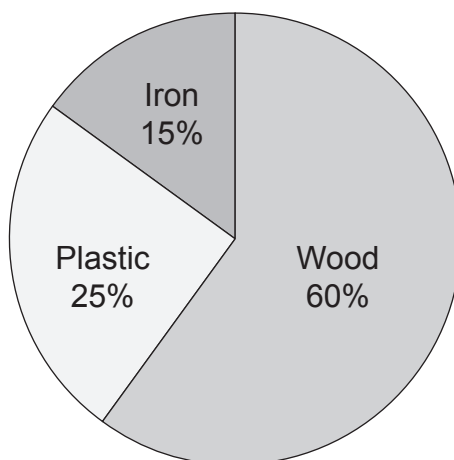
2. \_\_\_\_\_ [2]

- (ii) Give **one** disadvantage of using iron to make garden furniture. Explain your answer.

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



The pie chart below shows the percentage of garden furniture made from each type of material.



- (c) Calculate the difference in the percentage of garden furniture made from wood to that made from plastic.

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



[illegible]

- (i) Name two metals.

(ii) Name **one** element that is in Group 7.

(iii) Name **one** element that is in Period 2.

**(b)** What name is given to the elements in Group 2?

---

[1]



(c) In what order are elements in the modern Periodic Table arranged?

Circle your answer.

**atomic number        :        atomic mass        :        atomic weight**

[1]

(d) Complete the following sentence to explain why Group 0 elements are unreactive.

Group 0 elements do not need to lose or gain \_\_\_\_\_

because they already have \_\_\_\_\_ outer shells. [2]

[Turn over



- 5 A student wants to prepare some **sodium sulfate** crystals by reacting sodium carbonate with an acid.

(a) Which acid should the student use?  
Place a tick (✓) in the correct box.

nitric acid

☐

hydrochloric acid

☐

sulfuric acid

☐

[1]

(b) Sodium carbonate is an alkali. When it reacts with acid it forms a salt, water and a gas.

(i) Name this type of reaction.

\_\_\_\_\_

[1]

(ii) The gas produced turns limewater milky white.  
Name this gas.

\_\_\_\_\_

[1]

(c) The reaction between sodium carbonate and acid is exothermic.  
What is meant by the term **exothermic**?

\_\_\_\_\_

[1]

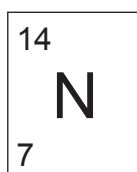
(d) The sodium sulfate produced in this reaction is dissolved in the water.  
How would the student separate the sodium sulfate from the water?

\_\_\_\_\_

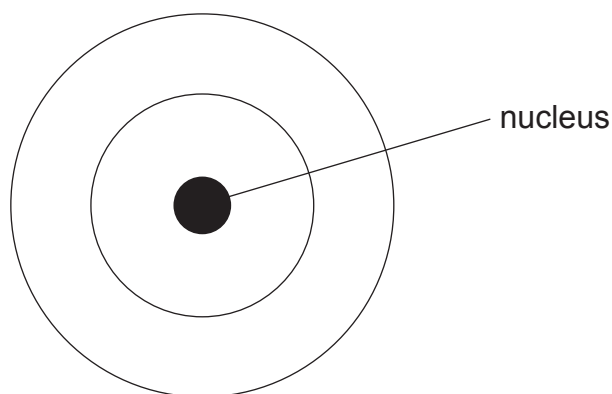
[1]



6 In the Periodic Table nitrogen is shown using the following symbol.



(a) On the diagram below show how the electrons are arranged in a nitrogen atom.



[1]

(b) Nitrogen is an element found in sodium nitrate ( $\text{NaNO}_3$ ).

(i) How many **elements** are in sodium nitrate,  $\text{NaNO}_3$ ?

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

(ii) How many **atoms** are represented by the formula  $\text{NaNO}_3$ ?

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

The formation of sodium nitrate involves the transfer of electrons between a metal and a non-metal.

(c) What name is given to this type of bonding?

