Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Monday 12 January 2026

Afternoon (Time: 1 hour 30 minutes)

Paper reference **WCH11/01**

Chemistry

International Advanced Subsidiary/Advanced Level
UNIT 1: Structure, Bonding and Introduction to Organic Chemistry

You must have:
Scientific calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- A Periodic Table is printed on the back cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Show all your working in calculations and include units where appropriate.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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C:1/1/1/

P 7 9 0 4 9 A 0 1 2 4

Pearson

SECTION A

Answer ALL the questions in this section.

You should aim to spend no more than 20 minutes on this section.

For each question, select one answer from A to D and put a cross in the box ☒. If you change your mind, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Which property determines the order of elements in the Periodic Table?

☒ **A** first ionisation energy

☒ **B** relative atomic mass

☒ **C** number of electrons in the outer shell

☒ **D** number of protons in the nucleus

(Total for Question 1 = 1 mark)

2 Which atom has the most orbitals that contain a single electron?

☒ **A** C

☒ **B** Cr

☒ **C** Mn

☒ **D** N

(Total for Question 2 = 1 mark)

3 The electronic configuration of element **X** is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$.

What is the formula of the compound formed when **X** reacts with potassium?

☒ **A** KX

☒ **B** K_2X

☒ **C** K_3X

☒ **D** KX_2

(Total for Question 3 = 1 mark)

Use this space for any rough working. Anything you write in this space will gain no credit.

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4 Which ion is **not** isoelectronic with the other ions?

- ☒ **A** Ti^{3+}
- ☒ **B** Ca^{2+}
- ☒ **C** P^{3-}
- ☒ **D** Cl^-

(Total for Question 4 = 1 mark)

5 Which properties of a cation result in the greatest polarising power?

	Radius	Charge
☒ **A**	small	small
☒ **B**	large	large
☒ **C**	small	large
☒ **D**	large	small

(Total for Question 5 = 1 mark)

6 The first five ionisation energies of element **Z** are shown.

1st	2nd	3rd	4th	5th
738	1451	7733	10541	13629

What is the formula of the most stable chloride of **Z**?

- ☒ **A** ZCl_4
- ☒ **B** ZCl_3
- ☒ **C** ZCl_2
- ☒ **D** ZCl

(Total for Question 6 = 1 mark)

7 Which is **not** a neutralisation reaction?

- ☒ **A** $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$
- ☒ **B** $CuO + 2HCl \rightarrow CuCl_2 + H_2O$
- ☒ **C** $NH_3 + HNO_3 \rightarrow NH_4NO_3$
- ☒ **D** $CaCO_3 + 2CH_3COOH \rightarrow Ca(CH_3COO)_2 + H_2O + CO_2$

(Total for Question 7 = 1 mark)

8 A hydrocarbon contains 82.8% carbon by mass.

Which could be the **molecular** formula of the hydrocarbon?

- ☒ **A** CH_3
- ☒ **B** C_2H_6
- ☒ **C** C_2H_5
- ☒ **D** C_4H_{10}

(Total for Question 8 = 1 mark)

9 What is the percentage composition by mass of nitrogen in $(NH_4)_2SO_4$?

- ☒ **A** 27.3%
- ☒ **B** 21.2%
- ☒ **C** 13.6%
- ☒ **D** 10.6%

(Total for Question 9 = 1 mark)

10 What is the total number of ions in 10.0 g of iron(III) sulfate, $Fe_2(SO_4)_3$?

[Data: Molar mass of iron(III) sulfate = 399.9 g mol^{-1}
Avogadro constant (L) = 6.02×10^{23} mol^{-1}]

- ☒ **A** 1.5×10^{22}
- ☒ **B** 3.0×10^{22}
- ☒ **C** 4.5×10^{22}
- ☒ **D** 7.5×10^{22}

(Total for Question 10 = 1 mark)

11 What mass of barium chloride, $BaCl_2$, is needed to make 500 cm^3 of a 0.100 mol dm^{-3} solution?

[Data: A_r Ba = 137.3 Cl = 35.5]

- ☒ **A** 41.66 g
- ☒ **B** 20.83 g
- ☒ **C** 10.42 g
- ☒ **D** 8.64 g

(Total for Question 11 = 1 mark)

12 Methane burns completely in oxygen, as shown.

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

50 cm^3 of methane was mixed with 200 cm^3 of oxygen and the mixture was ignited.

