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Candidate surname

Other names

Centre Number

Candidate Number

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## Pearson Edexcel International Advanced Level

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.
- **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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Q:1/1/1/1/1/



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

- 1 A student investigates two aqueous solutions, each containing a salt. Each salt has one cation and one anion. Solution **A** is blue. Solution **B** is orange.

Solution	Observation when aqueous sodium hydroxide is added	Observation when dilute nitric acid and aqueous silver nitrate are added
<b>A</b>	blue precipitate insoluble in excess sodium hydroxide	white precipitate in a blue solution
<b>B</b>	solution changes from orange to yellow gas evolved on warming which turns damp red litmus paper blue	red precipitate

- (a) (i) Identify, by name or formula, the salt in **A**.

(2)

- (ii) The white precipitate is separated from the solution.

Give a test on the precipitate and its positive result to confirm the identity of the anion in **A**.

(2)

Test

Result

- (b) (i) Identify, by name or formula, the gas given off when **B** is warmed with aqueous sodium hydroxide.

(1)

- (ii) Give the **formulae** of the ions of the salt in **B**.

(2)

(Total for Question 1 = 7 marks)



2 A student is asked to identify three colourless liquids labelled **C**, **D** and **E**. The compounds are all non-cyclic isomers with the formula  $C_5H_{10}O$ .

(a) (i) The student carries out three tests on separate samples of each compound.

Complete Table 1 to show the observations that the student makes.

(3)

Sample	Observations on addition of reagents			Functional group
	2,4-dinitro phenylhydrazine (Brady's reagent)	Fehling's or Benedict's solution and warm	$I_2(aq)$ and $NaOH(aq)$ and warm	
<b>C</b>	orange precipitate			$R-COCH_3$
<b>D</b>			pale yellow precipitate antiseptic smell	$R-CH(OH)CH_3$
<b>E</b>	orange precipitate			$R-CHO$

Table 1

(ii) Identify, by name or formula, the pale yellow precipitate that forms when iodine and sodium hydroxide are added to a sample of **D**.

(1)

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P 7 1 8 7 4 A 0 3 1 6



(ii) The melting temperatures of the derivatives of the reaction of Brady's reagent with some aldehydes and ketones are shown.

Carbonyl compound	Melting temperature of the derivative / °C
3-methylbutanal	123
2-ethylbutanal	134
pentan-2-one	144
cyclopentanone	146
pentan-3-one	156

Table 2

The melting temperature of the recrystallised derivative of sample **C** is found to be 138–140 °C.

Suggest the identity of compound **C**.

Justify your choice, using the information at the start of the question and the data in Tables 1 and 2.

(2)

