GradeMax

CAMBRIDGE
International Education

Cambridge International AS & A Level

CHEMISTRY **9701/14**

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

1 hour 15 minutes

8013561319

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 **16** pages.

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1 Which ion has the same electronic configuration as Cl^-?

A F^- **B** Sc^{3+} **C** P^+ **D** Si^{4+}

2 Four elements from Period 2 are B, C, N and Ne.

Which element has the largest fifth ionisation energy and which element has the smallest fifth ionisation energy?

	largest fifth ionisation energy	smallest fifth ionisation energy
A	C	B
B	C	N
C	Ne	B
D	Ne	N

3 An equation is shown.

$$2CON_2H_4 + xNO_2 \rightarrow 2CO_2 + yH_2O + zN_2$$

What are the values of *x*, *y* and *z* in a balanced equation?

	x	*y*	*z*
A	1.5	2	1.25
B	2	4	3
C	3	4	3.5
D	3	4	3

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4 14.9 g of sodium chlorate(I), NaOCl, is dissolved in 500 cm^3 of water. An equilibrium is established.

$$NaOCl(aq) + H_2O(l) \rightleftharpoons HOCl(aq) + NaOH(aq)$$

At equilibrium, 20% of the NaOCl(aq) remains.

What is the concentration of HOCl at equilibrium?

A 0.032 mol dm^{-3}

B 0.16 mol dm^{-3}

C 0.32 mol dm^{-3}

D 1.6 mol dm^{-3}

5 Three statements about hybridisation are listed.

1 In ethane, both carbon atoms are sp^3 hybridised.

2 In propene, two carbon atoms are sp^2 hybridised and the third carbon atom is sp^3 hybridised.

3 In methanenitrile, the carbon atom is sp hybridised.

Which statements are correct?

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

6 VSEPR should be used to answer this question.

Element E forms two chlorides. ECl_3 is pyramidal in shape. ECl_5 is trigonal bipyramidal in shape. Both compounds are simple molecular. All bonds are single covalent bonds. Neither compound has coordinate bonding.

What is element E?

A arsenic

B gallium

C germanium

D selenium

7 A container has a volume of 25.0 dm^3. It is filled with argon gas at a temperature of 25 °C and a pressure of 210 kPa. Argon behaves as an ideal gas under these conditions.

Which mass of argon gas is used?

A 84.6 g **B** 169 g **C** 1010 g **D** 84 600 g

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8 The boiling points of the hydrogen halides increase from HC*l* to HBr to HI.

Which factor is most responsible for this increase in boiling point?

A an increase in strength of hydrogen bonding

B an increase in the number of electrons in the hydrogen halide molecule

C an increase in strength of permanent dipole–permanent dipole attractions

D an increase in the polarity of the hydrogen–halogen bond

9 The enthalpy changes for two reactions are shown.

$$2NO_2 \rightarrow N_2O_4 \qquad \Delta H^{\ominus} = -23\,kJ\,mol^{-1}$$

$$N_2 + 2O_2 \rightarrow N_2O_4 \qquad \Delta H^{\ominus} = +9\,kJ\,mol^{-1}$$

What is the enthalpy change of formation, $\Delta H_f^{\ominus}$, of NO_2?

A $-14\,kJ\,mol^{-1}$ **B** $-7\,kJ\,mol^{-1}$ **C** $+16\,kJ\,mol^{-1}$ **D** $+32\,kJ\,mol^{-1}$

10 A butane burner is used to heat water.

- The M_r of butane is 58.
- ΔH_c of butane is $-2877\,kJ\,mol^{-1}$.
- 250 g of water is heated from 12 °C to 100 °C.
- The burner transfers 47% of the heat released from the burning fuel to the water.

Assume that the butane undergoes complete combustion and none of the water evaporates.

What is the minimum mass of butane that must be burnt?

A 0.068 g **B** 1.85 g **C** 3.94 g **D** 4.48 g

11 In acidic solution, $Cr_2O_7^{2-}(aq)$ can be reduced to $Cr^{3+}(aq)$.

How many moles of $Fe^{2+}(aq)$ can be oxidised to $Fe^{3+}(aq)$ by 1 mol of $Cr_2O_7^{2-}(aq)$ in acidic solution?

