



# Cambridge O Level

## CHEMISTRY

5070/11

Paper 1 Multiple Choice

May/June 2023

1 hour

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet  
Soft clean eraser  
Soft pencil (type B or HB is recommended)

## INSTRUCTIONS

- 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 multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

## INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.



1 In a change of state at constant temperature and pressure:

- energy is released as stronger forces of attraction form between the particles
- the average distance between the particles changes very little.

Which change of state is being described?

- A** gas to liquid  
**B** liquid to gas  
**C** liquid to solid  
**D** solid to liquid

2 X, Y and Z are elements.

X and Y are in the same period of the Periodic Table.

Y and Z are in the same group of the Periodic Table.

What are possible electronic configurations for X, Y and Z?

	X	Y	Z
<b>A</b>	2,4	2,7	2,8,4
<b>B</b>	2,4	2,7	2,8,7
<b>C</b>	2,4	2,8,4	2,8,7
<b>D</b>	2,8,4	2,8,7	2,4

3 The numbers of electrons, protons and neutrons in four different particles are shown.

particle	electrons	protons	neutrons
1	19	19	20
2	18	19	20
3	20	20	20
4	19	19	22

Which particles are isotopes of the same element?

- A** 1 and 2 only    **B** 1 and 3 only    **C** 1 and 4    **D** 1, 2 and 3

4 Some statements about the bonding in magnesium chloride are listed.

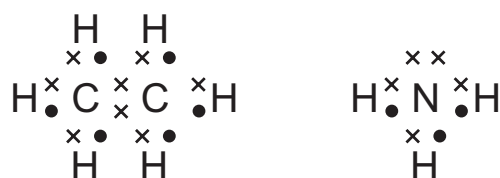
- 1 Each magnesium atom donates two electrons; each chlorine atom accepts one electron.
- 2 Chlorine forms an ion with a 2– charge.
- 3 Magnesium atoms and chlorine atoms share electrons.
- 4 Magnesium forms an ion with a 2+ charge.

Which statements are correct?

- A** 1 and 2      **B** 1 and 4      **C** 2 and 3      **D** 3 and 4

5 Ethane, C<sub>2</sub>H<sub>6</sub>, and ammonia, NH<sub>3</sub>, are covalent compounds.

The dot-and-cross diagrams of these compounds are shown.



Which statements are correct?

- 1 A molecule of ethane contains twice as many hydrogen atoms as a molecule of ammonia.
- 2 An unreacted nitrogen atom has five outer-shell electrons.
- 3 In a molecule of ethane, the bond between the carbon atoms is formed by sharing two electrons, one from each carbon atom.

- A** 1, 2 and 3      **B** 1 and 2 only      **C** 1 and 3 only      **D** 2 and 3 only

6 When a strip of copper is placed in aqueous silver nitrate, a displacement reaction takes place.

What is the ionic equation for the reaction which takes place?

- A**  $\text{Ag}^+(\text{aq}) + \text{Cu}(\text{s}) \rightarrow \text{Ag}(\text{s}) + \text{Cu}^{2+}(\text{aq}) + \text{e}^-$
- B**  $2\text{Ag}^+(\text{aq}) + \text{Cu}(\text{s}) \rightarrow 2\text{Ag}(\text{s}) + \text{Cu}^{2+}(\text{aq})$
- C**  $2\text{AgNO}_3(\text{aq}) + \text{Cu}(\text{s}) \rightarrow 2\text{Ag}(\text{s}) + \text{Cu}(\text{NO}_3)_2(\text{aq})$
- D**  $2\text{Ag}(\text{s}) + \text{Cu}^{2+}(\text{aq}) \rightarrow 2\text{Ag}^+(\text{aq}) + \text{Cu}(\text{s})$

7 Three compounds are listed.

- calcium carbonate
- potassium sulfate
- zinc nitrate

Which row shows the element present in the greatest percentage by mass in each compound?

