



Rewarding Learning

General Certificate of Secondary Education
2024

Centre Number

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Candidate Number

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Double Award Science: Chemistry

Unit C2



Foundation Tier

[GDW51]

GDW51

FRIDAY 14 JUNE, MORNING

TIME

1 hour 15 minutes.

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 seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is **70**.

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 **6(b)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

You may use a scientific calculator.

14222



24GDW5101

- 1 (a) Calcium is a reactive metal, found in Group 2 of the Periodic Table. A small piece of calcium is added to a beaker of water. The metal reacts with water as shown in the equation below.



- (i) Tick (✓) two correct observations in the table below for the reaction of calcium with water.

Observations	Tick (✓)
bubbles of gas	
the reaction is slow throughout	
the metal sinks and rises	
the metal stays on the surface of the water	

[2]

- (ii) What is the name of compound A?

[1]



- (b) To find the order of the reactivity of silver, copper, zinc and lead, a small amount of each metal was placed into a test tube containing a salt solution of one of the other metals. For example, when some silver was added to a test tube containing copper(II) nitrate solution there was no reaction.

The table below illustrates the results for the whole investigation.

Salt solution Metal	Silver nitrate	Copper(II) nitrate	Zinc nitrate	Lead(II) nitrate
Silver		no reaction	no reaction	no reaction
Copper	reaction		no reaction	no reaction
Zinc	reaction	reaction		reaction
Lead	reaction	reaction	no reaction	

- (i) Write down the order of the reactivity of the four metals from the most reactive to the least reactive.

	Most Reactive  Least Reactive

[2]

[Turn over



- (ii) Complete the word equation for the reaction of zinc and silver nitrate solution.

zinc + silver nitrate $\longrightarrow$ +

[2]

- (iii) Circle **two** correct observations for the reaction of copper with silver nitrate solution.

blue solution
formed

red-brown solution
formed

grey solid
formed

white smoke
formed

[2]

- (c) Some metals react with oxygen to form a metal oxide.

- (i) Balance the symbol equation below for the reaction between calcium and oxygen.



[1]

- (ii) Which **one** of the following metals would be less reactive than calcium with oxygen?

Circle the correct answer.

potassium

sodium

lithium

iron

[1]





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(Questions continue overleaf)

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[Turn over



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- 2 Four chemical reactions, **A**, **B**, **C** and **D**, are represented by the word equations below.

Reaction	Word equation
A	aluminium oxide $\longrightarrow$ aluminium + oxygen
B	nitrogen + hydrogen $\longrightarrow$ ammonia
C	lead(II) oxide + magnesium $\longrightarrow$ lead + magnesium oxide
D	iron + oxygen + water $\longrightarrow$ rust

- (a) **Reaction A** is endothermic.

Tick (✓) **one** statement in the table below which is **always** correct for an endothermic reaction.

Statements	Tick (✓)
Heat is given out	
Oxygen is lost	
Heat is taken in	
A gas is formed	

[1]

- (b) Name the **type** of reaction occurring in **Reaction B**.

Circle the correct answer.

oxidation **displacement** **reduction** **combustion**

[1]



(c) State what is oxidised in **Reaction C**. Explain your answer in terms of loss or gain of oxygen.

What is oxidised: _____

Explanation: _____

_____ [2]

(d) **Reaction D** represents iron rusting.

State **two** barrier methods used to prevent iron from rusting.

