



General Certificate of Secondary Education
2023–2024

Centre Number

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Candidate Number

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Single Award Science: Chemistry

Unit 2
Foundation Tier



[GSA21]

GSA21

TUESDAY 14 NOVEMBER 2023, 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 **9(a)**.

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



- 1 (a) Shown below are the names of three chemicals and their hazard symbols.



nitric acid



ethanol



lead oxide

Use this information and your knowledge to answer the following questions.

- (i) Name the chemical that is corrosive.

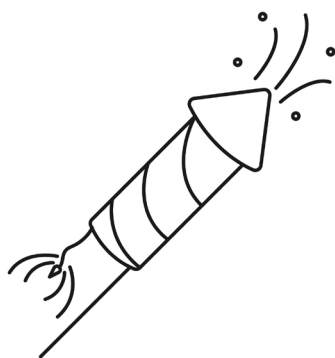
_____ [1]

- (ii) Name the chemical that is flammable.

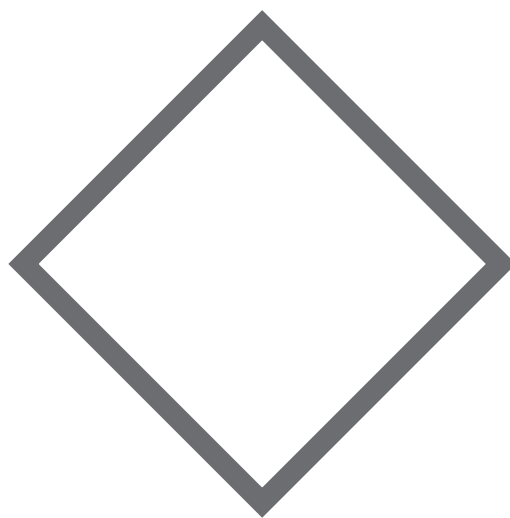
_____ [1]



Fireworks are explosive.



(b) In the box below draw the hazard symbol that should be on fireworks.



[1]

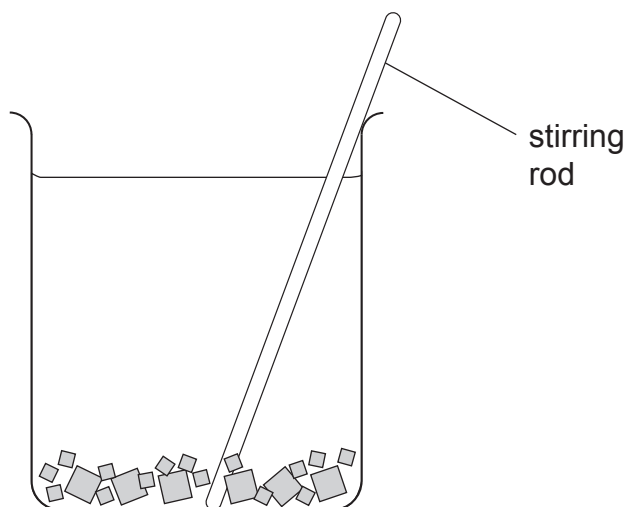
(c) Hazard symbols are used to warn of danger. Give **one** reason why symbols are used rather than words.

[1]

[Turn over



- 2 A student added some **salt** to **water** and stirred until it dissolved, producing **salty water**.



- (a) Using lines, match each of the substances named above to the term used to describe it.

Substance	Term
salt	solute
water	solution
salty water	solvent

[2]



- (b) Apart from stirring, suggest **one** other way the student could make the salt dissolve faster.

[1]

- (c) Name the method that could be used to get dry salt from salty water.

Circle your answer.

filtration

chromatography

evaporation

[1]



- 3 The table below shows the soil pH range in which some plants grow best.

Plant	pH range
onion	6.0–7.0
cabbage	7.0–8.5
Brussels sprout	5.5–6.5
cauliflower	7.0–8.0
lettuce	6.0–7.0
beetroot	6.0–7.5
potato	4.5–6.0

- (a) Name the plant that will grow best in the most **alkaline** soil.

_____ [1]

- (b) The soil in Frank's garden has a **pH of 8**.

- (i) How many plants will grow well in his garden?

