GradeMax

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 8 June 2026

Morning (Time: 1 hour 20 minutes)

Paper reference **WCH16/01**

Chemistry

International Advanced Level
UNIT 6: Practical Skills in Chemistry II

You must have:
Scientific calculator, ruler

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 50.
- 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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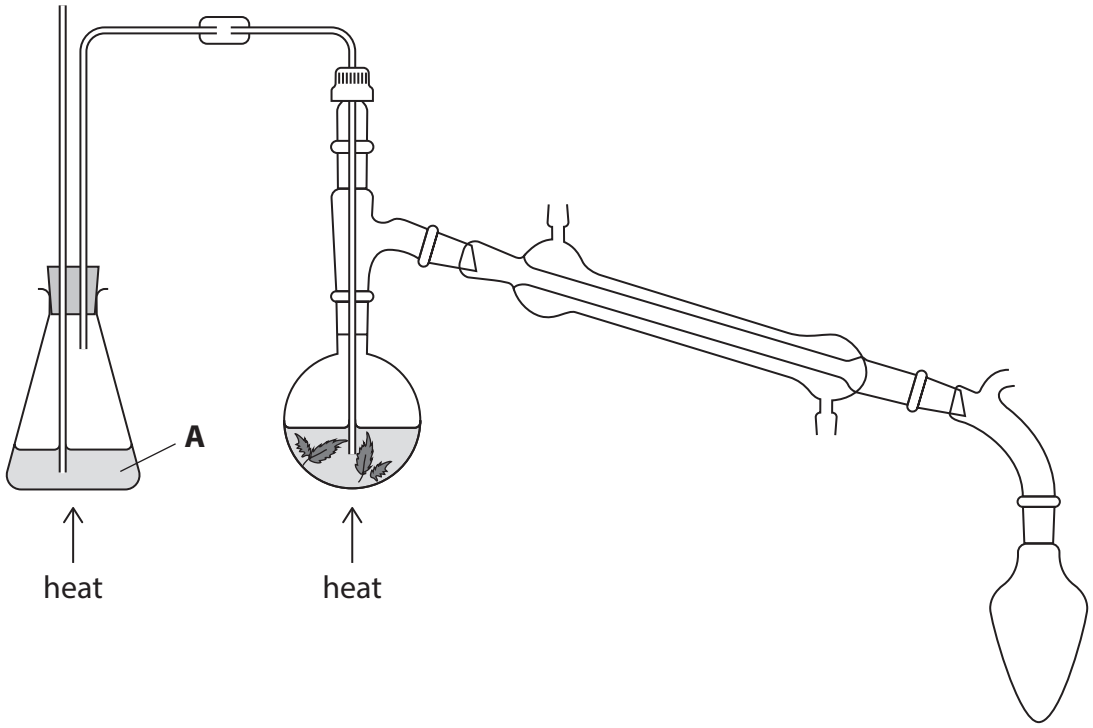
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Answer ALL the questions. Write your answers in the spaces provided.

1 Valerian is a plant that has been used in herbal medicine for many centuries. Two of the compounds that can be extracted from this plant are valeric acid and valerenic acid.

(a) Valeric acid, $CH_3CH_2CH_2CH_2COOH$, can be separated from the leaves of valerian using steam distillation. The apparatus is shown.



(i) Add labelled arrows to the diagram to show the water entering and leaving the condenser.

(1)

(ii) State the identity of liquid **A**.

(1)

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(iii) Give a chemical test and its positive result to confirm the presence of an acid in the distillate.

Do not include use of an indicator.

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(iv) Calcium valerate is precipitated when calcium hydroxide is added to valeric acid in the distillate. The equation is shown.

$$2CH_3CH_2CH_2CH_2COOH + Ca(OH)_2 \rightarrow Ca(CH_3CH_2CH_2CH_2COO)_2 + 2H_2O$$

Calculate the **maximum** volume of liquid valeric acid that is removed from the distillate when 2.00 g of solid calcium hydroxide is added.

[Data: Density of valeric acid = 0.939 g cm^{-3}]

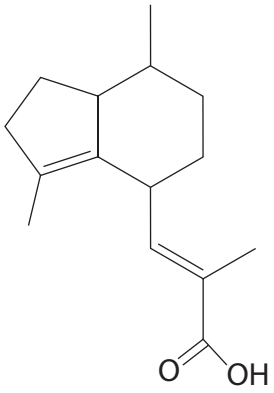
(5)

(v) Give the name of valeric acid using IUPAC rules.

(1)

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(b) The most active compound extracted from valerian leaves is valerenic acid.
The structure of valerenic acid is shown.



(i) Give a **chemical** test to distinguish between valerenic acid and valeric acid, $CH_3CH_2CH_2CH_2COOH$.

Include the results for **both** compounds.

