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Candidate surname	Other names

Centre Number | Candidate Number

October 2021

Pearson Edexcel International Advanced Level

Time 1 hour 20 minutes

Paper reference **WCH13/01**

Chemistry

International Advanced Subsidiary/Advanced Level
UNIT 3: Practical Skills in Chemistry I

You must have:
Scientific calculator, ruler

Total Marks

Instructions

- Use **black** ink or **black** 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.
- There is a Periodic Table 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.
- Check your answers if you have time at the end.

Turn over ▶

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

1 This question is about some compounds of strontium.

(a) State a test for the strontium cation, giving the expected result.

(2)

.....

.....

(b) An unlabelled bottle was thought to contain solid strontium chloride.

A sample of the solid was dissolved in distilled water for tests to identify the anion.

Complete the table to give the expected results of the anion tests.

(2)

Reagent added for test	Expected result for the strontium chloride solution
Barium chloride acidified with hydrochloric acid	....
Silver nitrate acidified with nitric acid	....

(c) Anhydrous strontium sulfate undergoes thermal decomposition at approximately 1300 °C.

$$SrSO_4(s) \rightarrow SrO(s) + SO_2(g) + \tfrac{1}{2}O_2(g)$$

Suggest why this decomposition is unlikely to be possible in a school laboratory.

(1)

.....

.....

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(d) Anhydrous strontium nitrate decomposes at 570 °C.

$$Sr(NO_3)_2(s) \rightarrow SrO(s) + 2NO_2(g) + \tfrac{1}{2}O_2(g)$$

(i) Describe how to ensure the strontium nitrate decomposes fully.

(1)

(ii) State the colour of nitrogen dioxide gas.

(1)

(iii) Give the test for oxygen and the expected positive result.

(1)

(iv) The solid residue from the decomposition was added to distilled water.

Give **one** observation for the reaction that takes place, identifying the product of the reaction by name or formula.

(2)

Observation

Product

(Total for Question 1 = 10 marks)

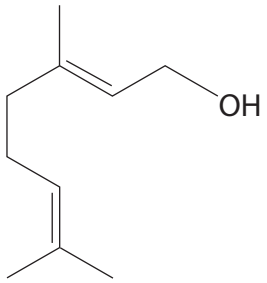
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2 Geraniol is used in perfumes and can be extracted from many plants.

Data on geraniol are shown.

Solubility in water	Melting temperature / °C	Boiling temperature / °C	Density / g cm^{-3}
insoluble	–15	230	0.889

The structure of geraniol is shown.



(a) Geraniol has **two** different types of functional group.

Name the functional groups, giving a chemical test and its positive result to show the presence of each group.

(4)

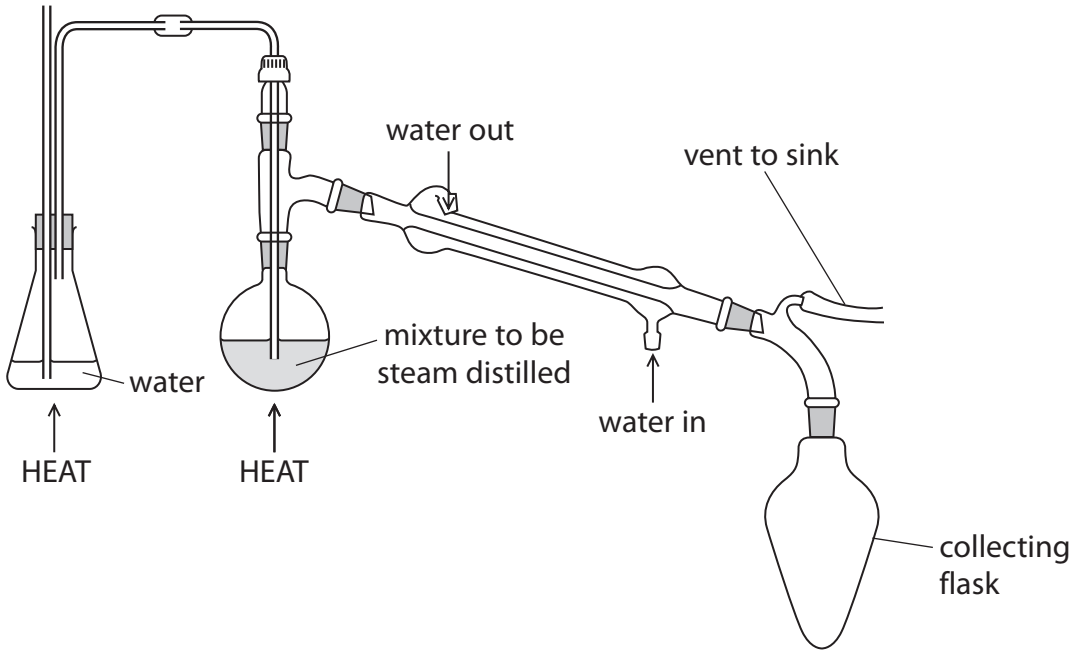
First functional group:

Second functional group:

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(b) Geraniol is extracted by steam distillation.



The steam distillation product is geraniol and water. The water may contain dissolved impurities which have similar boiling temperatures to geraniol.

The contents of the collecting flask are transferred to a piece of apparatus used to separate the geraniol from the water layer.

Draw a labelled diagram of this apparatus and its contents.

(3)

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(c) The geraniol will still contain small quantities of water.

Describe how to produce a sample of pure, dry geraniol using a named drying agent.

(3)

.....

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.....

(d) The hazard labels for pure geraniol are shown.

		
.....	.....	.....

(i) Complete the table to identify the hazards indicated by the symbols.

(2)

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(ii) State **one** precaution, other than wearing safety spectacles and a laboratory coat, that should be taken when using pure geraniol to reduce the risk associated with the hazard symbol shown.



(1)

.....

.....

(e) State the appearance of the flame when geraniol is ignited.

(1)

.....

.....

(f) Geraniol reacts with **excess** hydrogen gas.

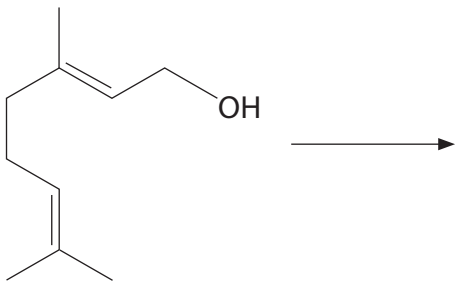
(i) State the essential condition required for this reaction.

(1)

.....

(ii) Draw the **skeletal** formula of the product of this reaction.

(1)



geraniol

(Total for Question 2 = 16 marks)

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3 A student carried out experiments to determine the enthalpy change for the hydration of anhydrous copper(II) sulfate, $CuSO_4$, to form hydrated copper(II) sulfate crystals, $CuSO_4 \cdot 5H_2O$.

To find the enthalpy change of solution of anhydrous copper(II) sulfate, 25.0 cm^3 of distilled water was placed in a polystyrene cup and the temperature measured at one minute intervals.

After 2.5 minutes, 7.50 g of anhydrous copper(II) sulfate was added and the mixture stirred continuously.

The results are shown.

Time / minutes	0	1	2	2.5	3	4	5	6	7	8
Temperature / °C	21.1	21.0	21.0	X	34.2	37.6	36.9	36.1	35.2	34.3