_____ [1]

- (ii) Frank wants to grow potatoes. Explain why the pH of his soil means they will **not** grow well.

_____ [1]



(c) The table below gives information about three household substances.

(i) Complete the table.

Choose from:

acid

yellow

neutral

blue

alkali

Substance	pH	Colour in universal indicator	Acid/alkali/neutral
toothpaste	9	blue	alkali
vinegar	5		acid
oven cleaner	13	purple	

[2]

(ii) Complete the following sentence.

Toothpaste can react with vinegar to produce a solution that is pH 7,

this is an example of a _____ reaction. [1]

(d) Why is a pH meter more useful than universal indicator?

Place a tick (✓) beside the correct statement.

A pH meter is more reliable.	
A pH meter is more accurate.	
A pH meter gives a wider range of colours.	

[1]

[Turn over

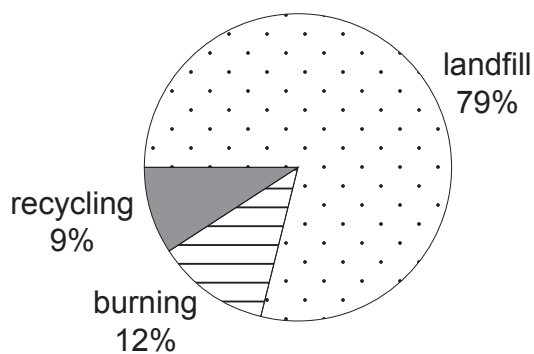


4 Plastics are non-biodegradable.

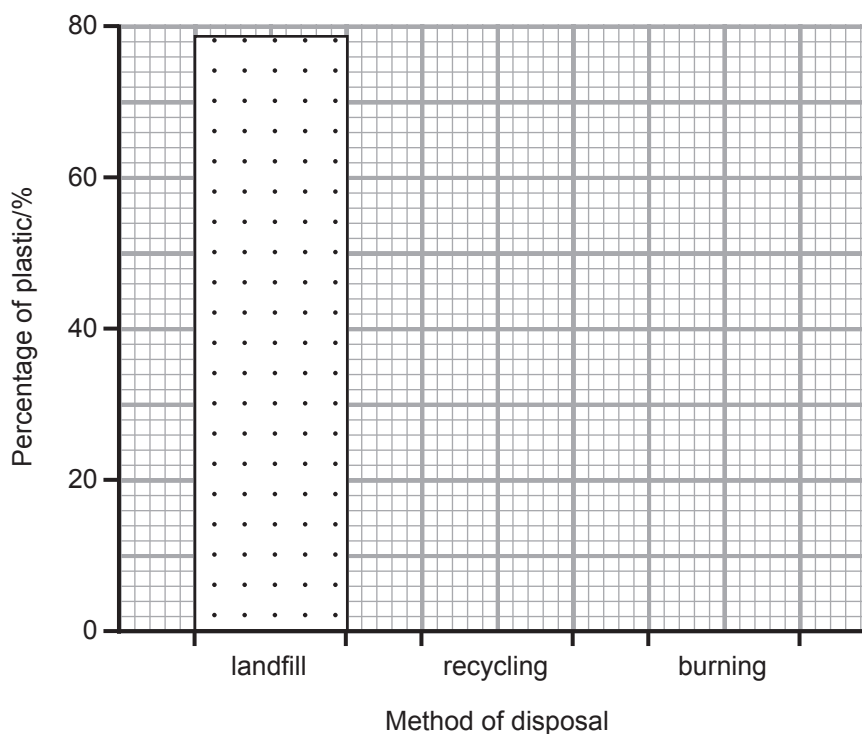
(a) What is meant by the term **non-biodegradable**?

[2]

The pie chart below shows how plastics were disposed of in the UK in 2022.



(b) Use this information to complete the bar chart below.
The bar for landfill has been drawn for you.



[1]



(c) Below is a description of each method used to dispose of plastics.

- **Burning** – Waste plastic can be burned to provide energy. This can produce toxic gases.
- **Landfill** – Waste plastic can be put into landfill sites and left underground for many years. This can cause pollution of groundwater.
- **Recycling** – Waste plastic can be recycled by melting and remoulding into new items.

