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**SECONDARY 4 EXPRESS
PRELIMINARY EXAMINATION 2024**

CHEMISTRY

6092/01

Paper 1 Multiple Choice

26 Aug 2024

Monday 0920 – 1020

1 hour

Additional Material: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, class and register number on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 14.

The use of an approved scientific calculator is expected, where appropriate.

This document consists of **14** printed pages, including the cover page.

- 1 Which apparatus can be used to determine the end-point of the neutralisation reaction between hydrochloric acid and potassium hydroxide?
- A electronic balance B gas syringe
C stopwatch D thermometer
- 2 Which property of a liquid ester can be used to check its purity before use as a food flavouring?
- A boiling point B colour
C smell D solubility in water
- 3 Which sequence of procedures is used to separate a pure, dry sample of hydrated copper(II) sulfate, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, from a mixture containing hydrated copper(II) sulfate and calcium carbonate, CaCO_3 ?
- A dissolve in water → distillation → crystallisation
B dissolve in water → filtration → crystallisation
C distillation → crystallisation → heating to remove all water
D fractional distillation → filtration → heating to remove all water

- 4 The melting and boiling points of four substances are given.

substance	melting point / °C	boiling point / °C
W	50	90
X	70	600
Y	-30	-12
Z	-15	101

At what temperature would there be exactly **two** substances in liquid state?

- A -20 °C B 0 °C
C 16 °C D 60 °C
- 5 The rate of diffusion of two gases is measured at constant pressure.
- Which gas would diffuse the fastest?
- A carbon monoxide at 25 °C B carbon monoxide at 50 °C
C oxygen at 25 °C D oxygen at 50 °C

6 Which ion contains the smallest number of electrons?

- A** B^{3+}
- B** Be^{2+}
- C** H^{-}
- D** He^{+}

7 An element **J** forms an ion **J²⁻**. The electronic configuration of this ion is 2.8.

Which statement is true?

- A** J is in Group 2 and Period 2.
B J is in Group 2 and Period 3.
C J is in Group 16 and Period 2.
D J is in Group 16 and Period 3.

8 A new substance was discovered and a series of experiments was conducted on it.

Which observation suggests that the substance **cannot** be an element?

- A** It has a fixed boiling point.
B It dissolves in water to form a yellowish-green solution.
C When heated in air, it can form oxides with two different chemical formulae.
D When heated strongly, a brown solid and a yellow gas are produced.

9 The electrical conductivities of two compounds, **M** and **N**, are shown in the table.

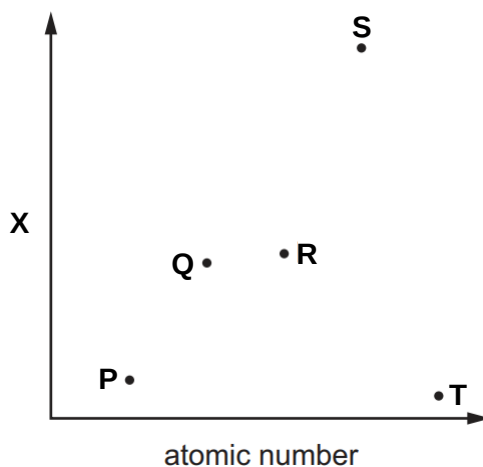
	M	N
conductivity of the compound in liquid state	good	good
conductivity of the mixture obtained by adding the compound to water	good	does not conduct

	M	N
A	Al_2O_3	SiO_2
B	Na_2O	Al_2O_3
C	Na_2O	SiO_2
D	SiO_2	Al_2O_3

10 Which substance contains both ionic and covalent bonds?

- A** ammonium chloride **B** hydrogen chloride
C lithium oxide **D** silicon dioxide

- 11 The magnitude of property **X** of the first five elements from the third period of the Periodic Table, **P**, **Q**, **R**, **S** and **T** is shown. **P**, **Q**, **R**, **S** and **T** have consecutive atomic numbers. The letters do not represent the symbols of the elements.