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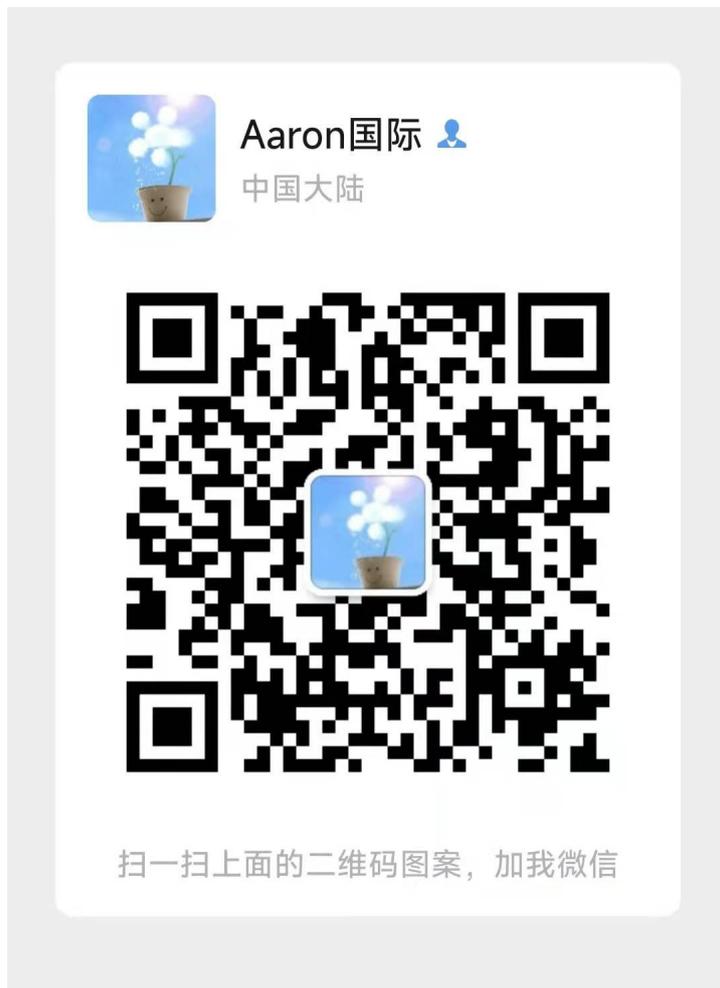
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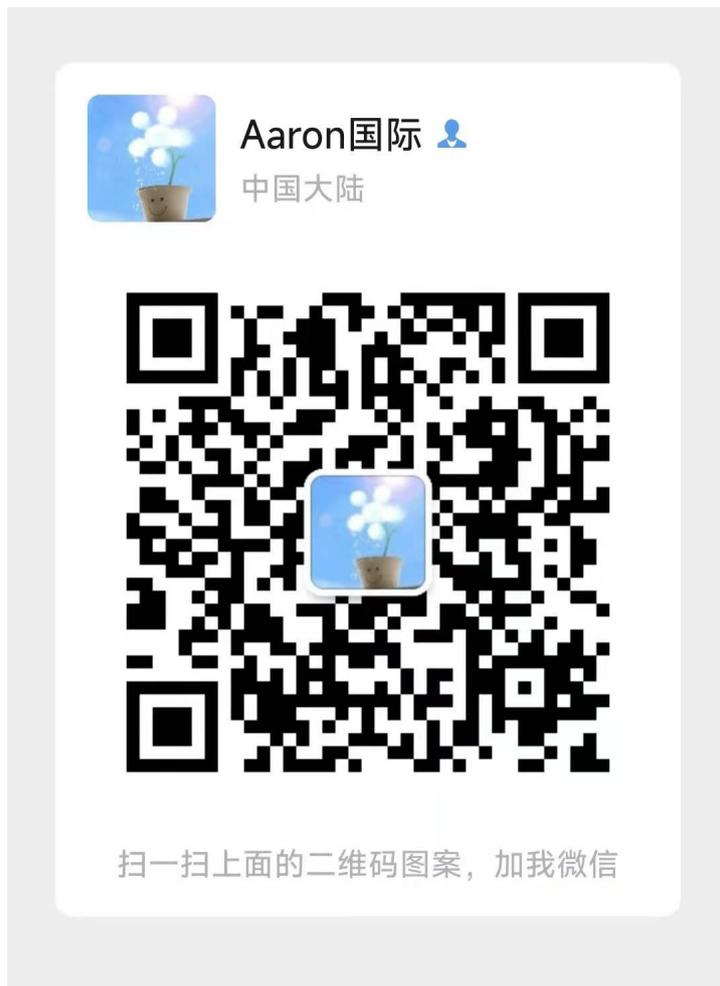


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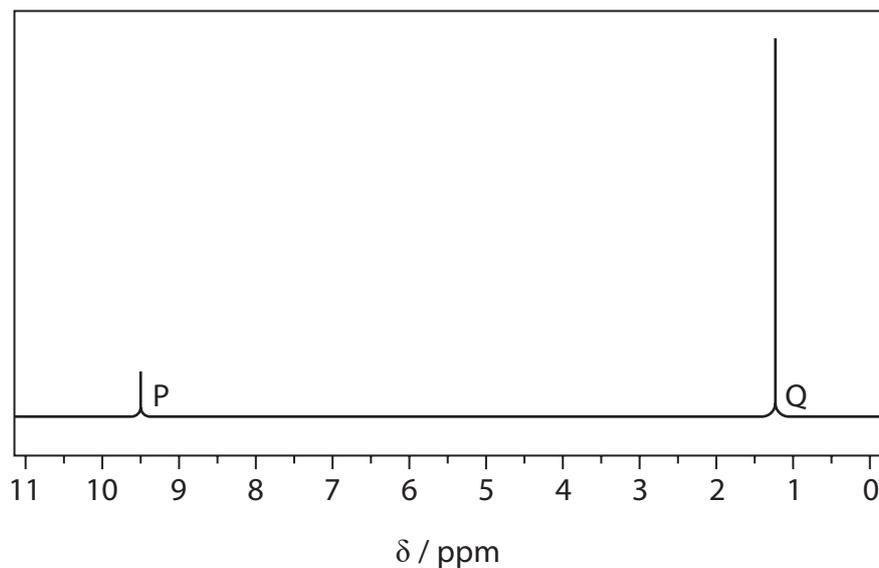
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(c) The **high** resolution proton NMR spectrum of **E** is shown.