Using **only** this information answer the following questions.

- (i) Name the method which is the **most** environmentally friendly way to dispose of waste plastic.

_____ [1]

- (ii) For each of the other two methods give **one** reason why they are **less** environmentally friendly ways to dispose of plastics.

Method _____

Reason _____

Method _____

Reason _____

_____ [2]

[Turn over



- 5 The table below gives some information about the reactions of four metals **A**, **B**, **C** and **D**.

Metal	Reaction when heated in air	Reaction with cold water
A	burns with a lilac flame	violent reaction
B	burns to form a white powder	no reaction
C	burns very slowly to form a black powder	no reaction
D	burns with a bright white light	very slow reaction

- (a) Use this information to put the metals (**A**, **B**, **C** and **D**) in order of reactivity.

most reactive



least reactive

[2]

- (b) Name the metal labelled **A**.

[1]



When some metals react with cold water they produce heat.

(c) What term is used to describe a reaction that gives out heat?

_____ [1]

One of the metals is magnesium.

(d) Complete the word equation below for the reaction of magnesium with oxygen.

magnesium + oxygen → [1]

[Turn over



- 6 (a) In 1869 a Russian scientist put the 60 known elements into a periodic table.



- (i) Name the Russian scientist who produced this early periodic table.

_____ [1]

- (ii) This scientist put the elements into groups and in order of atomic mass.
Give **one** other important feature of his table.

_____ [1]



[illegible]

(i) Give the symbol of the element that is an **alkaline earth metal**.

 [1]

(ii) Give the symbol of an element in the same **period** as Ar (Argon).

 [1]

(iii) Give the symbol of the element with the **highest** atomic mass.

 [1]

(iv) Name the element that has 7 electrons in its **outer** shell.

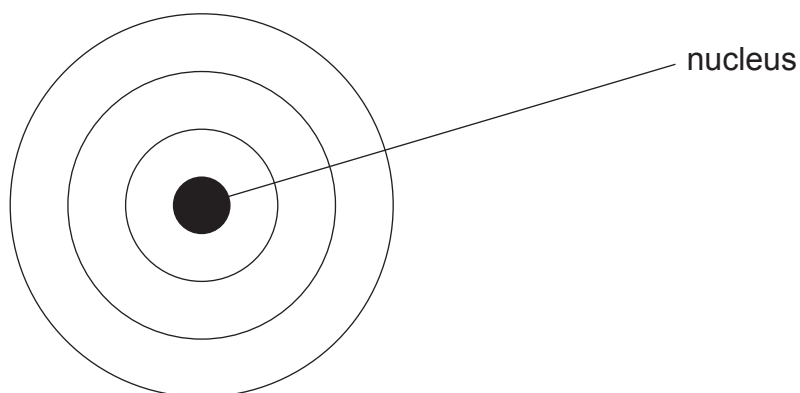
[1]

[Turn over



(c) Sodium (Na) has 11 electrons.

(i) On the diagram below, draw the electronic structure for a sodium atom.



[1]

When sodium reacts it loses 1 electron to form a sodium ion.

(ii) What is the formula of a sodium ion?