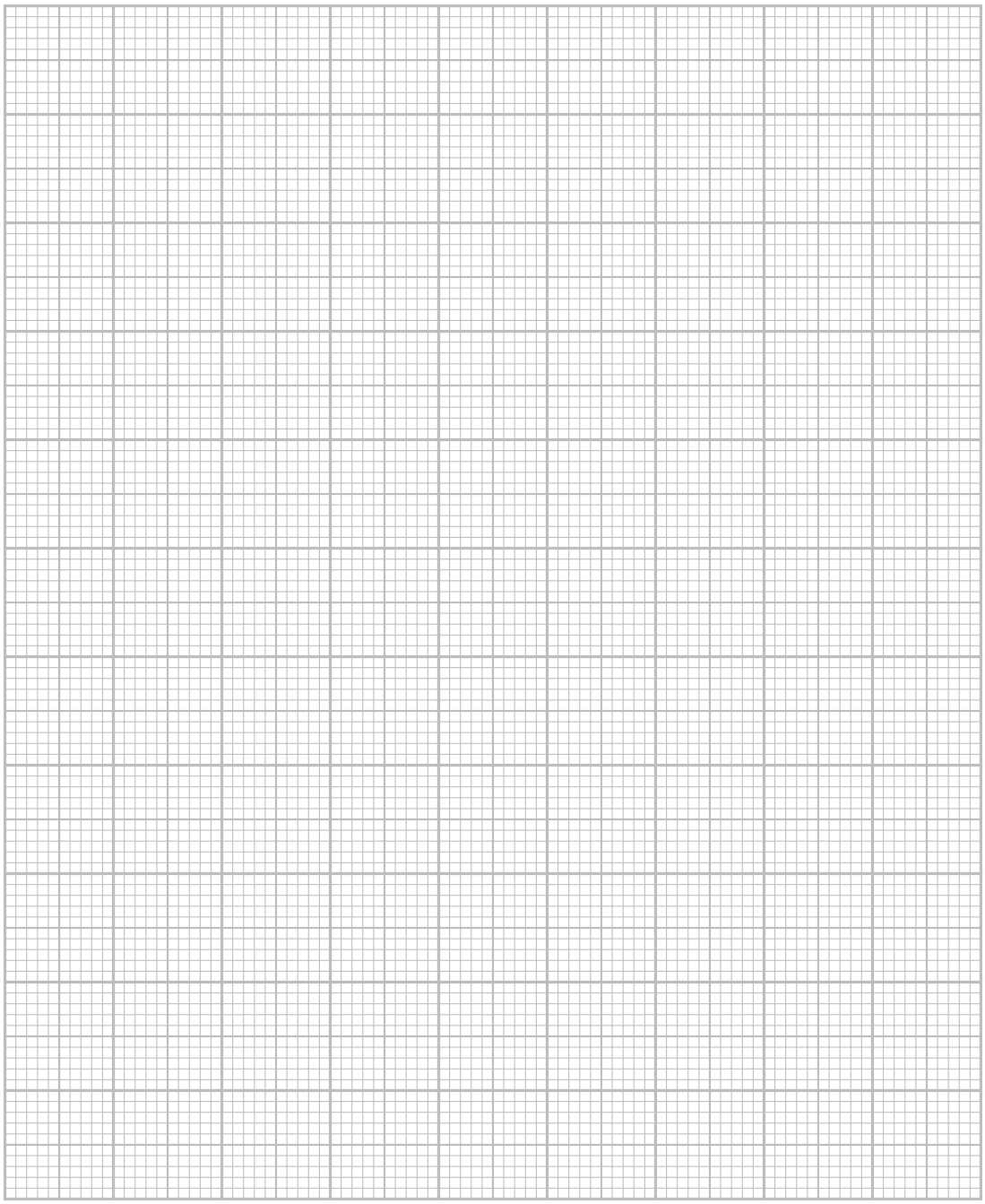
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(a) Plot a graph of temperature against time on the grid.

(3)



(b) Determine the maximum temperature change, ΔT, using your graph.

You **must** show your working on the graph.

(2)

ΔT = ...

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(c) The value of the enthalpy change from this experiment was $-39.0\,kJ\,mol^{-1}$.

Give **one** possible reason why this value is different from a data book value of $-61.4\,kJ\,mol^{-1}$.

(1)

.....

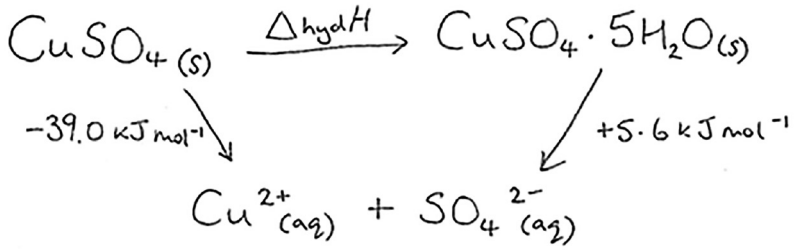
.....