A 2 **B** 3 **C** 4 **D** 6

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12 Four reversible reactions are shown.

W, X, Y and Z represent different compounds, all of which are present in aqueous solution.

In which reaction does K_c have units $mol^{-2}\ dm^6$?

A $W + X \rightleftharpoons Y + Z$

B $2X + Y \rightleftharpoons 2Z$

C $W \rightleftharpoons X + Z$

D $W + 2X \rightleftharpoons Z$

13 KNH_2 is an ionic compound. It contains K^+ ions and a single species of anion. Under appropriate conditions, NH_4Br and KNH_2 react as follows.

$$NH_4Br + KNH_2 \rightarrow KBr + 2NH_3$$

How can the reaction be classified?

A acid–base

B condensation

C disproportionation

D oxidation–reduction

14 The reaction shown is exothermic in the forward direction.

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$$

Which statement about the reaction is correct?

A Increasing the pressure reduces the rate of reaction.

B A higher temperature increases the percentage yield of the products at equilibrium.

C A higher temperature increases the collision frequency between molecules.

D A catalyst increases the percentage yield of the products at equilibrium.

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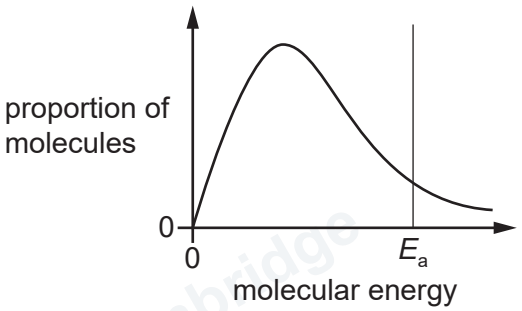
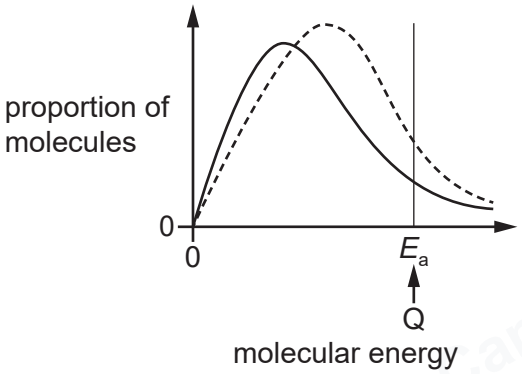
15 The diagram represents, for a given temperature, the Boltzmann distribution of the kinetic energies of the molecules in a mixture of two gases that react together. The activation energy for the reaction, E_a, is marked.



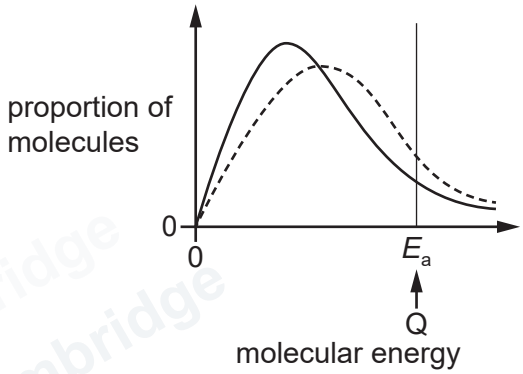
The dotted curves below show the Boltzmann distribution for the same reaction at a higher temperature. On these diagrams, Q represents the activation energy at the higher temperature.

Which diagram is correct?