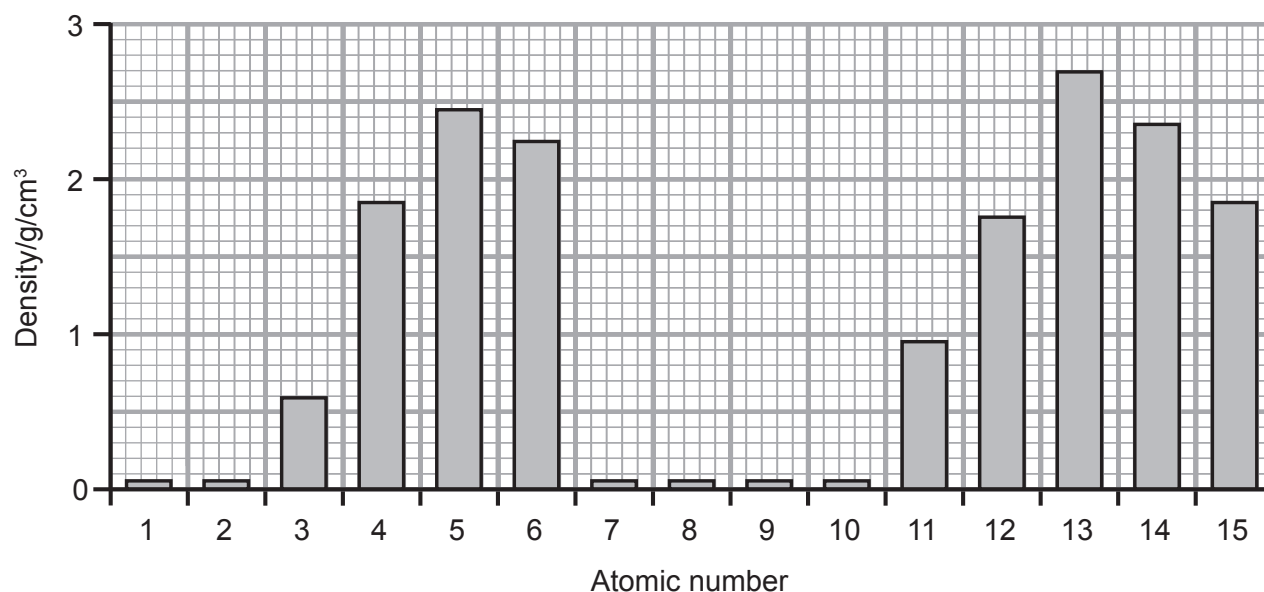
Circle your answer.



[1]



- (d) The graph below shows the densities of the first 15 elements of the Periodic Table.



Use the graph and your knowledge to answer the following questions.
(You may find your Data Leaflet useful.)

- (i) What is the density of the element with the atomic number of 3?

_____ g/cm³ [1]

- (ii) Name the element with the **highest** density.

_____ [1]

- (iii) What do the elements with the **lowest** densities have in common?
Place a tick (✓) beside the correct statement.

They are all metals.	
They are all in the same Group of the Periodic Table.	
They are all gases.	

[1]

[Turn over



- 7 The table below gives the percentage of each gas produced during a volcanic eruption.

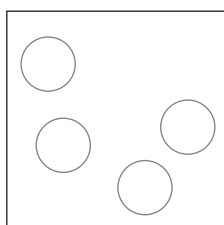
Name of gas	Percentage/%
carbon dioxide	15.00
hydrogen	1.00
helium	0.25
methane	0.75
sulfur dioxide	3.00
water vapour	

- (a) Calculate the percentage of water vapour produced by the volcanic eruption.

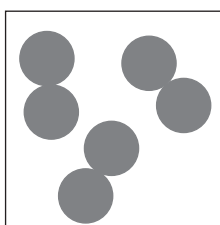
(Show your working out.)

_____ % [2]

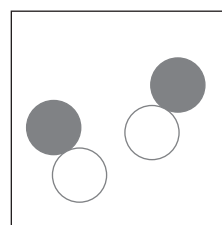
Shown below are some particle diagrams that represent elements or compounds.



X



Y



Z

- (b) Which diagram (**X**, **Y** or **Z**) represents hydrogen gas (H_2)? Explain your answer.

Diagram _____

Explanation _____

[2]