What was the **total** volume, in cm^3, of the gas mixture at the end of the reaction?
All gas volumes were measured at the same temperature and pressure.

☒ **A** 150 cm^3

☒ **B** 200 cm^3

☒ **C** 250 cm^3

☒ **D** 400 cm^3

(Total for Question 12 = 1 mark)

13 What is the volume of 0.0100 mol of O_2 at 250 °C and 200 000 Pa?

[Data: $pV = nRT$ $R = 8.31\ J\ mol^{-1}\ K^{-1}$]

☒ **A** 104 cm^3

☒ **B** 217 cm^3

☒ **C** 104 dm^3

☒ **D** 217 dm^3

(Total for Question 13 = 1 mark)

14 Which reaction has the **lowest** atom economy by mass for the formation of $CaCl_2$?

☒ **A** $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

☒ **B** $CaO + 2HCl \rightarrow CaCl_2 + H_2O$

☒ **C** $CaCl_2 \cdot 2H_2O \rightarrow CaCl_2 + 2H_2O$

☒ **D** $Ca + 2HCl \rightarrow CaCl_2 + H_2$

(Total for Question 14 = 1 mark)

15 When one molecule of $C_{10}H_{22}$ is cracked and reformed, which of these mixtures could **not** be formed?

☒ **A** pent-1-ene and 2-methylbutane

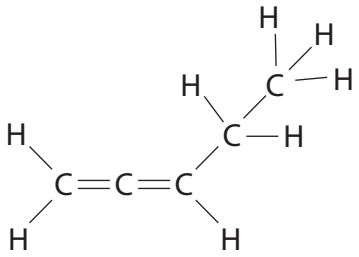
☒ **B** propene, ethene and 2,2-dimethylpropane

☒ **C** butane, cyclobutane and ethene

☒ **D** pent-2-ene and cyclopentane

(Total for Question 15 = 1 mark)

16 How many σ-bonds and π-bonds are in the molecule shown?



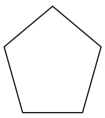
	σ-bonds	π-bonds
☒ **A**	2	4
☒ **B**	10	2
☒ **C**	12	2
☒ **D**	12	4

(Total for Question 16 = 1 mark)

17 Which two organic compounds are isomers?

1

2



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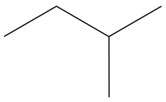

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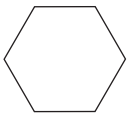

☒ **A** 1 and 3

☒ **B** 1 and 4

☒ **C** 2 and 3

☒ **D** 2 and 4

(Total for Question 17 = 1 mark)

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18 How many structural isomers have the formula C_4H_9Br?

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

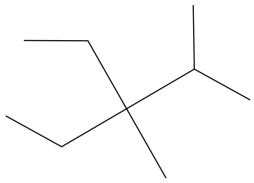
(Total for Question 18 = 1 mark)

19 Which alkene exists as *E–Z* isomers?

- ☒ **A** 2-methylbut-1-ene
- ☒ **B** 2-methylbut-2-ene
- ☒ **C** but-1-ene
- ☒ **D** but-2-ene

(Total for Question 19 = 1 mark)

20 What is the IUPAC name of the compound shown?



- ☒ **A** 3-methyl-3-propylpentane
- ☒ **B** 2,3-dimethyl-3,3-diethylpropane
- ☒ **C** 2-ethyl-3-propylbutane
- ☒ **D** 3-ethyl-2,3-dimethylpentane

(Total for Question 20 = 1 mark)

TOTAL FOR SECTION A = 20 MARKS

SECTION B

Answer ALL the questions. Write your answers in the spaces provided.

