Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2022–2023

Single Award Science: Chemistry

Unit 2

Foundation Tier

[GSA21]

GSA21

TUESDAY 22 NOVEMBER 2022, 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.

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1 The symbol shown below is found on a bottle of bleach.

© Getty Images

(a) What name is given to the symbols that are used to identify dangerous substances?

Circle your answer.

warning **hazard** **risk**

[1]

(b) Name the symbol shown above.

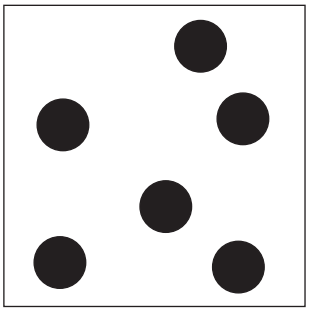
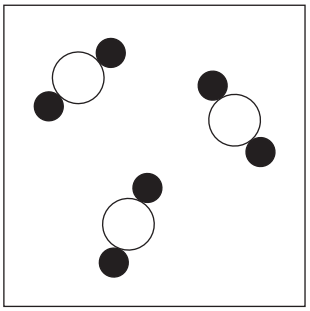
_____ [1]

(c) In the box below, draw the symbol for a toxic substance.

[1]

2 Elements, mixtures and compounds can be represented using particle diagrams.

(a) Using lines, match each particle diagram to the substance it represents.

Diagram	**Substance**
	**compound**
	mixture
	**element**

[2]

(b) Name the smallest particle that makes up all chemical substances.

_____ [1]

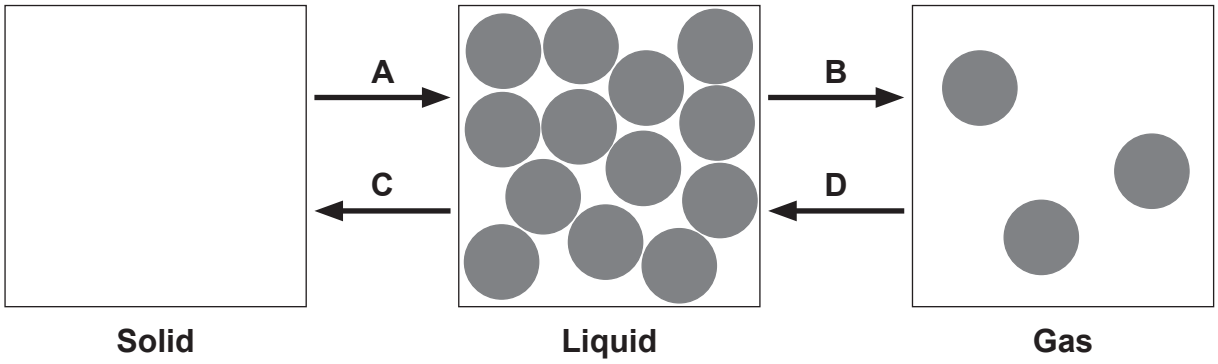
(c) What is meant by the term a **pure substance**?

_____

_____ [1]

[Turn over

3 **(a)** The diagram below shows the arrangement of particles in a liquid and in a gas.



(i) Complete the diagram above to show the arrangement of particles in a solid. [1]

The letters **A**, **B**, **C** and **D** show changes of state.

(ii) Which letter represents:

evaporation? _____

freezing? _____ [2]

Some solids can change directly into a gas when heated.

(b) What is the name given to this change of state?

_____ [1]

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(Questions continue overleaf)

4 A class of 20 students recorded their fingerprint type.
The results are shown below.

Fingerprint type	Number of students
loop	10
whorl	6
arch	4

(a) Calculate the percentage of students that have a loop fingerprint.

(Show your working out.)

_____ % [2]

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The fingerprint below belongs to the class teacher.

© Getty Images

(b) What type of fingerprint does the class teacher have?

_____ [1]

(c) Describe how a fingerprint can be collected from a **white** surface.

_____

_____

_____

_____ [2]

(d) Why are fingerprints useful in helping to identify a person?