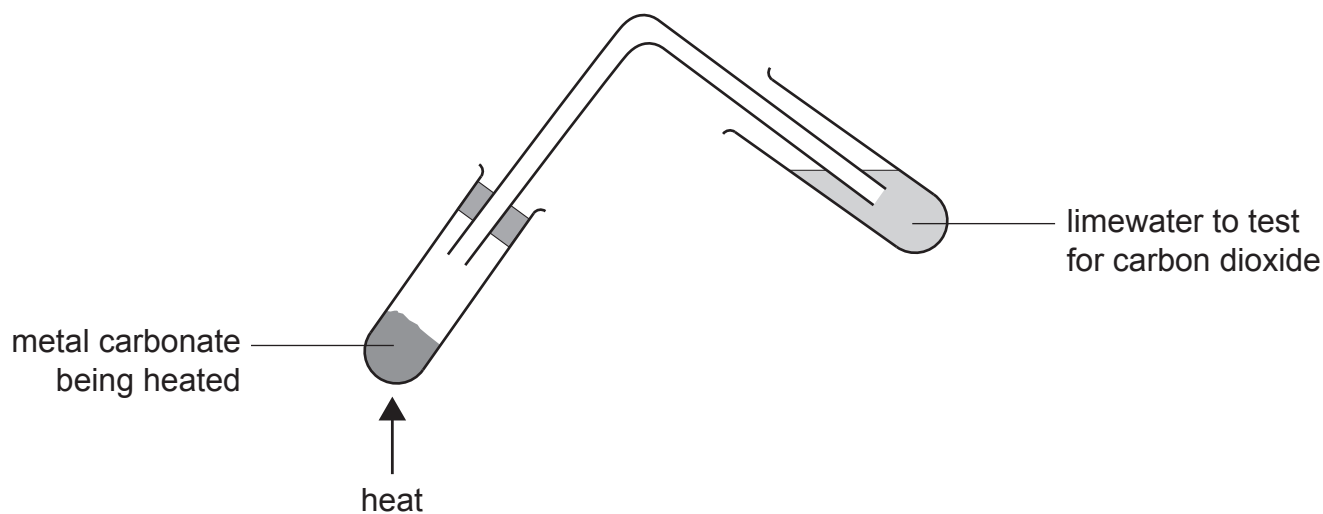
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(Questions continue overleaf)



- 8 A student investigated the effect of heat on different metal carbonates using the apparatus shown in the diagram.



He recorded the mass and colour of the solid before and after heating.

The results are shown below.

Metal carbonate	Mass before heating/g	Mass after heating/g	Colour before heating	Colour after heating	Carbon dioxide produced
copper carbonate	2.3	1.8	green	black	yes
manganese carbonate	2.5	2.0	pink	black	yes
sodium carbonate	2.5	2.5	white	white	no
zinc carbonate	2.6	1.9	white	white	yes



- (a) Name the piece of apparatus that could be used to heat the metal carbonate in this investigation.

_____ [1]

- (b) Suggest **one** reason for the **decrease** in mass during some of these reactions.

_____ [1]

- (c) Which metal carbonate lost the **most** mass during the investigation?

_____ [1]

- (d) Which metal carbonate does **not** decompose when heated? Use evidence from the table to explain your answer.

_____ [2]

- (e) The formula for copper carbonate is CuCO_3 .

- (i) How many **elements** are in copper carbonate (CuCO_3)?

