

Write your name here

Surname

Other names

**Pearson Edexcel
International
Advanced Level**

Centre Number

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Candidate Number

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Chemistry

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

Sample Assessment Materials for first teaching September 2018

Time: 1 hour 30 minutes

Paper Reference

WCH11/01

You must have:

Scientific calculator, ruler

Total Marks

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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.*
- **Show all your working in calculations and include units where appropriate.**

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.*
- There is a Periodic Table on the back page 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.

Turn over ►

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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 \boxtimes .
If you change your mind, put a line through the box \boxtimes and then mark your new answer with a cross \boxtimes .

- 1 An outline of part of the Periodic Table is shown.
The letters are not the usual symbols of the elements.

					Z															
			X																	
R												S				T				
	U												V				W			

- (a) Which elements are in the s-block of the Periodic Table?

(1)

- A R and U
 B T and Y
 C V and W
 D X and Z

- (b) Which element has four occupied quantum shells, with six electrons in the outermost shell?

(1)

- A V
 B X
 C Y
 D Z

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(c) In which pair do the ions have the same electronic configuration?

(1)

- A R^+ and T^{2-}
- B T^{2-} and Y^{2-}
- C U^{2+} and T^{2-}
- D U^{2+} and W^-

(Total for Question 1 = 3 marks)

2 This question is about phosphorus and sulfur.

Which species contains 15 protons, 16 neutrons and 18 electrons?

- A P^{3-}
- B P^{3+}
- C S^{2-}
- D S^{2+}

(Total for Question 2 = 1 mark)

3 Which is the electronic configuration of nitrogen?

- | | 1s | 2s | 2p |
|----------------------------|----------------------|----------------------|--|
| <input type="checkbox"/> A | \uparrow | \uparrow | $\uparrow\downarrow \uparrow\downarrow \uparrow$ |
| <input type="checkbox"/> B | $\uparrow\downarrow$ | \uparrow | $\uparrow\downarrow \uparrow\downarrow \square$ |
| <input type="checkbox"/> C | $\uparrow\downarrow$ | $\uparrow\downarrow$ | $\uparrow\downarrow \uparrow \square$ |
| <input type="checkbox"/> D | $\uparrow\downarrow$ | $\uparrow\downarrow$ | $\uparrow \uparrow \uparrow$ |

(Total for Question 3 = 1 mark)

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

4 A sample of neon contains the following isotopes.

Isotope	Percentage abundance
^{20}Ne	90.92
^{21}Ne	0.26
^{22}Ne	8.82

What is the relative atomic mass of neon to two decimal places?

- A 20.00
- B 20.09
- C 20.18
- D 21.00

(Total for Question 4 = 1 mark)

5 Data from the mass spectrum of a sample of pure iron is given in the table.

m/z	Relative peak height
28	0.1
54	6.3
56	100.0
57	2.4
58	0.3

Which species is most likely to cause the peak at $m/z = 28$?

- A $^{28}\text{Fe}^+$
- B $^{56}\text{Fe}^{2+}$
- C $^{28}\text{Si}^+$
- D $^{84}\text{Sr}^{3+}$

(Total for Question 5 = 1 mark)

6 Which of these is not a chemical reaction?

- A cracking
- B fractional distillation
- C polymerisation
- D reforming

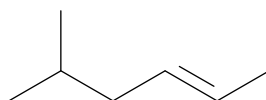
(Total for Question 6 = 1 mark)

7 Which of these fuels is obtained from fermented sugar cane?

- A ethanol
- B hydrogen
- C petrol
- D propane

(Total for Question 7 = 1 mark)

8 What is the systematic name for this compound?

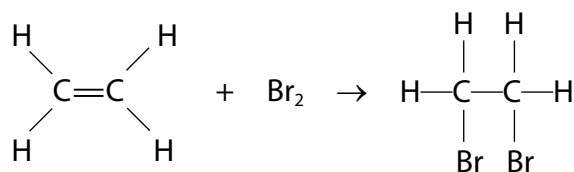


- A *E*-5-methylhex-2-ene
- B *Z*-5-methylhex-2-ene
- C *E*-2-methylpent-4-ene
- D *Z*-2-methylpent-4-ene

(Total for Question 8 = 1 mark)

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

9 Ethene reacts with bromine to form 1,2-dibromoethane.



For the ethene molecule, what is the type of bond broken and the type of bond fission occurring in this reaction?