[A<sub>r</sub>: Ca, 40; C, 12; O, 16; K, 39; S, 32; Zn, 65; N, 14]

	element present in the greatest percentage by mass in calcium carbonate	element present in the greatest percentage by mass in potassium sulfate	element present in the greatest percentage by mass in zinc nitrate
<b>A</b>	calcium	oxygen	oxygen
<b>B</b>	calcium	oxygen	zinc
<b>C</b>	oxygen	potassium	zinc
<b>D</b>	oxygen	potassium	oxygen

8 Two aqueous solutions, Q and R, have the same concentration in mol/dm<sup>3</sup>.

Solution Q contains 4.0 g of NaOH in 500 cm<sup>3</sup> of solution.

Which solution could be solution R?

[A<sub>r</sub>: Na, 23; O, 16; H, 1]

- A** 0.2 mol of Ca(OH)<sub>2</sub> in 250 cm<sup>3</sup> of solution
- B** 0.2 mol of HCl in 100 cm<sup>3</sup> of solution
- C** 0.05 mol of H<sub>2</sub>SO<sub>4</sub> in 250 cm<sup>3</sup> of solution
- D** 0.1 mol of KOH in 1000 cm<sup>3</sup> of solution

- 9 Samples of two hydrated compounds are weighed and then dehydrated by heating.

The anhydrous compounds are weighed and the results are shown.

3.97 g  $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$  gives 2.17 g anhydrous  $\text{FeSO}_4$ .

2.88 g  $\text{CaSO}_4 \cdot y\text{H}_2\text{O}$  gives 2.27 g anhydrous  $\text{CaSO}_4$ .

What are the values of  $x$  and  $y$ ?

[ $M_r$ :  $\text{FeSO}_4$ , 152;  $\text{CaSO}_4$ , 136;  $\text{H}_2\text{O}$ , 18]

	$x$	$y$
<b>A</b>	5	2
<b>B</b>	5	5
<b>C</b>	7	5
<b>D</b>	7	2

- 10 What has a mass equal to the mass of one mole of water?

- A** 24 dm<sup>3</sup> of water at room temperature and pressure  
**B** one mole of steam at 200 °C and 100 kPa / 1 atm pressure  
**C** one molecule of water at room temperature and pressure  
**D** two moles of hydrogen molecules and one mole of oxygen molecules

- 11 Concentrated aqueous sodium chloride is electrolysed using inert electrodes.

Which row shows what happens in this electrolysis and why it happens?

	change occurring	explanation
<b>A</b>	oxygen is discharged at the anode	$\text{OH}^-(\text{aq})$ loses electrons more easily than $\text{Cl}^-(\text{aq})$
<b>B</b>	during electrolysis the pH of the electrolyte increases	the electrolysis in aqueous solution involves the reduction of $\text{H}^+(\text{aq})$ ions
<b>C</b>	solid sodium is produced at the cathode	$\text{Na}^+(\text{aq})$ is present in aqueous solution
<b>D</b>	the products stay the same if the aqueous sodium chloride is replaced by molten sodium chloride	$\text{Na}^+$ and $\text{Cl}^-$ are present in both molten and aqueous sodium chloride

**12** Which statements about the energy changes during a chemical reaction are correct?

- 1 The activation energy,  $E_a$ , is the maximum energy the colliding particles must have in order to react.
- 2 During an endothermic reaction, thermal energy is taken in from the surroundings leading to a decrease in the temperature of the surroundings.
- 3 The making of chemical bonds is an exothermic process.

**A** 1 and 2 only    **B** 1 and 3 only    **C** 2 and 3 only    **D** 1, 2 and 3

**13** Two gases react inside a sealed vessel.

Which change in conditions would increase the rate of reaction?

- 1 increasing the pressure inside the vessel
- 2 increasing the temperature inside the vessel
- 3 increasing the volume of the vessel

**A** 1, 2 and 3    **B** 1 and 2 only    **C** 1 and 3 only    **D** 2 and 3 only

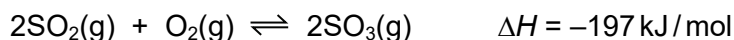
**14** Catalysts change the rate of chemical reactions.