The relative numbers of protons responsible for the singlet peaks shown are  $P = 1$  and  $Q = 9$ .

Use this information and the results of the tests in (a) to draw the displayed formula of **E**, labelling the proton environments.

(2)

(Total for Question 2 = 12 marks)



3 Brass is an alloy of copper. The percentage by mass of copper in a sample of brass can be determined by a three-stage process.

Stage 1 Oxidation of the copper to copper(II) ions with excess concentrated nitric acid.

Stage 2 Reduction of the copper(II) ions to copper(I) ions with excess iodide ions.

Stage 3 Titration of the iodine produced in Stage 2 against a standard solution of sodium thiosulfate.

(a) In Stage 1, 2.53 g of brass is carefully warmed with 25 cm<sup>3</sup> concentrated nitric acid in a 250 cm<sup>3</sup> beaker.

The equation for the oxidation of copper metal by nitric acid is shown.



(i) State two hazards in this experiment, giving the precautions you would take to minimise the risk associated with each hazard.  
Assume safety spectacles and a laboratory coat are worn.

(2)

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(ii) State what would be **seen** during the reaction.

(2)

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- (iii) Excess nitric acid must be neutralised before the iodide ions are added in Stage 2.

Sodium carbonate solution is slowly added to the cooled solution. The solution is neutralised when a faint precipitate appears.

Suggest why the solution is cooled before the addition of the sodium carbonate solution.

(1)

- (iv) Ethanoic acid solution is added, drop by drop, to the neutralised mixture until the precipitate redissolves.

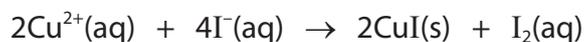
Describe how the solution in the beaker should then be made into  $250.0\text{ cm}^3$  of a homogeneous solution before Stage 2.

(3)



- (b) In Stage 2, 25.0 cm<sup>3</sup> portions of the solution from Stage 1 are transferred into conical flasks.  
10 cm<sup>3</sup> of a solution of potassium iodide is added to each flask and the mixtures are swirled. Copper(I) iodide is precipitated.

The redox equation for the reaction between copper(II) ions and iodide ions is shown.



The standard electrode potentials for the half-equations are



- (i) Use the electrode potential data to explain why the redox reaction might not be expected to be feasible.

(2)

- (ii) Explain why the redox reaction does, in fact, take place.

(2)



(c) The procedure in Stage 3 is shown:

- the iodine produced in each flask from Stage 2 is titrated with  $0.095 \text{ mol dm}^{-3}$  sodium thiosulfate solution until the iodine colour is pale yellow
- a few drops of starch indicator are added
- sodium thiosulfate is added drop by drop with swirling until the end-point is reached
- the titration is repeated until two concordant titres are obtained.

(i) Give a possible reason why the starch indicator is added when the iodine colour is pale yellow rather than at the start of the titration.

(1)

(ii) Give the colour **change** at the end-point of the reaction.

(1)



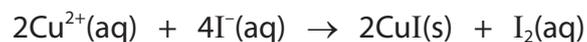
(iii) The results of the titration are shown.

Titration number	1	2	3
Final burette reading / cm <sup>3</sup>	27.05	28.65	27.45
Initial burette reading / cm <sup>3</sup>	0.00	2.00	1.00
Titre / cm <sup>3</sup>	27.05	26.65	

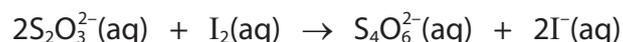
Complete the table and calculate the mean titre of the concordant results.