21 This question is about sodium and sodium fluoride.

(a) Describe the metallic bonding in sodium.

(2)

(b) Explain how the melting temperature of magnesium compares to that of sodium.

(2)

(c) Draw a dot-and-cross diagram showing the ionic bonding in sodium fluoride.
Use dots (●) for the fluorine electrons and crosses (×) for the sodium electrons.
Include **all** electron shells in your diagram.

(2)

(d) Explain how the sodium ion and the fluoride ion compare in size.

(2)

(e) Explain the electrical conductivities of sodium and sodium fluoride in the solid and liquid states.

(4)

(f) Many toothpastes contain sodium fluoride because the fluoride ion has been shown to reduce tooth decay.

A 1.00 g sample of a toothpaste contains 5.68×10^{-5} mol of sodium fluoride.

Calculate the concentration, in **parts per million** (ppm), of fluoride ions in this sample of toothpaste.
Give your answer to an appropriate number of significant figures.

[Data: A_r F = 19.0]

(3)

(Total for Question 21 = 15 marks)

22 This question is about some compounds that contain a halogen.

(a) (i) Draw a dot-and-cross diagram of a molecule of tetrachloromethane, CCl_4.
Show the outer shell electrons only.
Use dots (●) for the chlorine electrons and crosses (×) for the carbon electrons.

(2)

(ii) Predict the Cl—C—Cl bond angle in CCl_4.
Justify your answer.

(2)

(iii) Explain why the C—Cl bond in CCl_4 is polar, but the molecule is non-polar.

(2)

(b) The oxygen atom in chloric(I) acid, HOCl, has two lone pairs of electrons.

Explain the effect that these lone pairs have on the H—O—Cl bond angle.

(2)

.....

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.....

(c) A metal, **M**, reacts with hydrochloric acid to produce a metal chloride and hydrogen gas.

In an experiment, 0.018 mol of **M** reacts exactly with 22.5 cm^3 of 1.60 mol dm^{-3} hydrochloric acid.
The hydrogen gas collected has a volume of 430 cm^3 at room temperature and pressure (r.t.p.).

(i) Calculate the number of moles of hydrochloric acid used.

(1)

(ii) Calculate the number of moles of hydrogen gas produced.

[Data: Molar volume of gas at r.t.p. = 24 000 cm^3 mol^{-1}]

(1)

(iii) Write the equation for the reaction between **M** and hydrochloric acid.
Use your answers from (c)(i) and (c)(ii) and the information in the question.
State symbols are not required.

(2)

(d) Sea water contains bromide ions.

An experiment was carried out to determine the concentration of bromide ions in sea water. A 400 cm^3 sample of sea water was added to an excess of silver nitrate solution and nitric acid. The precipitate of silver bromide was filtered, washed and dried.

Mass of silver bromide, AgBr = 0.13 g

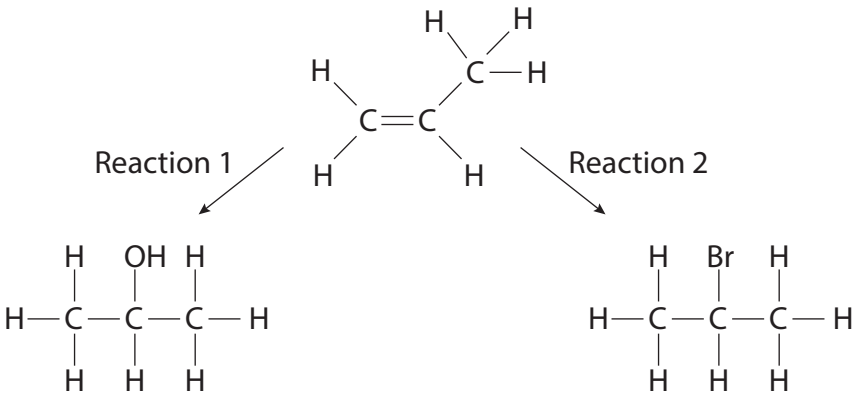
Calculate the concentration, in mol dm^{-3}, of bromide ions in this sample of sea water.