.....

(d) After another experiment to find the enthalpy change of solution of hydrated copper(II) sulfate crystals, the student constructed the Hess cycle shown.

(i) Calculate the enthalpy change of hydration for the conversion of anhydrous copper(II) sulfate to hydrated copper(II) sulfate crystals.

(1)



(ii) Give **one** possible reason why the enthalpy change of hydration in (d)(i) could **not** be found directly by experiment.

(1)

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(Total for Question 3 = 8 marks)

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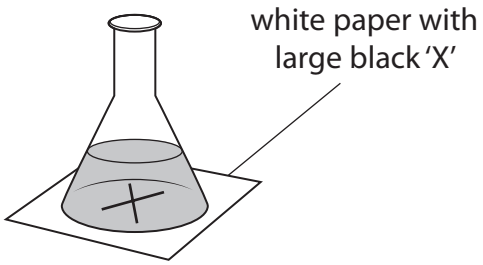
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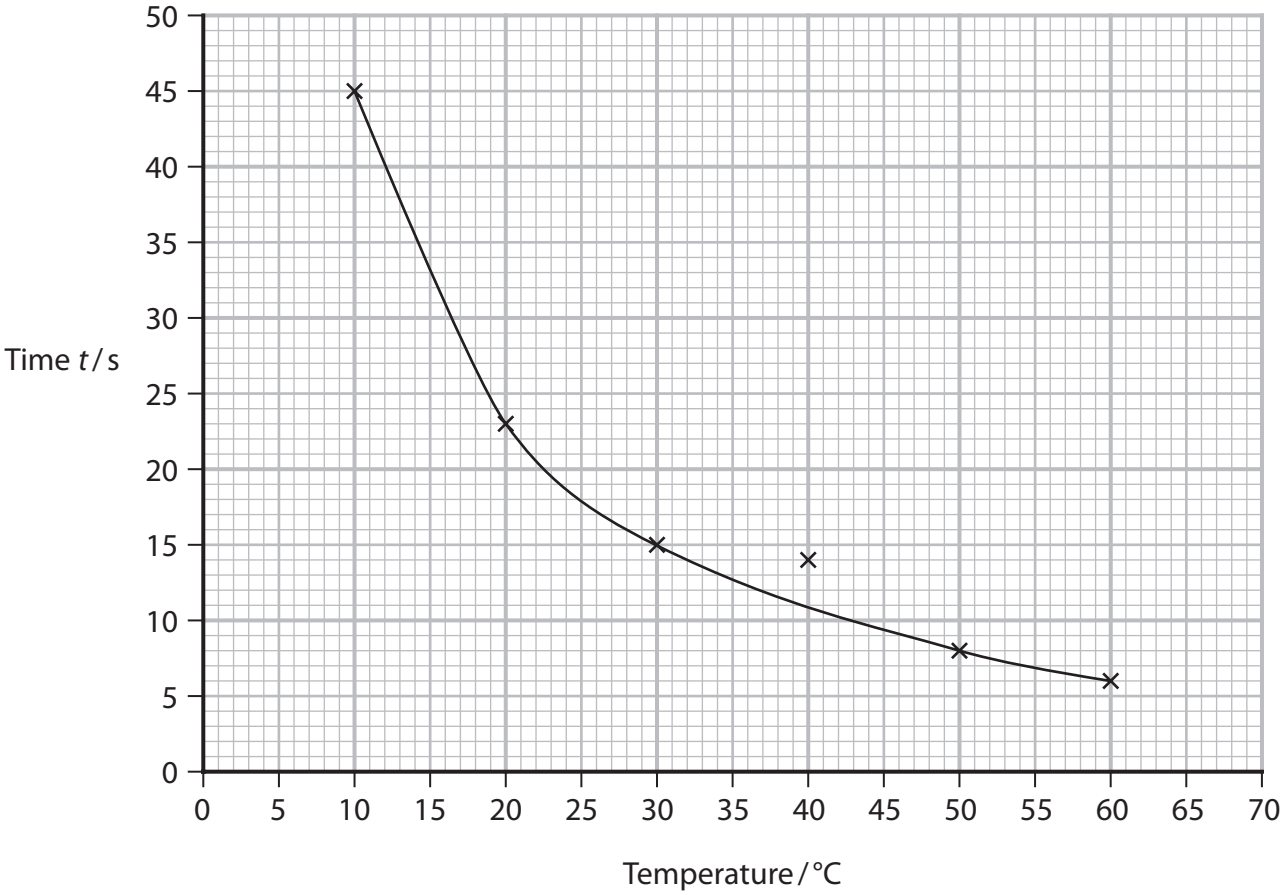
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4 Students were set a challenge by their teacher to produce a chemical clock measuring a 20 s time interval. They used an opaque solution that became transparent, allowing a black cross to become visible after 20 s.



