GradeMax

CAMBRIDGE
International Education

Cambridge International AS & A Level

CHEMISTRY **9701/12**

Paper 1 Multiple Choice **May/June 2026**

1 hour 15 minutes

7664485483

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.
- Important values, constants and standards are printed in the question paper.

This document has **20** pages. Any blank pages are indicated.

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[Turn over

1 Which mass of aluminium is needed to produce 0.10 mol of Al_2Cl_6?

A 0.54 g **B** 2.7 g **C** 5.4 g **D** 10.8 g

2 Compound Q contains the elements C, H and O only.

When completely combusted, 2.00 g of Q produces 4.00 g of carbon dioxide and 1.63 g of water.

What is the empirical formula of Q?

A CHO_2 **B** C_2H_2O **C** C_2H_4O **D** CH_2O_2

3 Which row correctly describes the ion $^{35}_{16}S^{2-}$?

	neutrons	electrons
A	16	16
B	16	18
C	19	16
D	19	18

4 Element X has a higher first ionisation energy than element Y.

Two students state **one** factor that helps to explain this.

student 1 'X has a higher first ionisation energy than Y because an atom of X has more protons in its nucleus than an atom of Y.'

student 2 'X has a higher first ionisation energy than Y because X has a smaller atomic radius than Y.'

Only **one** of the two students is correct.

Which elements could X and Y be?

	X	Y
A	carbon	boron
B	magnesium	aluminium
C	oxygen	nitrogen
D	oxygen	sulfur

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5 In which substance, when in pure liquid form, are instantaneous dipole-induced dipole forces the only intermolecular force in the substance?

A ethyl ethanoate

B helium

C hydrogen chloride

D water

6 Descriptions of some covalent bonds are given.

1 the overlap of two p orbitals

2 the overlap of two sp hybrid orbitals

3 the overlap of two s orbitals

Which bonds are present in the hydrogen cyanide molecule, HCN?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

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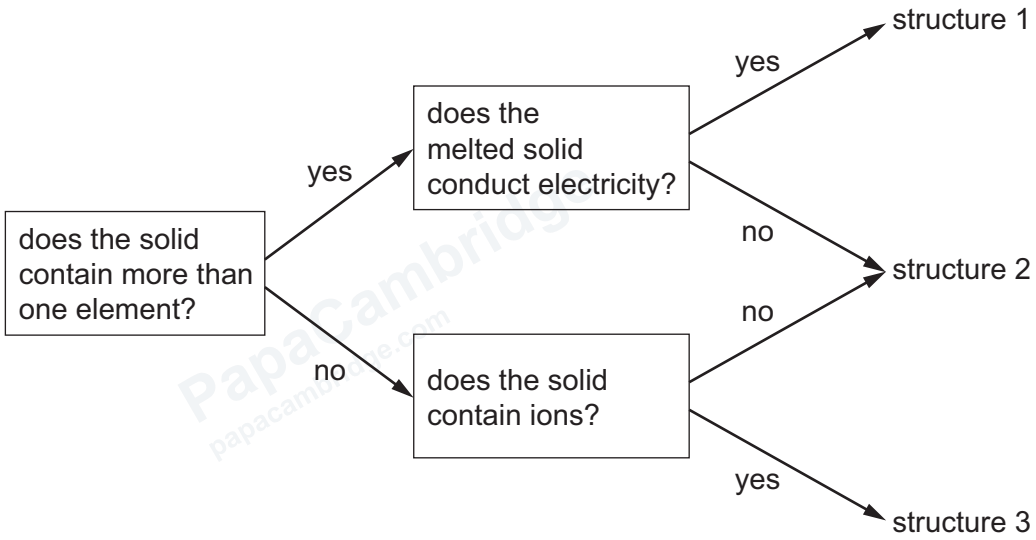
7 Solid X is known to be an element or compound with a giant lattice structure.

The identification key shown can be used to identify the type of giant lattice structure in solid X.