(2)

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(ii) Pure valerenic acid has a melting temperature of 139 °C.

State **two** ways that the melting temperature of an impure sample of valerenic acid differs from this value.

(2)

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(iii) Describe how an impure sample of solid valerenic acid could be purified by recrystallisation to remove **both** insoluble and soluble impurities.

(5)

(Total for Question 1 = 19 marks)

2 Borax is a compound that forms an equilibrium mixture when dissolved in water as shown.

$$Na_2B_4O_5(OH)_4{\bullet}8H_2O(s) \rightleftharpoons 2Na^+(aq) + B_4O_5(OH)_4^{2-}(aq) + 8H_2O(l)$$

The position of this equilibrium at different temperatures can be calculated by titrating 25.0 cm^3 portions of the equilibrium mixture with 0.200 mol dm^{-3} hydrochloric acid.

Assume that the position of the equilibrium does not change during the titration.

The reaction occurring in the titration is shown.

$$B_4O_5(OH)_4^{2-} + 2HCl + 3H_2O \rightarrow 4H_3BO_3 + 2Cl^-$$

The table shows the titration results at room temperature, 20°C.

	Rough	1	2	3
Final burette reading / cm^3	13.10	25.75	39.40	12.70
Initial burette reading / cm^3	0.00	13.05	25.75	0.10
Titre / cm^3	13.10	12.70	13.65	12.60

(a) Calculate the mean titre.

(1)

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(b) The pH change at neutralisation is in the range 3.5–6.5.

Identify a suitable indicator for this titration, using the information given.

Indicators					
		p*K*in (at 298 K)	***acid***	**pH range**	***alkaline***
1	Thymol blue (acid)	1.7	red	1.2–2.8	yellow
2	Screened methyl orange	3.7	purple	3.2–4.2	green
3	Methyl orange	3.7	red	3.2–4.4	yellow
4	Bromophenol blue	4.0	yellow	2.8–4.6	blue
5	Bromocresol green	4.7	yellow	3.8–5.4	blue
6	Methyl red	5.1	red	4.2–6.3	yellow
7	Litmus		red	5.0–8.0	blue
8	Bromothymol blue	7.0	yellow	6.0–7.6	blue
9	Phenol red	7.9	yellow	6.8–8.4	red
10	Phenolphthalein (in ethanol)	9.3	colourless	8.2–10.0	red

(1)

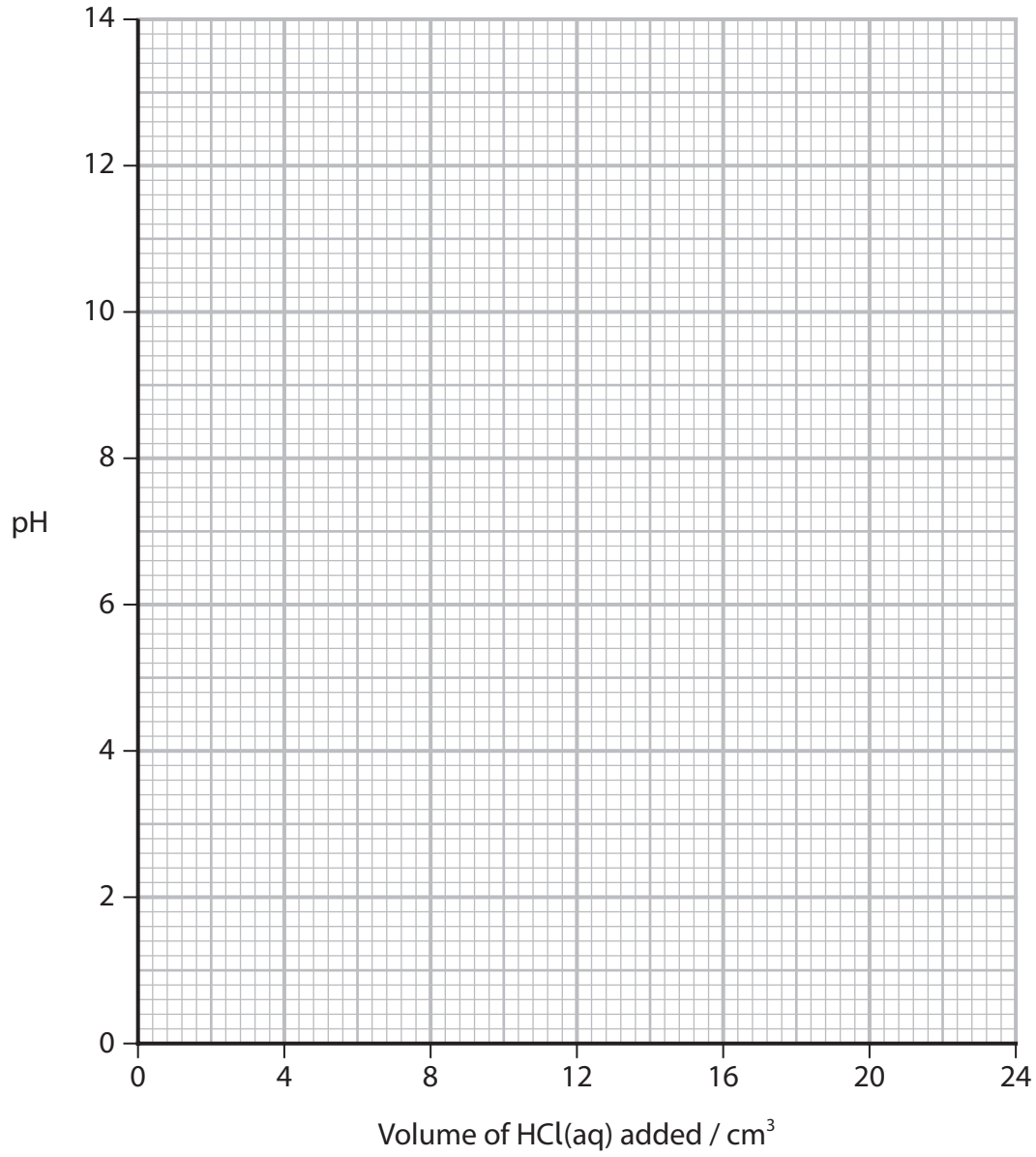
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(c) The pH of the borax solution is 9.0.