_____ [1]

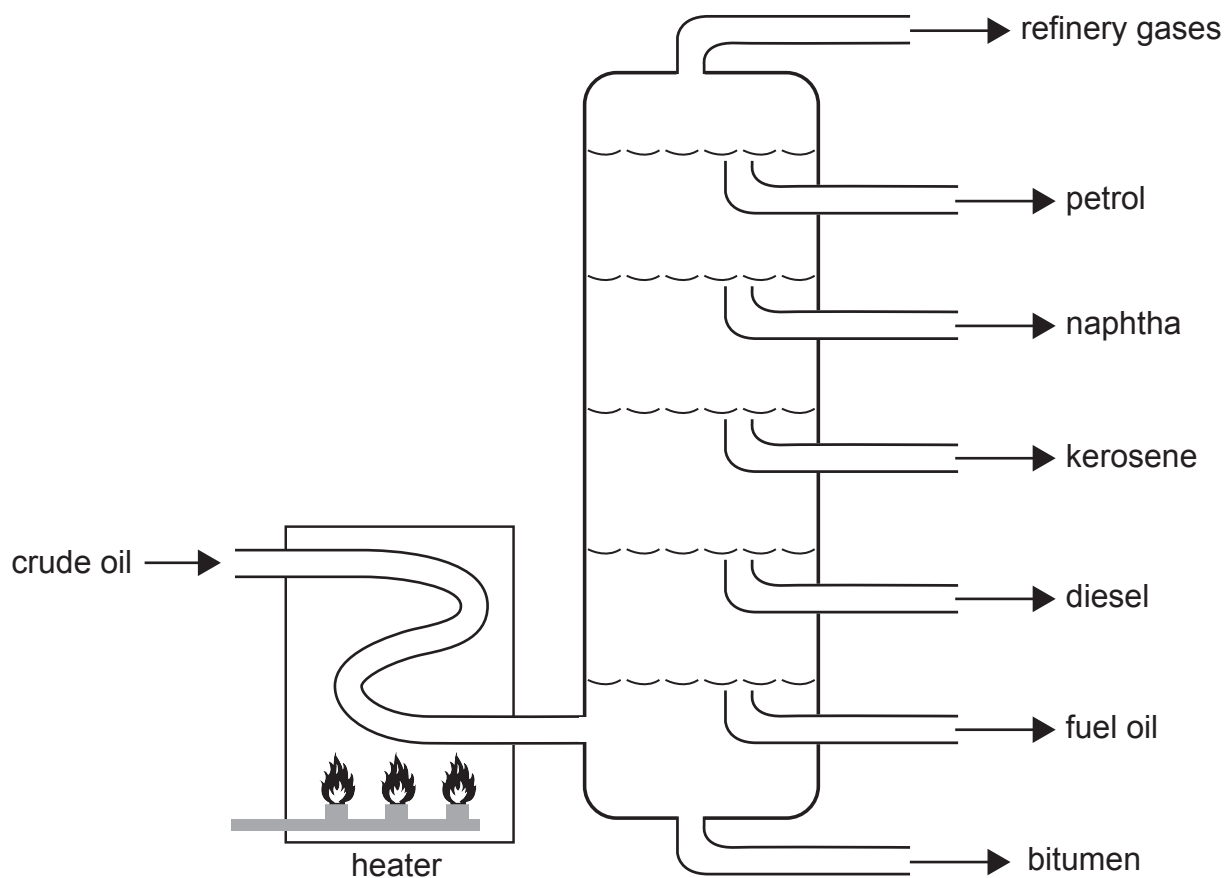
- (ii) How many **atoms** are represented by the formula CuCO_3 ?

_____ [1]

[Turn over



- 9 Crude oil is a mixture of hydrocarbons that can be separated into the useful chemicals as shown below.



- (a) Describe how crude oil is formed and how the process shown above separates it into useful chemicals.

Your answer should include:

- a description of the formation of crude oil; and
- the name of the process shown above and how it separates crude oil.

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



A description of the formation of crude oil: _____

The name of the process and how it separates crude oil: _____

[6]

[Turn over



- (b) The table below shows some properties of the chemicals produced from crude oil.

Fraction	Number of carbon atoms in chain	State at room temperature	Ease of catching fire
refinery gas	1 – 4	gas	
petrol	5 – 9	liquid	
naphtha	6 – 11	liquid	
kerosene	11 – 18	liquid	
diesel oil	16 – 20	liquid	
fuel oil	21 – 70	liquid	
bitumen	more than 70	solid	

- (i) Complete the sentence below to give **one** trend shown by this information.

As the number of carbon atoms _____

[1]

- (ii) Use information from the table to give **two** reasons why petrol is a good choice as a fuel for cars.

1. _____

2. _____ [2]



(c) One of the hydrocarbons found in the refinery gas fraction is ethane (C_2H_6).

(i) In the box below draw the structure of ethane.



[1]

(ii) Name the type of bonding present in ethane.

_____ [1]

(iii) Ethane is an alkane. What is the general formula for alkanes?

Circle your answer.

C_nH_{2n} : C_nH_{2n+1} : C_nH_{2n+2}

[1]

THIS IS THE END OF THE QUESTION PAPER



Sources:

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Question 1(b) . . . © Getty Images

Question 2 Principal Examiner

Question 6(a) . . . © Getty Images

Question 8 Principal Examiner

Question 9 Principal Examiner

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Question Number	Marks
1	
2	
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Total Marks	
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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	$\text{C}_3\text{H}_7\text{COO}^-$
Carbonate	CO_3^{2-}
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	HCOO^-
Nitrate	NO_3^-
Propanoate	$\text{C}_2\text{H}_5\text{COO}^-$
Sulfate	SO_4^{2-}
Sulfite	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

																										0				
1		2																		3		4		5		6		7		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																	

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

a

X

b

a = relative atomic mass (approx)

x = atomic symbol

b = atomic number

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