Which statements correctly describe the effect of adding a catalyst to a reaction?

- 1 All reactant particles have more energy and move faster.
- 2 The activation energy is lowered.
- 3 More reactant particles collide with enough energy to react.

**A** 1, 2 and 3    **B** 1 and 3 only    **C** 2 and 3 only    **D** 3 only

**15** The equation for a reaction in the Contact process is shown.

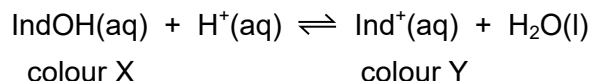


The conditions used are 450 °C, 2 atmospheres pressure and a catalyst.

What will be the effects when the temperature is reduced to 250 °C and the catalyst is removed?

	percentage of $\text{SO}_3$ in the equilibrium mixture	rate of the forward reaction
<b>A</b>	decrease	no change
<b>B</b>	decrease	decrease
<b>C</b>	increase	increase
<b>D</b>	increase	decrease

- 16 Universal indicator contains several dyes. The reversible reaction of one dye, IndOH, is shown.



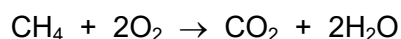
A few drops of universal indicator solution are added to 50 cm<sup>3</sup> of water.

A few drops of dilute hydrochloric acid are added to the solution.

Which row describes what happens when the acid is added?

	pH	colour of solution shifts towards
<b>A</b>	decreases	colour X
<b>B</b>	decreases	colour Y
<b>C</b>	increases	colour X
<b>D</b>	increases	colour Y

- 17 The combustion of methane is a redox reaction.



Which statement about this reaction is correct?

- A** Only carbon is oxidised.
  - B** Only carbon is reduced.
  - C** Only oxygen is oxidised.
  - D** Only oxygen is reduced.
- 18 Which method of preparation of magnesium sulfate is an example of a redox reaction?
- A**  $\text{Mg} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2$
  - B**  $\text{MgO} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2\text{O}$
  - C**  $\text{Mg(OH)}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + 2\text{H}_2\text{O}$
  - D**  $\text{MgCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2\text{O} + \text{CO}_2$

- 19** Samples of  $\text{HCl}(\text{aq})$  and  $\text{HNO}_3(\text{aq})$  are tested using universal indicator paper.

The sample of  $\text{HCl}(\text{aq})$  has a pH of 4 and the sample of  $\text{HNO}_3(\text{aq})$  has a pH of 2.

Which statement is correct?

- A**  $\text{HCl}(\text{aq})$  is a weak acid and  $\text{HNO}_3(\text{aq})$  is a strong acid.
  - B**  $\text{HNO}_3(\text{aq})$  has a lower formula mass than  $\text{HCl}(\text{aq})$ .
  - C** The  $\text{HNO}_3(\text{aq})$  is more concentrated than the  $\text{HCl}(\text{aq})$ .
  - D** The  $\text{HCl}(\text{aq})$  has dissociated more than the  $\text{HNO}_3(\text{aq})$ .
- 20** Which two substances react to form a salt and water only?
- A** aqueous sodium carbonate and dilute sulfuric acid
  - B** aqueous sodium chloride and aqueous silver nitrate
  - C** aqueous sodium hydroxide and dilute ethanoic acid
  - D** zinc and dilute hydrochloric acid

- 21** The elements are arranged in groups and periods in the Periodic Table.

Which row is correct?

	group determined by	period determined by	elements in the Periodic Table are arranged by
<b>A</b>	the number of electrons in the outer shell	the number of occupied shells	increasing proton number
<b>B</b>	the number of occupied shells	the number of electrons in the outer shell	increasing mass number
<b>C</b>	the number of electrons in the outer shell	the number of occupied shells	increasing mass number
<b>D</b>	the number of occupied shells	the number of electrons in the outer shell	increasing proton number

- 22** Sodium, potassium and rubidium are in Group I of the Periodic Table. Chlorine, bromine and iodine are in Group VII.