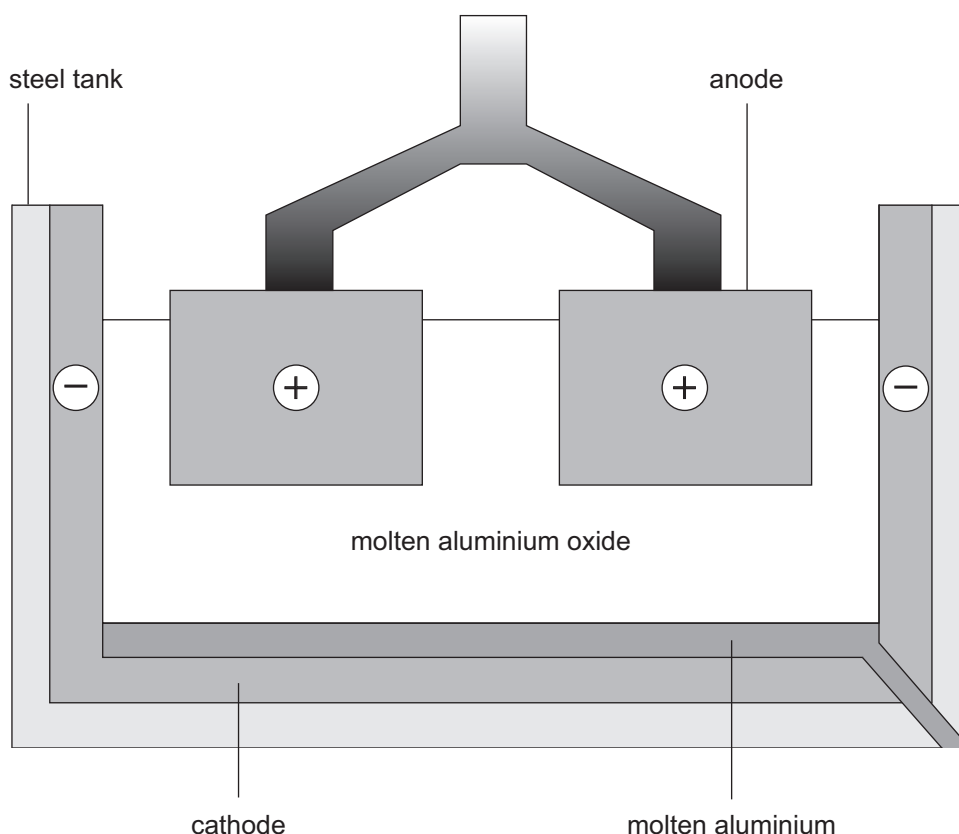
1. _____

2. _____ [2]

[Turn over



- 3 Aluminium is extracted from aluminium oxide by electrolysis. The process takes place in a steel tank as shown below. This is an example of a redox reaction.



- (a) (i) What are the anodes made from?

_____ [1]

- (ii) Oxygen is produced at the anode.

Explain why the anodes have to be replaced regularly.

_____ [2]



(iii) Explain why the aluminium oxide must be molten to conduct electricity.

[2]

(iv) The aluminium oxide is dissolved in a substance to lower its melting point.

What is this substance?

Circle the correct answer.

water oil cryolite alumina [1]

(v) How is molten aluminium removed from the tank?

[1]

(b) The extraction of aluminium from aluminium oxide is an example of a redox reaction. Define the term **redox reaction**.

[2]

[Turn over



4 This question is about crude oil and organic chemistry.

(a) Crude oil is a mixture of compounds made of hydrogen and carbon only.

(i) What name is given to compounds made of hydrogen and carbon only?

_____ [1]

(ii) The following sentences describe the separation of crude oil by fractional distillation.

Select words from the list below to correctly complete the sentences.

evaporate

melt

condense

freeze

melting

boiling

In fractional distillation the crude oil is heated. This causes the compounds to _____ .

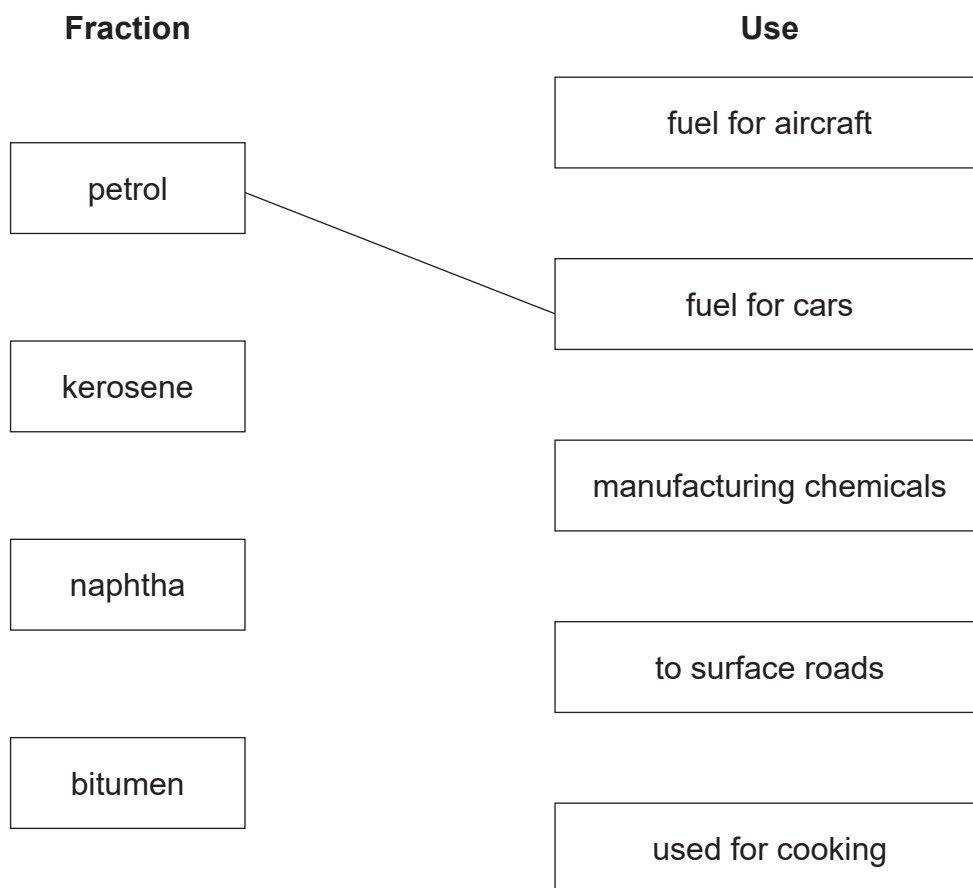
The compounds rise up the fractionating column and _____