_____

_____ [1]

[Turn over

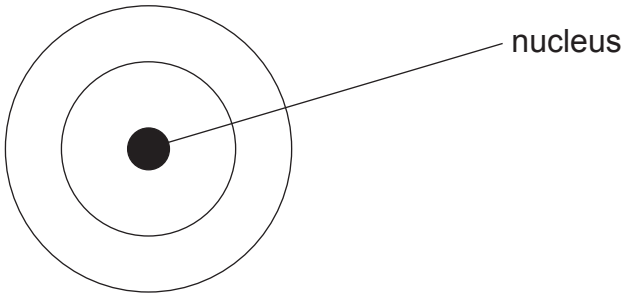
5 **(a)** An atom of fluorine has an atomic number of 9 and a mass number of 19.

(i) Complete the table below to show the number of protons and neutrons in a fluorine atom.

Particle	Number
protons	
neutrons	
electrons	9

[2]

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



[1]

(b) Fluorine is in Group 7 and Period 2 of the Periodic Table.

(i) What name is given to Group 7 elements?

_____ [1]

(ii) Explain, in terms of electrons, why Group 7 elements have similar chemical properties.

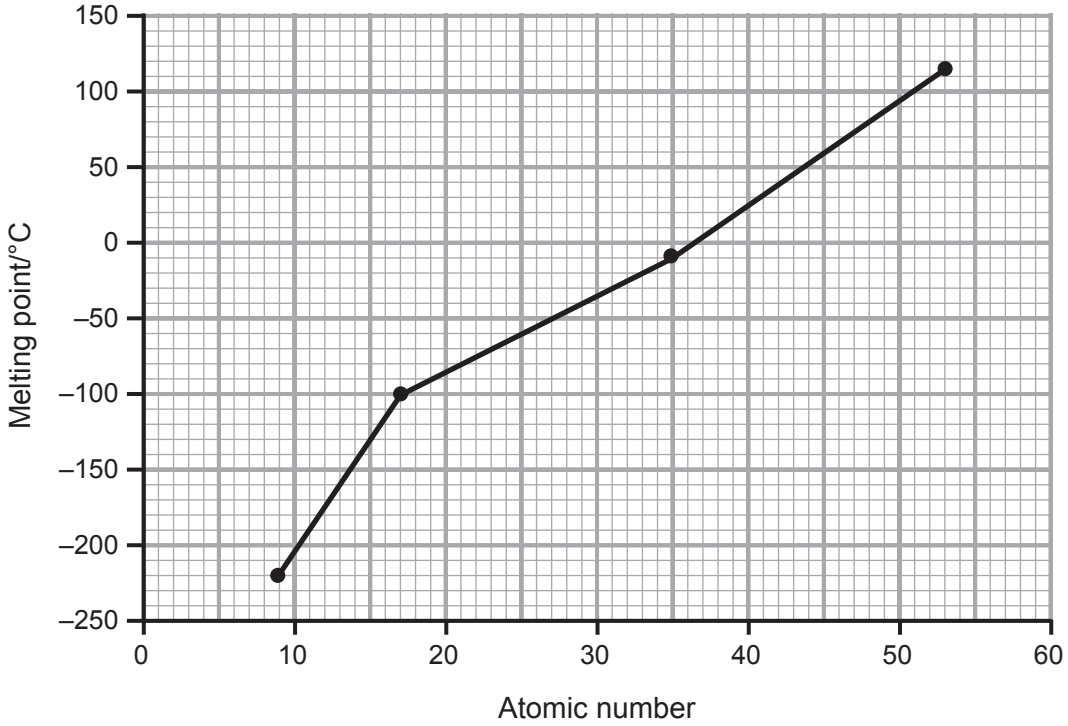
_____

_____ [1]

(iii) Apart from fluorine, name **one** other element found in Period 2.

_____ [1]

The graph below shows the melting points for some Group 7 elements.



(c) State the trend shown by this information.

_____

_____ [1]

6 Hydrochloric acid is a strong acid.

(a) Suggest a pH value for hydrochloric acid.

pH _____ [1]

(b) Hydrochloric acid and sodium hydroxide react to form a salt and water.