	Bond broken	Bond fission
<input type="checkbox"/> A	π	heterolytic
<input type="checkbox"/> B	π	homolytic
<input type="checkbox"/> C	σ	heterolytic
<input type="checkbox"/> D	σ	homolytic

(Total for Question 9 = 1 mark)

10 There is 0.045 g of solute in 1500 g of a solution.

What is the concentration of the solution in parts per million (ppm)?

- A 3.00
 B 6.75
 C 30.0
 D 67.5

(Total for Question 10 = 1 mark)

11 What is the concentration, in mol dm^{-3} , of a solution containing 7.84 g of phosphoric(V) acid, H_3PO_4 , in 400 cm^3 of solution?

- A 0.02
 B 0.08
 C 0.20
 D 19.6

(Total for Question 11 = 1 mark)

12 A sample of a hydrocarbon with mass 7.2 g contained 6.0 g of carbon.

What is the empirical formula of the hydrocarbon?

- A CH₂
- B C₅H₁₂
- C C₆H₆
- D C₇H₆

(Total for Question 12 = 1 mark)

13 Which pair of substances contains the same number of moles at room temperature and pressure (r.t.p.)?

[A, values Ca = 40, Li = 7, Al = 27, Mg = 24. Molar volume of gas at r.t.p. = 24 dm³ mol⁻¹]

- A 24 dm³ of chlorine, Cl₂, and 20 g of calcium, Ca
- B 24 dm³ of oxygen, O₂, and 14 g of lithium, Li
- C 1.2 dm³ of hydrogen, H₂, and 2.7 g of aluminium, Al
- D 1.2 dm³ of nitrogen, N₂, and 1.2 g of magnesium, Mg

(Total for Question 13 = 1 mark)

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

14 What are the maximum numbers of electrons in a 2p orbital and in the third quantum shell?

	Maximum number of electrons in a 2p orbital	Maximum number of electrons in the third quantum shell
<input type="checkbox"/> A	2	8
<input type="checkbox"/> B	2	18
<input type="checkbox"/> C	6	8
<input type="checkbox"/> D	6	18

(Total for Question 14 = 1 mark)

15 Water reacts with H^+ ions to form H_3O^+ ions.

Identify the bonding **within** the H_3O^+ ion.

- A covalent bonding only
- B covalent and dative covalent bonding only
- C covalent, dative covalent and ionic bonding
- D ionic bonding only

(Total for Question 15 = 1 mark)

16 What are the shapes of the AlCl_3 and PH_3 molecules?

	Shape of AlCl_3 molecule	Shape of PH_3 molecule
<input type="checkbox"/> A	pyramidal	pyramidal
<input type="checkbox"/> B	pyramidal	trigonal planar
<input type="checkbox"/> C	trigonal planar	trigonal planar
<input type="checkbox"/> D	trigonal planar	pyramidal

(Total for Question 16 = 1 mark)

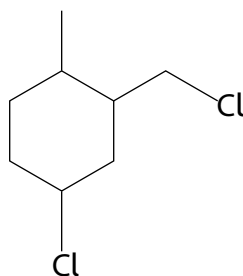
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17 Which describes the polarity of the C—Cl bond and the polarity of the CCl₄ molecule?

	Polarity of C—Cl bond	Polarity of CCl ₄ molecule
<input type="checkbox"/> A	non-polar	non-polar
<input type="checkbox"/> B	non-polar	polar
<input type="checkbox"/> C	polar	polar
<input type="checkbox"/> D	polar	non-polar

(Total for Question 17 = 1 mark)

18 What is the empirical formula of the following molecule?



- A C₄H₄Cl
- B C₄H₇Cl
- C C₈H₁₁Cl₂
- D C₈H₁₄Cl₂

(Total for Question 18 = 1 mark)

