Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2024–2025

Single Award Science: Chemistry

Unit 2

Foundation Tier

[GSA21]

GSA21

MONDAY 19 MAY 2025, 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 questions in black ink and use a dark HB pencil for drawings and graphs.
Do not write with a gel pen.
Answer **all ten** questions.

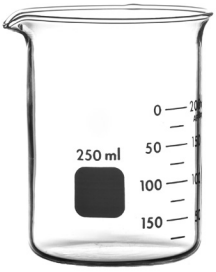
INFORMATION FOR CANDIDATES

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.
You may use a scientific calculator.
Quality of written communication will be assessed in Question **9**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

14883

20GSA2101

1 **(a)** Given below are three materials and some of their uses.
Use lines to match each material to its use.

Material	**Use**
wool	fork
glass	hat
steel	 beaker

[2]

(b) Use ticks (✓) to complete the table below to show if each material is natural or synthetic.

Material	Natural	Synthetic
wool		
nylon		
wood		
plastic		

[2]

The frames of most sunglasses are made from plastic.

(c) Give two reasons why plastic is more suitable than metal to use in the frames of sunglasses.

Circle **two** answers.

lightweight : **good conductor of heat** : **does not rust**

shatters easily : **heavy**

[2]

(d) Some materials produce new properties when their particle size is reduced. What name is given to this **type** of material?

Choose from:

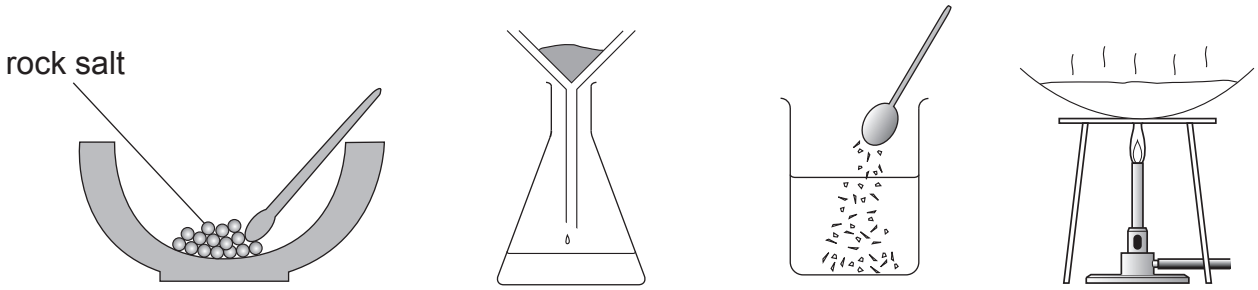
nanomaterial **synthetic material** **smart material**

_____ [1]

[Turn over

2 Rock salt is a mixture of salt and sand.

The diagrams below show the steps used to separate a sample of pure salt from rock salt. The steps are **not** in the correct order.



A **B** **C** **D**

(a) Use the letters, **A**, **B**, **C** and **D**, to put the steps in the correct order.

_____ _____ _____ _____ [2]

(b) Which step, **A**, **B**, **C** or **D**, uses evaporation?

_____ [1]

(c) Complete the sentences below about dissolving.

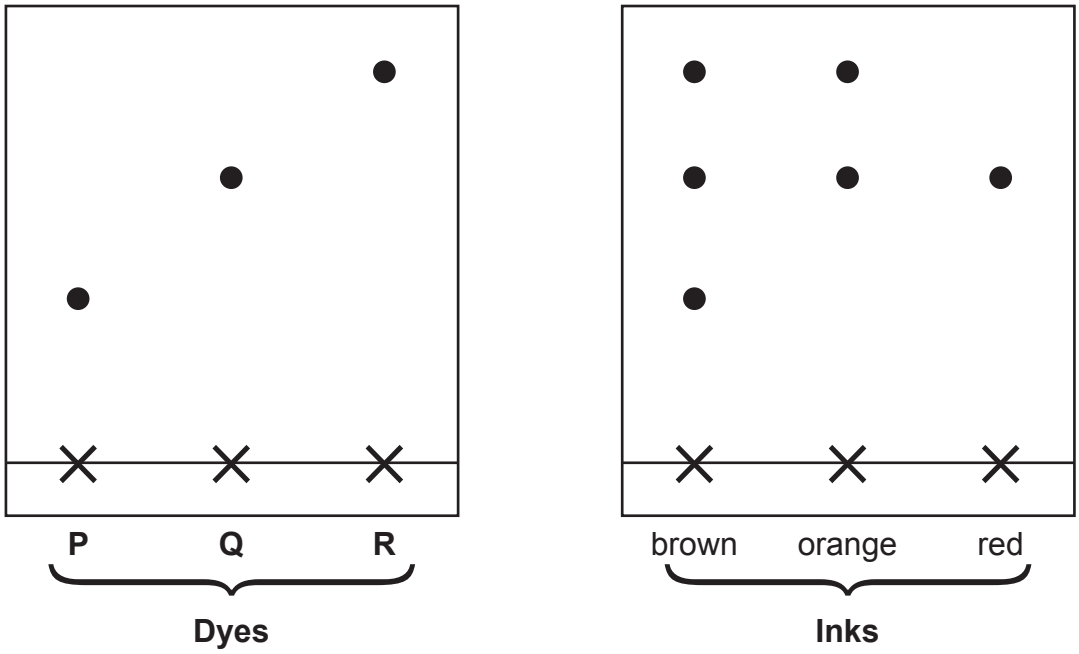
Choose from:

soluble **insoluble** **solvent** **solution**

Salt dissolves in water because salt is _____ .

Water is the _____ because it dissolves the salt. [2]

(d) The chromatograms below show the dyes **P**, **Q** and **R** that make up the different coloured inks brown, orange and red.



(i) The red ink only contains one dye. Which dye, **P**, **Q** or **R**, does red ink contain?

_____ [1]

(ii) Which dye, **P**, **Q** or **R**, is the most soluble?

_____ [1]

[Turn over

3 The photograph below shows a teacher demonstrating a flame test to his class.

(a) What colour of Bunsen burner flame should be used to carry out the flame test?

_____ [1]

(b) The teacher wants to test two different chemicals using the same piece of nichrome wire. Describe how he should **clean** the wire between tests.

_____

_____

_____ [2]

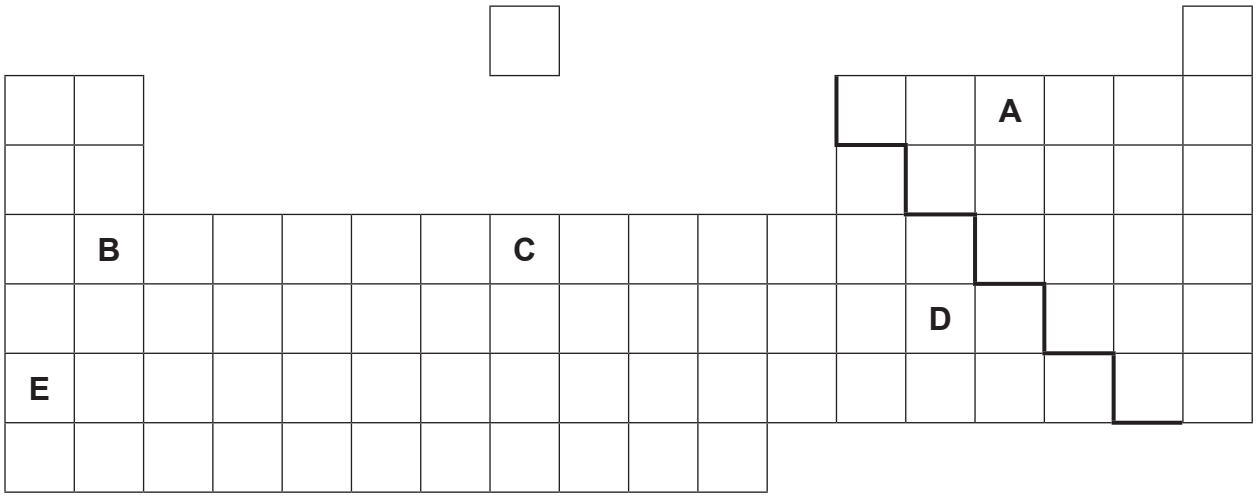
(c) Complete the table below about flame colours for different metal ions.

Metal ion	**Flame colour**
calcium	
	blue-green

[2]

4 Below is an outline of the modern Periodic Table.

The letters **A**, **B**, **C**, **D** and **E** represent the positions of some elements.



Use **only** the elements shown above to answer the following questions.

