Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Chemistry

Advanced Subsidiary

Paper 1: Core Inorganic and Physical Chemistry

Specimen Paper for first teaching September 2015

Time: 1 hour 30 minutes

Paper Reference

8CH0/01

You must have:
Data Booklet
Scientific calculator

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 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 may use a scientific calculator.
- For questions marked with an **asterisk (*)**, marks will be awarded for your ability to structure your answer logically showing the points that you make are related or follow on from each other where appropriate.
- A Periodic Table is printed on the back cover of this paper.

Advice

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

Turn over ▶

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Answer ALL questions.

Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) State what is meant by the term **relative atomic mass**.

(2)

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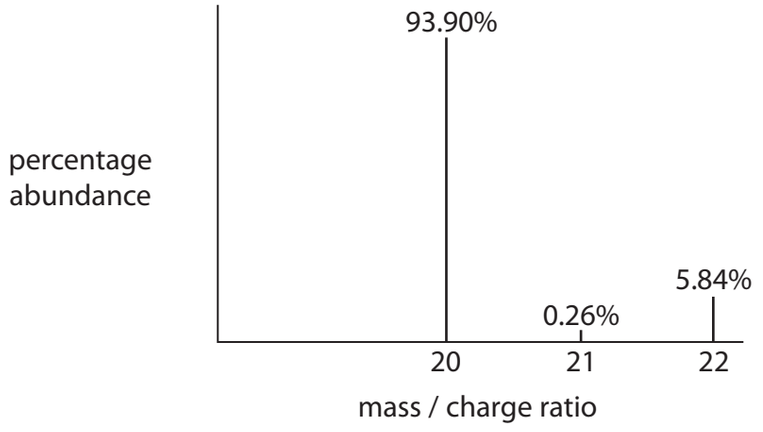
(b) The mass spectrum of a sample of neon is shown.



(i) State why there are three peaks in the spectrum.

(1)

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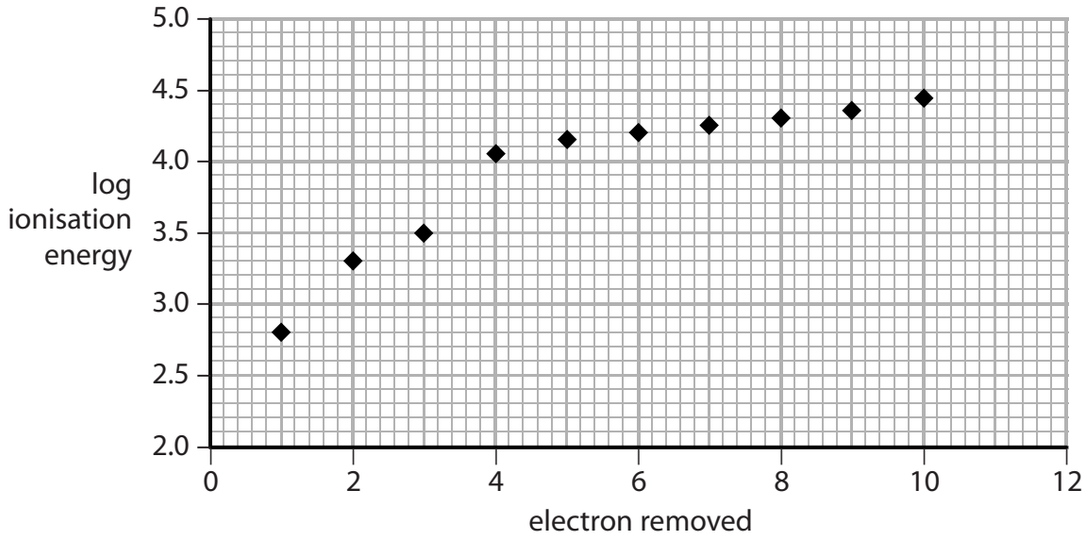
(ii) Use the spectrum to calculate the relative atomic mass of neon.
Show your working and give your answer to 3 significant figures.

(2)

(Total for Question 1 = 5 marks)

2 This question is about ionisation energies.

(a) The graph represents log of the first ten successive ionisation energies of an element **X** plotted against the number of the electron removed.