Circle your answer.

ionic

covalent

metallic

[1]

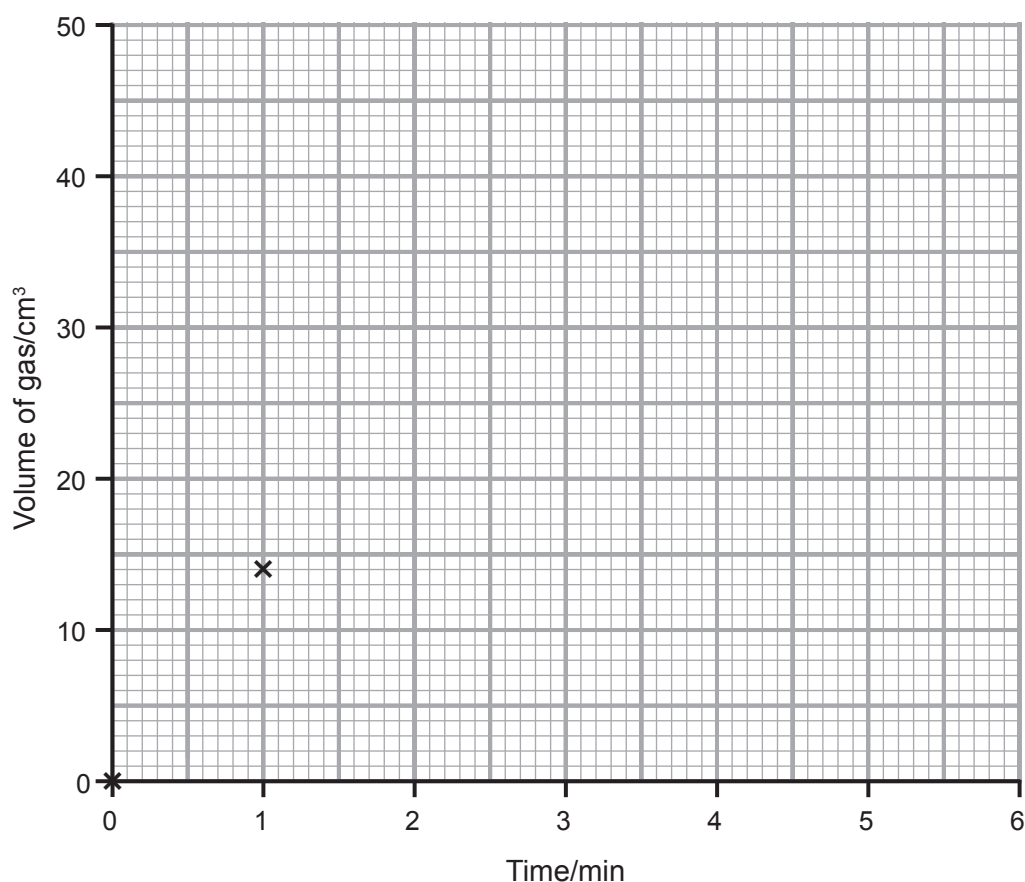
[Turn over]



- 7 Linda investigated the reaction between magnesium and hydrochloric acid by adding one strip of magnesium to acid. She measured the volume of gas produced every minute for a total of six minutes. Her results are shown below.

Time/min	0	1	2	3	4	5	6
Volume of gas/cm <sup>3</sup>	0	14	25	33	37	40	42

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



[3]

- (b) Describe the trend shown by these results.

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[1]