Which statement is correct?

- A** Bromine displaces chlorine from an aqueous solution of sodium chloride.
- B** Iodine is discharged at the negative electrode when concentrated aqueous potassium iodide is electrolysed.
- C** Rubidium has a greater tendency to form positive ions than potassium.
- D** Sodium and potassium both react with water but the reaction is more violent with sodium.



**23** Which statement about transition elements and their compounds is correct?

- A** Copper(II) oxide catalyses the conversion of sulfuric acid to copper(II) sulfate.
- B** Iron allows hydrogen and nitrogen to react at a lower temperature.
- C** Nickel increases the rate of reaction between hydrogen and saturated hydrocarbons.
- D** Vanadium(V) oxide speeds up the oxidation of sulfur to sulfur dioxide.

**24** Three statements about the properties of metals are shown.

- 1 All metals conduct electricity.
- 2 All metals have two electrons in their innermost shell.
- 3 All metals have high melting points.

Which statements are correct?

- A** 1 and 2 only    **B** 1 and 3 only    **C** 2 and 3 only    **D** 1, 2 and 3

**25** Which statements about metals and their uses are correct?

- 1 Aluminium is used to make overhead electrical cables because it has a low density.
- 2 Aluminium is used to make food containers because it is resistant to corrosion.
- 3 Copper is used to make electrical wiring because it is ductile.

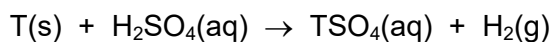
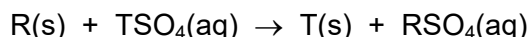
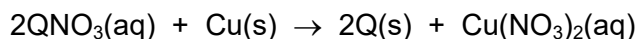
- A** 1 and 2 only    **B** 1 and 3 only    **C** 2 and 3 only    **D** 1, 2 and 3

**26** Stainless steel is an alloy. It contains iron and more than one other element.

Which elements other than iron are commonly used in stainless steel?

- A** copper and chromium
- B** copper and nickel
- C** nickel and carbon
- D** zinc and carbon

27 The equations for some of the reactions of metals Q, R and T are shown.



Using the equations, what is the order of reactivity of Q, R and T?

	most reactive	→	least reactive
<b>A</b>	Q	T	R
<b>B</b>	R	Q	T
<b>C</b>	R	T	Q
<b>D</b>	T	R	Q

28 Zinc is used to galvanise iron, which prevents the iron from rusting.

Which statements are correct?

- 1 The layer of zinc forms a barrier between the iron and the oxygen and water in the atmosphere.
- 2 Zinc will oxidise before the iron does, even if the layer of zinc is scratched.
- 3 When iron rusts, atoms of iron gain electrons to form ions.

**A** 1 and 2 only    **B** 1 and 3 only    **C** 2 and 3 only    **D** 1, 2 and 3

29 Three statements about the extraction of aluminium are shown.

- 1 The electrolyte is aluminium oxide dissolved in molten cryolite.
- 2 Carbon is used for both the cathode and the anode.
- 3 Carbon dioxide is given off at the cathode.

Which statements are correct?

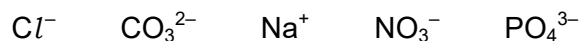
**A** 1 and 2 only    **B** 1 and 3 only    **C** 2 and 3 only    **D** 1, 2 and 3

30 What is a cause of deoxygenation of water in a lake?

- A** acid rain  
**B** excess calcium hydroxide  
**C** insoluble nitrates  
**D** soluble fertilisers

31 Dissolved substances can cause eutrophication and the deoxygenation of water.

How many of the ions shown cause this effect?