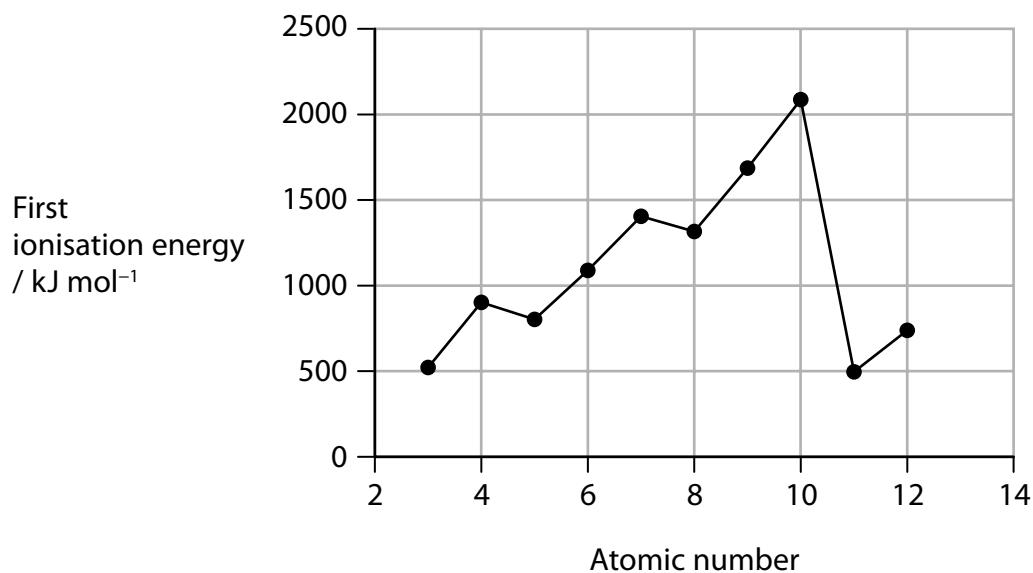
TOTAL FOR SECTION A = 20 MARKS

SECTION B

Answer ALL the questions.

Write your answers in the spaces provided.

- 19 The graph shows the first ionisation energies for the elements with atomic numbers from 3 to 12.



- (a) Write the equation for the first ionisation energy of nitrogen. Include state symbols.

(2)

- (b) Explain the changes in first ionisation energy for the elements with atomic numbers from 3 to 10.

(4)

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(c) Explain why the first ionisation energy of element 11 is lower than that of element 3.

(2)

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(Total for Question 19 = 8 marks)

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20 This question is about bromine.

- (a) Complete the electronic configuration for a bromine atom, using the s, p, d notation. (1)

[Ar].....

- (b) Bromine exists as two isotopes with mass numbers 79 and 81.

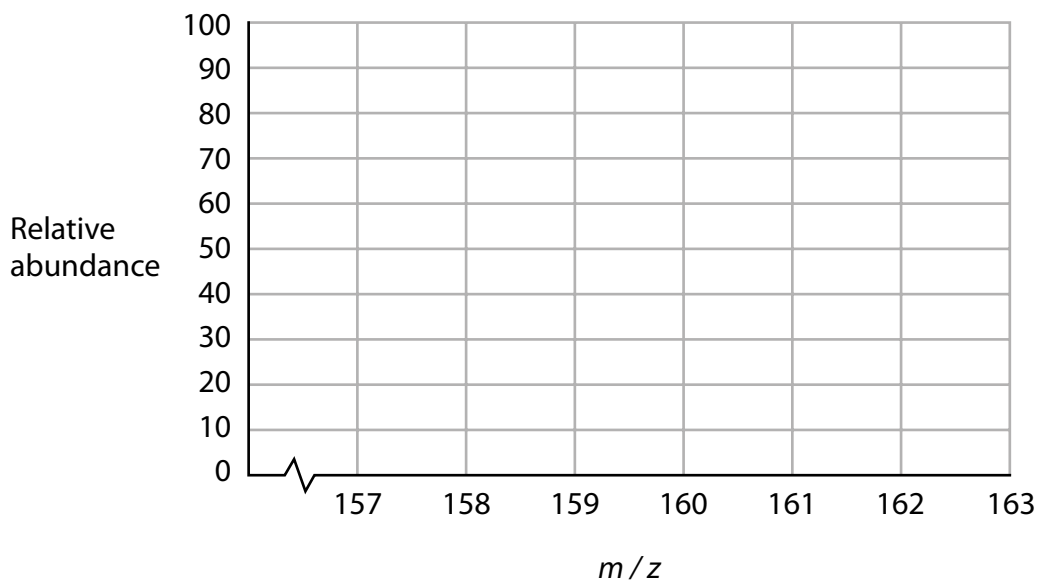
- (i) Complete the table to show the numbers of subatomic particles in a ^{79}Br atom and a $^{81}\text{Br}^-$ ion. (2)

Species	Protons	Neutrons	Electrons
^{79}Br			
$^{81}\text{Br}^-$			

- (ii) A sample of bromine contained equal amounts of the two isotopes.