In which group of the Periodic Table is **X** found?

(1)

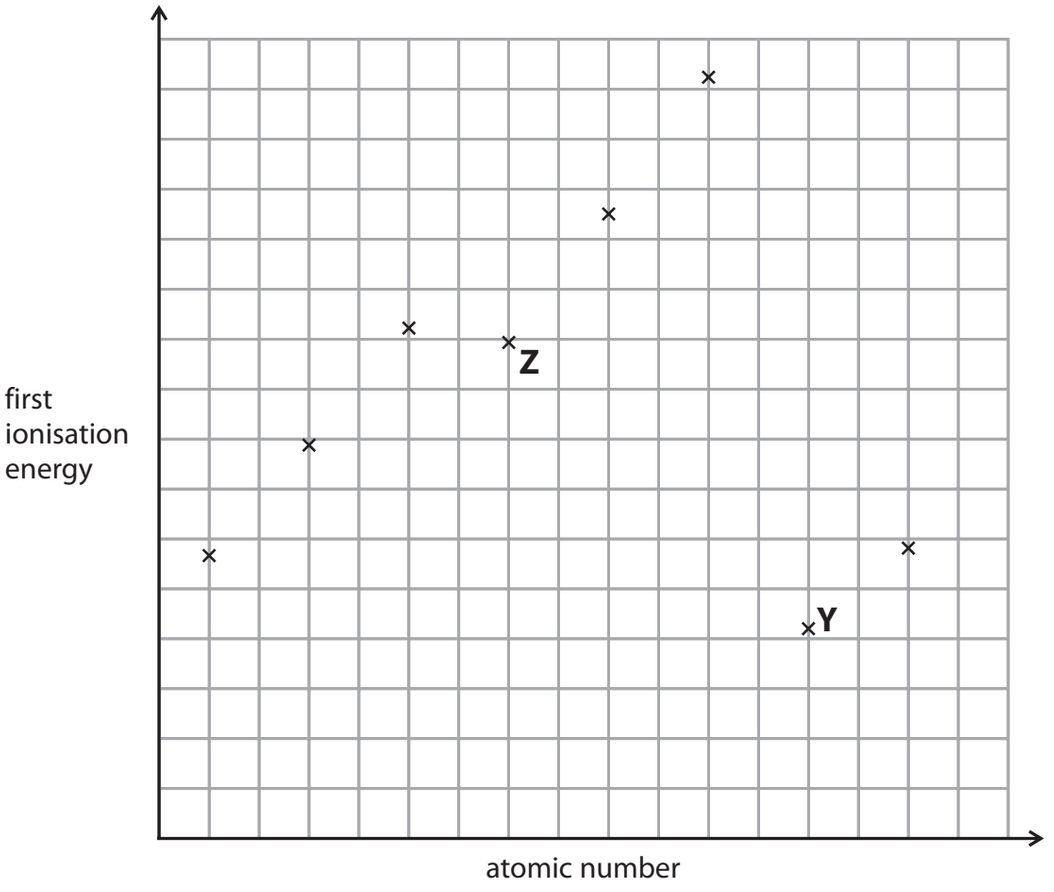
☒ **A** Group 1

☒ **B** Group 3

☒ **C** Group 5

☒ **D** Group 7

(b) The graph shows the first ionisation energy of eight successive elements in the Periodic Table.



What is the formula of the compound formed between **Y** and **Z**?

(1)

- ☒ **A** YZ_4
- ☒ **B** YZ_2
- ☒ **C** Y_2Z
- ☒ **D** Y_4Z

(c) Give reasons for the general increase in the first ionisation energy of the elements, going across the Periodic Table from left to right in period 2.

(2)

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(d) Give a reason why the first ionisation energy of the elements decreases going down Group 1.

(1)

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(e) (i) Write an equation, including state symbols, to illustrate the process occurring when the second ionisation energy of the element, **X**, is measured.

(2)

(ii) Which element has the greatest second ionisation energy?

(1)

☒ **A** Ne

☒ **B** Na

☒ **C** Mg

☒ **D** Al

(Total for Question 2 = 8 marks)

***3** Two white solids are known to be the compounds magnesium nitrate and barium nitrate. Both solids are soluble in water.