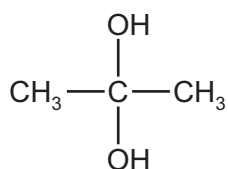


- A** 1                      **B** 2                      **C** 3                      **D** 4

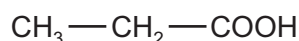
32 Which statement about global warming is correct?

- A** Methane produced by digestion in animals has no effect on the rate of global warming.  
**B** The products of burning fossil fuels have no effect on the rate of global warming.  
**C** The products of decomposition of vegetation have no effect on the rate of global warming.  
**D** The products of photosynthesis have no effect on the rate of global warming.

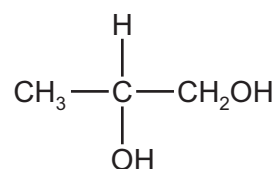
33 The structures of three compounds, W, X and Y, are shown.



W



X



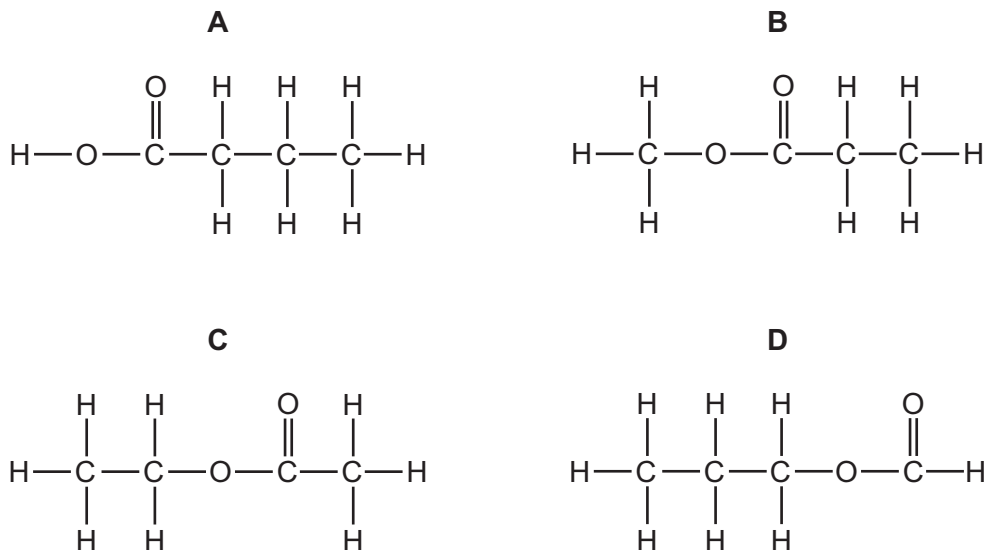
Y

Which statements about these three compounds are correct?

- 1 W and Y are both alcohols and X is a carboxylic acid.  
 2 W, X and Y have the same molecular formula.  
 3 W and Y are structural isomers of each other.

- A** 1 and 2 only    **B** 1 and 3 only    **C** 2 and 3 only    **D** 1, 2 and 3

34 What is the displayed formula of propyl methanoate?



35 The table shows some of the fractions obtained by the fractional distillation of petroleum and their uses.

	fraction	use
1	bitumen	making roads
2	kerosene / paraffin	chemical feedstock
3	naphtha	jet fuel
4	refinery gases	heating and cooking

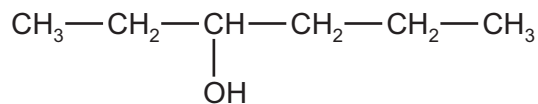
Which rows are correct?

- A** 1 and 2      **B** 1 and 4      **C** 2 and 3      **D** 3 and 4

36 Which equation shows the reaction of ethane with chlorine in the presence of ultraviolet light?

- A**  $\text{C}_2\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_6\text{Cl}_2$   
**B**  $\text{C}_2\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_4\text{Cl}_2 + \text{H}_2$   
**C**  $\text{C}_2\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_5\text{Cl} + \text{HCl}$   
**D**  $\text{C}_2\text{H}_6 + \text{Cl}_2 \rightarrow 2\text{CH}_3\text{Cl}$

37 Hexan-3-ol is an alcohol.



hexan-3-ol

How many molecules of oxygen are needed for the complete combustion of one molecule of hexan-3-ol?