(1)

(iv) The redox equation for the reaction between copper(II) ions and iodide ions is shown.



The reaction of sodium thiosulfate solution with iodine is shown.



Calculate the percentage by mass of copper in the 2.53 g of brass.

[ $A_r$  Cu = 63.5]

(3)

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(v) Nitric acid reacts with iodide ions to form iodine.

In another experiment the nitric acid was **not** neutralised before the start of Stage 2.

Explain the effect on the value obtained for the percentage of copper in the sample.

(2)

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**(Total for Question 3 = 20 marks)**

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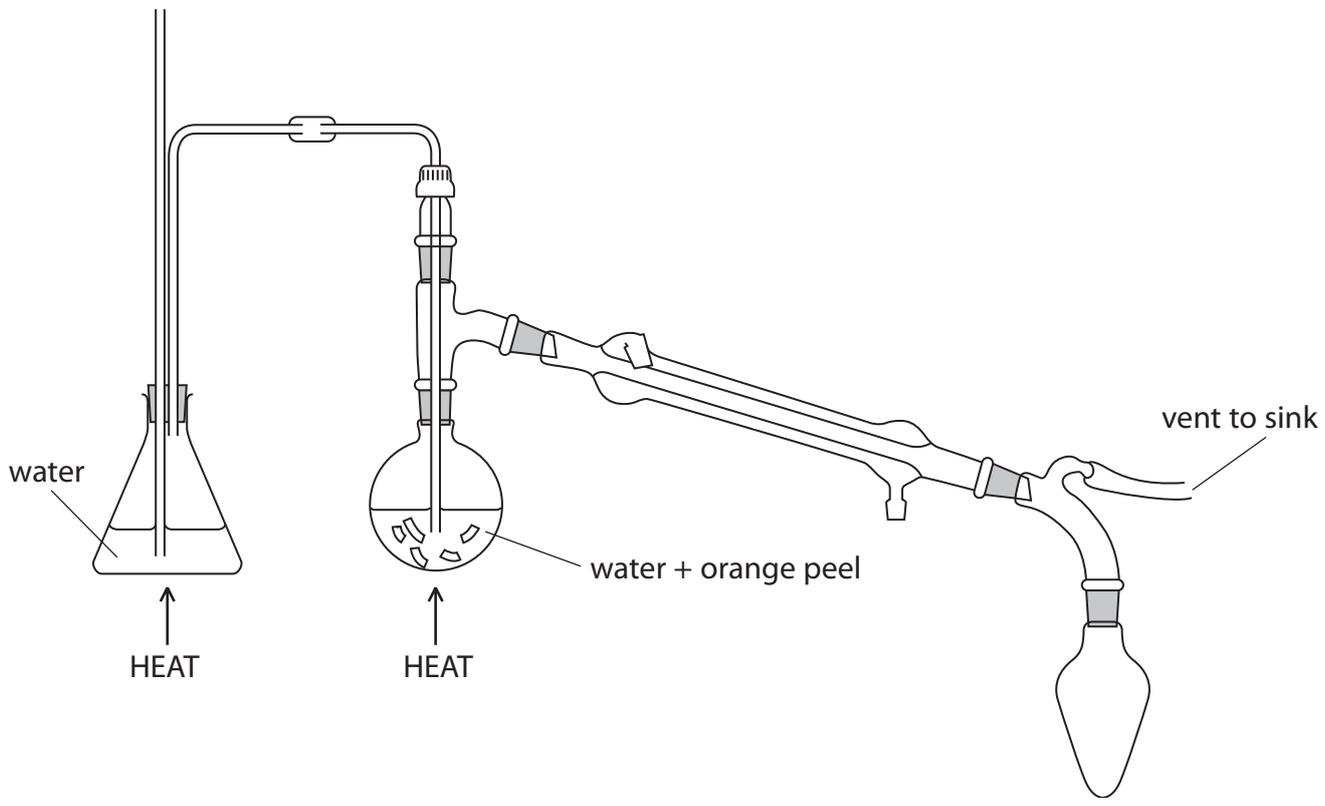
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4 Limonene is a liquid hydrocarbon which has a boiling temperature of  $176^{\circ}\text{C}$  and a density of  $0.851\text{ g cm}^3$ .