A



B



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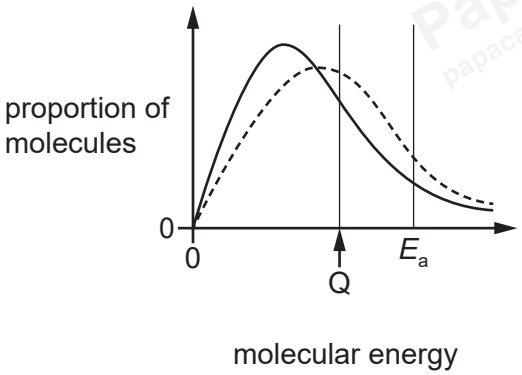
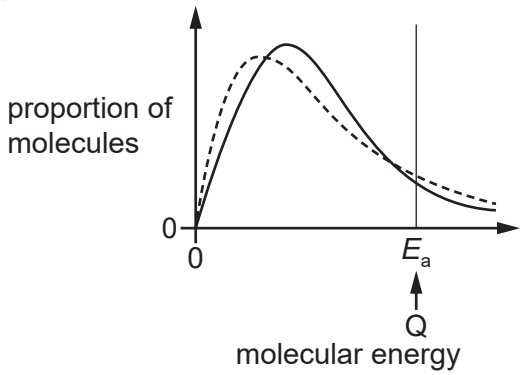


D



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16 Ammonia molecules react to produce ammonium ions.

Some statements about this reaction are listed.

1 Ammonia acts as a Brønsted–Lowry base.

2 The H–N–H bond angle increases.

3 An ammonium ion contains the same number of electrons as an ammonia molecule.

Which statements are correct?

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

17 The elements C*l*, Mg, Si and S are all in Period 3.

What is the correct sequence of the melting points of these elements, from lowest to highest?

	lowest melting point	→		**highest melting point**
A	C*l*	S	Mg	Si
B	C*l*	S	Si	Mg
C	Mg	Si	S	C*l*
D	Si	Mg	S	C*l*

18 X and Y are elements in Period 3 of the Periodic Table.

- The atomic radius of X is greater than the atomic radius of Y.
- For common ions, the ionic radius of Y is greater than the ionic radius of X.

Which statement is correct?

A X has a greater atomic number than Y.

B The oxide of Y is acidic.

C The chloride of X is basic.

D X has a greater 1st ionisation energy than Y.

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19 0.010 mol of anhydrous magnesium nitrate is thermally decomposed.

Which volume of gas is produced, measured under room conditions?

A 240 cm^3 of NO_2 only

B 240 cm^3 of NO_2 and 60 cm^3 of O_2

C 240 cm^3 of NO_2 and 360 cm^3 of O_2

D 480 cm^3 of NO_2 and 120 cm^3 of O_2

20 Which row is correct?

	fourth ionisation energy		**reaction with water**	
	magnesium	**barium**	**magnesium**	**barium**
A	higher	lower	faster	slower
B	higher	lower	slower	faster
C	lower	higher	faster	slower
D	lower	higher	slower	faster

21 A solid mixture of barium oxide and magnesium nitrate is stirred into water. The mixture is filtered and a colourless solution, Y, and a white solid, Z, are obtained. Z is washed with distilled water and dried.

Which observations are made when Y and Z are added separately to an excess of dilute sulfuric acid?

	observation with Y	**observation with Z**
A	colourless solution	colourless solution
B	colourless solution	white precipitate
C	white precipitate	white precipitate
D	white precipitate	colourless solution

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22 Solutions of HBr(aq) and HI(aq) react separately with $O_2(g)$.

The equation shows the reaction, where HX represents either HBr(aq) or HI(aq).

$$4HX(aq) + O_2(g) \rightarrow 2X_2(aq) + 2H_2O(l)$$

Which statement is correct?

A HBr(aq) reacts more vigorously than HI(aq) because Br^- is a stronger oxidising agent than I^-.

B HBr(aq) reacts more vigorously than HI(aq) because Br^- is a stronger reducing agent than I^-.

C HBr(aq) reacts less vigorously than HI(aq) because Br^- is a weaker oxidising agent than I^-.

D HBr(aq) reacts less vigorously than HI(aq) because Br^- is a weaker reducing agent than I^-.

23 The equation shows the reaction of chlorine with cold aqueous sodium hydroxide.

$$2NaOH(aq) + Cl_2(g) \rightarrow NaCl(aq) + NaOCl(aq) + H_2O(l)$$

Chlorine also reacts with hot aqueous sodium hydroxide.