(i) Complete the word equation below to name the salt produced in this reaction.

hydrochloric acid + sodium hydroxide → [ ] + water

[1]

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

_____ [1]

(c) Hydrochloric acid also reacts with sodium hydrogencarbonate to produce a gas. This gas turns limewater milky white.

(i) Name the gas that turns limewater milky white.

_____ [1]

(ii) How many **elements** are in sodium hydrogencarbonate, $NaHCO_3$?

_____ [1]

(iii) How many **atoms** are represented by the formula $NaHCO_3$?

_____ [1]

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(Questions continue overleaf)

7 **(a)** The photograph below shows an outdoor patio heater that uses propane gas. Propane is a compound containing carbon and hydrogen only.

© Getty Images

(i) What name is given to a compound that contains carbon and hydrogen only?

_____ [1]

(ii) What type of chemical bonding takes place between carbon and hydrogen to form propane?

Circle your answer.

metallic **covalent** **ionic**

[1]

(b) When propane burns in oxygen it produces heat.

(i) What name is given to a chemical reaction that gives out heat energy?

_____ [1]

(ii) Complete the word equation below for the combustion of propane.

propane + oxygen ⟶ [ ] + [ ]

[2]

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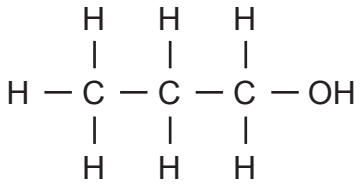
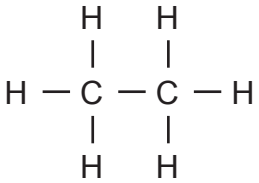
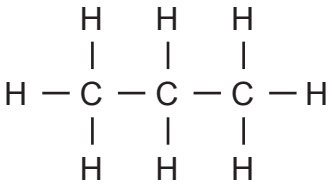
Propane is an alkane and has the chemical formula C_3H_8.

(c) Place a tick (✓) in the table below beside the correct structure for propane.

Structure	Tick (✓)
	
	
	

[1]

(d) The table below shows the boiling points of some other alkanes.

Alkane	Formula	Boiling point/°C
hexane	C_6H_{14}	70
heptane	C_7H_{16}	98
octane	C_8H_{18}	126
nonane	C_9H_{20}	151

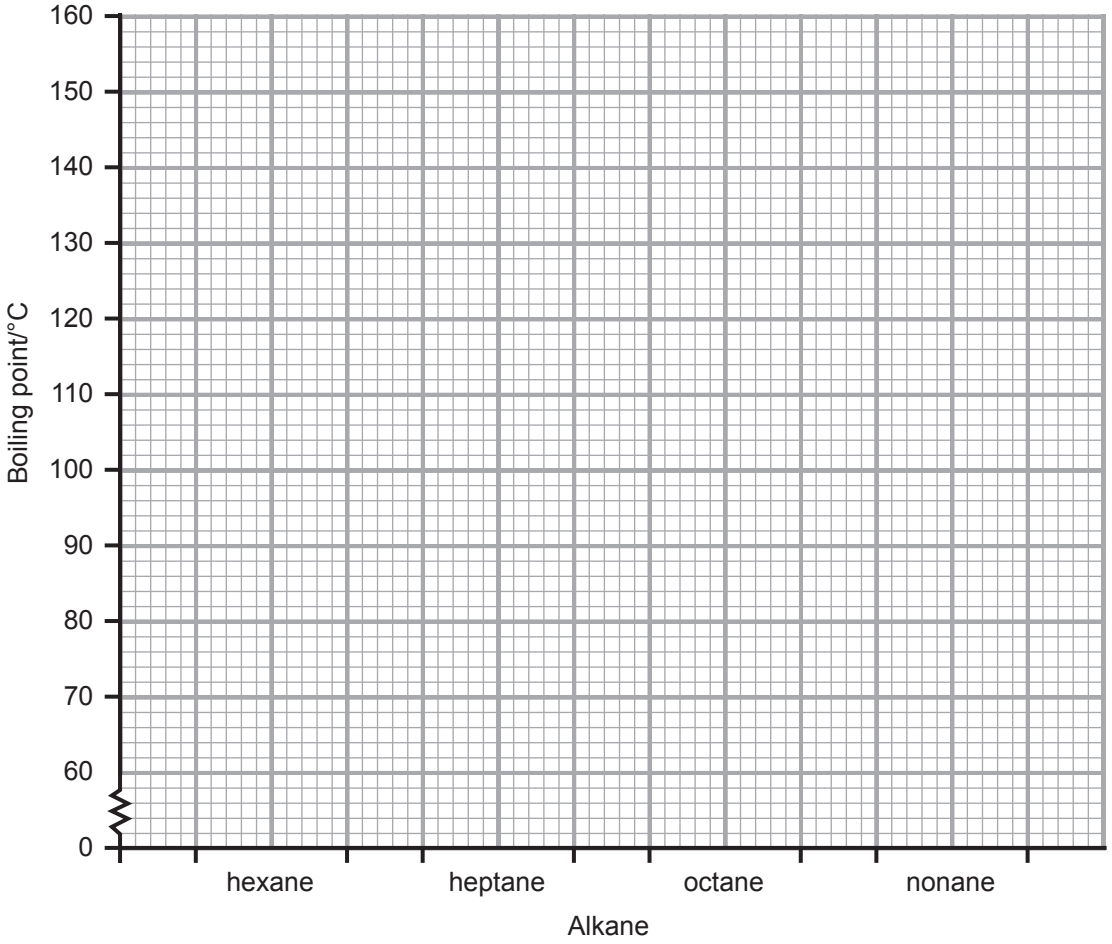
(i) The next alkane in the series is decane. It has 10 carbon atoms. Suggest the formula for decane.