(a) Which letter, **A**, **B**, **C**, **D** or **E**, shows the position of:

an alkali metal? _____

a non-metal element? _____

a Period 5 element? _____ [3]

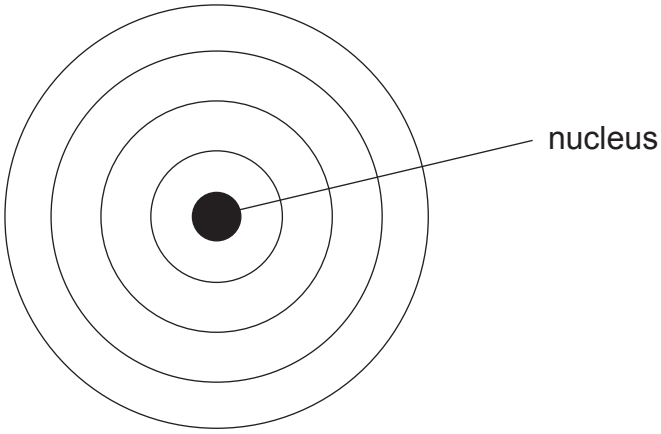
(b) Complete the following sentences.

The first periodic table was produced in 1869 by the Russian scientist, Dmitri Mendeleev. His table did not include Group 0 elements, called the _____ gases, because they had not been discovered at that time. [1]

[Turn over

5 An atom of potassium has 19 electrons.

(a) Complete the diagram below to show the electronic configuration (structure) of a potassium atom.



[1]

(b) How many electrons does a potassium atom lose to become a potassium ion?

_____ [1]

(c) The compound potassium sulfate has the formula $\mathbf{K_2SO_4}$.

(i) How many elements are present in $\mathbf{K_2SO_4}$?

_____ [1]

(ii) How many atoms are represented by the formula $\mathbf{K_2SO_4}$?

_____ [1]

(d) Potassium sulfate can be made from the reaction of an alkali with an acid. Complete the word equation below to show the formation of potassium sulfate.

potassium hydroxide + [ ] → potassium sulfate + [ ]

[2]

14883

6 **(a)** The table below gives the colour of four indicators at different pH values.

Indicator	pH value													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
methyl red	R	R	R	R	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
universal	R	R	O	O	Y	Y	G	B	B	I	I	I	V	V
alizarin yellow	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	R	R	R
thymol blue	Y	Y	Y	Y	Y	Y	Y	Y	B	B	B	B	B	B

Key
R = Red O = Orange Y = Yellow G = Green B = Blue I = Indigo V = Violet

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

(i) What colour is alizarin yellow indicator in a strong alkali?

_____ [1]

(ii) What colour is universal indicator in hydrochloric acid?

_____ [1]

(iii) Name the indicator that is the same colour over the largest pH range.

_____ [1]

(b) A scientist is adding an alkali to an acid and needs to stop when the pH is 7.

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

_____ [1]

(ii) Explain why universal indicator is the **best** indicator to show when the mixture is pH 7.

_____

_____ [1]

[Turn over

7 A student wanted to find the rate of reaction between magnesium and hydrochloric acid. The word equation for this reaction is given below.

magnesium + hydrochloric acid ⟶ magnesium chloride + hydrogen

(a) Use **one** of the chemicals from the word equation above to complete the following sentence.