The students investigated the effect of temperature on their results and plotted a graph.



(a) In this type of experiment $1 / t$ (where t is time) may be used as a measure of the rate of reaction.

(i) Calculate the rate at 15 °C to a suitable number of significant figures. Include units in your answer.

(3)

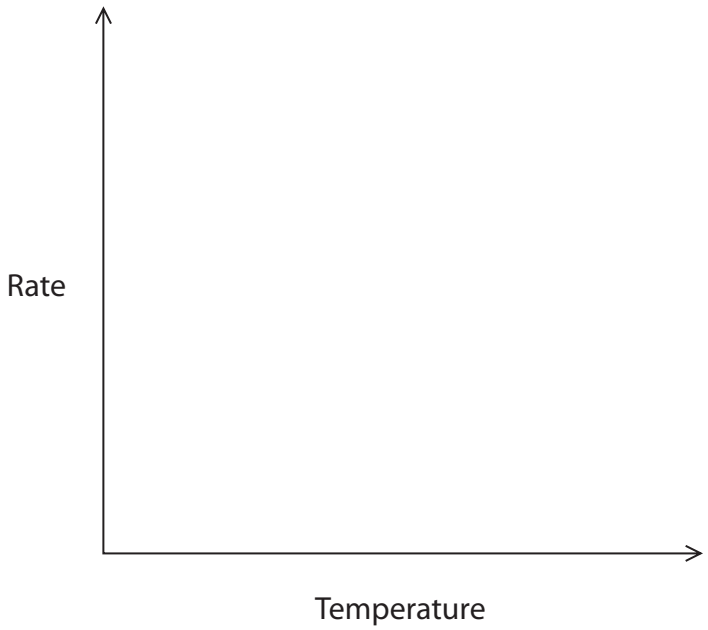
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(ii) Sketch a line showing how the rate of reaction varies with temperature for this reaction.

(1)



(b) Evaluate the students' results and decide whether it is necessary to repeat their experiments.

(2)

(c) State how you would change the conditions to make this chemical clock measure 40 s at 22 °C.

(1)

(Total for Question 4 = 7 marks)

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5 A technician found a bottle of sodium hydroxide solution at the back of a cupboard. The technician determined its concentration by titrating 25.0 cm^3 samples against 0.500 mol dm^{-3} hydrochloric acid from a burette.

The results obtained are shown.

(a) Complete the titre values.

(1)

	Titration number				
	Rough	1	2	3	4
Final reading / cm^3	24.90	21.25	42.85	21.80	43.15
Initial reading / cm^3	2.30	0.00	21.25	0.50	21.80
Titre / cm^3					21.35

(b) (i) State why the value from Titration 2 was **not** used to calculate the mean.

(1)

.....

.....

(ii) Calculate the concentration of the sodium hydroxide solution in mol dm^{-3}.

(4)

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(c) Each reading of the burette has an uncertainty of $\pm 0.05\,cm^3$.

Calculate the percentage uncertainty in Titration 4.

(1)

(d) State the colour change that would be seen at the end-point in this titration using phenolphthalein as the indicator.

(2)

From ..... to .....

(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)
																	(18)
							1.0 H hydrogen 1										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 darmstadtium 110	[272] Rg roentgenium 111							

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

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

* Lanthanide series

* Actinide series

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