_____ [1]

(ii) Predict a value for the boiling point of decane.

_____ °C [1]

(iii) On the grid below draw a **bar graph** to show the boiling points for the alkanes in the table opposite.



[2]

[Turn over

8 A student made a chemical indicator from a plant so that he could test different substances to find out if they were acid, alkali or neutral.

(a) Describe how an indicator can be made from a plant.

Your answer should include:

- the name of a suitable plant;
- a description of the method;
- how the indicator shows which substances are acids and alkalis; and
- **two** safety precautions that need to be taken.

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) Explain fully why universal indicator is one of the most useful chemical indicators.

_____

_____

_____ [2]

(c) **(i)** Name a piece of apparatus the student could use if he wanted to measure the pH level of each substance.

_____ [1]

(ii) Give **one** reason why this apparatus is more useful than universal indicator.

_____ [1]

9 Many people enjoy cycling. The materials used to make bicycles and helmets have improved over the years.

© Getty Images

The table below gives information about four materials that could be used to make bicycle frames or helmets.

Material	Strength	Density/ g/cm^3	Average Bicycle Cost	Other Information
aluminium	medium	2.7	£900	Easily shaped, durable, corrosion resistant.
steel	very high	7.9	£600	Easily shaped, durable, easily repaired, can corrode.
carbon-fibre	high	1.6	£1500	Corrosion resistant, easily shaped, durable.
titanium	high	4.5	£3000	Excellent corrosion resistance, difficult to manufacture, durable, virtually indestructible.

Use information from the table opposite to answer the following questions.

(a) Give **one** reason why aluminium would be better than steel to make a bicycle frame. Explain your answer.

_____

_____ [2]

(b) Name the material that would be best to use to make cycle helmets.
Give the **two** most important reasons why this material is most suitable.

_____

_____

_____ [2]

(c) Shown below is a cyclist wearing a lycra T-shirt and glasses containing photochromic lenses.

© Getty Images

(i) Lycra is a synthetic material. What is meant by the term **synthetic**?

_____

_____ [1]

(ii) What is meant by the term **photochromic** material?

_____

_____ [2]

(d) Nanoparticles of titanium dioxide are used in sun creams.

(i) Give **two** reasons why nanoparticles are used in sun creams.

1. _____

2. _____ [2]

(ii) Give **one** reason why some people are concerned about the use of nanoparticles in sun creams.

_____

_____ [1]

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For Examiner's use only	
Question Number	Marks
1	
2	
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6	
7	
8	
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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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

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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

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