in the section where the temperature matches their _____ point. [3]



(iii) Listed below are four fractions of hydrocarbons obtained from crude oil.

Draw a line from each fraction to its most appropriate use. One has been done for you. Each use can only be linked to one fraction.



[3]

[Turn over



(b) The structural formulae of six organic molecules, labelled, **P**, **Q**, **R**, **S**, **T** and **U**, are given below.

P <pre> H H H H — C — C = C H H </pre>	Q <pre> H H C = C H H </pre>	R <pre> H H H — C — C — H H H </pre>
S <pre> H H H H — C — C — C — H H H H </pre>	T <pre> H H — C — H H </pre>	U <pre> H H H H H — C — C = C — C — H H H </pre>

(i) Which molecule, **P**, **Q**, **R**, **S**, **T** or **U**, has the molecular formula C_3H_8 ?

_____ [1]

(ii) Which molecule, **P**, **Q**, **R**, **S**, **T** or **U**, is ethene?

_____ [1]

(iii) What is the physical state at room temperature and pressure of molecule **S**?

_____ [1]

(iv) State the colour change observed in bromine water when it is mixed with molecule **U**.

from _____ to _____ [2]





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5 (a) Barium chloride, $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$, contains water of crystallisation.

(i) State the chemical term that refers to a solid which contains water of crystallisation.

_____ [1]

(ii) Calculate the relative formula mass of the $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$.

(Relative atomic masses (A_r): Ba = 137; Cl = 35.5; H = 1; O = 16)

_____ [1]

(b) Water of crystallisation can be removed from a sample of solid $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ by heating strongly.

(i) Complete the following statement.

The type of reaction used for the removal of water of crystallisation is called thermal _____ . [1]

(ii) Describe the method used to remove **all** the water of crystallisation from a sample of solid $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$, by completing the sentences below.

Place a sample of solid $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ into an _____ dish.

Heat strongly with a _____ until constant

_____ . [3]



(iii) State what happens to the **mass** of the sample of solid $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ during heating.

Circle the correct answer.

increases

stays the same

decreases

[1]

(iv) Complete the balanced symbol equation below to show the removal of all the water of crystallisation from $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$.

$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ $\longrightarrow$ _____ + _____ [2]

[Turn over]



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6 Nitrogen and hydrogen are important gases with many uses.

Nitrogen gas is present in the atmosphere.

(a) (i) What is the approximate percentage of nitrogen in the atmosphere?

Circle the correct answer.

0.03%

1%

21%

78%

[1]

(ii) Four uses of gases are given below.

Circle the one use that relates to nitrogen.

welding

coolant

fizzy drinks

clean fuel

[1]

(iii) Nitrogen is also used in food packaging because it is unreactive.

Explain why nitrogen is unreactive.

[2]

(iv) Listed below are three statements about the physical properties of nitrogen.

Use a tick (✓) to identify whether the statements are **true** or **false**.