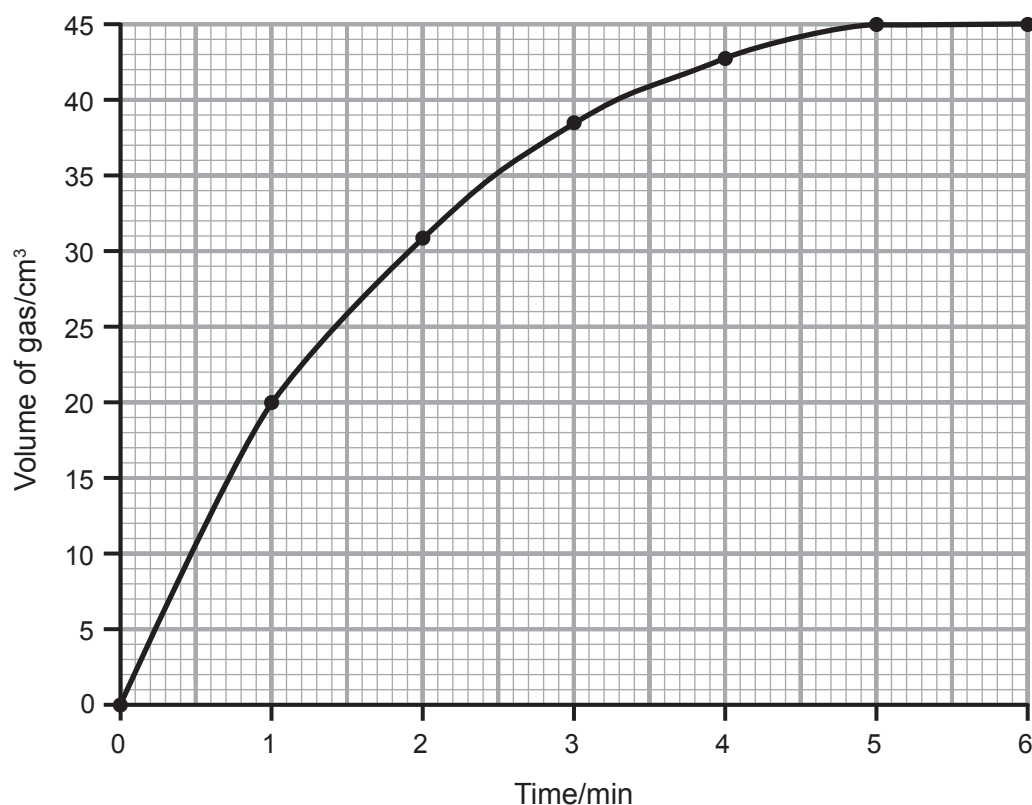


- (c) The gas produced in this reaction is hydrogen. Describe the test for hydrogen gas.

\_\_\_\_\_

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

- (d) Linda repeated the experiment using a **more** concentrated acid. Her results are shown in the graph below.



- (i) What volume of gas is produced in the first 2.5 minutes?

\_\_\_\_\_ cm<sup>3</sup> [1]

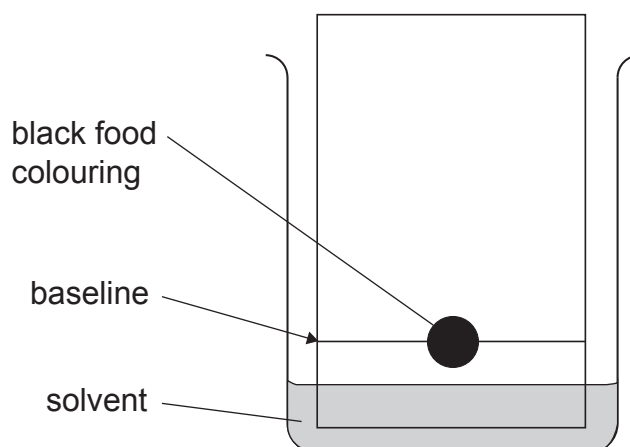
- (ii) At what time did this reaction finish?

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

[Turn over]



- 8 (a) A student used the apparatus shown below to investigate the soluble dyes present in black food colouring.



Describe how the student would use this apparatus to carry out the experiment.

Your answer should include:

- the name of this separation technique;
- a description of the set-up and method; and
- an explanation of how this set-up prevents spoiling the results.

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

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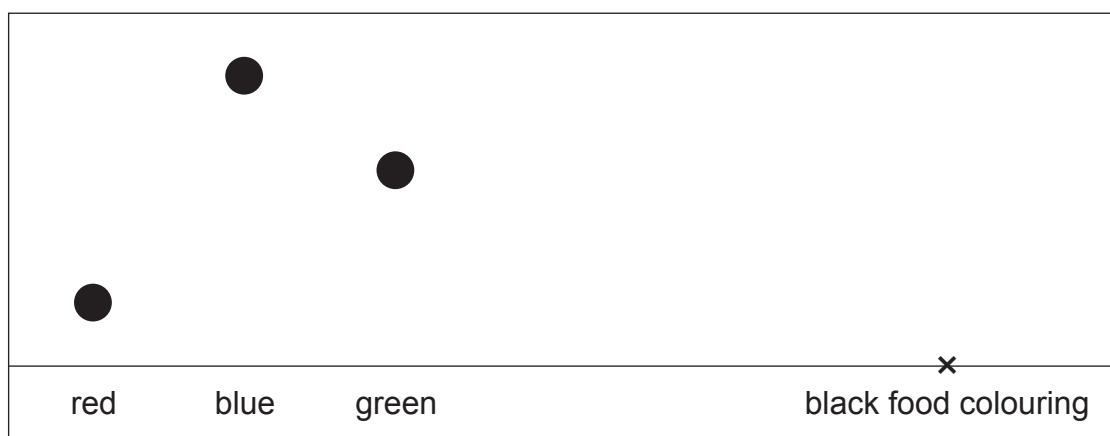
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[6]

- (b) The student found that black food colouring contains the red and blue dyes shown below.