Which statements are correct?

1 Both reaction conditions produce chloride ions.

2 The reaction of chlorine with hot aqueous sodium hydroxide is a disproportionation reaction.

3 Hot aqueous sodium hydroxide also reacts with chlorine in a 2 : 1 mole ratio.

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

24 When burned, sulfur forms gas P which can be oxidised to produce gas Q.

Gas Q reacts with water to produce R.

Which row correctly shows the oxidation states of sulfur in P, Q and R?

	P	Q	R
A	–2	+4	+4
B	–2	+4	+6
C	+4	+6	+4
D	+4	+6	+6

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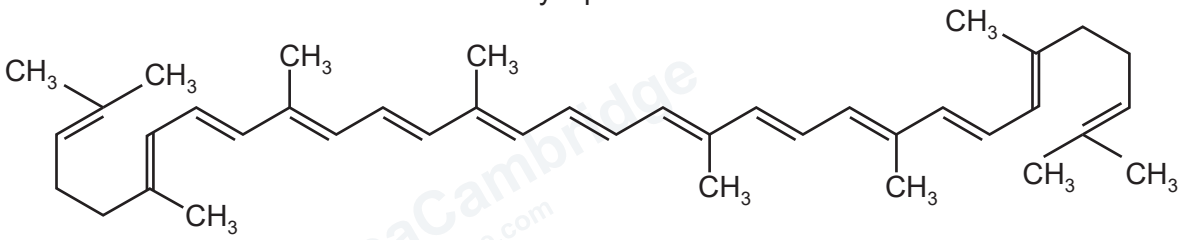
25 Structural isomerism and stereoisomerism should be considered when answering this question.

How many isomers with the formula C_4H_8 have structures that contain a π bond?

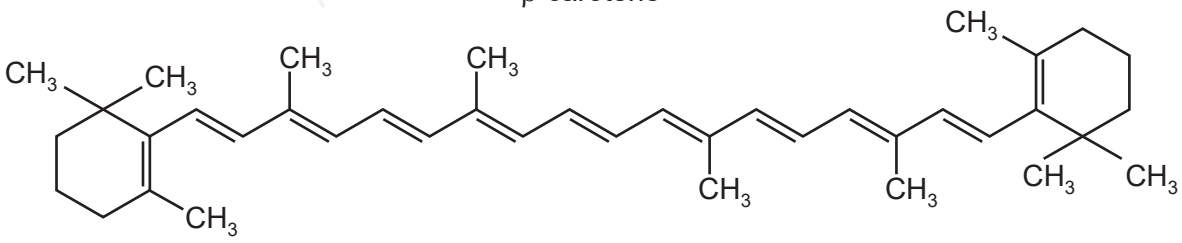
A 1 **B** 2 **C** 3 **D** 4

26 The diagrams show the structures of lycopene and β-carotene.

lycopene



β-carotene



When lycopene is converted into β-carotene, what is the loss or gain, if any, of hydrogen atoms per molecule?

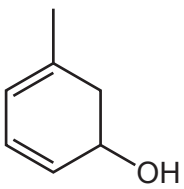
A two lost

B no change

C two gained

D four gained

27 The skeletal formula of an organic molecule is shown.



How many chiral centres does the molecule contain?

A 0 **B** 1 **C** 2 **D** 3

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28 Aqueous bromine is added dropwise to a sample of 2,3-dimethylcyclohexene with shaking.

Which colour change is observed?

A colourless to orange

B colourless to green

C orange to green

D orange to colourless

29 Some reagents are listed.

1 PCl_3(l)

2 Cl_2(g)

3 KCl(s) with concentrated H_2SO_4

Which reagents convert propan-2-ol into 2-chloropropane?

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

30 But-1-ene is reacted with steam, in the presence of phosphoric acid.

In a second step, the **main** organic product of this reaction is reacted with an excess of acidified potassium manganate(VII).

What is the organic product of the second step?