Tests were carried out on the two compounds and the following results were obtained.

- Dilute sulfuric acid was added to an aqueous solution of each compound. One showed no change; the other reacted to form a white precipitate.
- Dilute sodium hydroxide was added to an aqueous solution of each compound. One showed no change; the other reacted to form a white precipitate.
- The solids were heated separately. Both decomposed to form a white residue, a brown gas and a gas which relit a glowing splint. However, one solid decomposed faster than the other.

Discuss how observations from all three tests can be used to identify the two solids.

You should include equations for any reactions that take place (state symbols are not required).

(6)

(Total for Question 3 = 6 marks)

4 This question is about the element sulfur.

(a) Complete the electronic configuration of sulfur.

(1)

$1s^2\ 2s^2$ .....

(b) Sulfur reacts with sodium to form the compound sodium sulfide, Na_2S.

(i) Draw a dot-and-cross diagram for sodium sulfide only the outer electrons need be shown.

Include the charges present.

(2)

(ii) Which statement about the electrical conductivity of sodium sulfide is correct?

(1)

☒ **A** it conducts when solid and liquid

☒ **B** it conducts when solid but not when liquid

☒ **C** it conducts when liquid but not when solid

☒ **D** it does not conduct when solid or liquid

(iii) The melting temperature of sodium sulfide is higher than that of sodium chloride, even though both contain ionic bonding.

Explain this difference in melting temperature.

(2)

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(c) Sulfur forms the compound carbon disulfide, CS_2.

(i) Draw a dot-and-cross diagram for carbon disulfide.

Only the outer electrons need be shown. Use a dot (•) for the electrons from carbon and a cross (×) for the electrons from sulfur.

(2)

(ii) Deduce the value of the S-C-S bond angle in CS_2. Justify your answer.

(3)

Angle .....

Justification .....

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(d) Water is a good solvent for sodium sulfide but not for carbon disulfide.

(i) Which statement explains why sodium sulfide dissolves in water?

(1)

☒ **A** the attraction between sodium ions and sulfide ions is weaker than the bonding between oxygen and hydrogen in a water molecule

☒ **B** the attraction between sodium ions and sulfide ions is weaker than the hydrogen bonding between water molecules

☒ **C** the energy released when sodium ions and sulfide ions are hydrated is less than the energy required to break the hydrogen bonding between water molecules

☒ **D** the energy released when sodium ions and sulfide ions are hydrated is greater than the energy required to break the attraction between sodium ions and sulfide ions

(ii) State one factor that makes water a poor solvent for molecules such as carbon disulfide which contain atoms with very similar electronegativities.

(1)

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(e) Which are the correct names for both SO_2 and Na_2SO_4?

(1)

☒ **A** sulfur oxide(II) and sodium sulfate(IV)

☒ **B** sulfur(II) oxide and sodium(II) sulfate

☒ **C** sulfur oxide(IV) and sodium sulfate(IV)

☒ **D** sulfur(IV) oxide and sodium sulfate(VI)

(Total for Question 4 = 14 marks)

5 This question is about a carboxylic acid.

(a) (i) This acid contains 40.0% carbon and 6.67% hydrogen by mass. The remainder is oxygen. The molar mass of the acid is 60.0 g mol^{-1}.

Use this information to deduce the empirical formula and the molecular formula of the acid.

(3)

(ii) What is the total number of atoms in 6.00 g of the acid?

(1)

☒ **A** 6.02×10^{22}

☒ **B** 2.41×10^{23}

☒ **C** 4.82×10^{23}

☒ **D** 6.02×10^{24}

(b) A solution of the acid contains hydrogen ions. Write an ionic equation for the reaction of sodium with the hydrogen ions in the acid.
Include state symbols in your answer.

(2)

(c) When 2.00 mol of the acid react with sodium carbonate, 1.00 mol of carbon dioxide is formed.

Calculate the volume of carbon dioxide formed, in cm^3, from 8.00 g of the acid at room temperature and pressure.