- (i) On the diagram above draw the results the student would expect to see at the end of his investigation. [1]

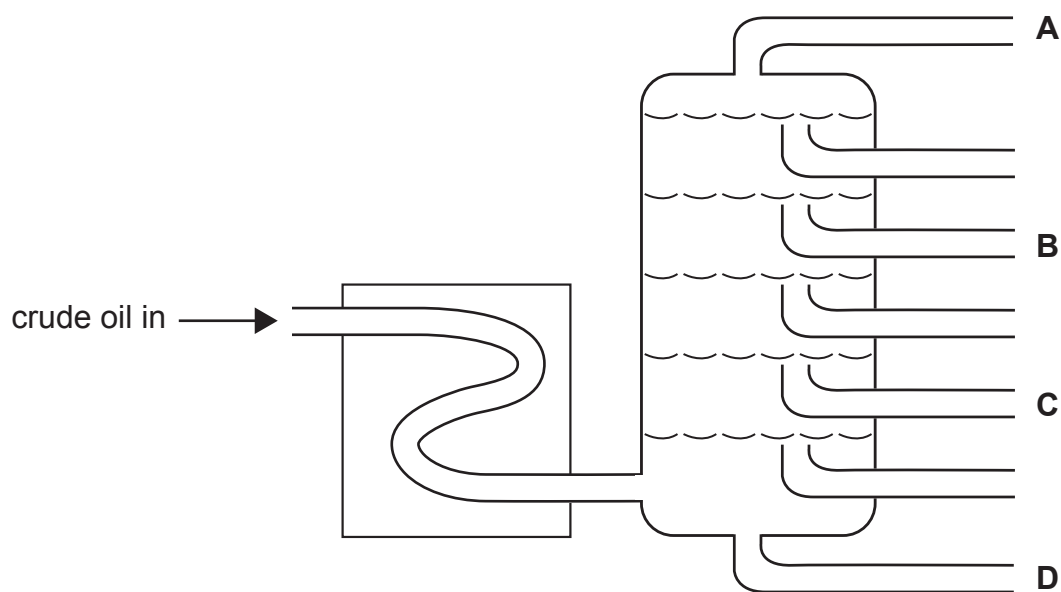
- (ii) Which of these coloured dyes (red, blue or green) is the most soluble?

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

[Turn over



- 9 Crude oil can be separated into its different fractions using a fractionating column as shown below.



- (a) Which letter (**A**, **B**, **C** or **D**) shows where refinery gas is collected?

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

- (b) What name is given to the process which separates crude oil into different fractions?

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

- (c) Describe how this process separates crude oil into its different fractions.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]





(d) Refinery gas contains methane and ethane.

(i) Name the homologous series (family) that methane and ethane belong to.

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

(ii) In the space below, draw the structural formula for ethane ( $C_2H_6$ ).



[1]

(iii) Complete the word equation below for the combustion of ethane.

ethane + oxygen  $\longrightarrow$



+



[2]

[Turn over



- (e) The table below shows the percentages of some gases in the exhaust of a diesel car engine.

Gas	Percentage/%
nitrogen	77.00
oxygen	12.50
carbon dioxide	5.50
water vapour	3.00
carbon monoxide	0.50
nitrogen oxides	0.25
sulfur dioxide	0.05
other gases	

- (i) Calculate the percentage of **other gases** found in the exhaust of a diesel car engine.

(Show your working out.)

\_\_\_\_\_ % [2]

- (ii) Name the **compound**, shown in the table, that makes up the largest percentage of the exhaust gases.

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



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Question Number	Marks
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Examiner Number

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\*20GSA2120\*

## 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	$\text{SO}_3^{2-}$

## 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

# THE PERIODIC TABLE OF ELEMENTS

## Group

[illegible]

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

$$\begin{array}{c} \text{a} \\ \text{X} \\ \text{b} \end{array}$$

**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