Which row correctly identifies property **X** and element **R**?

	property X	element R
A	electrical conductivity	<i>Al</i>
B	electrical conductivity	Si
C	melting point	<i>Al</i>
D	melting point	Si

- 12 The labels of two bottles of colourless solutions fell off in the Chemistry laboratory. One is known to be sodium sulfate solution while the other is potassium carbonate solution.

Which chemical can be added to identify the solutions?

- | | |
|-------------------------------|---------------------------------|
| A aqueous ammonia | B aqueous barium nitrate |
| C blue litmus solution | D dilute nitric acid |

- 13 The table shows the results of tests carried out to examine the air in an industrial area.

tests	observations
add aqueous calcium hydroxide	white precipitate formed
add anhydrous copper(II) sulfate	white solid turned blue
add acidified potassium manganate(VII)	purple solution decolourised

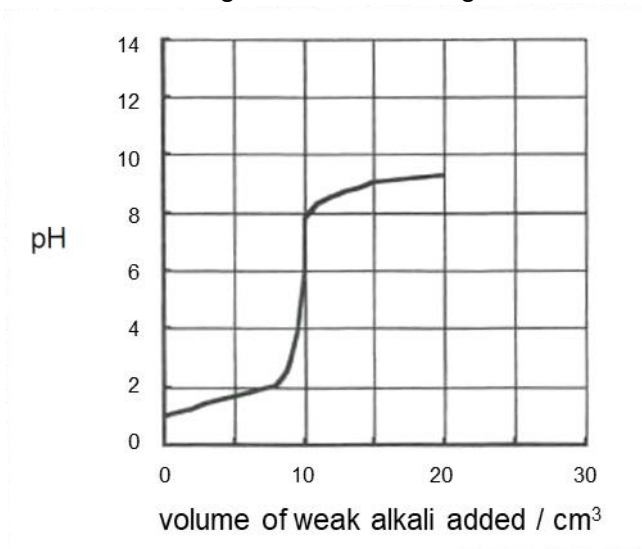
Which of the following sets of gases was present in the sample of air?

- | | |
|--|---|
| A CO, H ₂ , SO ₂ | B CO ₂ , H ₂ , O ₂ |
| C CO ₂ , H ₂ O, SO ₂ | D H ₂ O, O ₂ , SO ₂ |

- 14** The table shows how different indicators change colour over different pH ranges.

indicator	pH range for the colour change	colour	
		lower pH	higher pH
indigo carmine	11.6 to 14.0	blue	yellow
methyl red	4.2 to 6.3	red	yellow
methyl violet	0.3 to 3.0	yellow	violet
phenolphthalein	8.2 to 10.0	colourless	pink

When a weak alkali is added to a strong acid, the following titration curve is obtained.



Which indicator is the most suitable for the above titration?

- A** indigo carmine **B** methyl red
C methyl violet **D** phenolphthalein
- 15** Which method can be used to distinguish 1.00 mol/dm^3 of dilute hydrochloric acid from 1.00 mol/dm^3 of dilute ethanoic acid?
- Using a pH meter.
 - Determining the volume of 1.00 mol/dm^3 sodium hydroxide solution needed to completely neutralise 25.0 cm^3 of the acids separately.
 - Measuring the total volume of hydrogen gas formed when excess magnesium is added to 25.0 cm^3 of the acids separately.
- A** 1, 2 and 3 **B** 1 and 2 only
C 2 and 3 only **D** 1 only

- 16** Ammonium nitrate, NH_4NO_3 , and ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$, are used as fertilisers.

Which ammonium salt has a greater percentage by mass of nitrogen and shows the correct effect on pH of soil that contains both H^+ and OH^- ions?

	greater percentage of nitrogen by mass	effect on pH of soil
A	ammonium nitrate	decrease
B	ammonium nitrate	increase
C	ammonium sulfate	decrease
D	ammonium sulfate	increase

- 17** Element **K** has three naturally occurring isotopes, **K**–24, **K**–25 and **K**–26.