Sketch the expected pH curve for the titration of the borax solution with hydrochloric acid.

(4)

(Space for calculating final pH)



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(d) The titration between the borax solution and hydrochloric acid is repeated at 4°C. The mean titre at 4°C is 6.80 cm^3.

Explain what can be deduced about the enthalpy change of the equilibrium reaction.

(2)

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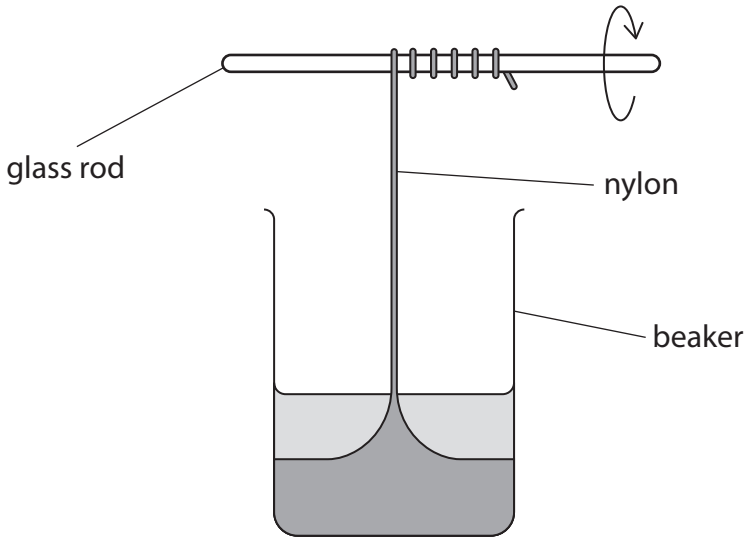
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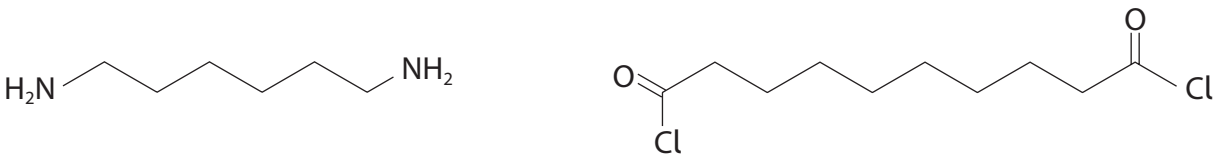
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(Total for Question 2 = 8 marks)

3 A polymerisation demonstration uses a beaker containing two immiscible solutions. The aqueous layer contains a diamine, and the organic layer contains a dioyl chloride. Nylon polymer forms where the two layers are in contact and can be twisted around a glass rod as shown.



(a) The two reagents used are shown.



A **B**

(i) Suggest which of **A** and **B** is in the upper layer of the beaker.
Justify your answer.

(1)

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(ii) Draw the repeat unit of the nylon produced.

(1)

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(b) State **two** precautions that should be taken during this demonstration.
Justify your answer.

Assume that a laboratory coat and eye protection are worn.