What are structures 1, 2 and 3, to complete this identification key?

	structure 1	structure 2	structure 3
A	covalent	ionic	metallic
B	ionic	covalent	metallic
C	metallic	covalent	ionic
D	ionic	metallic	covalent

8 In this question, you should assume that nitrogen behaves as an ideal gas.

What is the volume of 15.0 g of nitrogen at a temperature of 70.0 °C and a pressure of 192 kPa?

A 1.62 dm^3 **B** 7.95 dm^3 **C** 15.9 dm^3 **D** 27.7 dm^3

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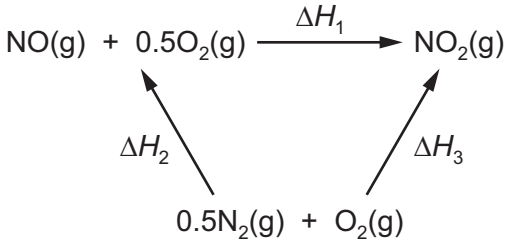
9 An energy cycle is shown.



Which expression equals the enthalpy change of formation of NO?

A $\Delta H_1 - \Delta H_3$ **B** $-\Delta H_1 - \Delta H_3$ **C** $\Delta H_3 + \Delta H_1$ **D** $\Delta H_3 - \Delta H_1$

10 50 cm^3 of 2.50 mol dm^{-3} hydrochloric acid was placed in a polystyrene beaker of negligible heat capacity. The temperature of the acid was recorded and then 50 cm^3 of 2.50 mol dm^{-3} NaOH at the same temperature was quickly added, with stirring. The temperature rose by 17 °C.

The resulting solution may be considered to have a specific heat capacity of 4.2 J g^{-1} K^{-1}.

What is an approximate value for the molar enthalpy change of neutralisation of hydrochloric acid with sodium hydroxide from this experiment?

A $\frac{-(50 \times 4.2 \times 17)}{(0.050 \times 2.5)}$ J mol^{-1}

B $\frac{-(50 \times 4.2 \times 17)}{(0.10 \times 2.5)}$ J mol^{-1}

C $\frac{-(100 \times 4.2 \times 17)}{(0.050 \times 2.5)}$ J mol^{-1}

D $\frac{-(100 \times 4.2 \times 17)}{(50 \times 2.5)}$ J mol^{-1}

11 TiO_2 is obtained from iron(II) titanate, $FeTiO_3$.

What is the change, if any, in the oxidation number of titanium?

A It is oxidised from +3 to +4.

B It is reduced from +3 to +2.

C It is reduced from +6 to +4.

D There is no change in the oxidation number.

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12 Copper(I) iodide is produced by the reaction shown.

$$2CuSO_4(aq) + 4KI(aq) \rightarrow 2CuI(s) + I_2(aq) + 2K_2SO_4(aq)$$

Which statement about this reaction is correct?

A All iodide ions act as oxidising agents.

B All iodide ions act as reducing agents.

C All copper ions act as oxidising agents.

D All copper ions act as reducing agents.

13 A chemist adds 3.0 mol of nitrogen dioxide to a container. The container is maintained at a constant temperature and equilibrium is reached.

$$2NO_2 \rightleftharpoons N_2O_4$$

The equilibrium mixture contains 2.3 mol of NO_2.

What is the amount of N_2O_4 in the equilibrium mixture?

A 0.35 mol **B** 0.70 mol **C** 1.40 mol **D** 1.50 mol

14 Ethanoic acid dissociates in water.

$$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+ \qquad \Delta H = -2\,kJ\,mol^{-1}$$

Which change causes the pH of this aqueous solution to decrease?

A adding a catalyst

B dissolving a small amount of potassium hydroxide into the mixture

C decreasing the temperature

D dissolving a small amount of sodium ethanoate into the aqueous ethanoic acid

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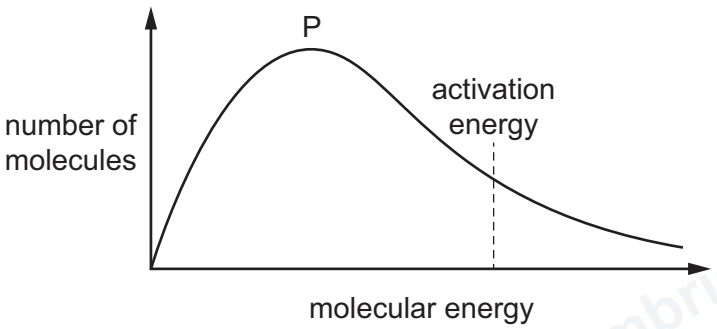
15 The diagram shows a Boltzmann distribution of molecular energies for a gaseous mixture. The distribution has a peak, labelled P.