What is the relative atomic mass of element **K** given that **K**–24 has an abundance of 79% and **K**–26 has an abundance of 10%?

- A** 21.6 **B** 24.3
C 25.0 **D** 25.3

- 18** The chemical equation for the thermal decomposition of calcium nitrate is shown.



What is the volume of gas produced at room temperature and pressure when 0.40 mol of calcium nitrate was heated until no further decomposition?

- A** 4.8 dm³ **B** 9.6 dm³
C 19.2 dm³ **D** 24.0 dm³

- 19** Ammonium salts produce ammonia gas when heated with aqueous sodium hydroxide.

Which ammonium salt will produce the largest volume of ammonia gas when heated with excess aqueous sodium hydroxide?

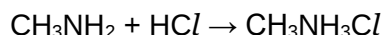
- A** 1.00 mol $(\text{NH}_4)_2\text{CO}_3$
B 1.00 mol $(\text{NH}_4)_3\text{PO}_4$
C 2.00 mol NH_4Cl
D 2.50 mol NH_4NO_3

- 20** ZnO and CO₂ are produced when ZnCO₃ is heated strongly.

What is the percentage yield of ZnO if 125 g of ZnCO₃ produces 75 g of ZnO on heating?

- | | |
|----------------|----------------|
| A 60.0% | B 64.8% |
| C 92.6% | D 100% |

- 21** Methylamine, CH₃NH₂, has very similar chemical properties to ammonia. Methylamine reacts with hydrogen chloride to form a white crystalline salt, methylammonium chloride.



A sample of methylammonium chloride is heated with aqueous sodium hydroxide.

What are the products formed?

- A** ammonia, sodium chloride and water
B ammonia, sodium hydrogencarbonate and sodium chloride
C methylamine, hydrogen chloride and water
D methylamine, sodium chloride and water
- 22** After black and white photographic film has been developed, unreacted silver bromide is removed by reacting it with sodium thiosulfate.



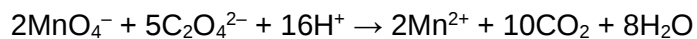
What is the function of the thiosulfate ion, S₂O₃²⁻?

- A** to make the silver ions soluble
B to oxidise the silver ions
C to reduce the bromide ions
D to reduce the silver ions
- 23** Rubidium is an element in the same group of the Periodic Table as lithium, sodium and potassium.

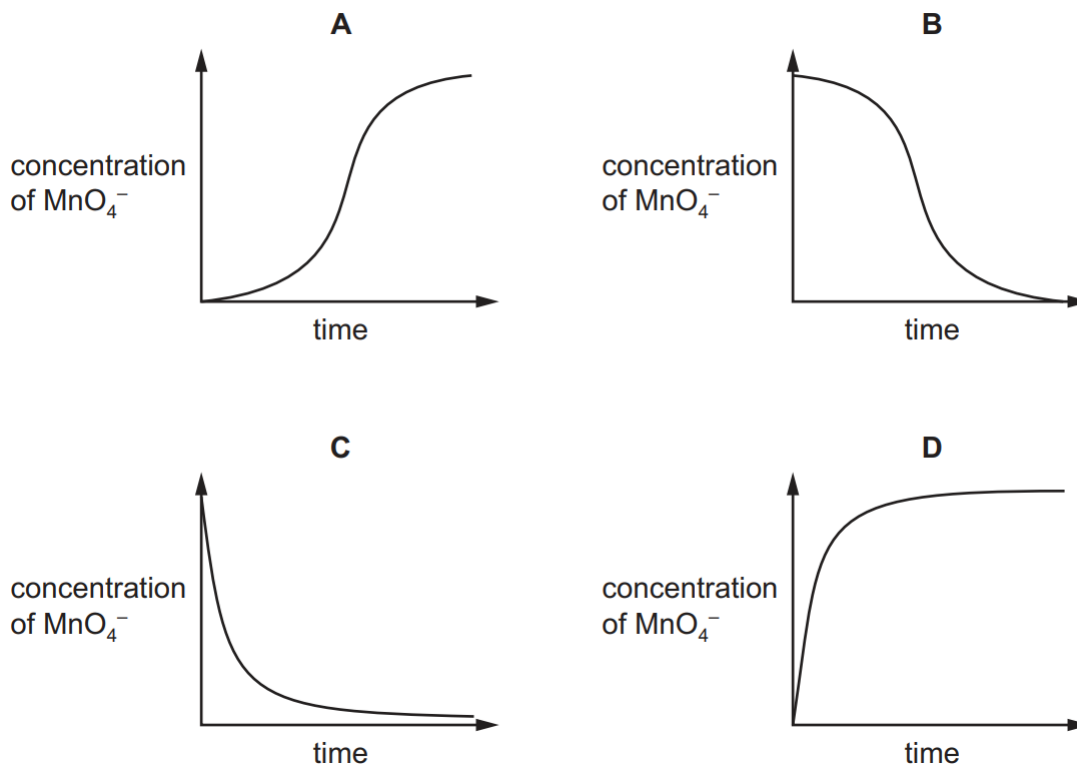
Which statement about rubidium is likely to be correct?