(3)

(Total for Question 22 = 15 marks)

23 This question is about alkenes.

(a) Two reactions of propene are shown.



(i) Give the reagent and conditions for Reaction 1.

(2)

Reagent

.....

Conditions

.....

(ii) Name the reaction mechanism and the product in Reaction 2.

(2)

Reaction mechanism

.....

Product

.....

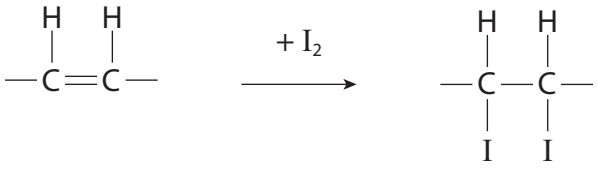
(iii) Propene forms an addition polymer.

Draw the displayed formula of the repeat unit of the polymer.

(1)

(b) The number of double bonds in molecules can be determined using the iodine number. The mass, in g, of iodine that reacts with 100 g of the compound is called the iodine number.

The addition of iodine to a double bond is shown.



Compound **X** has a molar mass of 278 g mol^{-1} and it contains **three** double bonds.

Calculate the iodine number of **X**.

[Data: A_r I = 126.9]

(2)

(Total for Question 23 = 7 marks)

24 This question is about the mechanism for the reaction between alkanes and halogens.

Chloroethane can be made by reacting ethane and chlorine.
The equation for the reaction is shown.

$$CH_3CH_3 + Cl_2 \rightarrow CH_3CH_2Cl + HCl$$

Initiation is the first step in this reaction mechanism and is shown.

$$Cl_2 \rightarrow 2Cl\bullet$$

(a) (i) State the conditions required for this initiation step.

(1)

.....

(ii) State what the • represents in the first step.

(1)

.....

.....

(b) Complete the mechanism by giving **two** propagation steps and **two** termination steps.

(3)

Propagation

Propagation

Termination

Termination

(c) State why this reaction is not suitable for the manufacture of chloroethane.

(1)

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(Total for Question 24 = 6 marks)

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25 This question is about isotopes.

(a) Magnesium exists as a mixture of three isotopes, ^{24}Mg, ^{25}Mg and ^{26}Mg.

(i) Complete the table to show the numbers of subatomic particles for ^{25}Mg.

(1)

	Protons	Neutrons	Electrons
^{25}Mg			

(ii) State one similarity **and** one difference between isotopes.

(1)

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(b) The relative atomic mass of magnesium can be determined using a mass spectrometer.

State what is meant by the term 'relative atomic mass'.

(2)

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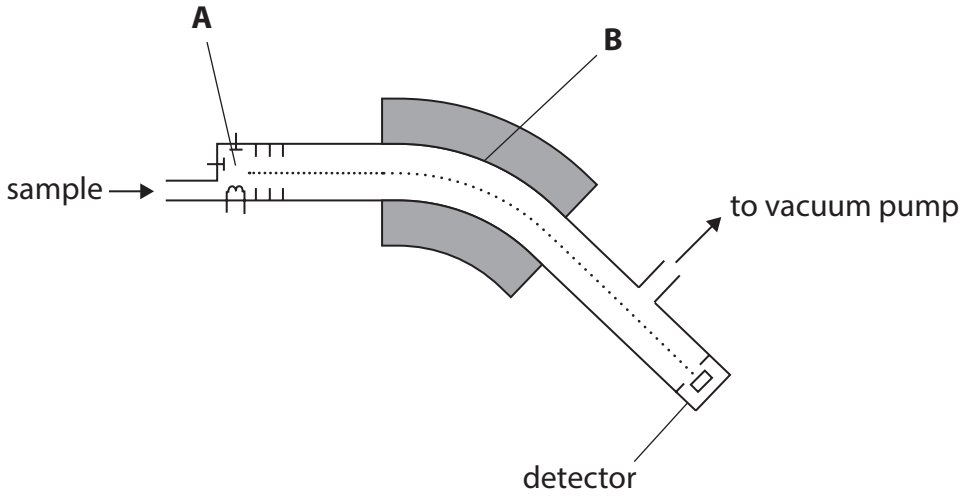
(c) A simplified diagram of a mass spectrometer is shown.