(2)

(Total for Question 5 = 8 marks)

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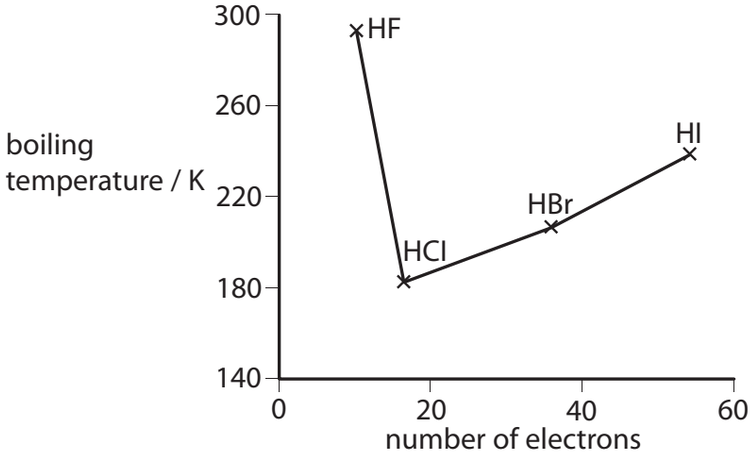
6 This question is about elements of Group 7 and their compounds.

(a) Give the physical states at room temperature of chlorine, bromine and iodine. Explain why they are different.

(4)

(b) The graph shows the boiling temperatures of the hydrides of Group 7.



Explain, in terms of the electronegativity of the elements involved, why hydrogen fluoride has a higher boiling temperature than expected.

(3)

(c) Misty fumes form when concentrated sulfuric acid is added to solid sodium chloride.

(i) Write an equation for this reaction. State symbols are not required.

(1)

(ii) The misty fumes can be identified by bringing them into contact with another gas **Q**. Identify gas **Q** and state the observation you would make.

(2)

Gas **Q** .....

Observation .....

(d) When concentrated sulfuric acid is added to solid sodium iodide a mixture of fuming gases forms, including iodine and hydrogen sulfide.

(i) Which description of the fumes indicates the presence of iodine?

(1)

☒ **A** blue-black

☒ **B** brown

☒ **C** misty

☒ **D** purple

(ii) Write the half-equation showing the formation of iodine from iodide ions. State symbols are not required.

(1)

(iii) Write the half-equation showing the formation of hydrogen sulfide from sulfuric acid and hydrogen ions.
State symbols are not required.

(1)

(iv) Hence write an overall equation for the reaction of iodide ions with sulfuric acid.

(1)

(e) (i) Halide ions in solution can be identified by the addition of silver nitrate solution followed by dilute aqueous ammonia.

State the observation you would make at each stage when silver nitrate solution is added to chloride ions, followed by dilute aqueous ammonia.

(2)

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(ii) Justify whether concentrated aqueous ammonia could be used to confirm that silver chloride has been formed.

(1)

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(Total for Question 6 = 17 marks)

7 Iodine reacts with hot concentrated aqueous potassium hydroxide to form a mixture of potassium iodide, KI, and potassium iodate, KIO_3.

$$3I_2 + 6KOH \rightarrow 5KI + KIO_3 + 3H_2O$$

(a) Explain, giving the relevant oxidation numbers, whether this is classed as a redox reaction.

(2)