- A** It forms an insoluble hydroxide.
B It is formed by the electrolysis of concentrated aqueous rubidium chloride.
C It oxidises rapidly when exposed to oxygen in the air.
D It reacts with cold water to form rubidium oxide and hydrogen gas.

- 27 Oxidation of ethanedioate ions, $\text{C}_2\text{O}_4^{2-}$, by acidified manganate(VII) ions is very slow at room temperature.



Given that Mn^{2+} ions catalyse this reaction, which graph shows the concentration of acidified manganate(VII) ions varies after ethanedioate ions are added?



- 28 An alloy of copper and zinc is added to an excess of dilute hydrochloric acid. The resulting mixture is then filtered.

Which row shows the correct observations?

	filtrate	residue
A	blue solution	grey
B	colourless solution	grey
C	blue solution	pink
D	colourless solution	pink

- 29 Tin is more reactive than lead but less reactive than iron.

Which method would be most suitable for extracting tin from its ore?

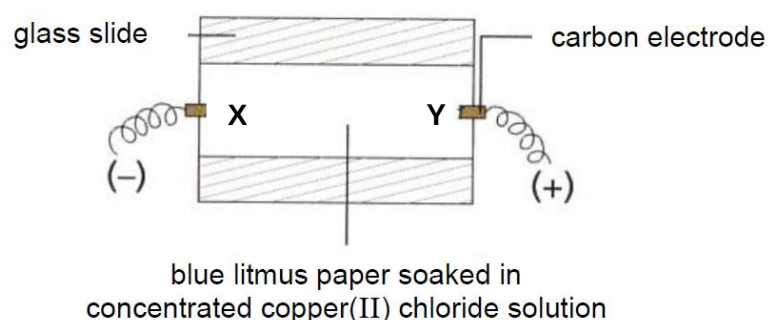
- A heating ore at high temperatures
- B heating ore with carbon
- C heating ore with water
- D passing electricity through the ore

- 30 Attaching pieces of magnesium to underground iron pipes can protect the iron from corrosion.

Which reaction shows how iron is protected from corrosion?

- A $\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}(\text{s})$
- B $\text{Fe}(\text{s}) \rightarrow \text{Fe}^{2+}(\text{aq}) + 2\text{e}^-$
- C $\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mg}(\text{s})$
- D $\text{Mg}(\text{s}) \rightarrow \text{Mg}^{2+}(\text{aq}) + 2\text{e}^-$

- 31 The apparatus shown is connected to a battery.



- 1 A gas is evolved at both X and Y.
- 2 A pink-brown solid is deposited at X.
- 3 Litmus paper at X remains blue but is bleached at Y.
- 4 The concentration of the electrolyte decreases with time.

Which statements about the experiment illustrated are correct?