A butan-1,2-diol

B butanal

C butanoic acid

D butanone

31 Three statements about reactions of 1-bromopropane are listed.

1 1-bromopropane reacts with hot KCN in ethanol to produce propanenitrile.

2 1-bromopropane reacts with hot ethanolic NH_3 under pressure to produce propylamine.

3 1-bromopropane reacts with hot aqueous NaOH to produce propan-1-ol.

Which statements are correct?

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

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32 $(CH_3)_3CBr$ is heated with NaOH(aq). An intermediate is formed.

Which row is correct?

	shape of intermediate	type of mechanism
A	pyramidal	S_N2
B	pyramidal	S_N1
C	trigonal planar	S_N2
D	trigonal planar	S_N1

33 Which compound reacts with both alkaline I_2(aq) and hot acidified $K_2Cr_2O_7$?

A $OHCCH_2CH_2CHO$

B $CH_3CH_2COOCH_3$

C CH_3COCH_2CHO

D $CH_3COCOCH_3$

34 Ethanal, CH_3CHO, undergoes an addition reaction with HCN in the presence of CN^-.

Which row is correct?

	type of reaction	name of product
A	electrophilic addition	2-hydroxypropanenitrile
B	electrophilic addition	2-hydroxyethanenitrile
C	nucleophilic addition	2-hydroxypropanenitrile
D	nucleophilic addition	2-hydroxyethanenitrile

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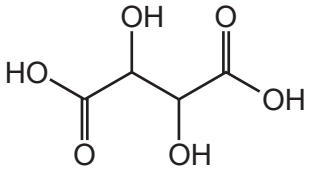
35 The structure of tartaric acid is shown.



Four moles of substance X react with one mole of tartaric acid.

What is substance X?

A sodium

B sodium carbonate

C sodium hydrogencarbonate

D sodium hydroxide

36 Bromine reacts with propene in an organic solvent at room temperature.

What is the mechanism of this reaction?

A electrophilic addition

B free-radical substitution

C nucleophilic addition

D nucleophilic substitution

37 Methyl propanoate can be produced by reacting together a carboxylic acid and an alcohol in the presence of a catalyst.

Which row describes the reaction that takes place?

	type of reaction	catalyst
A	condensation	aqueous sodium hydroxide
B	condensation	concentrated sulfuric acid
C	elimination	aqueous sodium hydroxide
D	hydrolysis	concentrated sulfuric acid

38 How many different organic compounds, in total, are produced by the acid hydrolysis of all esters with the molecular formula $C_4H_8O_2$?

A 4 **B** 6 **C** 7 **D** 8

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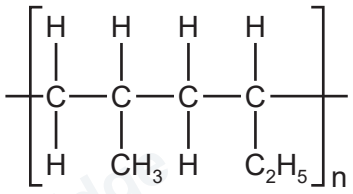
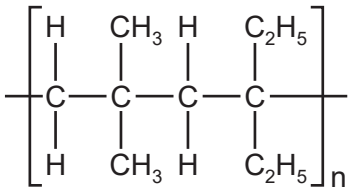
39 2-methylbut-1-ene is used as a monomer to produce an addition polymer.

What is the structure of the addition polymer that it forms?

A



B



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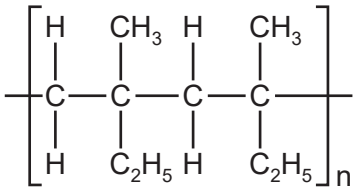
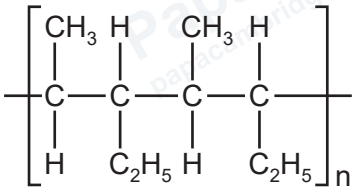


D



40 Statements about the mass spectrum of pentane, C_5H_{12}, are listed.

1 All peaks in the spectrum are due to positive ions.

2 The abundances of the M^+ ion and the $[M+1]^+$ ion can be used to calculate the number of carbon atoms in the pentane molecule.

3 An $[M+2]^+$ peak is seen at $m/e = 60$.

Which statements are correct?

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

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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

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		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 –

Key

atomic number
atomic symbol
name
relative atomic mass

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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