To find the rate of this reaction the student could measure the volume of

_____ produced in a given period of time. [1]

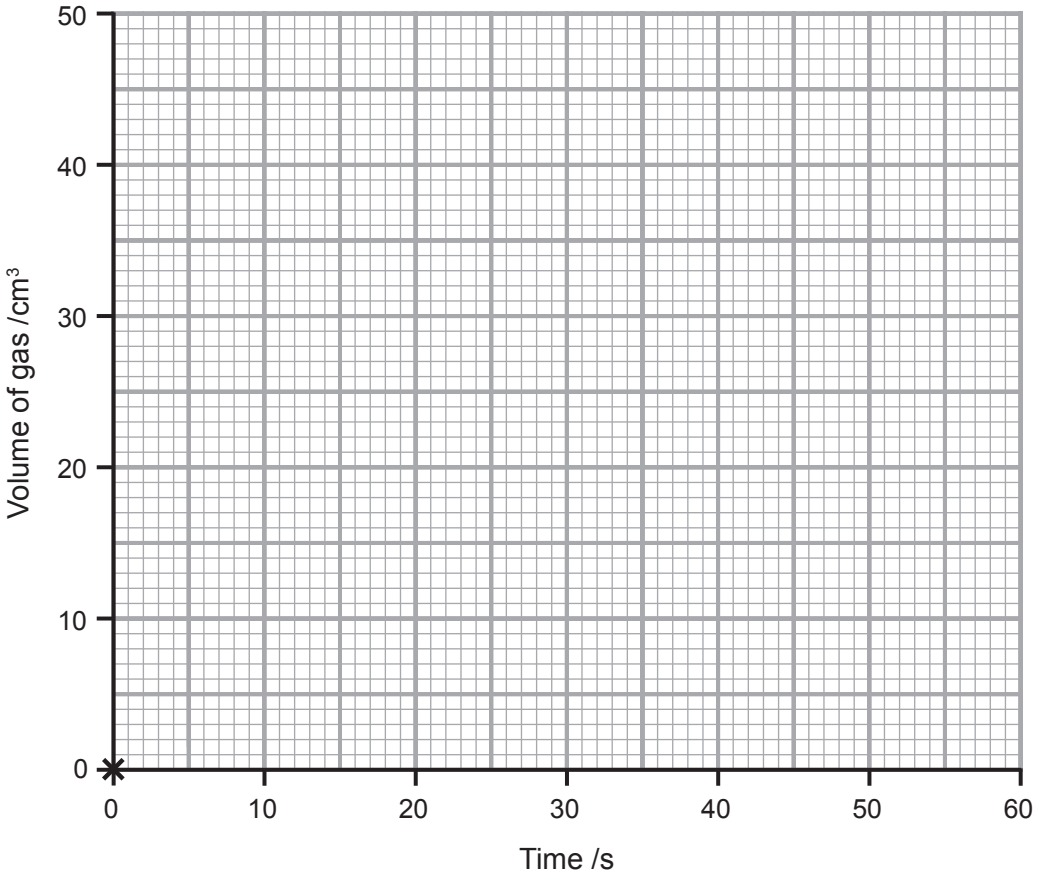
(b) This reaction is exothermic. What is meant by the term **exothermic**?

_____ [1]

(c) The table below shows the volume of gas produced during this reaction over 60 seconds.

Time /s	0	10	20	30	40	50	60
Volume of gas /cm^3	0	18	34	45	48	48	48

(i) On the grid below plot and draw a line graph for these results.
The first point has been plotted for you.



[3]

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

_____

_____

_____ [2]

[Turn over

8 In recent years local councils have tried to reduce the amount of waste produced. In 2005, **1 064 090** tonnes of waste were produced and in 2020, **913 546** tonnes of waste were produced.

(a) Calculate the decrease in the amount of waste produced from 2005 to 2020.

_____ tonnes [1]

(b) Local councils also tried to increase the amount of waste that is recycled. The table below shows the recycling targets that were set by local councils and the percentages of waste actually recycled between 2005 and 2020.

Year	Waste recycling target /%	Waste actually recycled /%
2005	15.0	17.0
2010	35.0	35.5
2015	40.0	41.0
2020	45.0	52.0

(i) Give **one** trend shown by this information.

_____

_____ [1]

(ii) In which year did local councils **exceed** their target by the greatest percentage?

_____ [1]

(c) It is important to recycle plastics because most are non-biodegradable.

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

_____

_____ [1]

(ii) Explain why it is important to reduce the amount of waste being sent to landfill.

_____

_____ [1]

[Turn over

9 Sodium and potassium are alkali metals that react with cold water.
Describe how a teacher could demonstrate these reactions to their students.

Your answer should include:

- how to carry out the demonstration safely;
- **two** similarities in the observations made during these reactions; and
- **two** differences in the observations made during these reactions.

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

[6]

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(Questions continue overleaf)

10 **(a)** Complete the following sentences about crude oil.