- | | |
|----------------|----------------|
| A 1 and 2 only | B 1 and 3 only |
| C 1 and 4 only | D 2 and 4 only |

- 32 During electrolysis of molten silver iodide using platinum electrodes, 0.5 mol of electrons was passed through an electrolytic cell.

What is the mass of the product formed at the positive electrode?

- | | |
|----------|----------|
| A 54.0 g | B 63.5 g |
| C 108 g | D 127 g |

- 33** A student set up three different electrochemical cells each containing two of the metals, **F**, **G** and **H**, immersed in an electrolyte. The table shows the voltage and the positive terminal of each chemical cell.

electrochemical cell	metals used	voltage / V	positive terminal
1	H and G	+2.80	G
2	F and G	+2.30	F
3	H and F	+3.70	F

Which is the order of decreasing reactivity of the metals **F**, **G** and **H**?

- A** $F > G > H$ **B** $G > F > H$
C $H > G > F$ **D** $H > F > G$

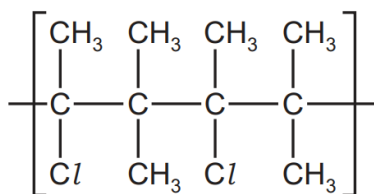
- 34** The boiling points of methane, ethane, propane and butane are given.

compound	CH_4	CH_3CH_3	$CH_3CH_2CH_3$	$CH_3CH_2CH_2CH_3$
boiling point / $^{\circ}C$	-162	-89	-42	0

Which statement explains the increase in boiling point from methane to butane?

- A** Larger molecular size results in stronger covalent bonds.
B Larger molecular size results in stronger intermolecular forces of attraction.
C More covalent bonds are present due to closer packing of the molecules.
D More intermolecular forces of attraction are present due to closer packing of the molecules.

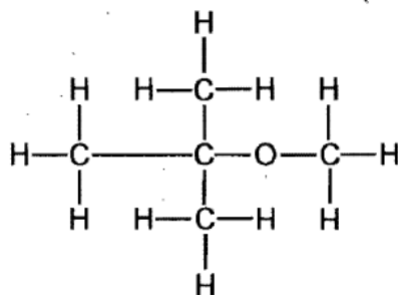
- 35** A section showing two repeat units of a polymer is shown.



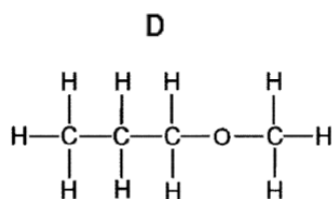
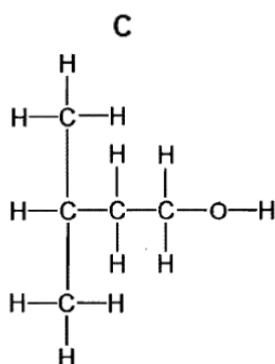
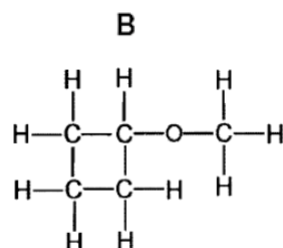
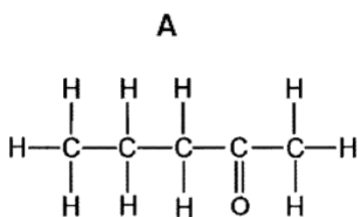
What is the molecular formula of the monomer that produced this polymer?

- A** C_5H_9Cl **B** $C_5H_{11}Cl$
C $C_{10}H_{18}Cl_2$ **D** $C_{10}H_{20}Cl_2$

- 36 The structural formula of compound **L** is shown.



Which of the structure is an isomer of compound **L**?