Complete the mass spectrum to show the peaks you would expect for Br_2^+ from this sample of bromine gas.

(2)



(iii) Calculate the number of bromine molecules in 2.00 g of Br₂.

[Avogadro constant = $6.02 \times 10^{23} \text{ mol}^{-1}$]

(2)

Number of molecules =

(c) A sample of bromine gas occupied 200 cm³ at a temperature of 77 °C and a pressure of $1.51 \times 10^5 \text{ Pa}$.

Calculate, using the ideal gas equation, the amount in moles of bromine molecules in this sample.

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

(4)

Amount of bromine molecules = mol

(Total for Question 20 = 11 marks)

21 Magnesium is a metal in Group 2 of the Periodic Table. It reacts with chlorine to form the salt magnesium chloride, MgCl_2 .

(a) Draw a dot-and-cross diagram for magnesium chloride.

Show outer shell electrons only.

(1)

(b) Magnesium conducts electricity when it is in the solid state. Magnesium chloride conducts electricity when it is molten or dissolved in water but not when it is in the solid state.

Explain these observations.

(3)

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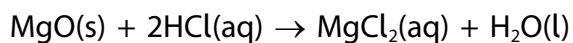
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(c) Magnesium chloride can also be made by reacting magnesium oxide with dilute hydrochloric acid.



(i) Write the **ionic** equation, including state symbols, for this reaction. (1)

(ii) Calculate the minimum volume of 2.00 mol dm^{-3} hydrochloric acid needed to completely react with 2.45 g of magnesium oxide. (3)

Minimum volume of hydrochloric acid = cm^3

- (d) A further method for making magnesium chloride is by reacting magnesium carbonate with dilute hydrochloric acid.



Calculate the maximum mass of magnesium chloride that could be formed when 2.25 g of magnesium carbonate is added to excess dilute hydrochloric acid.

(2)

Maximum mass magnesium chloride = g

- (e) Explain why the reaction to make magnesium chloride from magnesium oxide has a higher atom economy than the reaction using magnesium carbonate. No calculation is required.

(2)

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(Total for Question 21 = 12 marks)

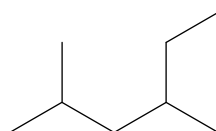
22 The alkanes are a homologous series of saturated hydrocarbons.

(a) Draw the displayed formulae of the three alkanes with molecular formula C_5H_{12} .

(3)

(b) Give the systematic name of compound **P**.

(1)



Compound **P**

Systematic name

(c) The table shows the boiling temperatures of the first four straight-chain alkanes.

Molecular formula of alkane	Boiling temperature / °C
CH ₄	-164
C ₂ H ₆	-89
C ₃ H ₈	-42
C ₄ H ₁₀	-0.5

Predict the molecular formula and boiling temperature of the straight-chain alkane that has five carbon atoms in its molecules.

(2)

Molecular formula

Boiling temperature

(d) Alkanes undergo incomplete combustion when they burn in a limited supply of air.

- (i) Write the equation for the incomplete combustion of propane, C₃H₈, to form carbon, carbon monoxide, carbon dioxide and water.
State symbols are not required.

(1)

- (ii) Explain the toxicity of carbon monoxide.

(2)

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(e) Propane reacts with chlorine in the presence of ultraviolet radiation. The reaction starts when some chlorine molecules are split into free radicals. A mixture of products is formed.