Crude oil is a fossil fuel formed from the remains of animals that died

_____ of years ago. It is a mixture of hydrocarbons,

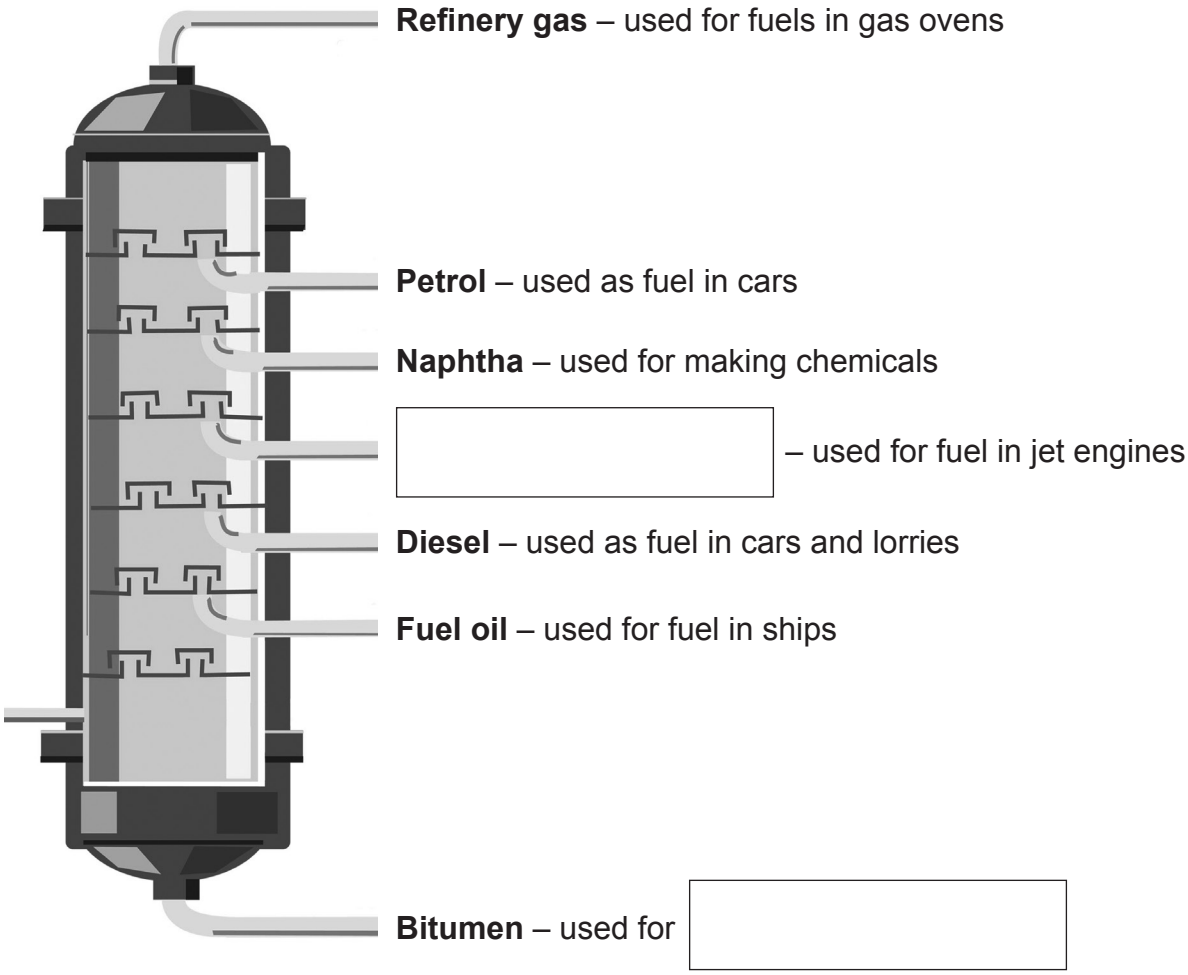
which are compounds that contain only the elements

_____ and _____ .

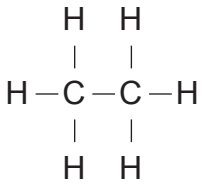
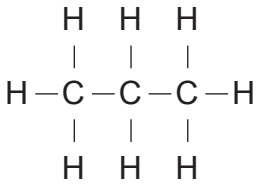
[2]

Different hydrocarbons are separated from crude oil by fractional distillation.

(b) Complete the diagram below to name the chemical used for fuel in jet engines and **one** use for bitumen. [2]



(c) (i) Complete the table below about some hydrocarbons.

Name	Molecular formula	Structural formula
butane	C_4H_{10}	
	C_2H_6	
propane		

[3]

(ii) Pentane is a hydrocarbon that contains five carbon atoms.
How many hydrogen atoms will be in a molecule of pentane?

_____ [1]

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Question Number	**Marks**
1	
2	
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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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