What happens when an effective catalyst is added to the mixture?

A The height of the peak decreases and the activation energy moves to the right.

B The height of the peak decreases and the activation energy moves to the left.

C The height of the peak remains the same and the activation energy moves to the right.

D The height of the peak remains the same and the activation energy moves to the left.

16 Which statement about the Period 3 elements sodium to phosphorus and their compounds is correct?

A All the chlorides of the elements are hydrolysed by water to form HC*l*.

B As the nuclear charge of the element increases, the electrons in the outer shell are further from the nucleus.

C The structure and bonding of all of the elements is either giant ionic or simple covalent.

D Only one of the oxides can form a solution with a pH greater than 12 when it is added to water.

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17 X, Y and Z are elements in Period 3.

Some physical properties of X, Y and Z are shown.

element	melting point / °C	electrical conductor
X	98	yes
Y	650	yes
Z	113	no

What are X, Y and Z?

	X	Y	Z
A	magnesium	sodium	sulfur
B	magnesium	sulfur	sodium
C	sodium	sulfur	magnesium
D	sodium	magnesium	sulfur

18 Two procedures are described.

1 Sulfur is burned in an excess of oxygen then NO is added to the product mixture.

2 Sulfur is burned in an excess of oxygen then NO_2 is added to the product mixture.

Which procedures will produce some sulfur trioxide, SO_3?

A both 1 and 2

B 1 only

C 2 only

D neither 1 nor 2

19 The chloride of element J is added to a beaker of water. The oxide of element J is then added to the same beaker. A neutralisation reaction occurs.

What is element J?

A A*l* **B** Mg **C** P **D** S

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20 When calcium nitrate thermally decomposes, oxygen is one of the products.

Which volume of oxygen is produced at room conditions when 0.50 mol of calcium nitrate thermally decomposes?

A $6.0\,dm^3$ **B** $12.0\,dm^3$ **C** $18.0\,dm^3$ **D** $30.0\,dm^3$

21 Two 0.20 g samples of different Group 2 compounds are each shaken with $10\,cm^3$ of water in separate test-tubes.

Which pair of compounds form clear solutions and then become cloudy when mixed together?

A barium hydroxide and barium sulfate

B barium sulfate and magnesium hydroxide

C magnesium sulfate and barium hydroxide

D magnesium sulfate and magnesium hydroxide

22 The volatility of the halogens decreases down the group.

What is the explanation for this trend?

A decreasing strength of covalent bonds

B increasing strength of covalent bonds

C decreasing strength of London dispersion forces

D increasing strength of London dispersion forces

23 Which is the strongest oxidising agent?

A Cl_2 **B** Cl^- **C** I_2 **D** I^-

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24 Ammonia can be made by a suitable reaction using ammonium chloride as one of the reactants.

Two statements are given about this reaction.

1 This reaction takes place when ammonium chloride is heated with KOH(aq).

2 The H–N–H bond angle decreases.

Which statements are correct?

A both 1 and 2

B 1 only

C 2 only

D neither 1 nor 2

25 What is the least number of carbon atoms in a non-cyclic alkane molecule that has a chiral centre?

A 7 **B** 8 **C** 9 **D** 10

26 The **first** propagation step in the reaction between methane and chlorine is shown.

$$CH_4 + Cl\bullet \rightarrow CH_3\bullet + HCl$$

How many different **first** propagation steps are possible in the reaction between pentane and chlorine?

A 2 **B** 3 **C** 4 **D** 5

27 Structural isomerism and stereoisomerism should be considered when answering this question.

Several isomers with molecular formula $C_5H_{10}O$ give an orange precipitate with 2,4-DNPH reagent.

Which statement is correct?