(i) Write the two propagating steps to show how C_3H_7Cl is formed.
Curly arrows are not required. (2)

(ii) Identify the different C_3H_7Cl molecules that are produced in this reaction. (1)

(iii) Give a reason why a mixture of C_3H_7Cl molecules is formed. (1)

(iv) Give a reason why some hexane is formed in this reaction. (1)

(v) A small amount of a product with molar mass 113 g mol^{-1} is formed.
Deduce the structure and name of a possible product with this molar mass. (2)

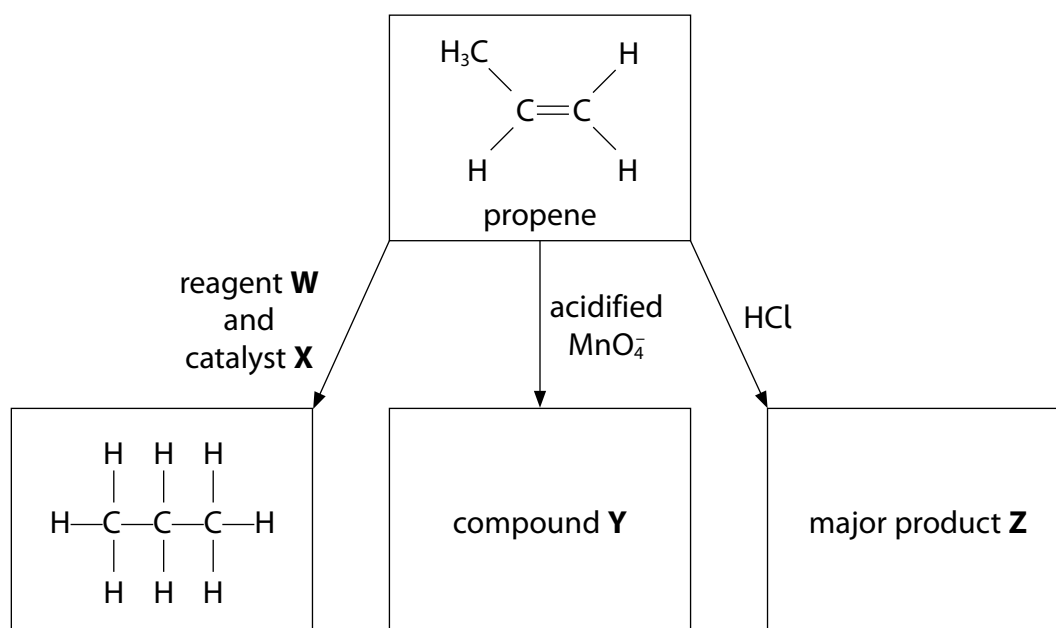
Structure

Name

(Total for Question 22 = 16 marks)

23 Alkenes contain a double bond between two carbon atoms.

(a) Some reactions of propene are shown.



(i) Give the names of reagent **W** and catalyst **X**.

(2)

Reagent **W**

Catalyst **X**

(ii) Draw the displayed formula of compound **Y**.

(1)

(iii) Draw the skeletal formula of the major product **Z**.

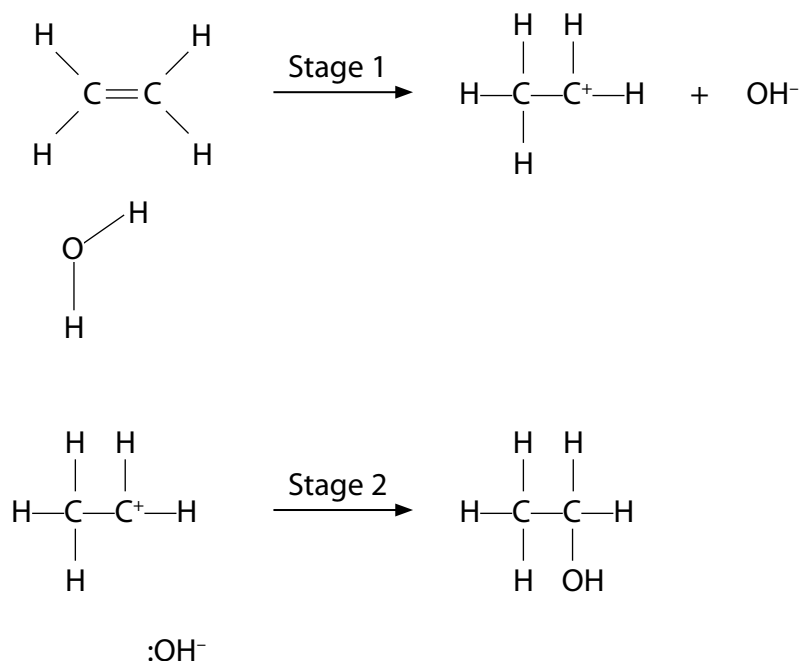
(1)

(b) Ethene reacts with steam in the presence of a catalyst to form ethanol.