(i) Name the **processes** that occur in the regions **A** and **B**.

(2)

A .....

B .....

(ii) Explain why a vacuum pump has to be used.

(2)

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(iii) The simplified diagram shows the path of the $^{25}Mg^{+}$ ion.

Draw on the diagram the path of a $^{24}Mg^{+}$ ion.

(1)

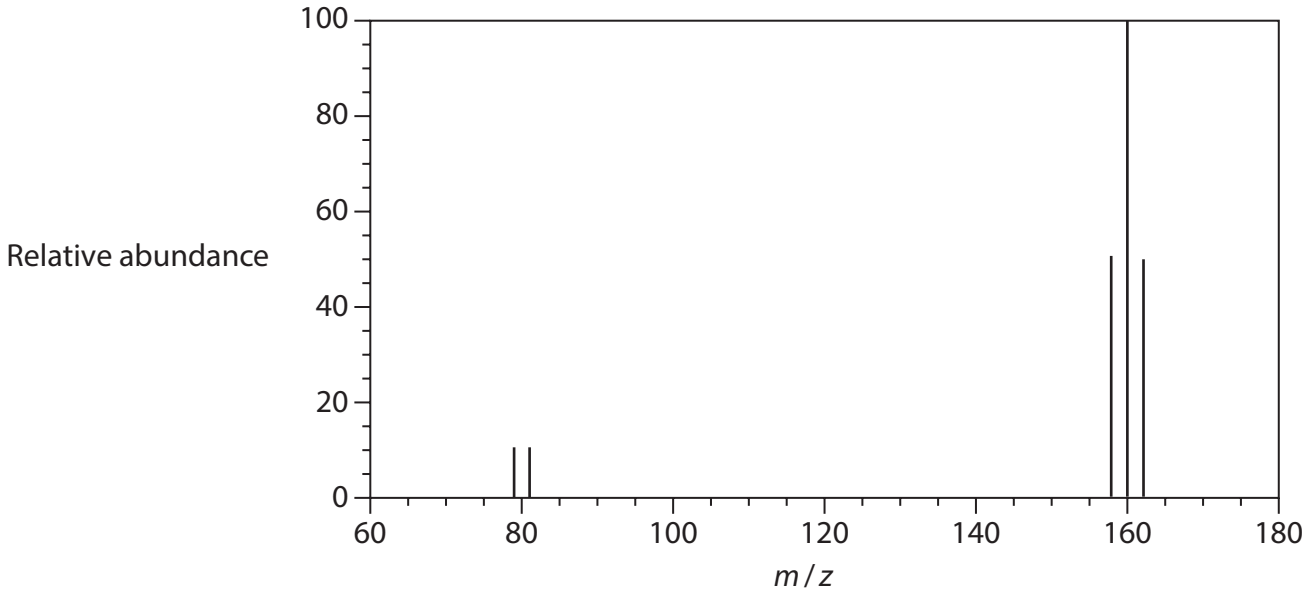
(iv) A sample of magnesium has a relative atomic mass of 24.3.

The percentage abundance of the ^{24}Mg isotope is 79.0%.

Calculate the percentage abundances of the ^{25}Mg and ^{26}Mg isotopes in this sample.

(4)

(d) A mass spectrum of a sample of bromine is shown.



Deduce the mass and the approximate abundances of the two isotopes of bromine.
Justify your answer by identifying the species causing **all** the *m* / *z* peaks.

(4)

(Total for Question 25 = 17 marks)

TOTAL FOR SECTION B = 60 MARKS
TOTAL FOR PAPER = 80 MARKS

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The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8)
																	(18)
							1.0 H hydrogen 1										4.0 He helium 2
(1)	(2)											(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4											10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] 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							

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* Lanthanide series	140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
* Actinide series	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