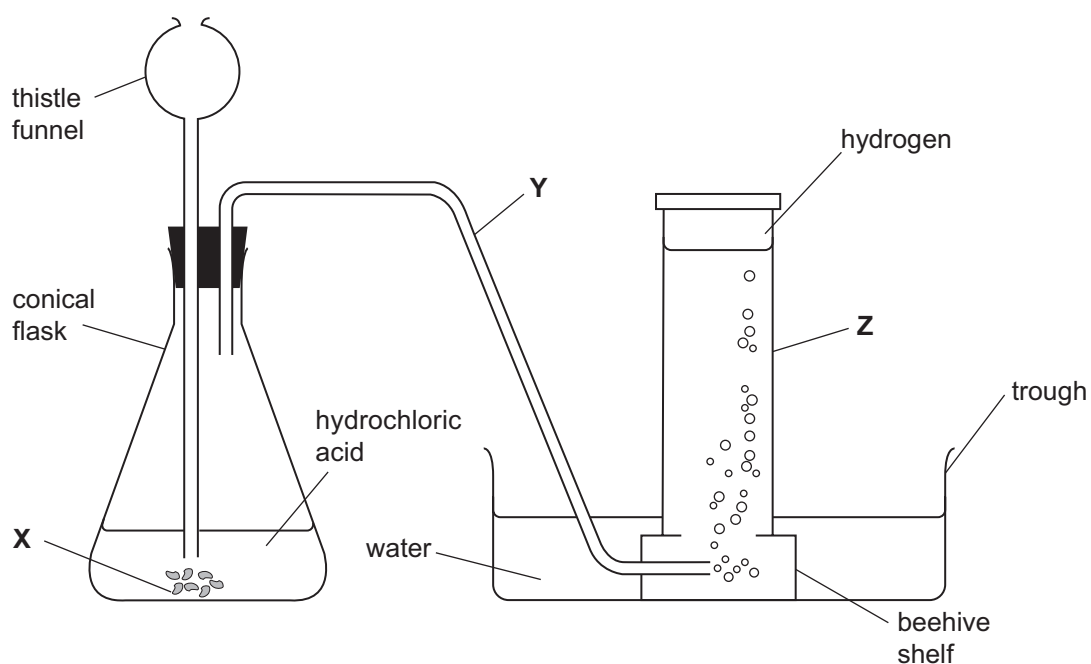
Statement	True	False
Nitrogen is colourless		
Nitrogen has a pungent odour		
Nitrogen has a low boiling point		

[3]

[Turn over



(b) The diagram below shows the preparation of hydrogen gas in a laboratory.



Give details of the preparation, test and use of hydrogen gas, using the following points:

- Name the solid **X** and the pieces of apparatus labelled **Y** and **Z**.
- Describe the test for hydrogen and state the result for a positive test.
- Explain why hydrogen is described as a clean fuel.



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

Name the solid **X** and the pieces of apparatus labelled **Y** and **Z**.

Describe the test for hydrogen and state the result for a positive test.

Explain why hydrogen is described as a clean fuel.

[6]

[Turn over



- 7 A student investigated how the rate of reaction between lumps of solid calcium carbonate and excess hydrochloric acid varied with time by recording the mass of the reaction mixture every 10 seconds.

A graph of the student's results is shown below.