It can be obtained from orange peel using steam distillation.

The distillation apparatus is shown.



- (a) (i) Label the diagram to show the direction of the water flow in the condenser. (1)
- (ii) Give a reason for using steam distillation to extract limonene. (1)

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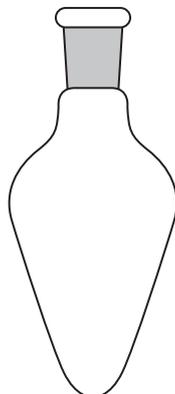
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(iii) The distillate may be collected in a pear-shaped flask.

Complete a labelled diagram showing the distillate.  
You should show clearly the limonene layer.

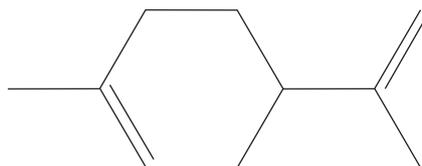
(1)



(b) Limonene exists as optical isomers.

(i) Identify the chiral carbon on the diagram.

(1)



(ii) The limonene extracted from orange peel is D-limonene.

State how the presence of a single optical isomer could be confirmed, naming the apparatus used. No experimental details are required.

(2)

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(iii) A student obtained  $1.20 \text{ cm}^3$  of limonene.

Calculate the amount, in moles, of limonene produced.

(3)

(c) Limonene reacts with acidified potassium manganate(VII).

(i) Give the colour change for this reaction.

(1)

(ii) Draw the structure of the organic product which might be expected when **excess** acidified potassium manganate(VII) reacts with limonene.

(1)

(Total for Question 4 = 11 marks)

TOTAL FOR PAPER = 50 MARKS

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# The Periodic Table of Elements

1 2 3 4 5 6 7 0 (8)