A There are eight isomers only. All of the isomers produce a brick-red precipitate with Fehling's reagent.

B There are eight isomers only. Five of the isomers produce a silver mirror with Tollens' reagent.

C There are six isomers only. Two of the isomers produce a yellow precipitate with alkaline I_2(aq).

D There are six isomers only. Four of the isomers turn acidified $K_2Cr_2O_7$ from orange to green on warming.

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28 Hydrogen iodide undergoes an addition reaction with propene forming 2-iodopropane.

When propene is bubbled through iodine monochloride, ICl, dissolved in a suitable solvent, a similar reaction occurs.

Which product will be present in the greatest yield?

A $CH_3\underset{\displaystyle Cl}{\underset{|}{C}}HCH_2Cl$

B $CH_3\underset{\displaystyle I}{\underset{|}{C}}HCH_2I$

C $CH_3\underset{\displaystyle Cl}{\underset{|}{C}}HCH_2I$

D $CH_3\underset{\displaystyle I}{\underset{|}{C}}HCH_2Cl$

29 Tertiary halogenoalkanes undergo a hydrolysis reaction with water.

In the equation, X represents either an iodine atom or a chlorine atom.

$$(CH_3)_3C–X + H_2O \rightarrow (CH_3)_3C–OH + HX$$

Which statement is correct for this reaction?

A The C–I bond is weaker than the C–Cl bond and so the reaction is faster when X is I.

B The reaction tends to proceed by the S_N2 mechanism.

C After the attack on the intermediate by an H_2O molecule, the last stage of the mechanism is the transfer of a proton from another water molecule.

D The planar intermediate has an unpaired electron which attacks a water molecule to form a C–O bond.

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30 A sample of 1-bromopropane, C_3H_7Br, of mass 36.9 g is heated with an excess of KCN in ethanol.

The reaction gives a 78.0% yield of the desired organic product.

Which row is correct?

	mass of product / g	name of product
A	16.2	butanenitrile
B	16.2	propanenitrile
C	28.8	butanenitrile
D	28.8	propanenitrile

31 Which reaction has ethanol as the major organic product?

A C_2H_4 is reacted with cold dilute acidified $KMnO_4$.

B C_2H_5Br is heated with a concentrated solution of NaOH in ethanol.

C CH_3CHO is heated with $NaBH_4$.

D $C_2H_5COOCH_3$ is heated under reflux with dilute acid.

32 Methylpropene reacts with steam in the presence of an H_3PO_4 catalyst.

The major product of this reaction is then heated with an excess of acidified $KMnO_4$.

If the mixture is distilled after heating, which organic compound will be collected?

A butanone

B methylpropan-2-ol

C methylpropanal

D methylpropanoic acid

33 Which pair of compounds can be distinguished by adding alkaline I_2(aq)?

A ethanal and propanal

B ethanol and propan-2-ol

C methanol and propan-1-ol

D propanone and butanone

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34 Two reactions are described.

1 Ethanoic acid reacts with methanol.

2 Ethanoic acid reacts with sodium carbonate.

Which statement is correct?

A Both reactions are redox.

B Only reaction 1 is redox.

C Only reaction 2 is redox.

D Neither reaction is redox.

35 Compound Z has the structural formula $CH_3CO_2CH_2CH_2CO_2H$.

What is produced when compound Z is heated for 30 minutes with an excess of aqueous sodium hydroxide?

A $CH_3CO_2^-Na^+$ and $HOCH_2CH_2CO_2H$

B $CH_3CO_2^-Na^+$ and $HOCH_2CH_2CO_2^-Na^+$

C $CH_3CO_2^-Na^+$ and $Na^+{}^-OCH_2CH_2CO_2^-Na^+$

D CH_3CH_2OH and $Na^+{}^-O_2CCH_2CO_2^-Na^+$

36 Ethanenitrile is heated with an excess of sodium hydroxide until the reaction is complete, giving organic compound X.

Which row is correct?

	C–C–N bond angle in ethanenitrile	**C–C–O bond angle in compound X**
A	120°	109°
B	120°	120°
C	180°	109°
D	180°	120°

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37 An addition polymer has the repeat unit $–CH_2C(CH_3)_2–$.