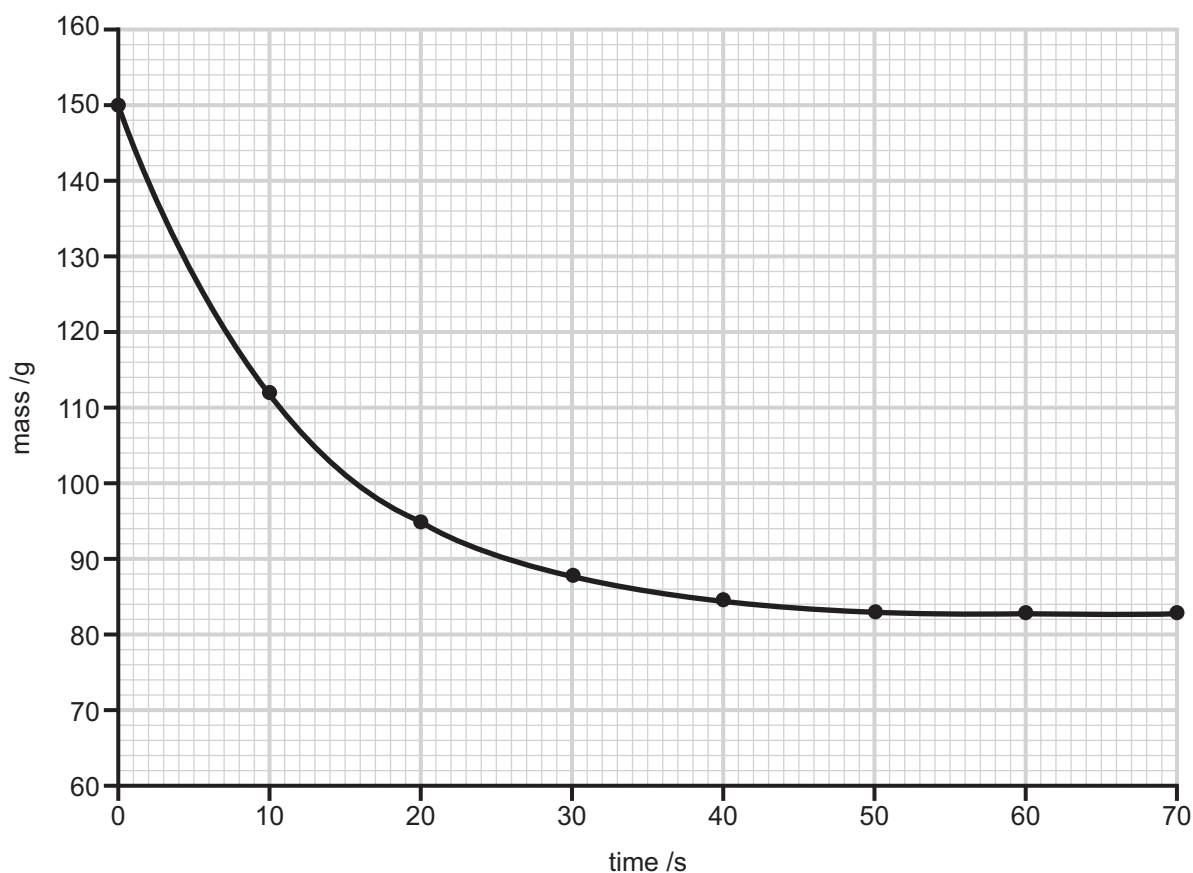
- (a) Complete the word equation for the reaction.

calcium carbonate + hydrochloric acid



+ carbon dioxide +

[2]



- (b) Name the piece of apparatus that could be used to record the mass in this reaction.

_____ [1]



(c) Suggest why the mass of the reaction mixture decreased.

[1]

(d) Use the graph to complete the following two statements.

The reaction finished when the time was _____ s.

At 20 s the mass of the reaction mixture was _____ g. [2]

(e) Suggest the effect that heating the hydrochloric acid would have on the rate of this reaction.

[1]

(f) **On the grid opposite** sketch the graph that would be obtained if the same mass of powdered calcium carbonate was used in place of lumps. [3]

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Question Number	Marks
1	
2	
3	
4	
5	
6	
7	

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																		4																							
7		9																		20																							
Li		Be																		He																							
Lithium		Beryllium																		Helium																							
3		4																		10																							
23		24																		40																							
Na		Mg																		Ar																							
Sodium		Magnesium																		Argon																							
11		12																		18																							
																11	12	14	16	19	20																						
																B	C	N	O	F	Ne																						
																Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon																						
																5	6	7	8	9	10																						
																27	28	31	32	35.5	40																						
																Al	Si	P	S	Cl	Ar																						
																Aluminium	Silicon	Phosphorus	Sulfur	Chlorine	Argon																						
																13	14	15	16	17	18																						
																39	40	45	48	51	52	55	56	59	59	64	65	70	73	75	79	80	84										
																K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr										
																Potassium	Calcium	Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Gallium	Germanium	Arsenic	Selenium	Bromine	Krypton										
																19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36										
																85	88	89	91	93	96	98	101	103	106	108	112	115	119	122	128	127	131										
																Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe										
																Rubidium	Strontium	Yttrium	Zirconium	Niobium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium	Indium	Tin	Antimony	Tellurium	Iodine	Xenon										
																37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54										
																133	137	139	178	181	184	186	190	192	195	197	201	204	207	209	210	210	222										
																Cs	Ba	La*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn										
																Caesium	Barium	Lanthanum	Hafnium	Tantalum	Tungsten	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury	Thallium	Lead	Bismuth	Polonium	Astatine	Radon										
																55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86										
																223	226	227	261	262	266	264	277	268	271	272	285																
																Fr	Ra	Ac†	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn																
																Francium	Radium	Actinium	Rutherfordium	Dubnium	Seaborgium	Bohrium	Hassium	Meitnerium	Darmstadtium	Roentgenium	Copernicium																
																87	88	89	104	105	106	107	108	109	110	111	112																

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



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