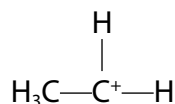
The mechanism takes place in two stages.

- (i) Complete the simplified mechanism for the reaction by adding curly arrows and the relevant dipole.

(4)

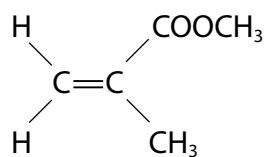


- (ii) Predict the shape of the intermediate ion with reference to the positively-charged carbon. Justify your answer.



(3)

(c) Methyl 2-methylpropenoate has the structure:



Draw a section of the polymer formed from methyl 2-methylpropenoate, showing two repeat units.

(2)

(Total for Question 23 = 13 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)	
	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 1.0 H hydrogen 1 </div>								
	Key relative atomic mass atomic symbol name atomic (proton) number								
(1)	6.9 Li lithium 3	9.0 Be beryllium 4	(2)	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)	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	(4)	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	(5)	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	(6)	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	209.0 Po polonium 84	[210] At astatine 85	[222] Rn radon 86
	[223] Fr francium 87	[226] Ra radium 88	(7)	200.6 Hg mercury 80	200.6 Hg mercury 80	197.0 Au gold 79	197.0 Au gold 79	[272] Rg roentgenium 111	
			(8)	55.8 Fe iron 26	58.7 Ni nickel 28	58.9 Co cobalt 27	58.9 Co cobalt 27	[271] Ds darmstadtium 110	
			(9)	101.1 Ru ruthenium 44	106.4 Pd palladium 46	102.9 Rh rhodium 45	102.9 Rh rhodium 45	[268] Mt meitnerium 109	
			(10)	[98] Tc technetium 43	106.4 Pd palladium 46	102.9 Rh rhodium 45	102.9 Rh rhodium 45	[277] Hs hassium 108	
			(11)	92.9 Nb niobium 41	95.9 Mo molybdenum 42	92.9 Nb niobium 41	92.9 Nb niobium 41	[272] Rg roentgenium 111	
			(12)	47.9 Ti titanium 22	52.0 Cr chromium 24	54.9 Mn manganese 25	54.9 Mn manganese 25	[264] Bh bohrium 107	
			(13)	45.0 Sc scandium 21	50.9 V vanadium 23	54.9 Mn manganese 25	54.9 Mn manganese 25	[266] Sg seaborgium 106	
			(14)	88.9 Y yttrium 39	92.9 Nb niobium 41	95.9 Mo molybdenum 42	95.9 Mo molybdenum 42	[262] Rf rutherfordium 104	
			(15)	138.9 La* lanthanum 57	180.9 Ta tantalum 73	183.8 W tungsten 74	183.8 W tungsten 74	[261] Rf rutherfordium 104	
			(16)	173.0 Lu lutetium 71	175.0 Yb ytterbium 70	173.0 Lu lutetium 71	173.0 Lu lutetium 71	[257] Lr lawrencium 103	
			(17)	167.3 Er erbium 68	168.9 Tm thulium 69	167.3 Er erbium 68	167.3 Er erbium 68	[254] No nobelium 102	
			(18)	162.5 Dy dysprosium 66	164.9 Ho holmium 67	162.5 Dy dysprosium 66	162.5 Dy dysprosium 66	[255] Lr lawrencium 103	
			(19)	140.1 Ce cerium 58	140.9 Pr praseodymium 59	140.1 Ce cerium 58	140.1 Ce cerium 58	[256] Md mendelevium 101	
			(20)	232.0 Th thorium 90	238.0 Pa protactinium 91	232.0 Th thorium 90	232.0 Th thorium 90	[257] Lr lawrencium 103	

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

* Lanthanide series

* Actinide series

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