Which monomer is this polymer produced from?

A but-1-ene

B but-2-ene

C methylpropene

D buta-1,3-diene

38 Compound X, $CH_3CH(OH)CH(CHO)CH_3$, is heated under reflux with an excess of acidified $K_2Cr_2O_7$ to form compound Y.

Both X and Y are separately warmed with Fehling's reagent and the observations noted.

What are the observations?

A Both X and Y give a red precipitate.

B Only X gives a red precipitate.

C Only Y gives a red precipitate.

D Neither X nor Y gives a red precipitate.

39 Structural isomerism and stereoisomerism should be considered when answering this question.

How many isomeric hydrocarbon molecules:

- are non-cyclic
- contain exactly four carbon atoms
- contain two sp^2 hybridised carbon atoms
- contain two sp^3 hybridised carbon atoms?

A 2 **B** 3 **C** 4 **D** 5

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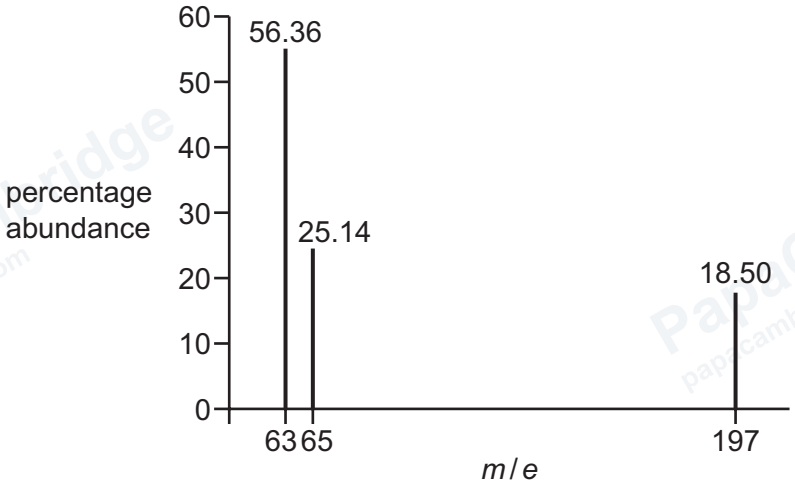
40 The mass spectrum of an alloy of copper and gold is shown.



Which expression can be used to calculate the relative atomic mass, A_r, of copper present in this sample?

A $\dfrac{(56.36 \times 63) + (25.14 \times 65)}{(56.36 + 25.14 + 18.50)}$

B $\dfrac{(56.36 \times 63) + (25.14 \times 65) + (18.50 \times 197)}{(56.36 + 25.14 + 18.50)}$

C $\dfrac{(56.36 \times 63) + (25.14 \times 65)}{(56.36 + 25.14)}$

D $\dfrac{(56.36 \times 63) + (25.14 \times 65)}{(63 + 65)}$

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Important values, constants and standards

molar gas constant	$R = 8.31\,\text{J K}^{-1}\,\text{mol}^{-1}$
Faraday constant	$F = 9.65 \times 10^{4}\,\text{C mol}^{-1}$
Avogadro constant	$L = 6.022 \times 10^{23}\,\text{mol}^{-1}$
electronic charge	$e = -1.60 \times 10^{-19}\,\text{C}$
molar volume of gas	$V_m = 22.4\,\text{dm}^3\,\text{mol}^{-1}$ at s.t.p. (101 kPa and 273 K) $V_m = 24.0\,\text{dm}^3\,\text{mol}^{-1}$ at room conditions
ionic product of water	$K_w = 1.00 \times 10^{-14}\,\text{mol}^2\,\text{dm}^{-6}$ (at 298 K (25 °C))
specific heat capacity of water	$c = 4.18\,\text{kJ kg}^{-1}\,\text{K}^{-1}$ ($4.18\,\text{J g}^{-1}\,\text{K}^{-1}$)

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The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1.0										2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium –	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

lanthanoids	57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium –	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0
actinoids	89 Ac actinium –	90 Th thorium 232.0	91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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