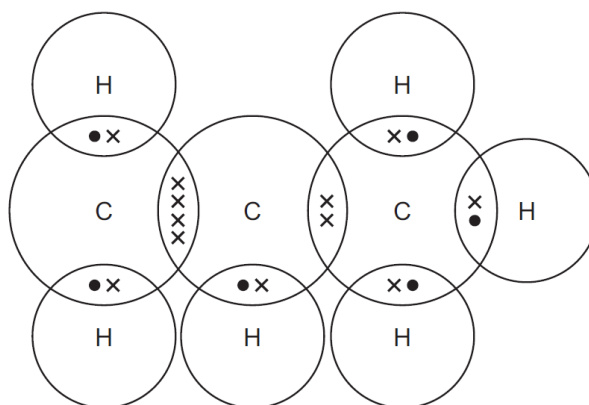
- 37 Which pairs of substances are used to remove sulfur dioxide from flue gases?

- | | |
|---|--|
| A CaCO_3 and CaO | B CaCO_3 and CaSO_4 |
| C CaSO_3 and CaO | D CaSO_3 and CaSO_4 |

- 38 Which is the correct description of the depolymerisation process?

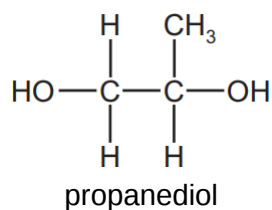
- A** the dehydration of polyesters using an acid as catalyst
- B** the dehydration of polyesters using an alkali as catalyst
- C** the hydrolysis of polyesters using an acid as catalyst
- D** the hydrolysis of polyesters using an alkali as catalyst

- 39 The dot-and-cross diagram of compound **Q** is shown.

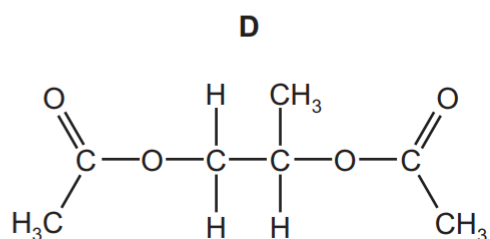
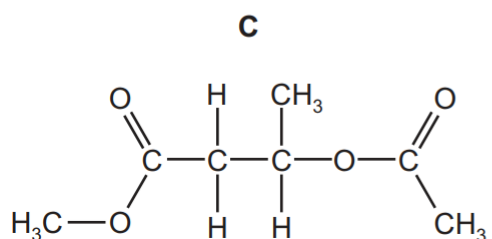
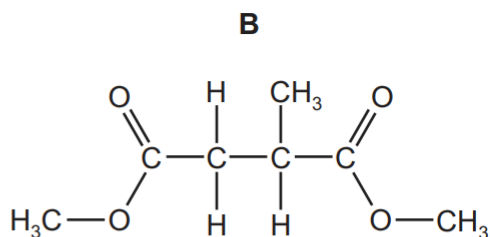
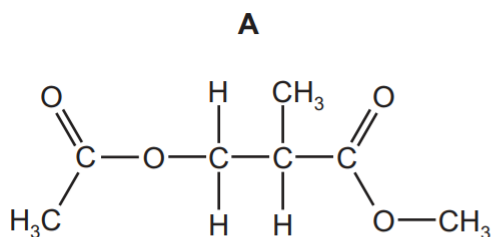


Which statement about compound **Q** is correct?

- A** It is a saturated hydrocarbon.
B It is an isomer of butene.
C It will oxidise to form a carboxylic acid.
D It will decolourise bromine water.
- 40 The fragrance compounds of perfumes are often dissolved in solvent **Z**, which has a molecular formula $C_7H_{12}O_4$. It is made by reacting propanediol with ethanoic acid in the presence of an acid catalyst.



What is the structure of solvent **Z**?



The Periodic Table of Elements

Group																			
1	2	1 H hydrogen 1												13	14	15	16	17	18
3 Li lithium 7	4 Be beryllium 9	Key proton (atomic) number atomic symbol name relative atomic mass																2 He helium 4	
	11 Na sodium 23	12 Mg magnesium 24	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84		
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium —	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131		
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —		
87 Fr francium —	88 Ra radium —	89–103 actinoids	104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganeson —		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

The Avogadro constant, $L = 6.02 \times 10^{23} \text{ mol}^{-1}$