(2)

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(Total for Question 3 = 4 marks)

4 The standard emf, E^{θ}_{cell}, of an electrochemical cell can be measured in the laboratory. A cell was made using the two electrode systems shown.

$$Mg^{2+} + 2e^{-} \rightleftharpoons Mg \qquad E^{\theta} = -2.37\,V$$

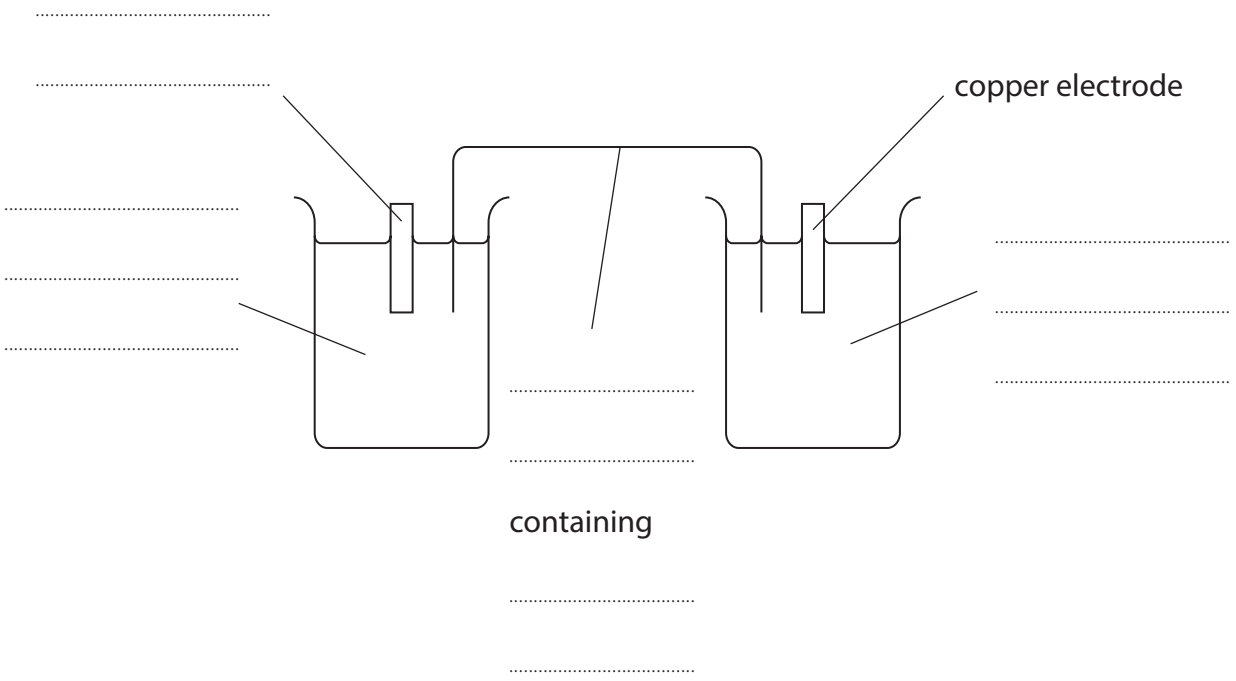
$$Cu^{2+} + 2e^{-} \rightleftharpoons Cu \qquad E^{\theta} = +0.34\,V$$

(a) Calculate the E^{θ}_{cell} of this cell.

(1)

(b) Complete the diagram to show all the apparatus, **reagents** and conditions used to measure the E^{θ}_{cell}.

(6)



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(c) State the observations, if any, that occur to the E^{θ}_{cell}, the electrodes and the solutions when current flows for several hours in this cell.

(3)

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(Total for Question 4 = 10 marks)

5 This question is about the colours of metal ions in flame tests and in aqueous solutions.

(a) A student carries out flame tests on three metal compounds.

A few drops of dilute sodium hydroxide are added to 5 cm^3 of solution of each metal compound.
Then more dilute sodium hydroxide is added until it is in excess.

Complete the table with the **formula** of each metal ion and the expected observations with excess dilute sodium hydroxide.

(3)

Flame colour	Observation with a few drops of NaOH(aq)	Formula of metal ion	Observation with excess NaOH(aq)
lilac	no reaction		
orange-red	faint white precipitate		
no colour	blue precipitate, turning pink on standing		

(b) The student adds a few drops of dilute ammonia solution to a solution of a different metal compound. A green precipitate forms.

(i) Suggest **three** possible identities for the metal **ion** in the compound.

(3)

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(ii) The student adds excess dilute ammonia solution to the metal compound solution.

Describe the results of the test for each of the ions identified in (b)(i).

(3)

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(Total for Question 5 = 9 marks)

TOTAL FOR PAPER = 50 MARKS

The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8)
							1.0 H hydrogen 1										(18) 4.0 He helium 2
(1)	(2)		Key									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass atomic symbol name atomic (proton) number									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 damstadtium 110	[272] Rg roentgenium 111							

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

* Lanthanide series

* Actinide 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
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

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