1.0	<b>H</b>
	hydrogen
	1

### Key

relative atomic mass
<b>atomic symbol</b>
name
atomic (proton) number

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
6.9	9.0	45.0	47.9	50.9	52.0	54.9	55.8	58.9	58.7	63.5	65.4	10.8	12.0	14.0	16.0	19.0	4.0
<b>Li</b>	<b>Be</b>	<b>Sc</b>	<b>Ti</b>	<b>V</b>	<b>Cr</b>	<b>Mn</b>	<b>Fe</b>	<b>Co</b>	<b>Ni</b>	<b>Cu</b>	<b>Zn</b>	<b>B</b>	<b>C</b>	<b>N</b>	<b>O</b>	<b>F</b>	<b>He</b>
lithium	beryllium	scandium	titanium	vanadium	chromium	manganese	iron	cobalt	nickel	copper	zinc	boron	carbon	nitrogen	oxygen	fluorine	helium
3	4	21	22	23	24	25	26	27	28	29	30	5	6	7	8	9	2
23.0	24.3	88.9	91.2	92.9	95.9	[98]	101.1	102.9	106.4	107.9	112.4	27.0	28.1	31.0	32.1	35.5	39.9
<b>Na</b>	<b>Mg</b>	<b>Y</b>	<b>Zr</b>	<b>Nb</b>	<b>Mo</b>	<b>Tc</b>	<b>Ru</b>	<b>Rh</b>	<b>Pd</b>	<b>Ag</b>	<b>Cd</b>	<b>Al</b>	<b>Si</b>	<b>P</b>	<b>S</b>	<b>Cl</b>	<b>Ar</b>
sodium	magnesium	yttrium	zirconium	niobium	molybdenum	technetium	ruthenium	rhodium	palladium	silver	cadmium	aluminium	silicon	phosphorus	sulfur	chlorine	argon
11	12	39	40	41	42	43	44	45	46	47	48	13	14	15	16	17	18
39.1	40.1	88.9	91.2	92.9	95.9	[98]	101.1	102.9	106.4	107.9	112.4	27.0	28.1	31.0	32.1	35.5	39.9
<b>K</b>	<b>Ca</b>	<b>La*</b>	<b>Hf</b>	<b>Ta</b>	<b>W</b>	<b>Re</b>	<b>Os</b>	<b>Ir</b>	<b>Pt</b>	<b>Au</b>	<b>Hg</b>	<b>Ga</b>	<b>Ge</b>	<b>As</b>	<b>Se</b>	<b>Br</b>	<b>Kr</b>
potassium	calcium	lanthanum	hafnium	tantalum	tungsten	rhenium	osmium	iridium	platinum	gold	mercury	gallium	germanium	arsenic	selenium	bromine	krypton
19	20	57	72	73	74	75	76	77	78	79	80	31	32	33	34	35	36
85.5	87.6	138.9	178.5	180.9	183.8	186.2	190.2	192.2	195.1	197.0	200.6	69.7	72.6	74.9	79.0	79.9	83.8
<b>Rb</b>	<b>Sr</b>	<b>La*</b>	<b>Hf</b>	<b>Ta</b>	<b>W</b>	<b>Re</b>	<b>Os</b>	<b>Ir</b>	<b>Pt</b>	<b>Au</b>	<b>Hg</b>	<b>In</b>	<b>Sn</b>	<b>Sb</b>	<b>Te</b>	<b>I</b>	<b>Xe</b>
rubidium	strontium	lanthanum	hafnium	tantalum	tungsten	rhenium	osmium	iridium	platinum	gold	mercury	indium	tin	antimony	tellurium	iodine	xenon
37	38	57	72	73	74	75	76	77	78	79	80	49	50	51	52	53	54
132.9	137.3	138.9	178.5	180.9	183.8	186.2	190.2	192.2	195.1	197.0	200.6	114.8	118.7	121.8	127.6	126.9	131.3
<b>Cs</b>	<b>Ba</b>	<b>Ac*</b>	<b>Rf</b>	<b>Db</b>	<b>Sg</b>	<b>Bh</b>	<b>Hs</b>	<b>Mt</b>	<b>Ds</b>	<b>Rg</b>	<b>Uuo</b>	<b>Tl</b>	<b>Pb</b>	<b>Bi</b>	<b>Po</b>	<b>At</b>	<b>Rn</b>
caesium	barium	actinium	rutherfordium	dubnium	seaborgium	bohrium	hassium	meitnerium	darmstadtium	roentgenium	[294]	thallium	lead	bismuth	polonium	astatine	radon
55	56	89	104	105	106	107	108	109	110	111	[294]	81	82	83	84	85	86
[223]	[226]	[227]	[261]	[262]	[266]	[264]	[277]	[268]	[271]	[272]	[294]	204.4	207.2	209.0	[209]	[210]	[222]
francium	radium	actinium	rutherfordium	dubnium	seaborgium	bohrium	hassium	meitnerium	darmstadtium	roentgenium	[294]	204.4	207.2	209.0	[209]	[210]	[222]
87	88	89	104	105	106	107	108	109	110	111	[294]	81	82	83	84	85	86

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

140	141	144	150	152	157	163	165	167	169	173	175
<b>Ce</b>	<b>Pr</b>	<b>Nd</b>	<b>Sm</b>	<b>Eu</b>	<b>Gd</b>	<b>Dy</b>	<b>Ho</b>	<b>Er</b>	<b>Tm</b>	<b>Yb</b>	<b>Lu</b>
cerium	praseodymium	neodymium	samarium	europium	gadolinium	dysprosium	holmium	erbium	thulium	ytterbium	lutetium
58	59	60	62	63	64	66	67	68	69	70	71
232	231	238	242	243	247	251	254	253	256	254	257
<b>Th</b>	<b>Pa</b>	<b>U</b>	<b>Pu</b>	<b>Am</b>	<b>Cm</b>	<b>Cf</b>	<b>Es</b>	<b>Fm</b>	<b>Md</b>	<b>No</b>	<b>Lr</b>
thorium	protactinium	uranium	plutonium	americium	curium	californium	einsteinium	fermium	mendelevium	nobelium	lawrencium
90	91	92	94	95	96	98	99	100	101	102	103

\* Lanthanide series  
\* Actinide series

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