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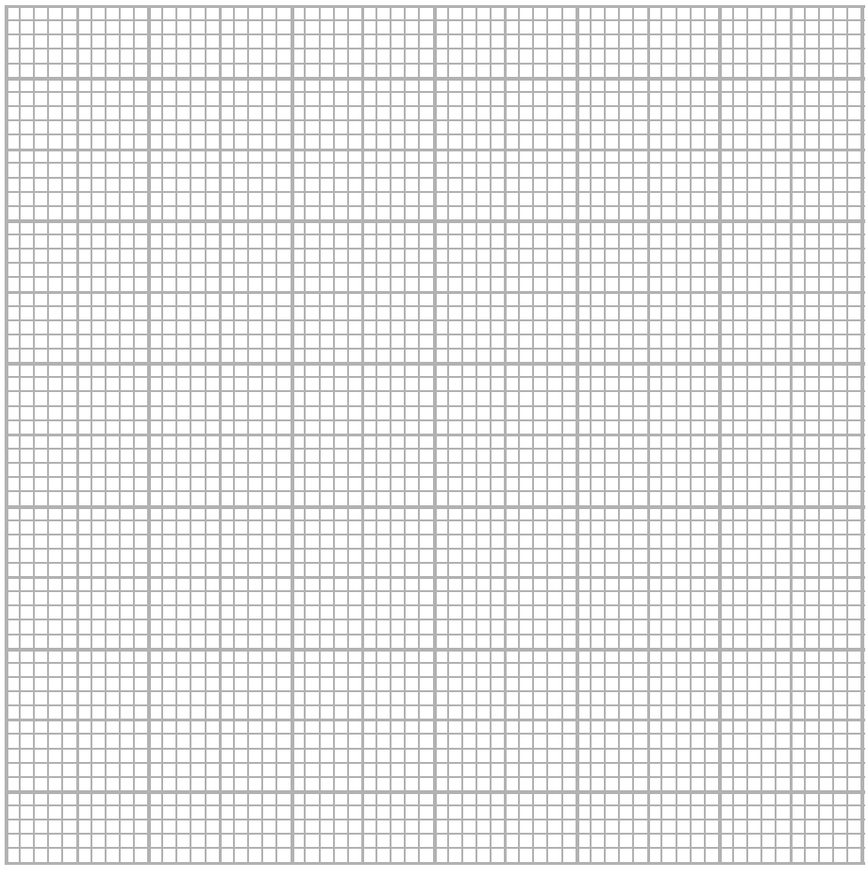
(b) (i) The table shows the solubility of potassium iodide and potassium iodate in 100 g of water at different temperatures.

	Solubility / g per 100 g of water				
Temperature / °C / **Compound**	0	20	40	60	100
KI	128	144	162	176	192
KIO_3	4.6	8.1	12.6	18.3	24.8

On the grid on page 17, plot one line for each substance, showing their solubilities at different temperatures.

(3)



(ii) In an experiment, some iodine was reacted completely with potassium hydroxide to form 6.64 g of potassium iodide and 1.71 g of potassium iodate. The mixture of solids was dissolved in 10 g of water at 100 °C and then cooled to 10 °C.

Use your graph to predict the identity of the solid which crystallises at 10 °C and calculate its mass.

(2)

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(Total for Question 7 = 7 marks)

8 The equation shows how lithium reacts with water.

$$2Li(s) + H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$$

A sample of lithium contains an inert impurity. An experiment was carried out to find the percentage purity of the sample.

(a) A piece of lithium was weighed on a balance reading to 3 decimal places. The mass recorded was 0.120 g. It was then added to 50 cm^3 of water in a beaker (in excess).

Calculate the maximum volume of hydrogen, in cm^3, which would be formed at a temperature of 20 °C and a pressure of 1.0×10^5 Pa.

(4)

(b) The solution formed in the reaction was used in a titration with hydrochloric acid of concentration 0.200 mol dm^{-3}. Lithium hydroxide reacts with hydrochloric acid.

$$LiOH(aq) + HCl(aq) \rightarrow LiCl(aq) + H_2O(l)$$

(i) The first stage was to make up the solution of lithium hydroxide to a volume of exactly 100 cm^3. Name the type of flask used to make the solution up to 100 cm^3.

(1)

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(ii) The mean titre of 0.200 mol dm^{-3} hydrochloric acid required to neutralise 25.00 cm^3 samples of lithium hydroxide was 20.40 cm^3.

Calculate the concentration of the lithium hydroxide solution.
Hence calculate the percentage purity of the original sample of lithium.

(5)

(c) (i) Calculate the percentage error in the mass of lithium recorded if there is an uncertainty of ±0.005 g each time the balance is read.

(1)

(ii) Does the greatest uncertainty in the result of this experiment arise from measurement of the mass of lithium, the pipette volume or the burette readings? Explain your answer.

No further calculations are required.

(2)

(iii) Justify one change you could make to this experiment to improve the accuracy of the result.

(2)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

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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: relative atomic mass / atomic symbol / name / atomic (proton) number									(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							

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