- A** 9                      **B** 10                      **C** 18                      **D** 19

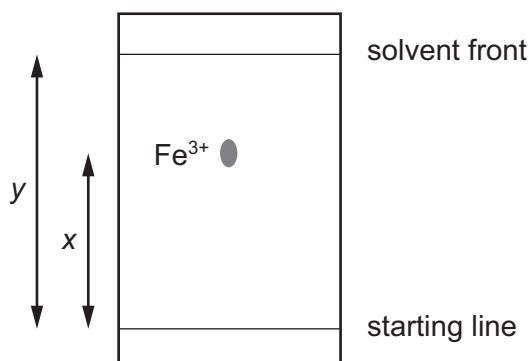
38 An organic compound, P, is dissolved in water. The concentration of the solution is  $0.1 \text{ mol/dm}^3$  and the pH is 3.

A solid is added to the solution and effervescence is seen.

Which equation could represent this reaction?

- A**  $2\text{CH}_3\text{CO}_2\text{H}(\text{aq}) + \text{Mg}(\text{s}) \rightarrow (\text{CH}_3\text{CO}_2)_2\text{Mg}(\text{aq}) + \text{H}_2(\text{g})$   
**B**  $2\text{CH}_3\text{CO}_2\text{H}(\text{aq}) + 2\text{Mg}(\text{s}) \rightarrow 2\text{CH}_3\text{CO}_2\text{Mg}(\text{aq}) + \text{H}_2(\text{g})$   
**C**  $2\text{CH}_3\text{CO}_2\text{H}(\text{aq}) + \text{K}_2\text{CO}_3(\text{s}) \rightarrow (\text{CH}_3\text{CO}_2)_2\text{K}(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$   
**D**  $2\text{HCl}(\text{aq}) + \text{K}_2\text{CO}_3(\text{s}) \rightarrow 2\text{KCl}(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$

- 39 A paper chromatography experiment is used to find an  $R_f$  value for  $\text{Fe}^{3+}(\text{aq})$ . The chromatogram is shown.



To make the spot containing  $\text{Fe}^{3+}(\text{aq})$  more visible, the paper is sprayed with aqueous sodium hydroxide so that a precipitate of iron(III) hydroxide forms.

In the chromatogram, the  $R_f$  of  $\text{Fe}^{3+}(\text{aq})$  is given by .....1..... and the colour of the precipitate is .....2..... .

Which row correctly completes gaps 1 and 2?

	gap 1	gap 2
<b>A</b>	$\frac{x}{y}$	red-brown
<b>B</b>	$\frac{x}{y}$	green
<b>C</b>	$\frac{y}{x}$	red-brown
<b>D</b>	$\frac{y}{x}$	green

- 40 A laboratory has a powdered mixture of solid iodine and solid carbon.

Iodine is very soluble in hexane and slightly soluble in water. Carbon is insoluble in both solvents.

One sample of the mixture is shaken with hexane. This is X.

Another sample of the mixture is shaken with water. This is Y.

Which procedure is used to prepare a pure sample of iodine?

- A** X is distilled and the distillate is evaporated to dryness.
- B** X is filtered and the filtrate is allowed to evaporate to dryness.
- C** X is filtered and the residue is allowed to evaporate to dryness.
- D** Y is distilled and the distillate is evaporated to dryness.

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The Periodic Table of Elements

Group																			
I	II											III	IV	V	VI	VII	VIII		
		<div>1 H hydrogen 1</div>																	
		<div>Key</div> <div>atomic number atomic symbol name relative atomic mass</div>																	
3 Li lithium 7	4 Be beryllium 9													5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24													13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
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 oganesson —	

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
	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 dm<sup>3</sup> at room temperature and pressure (r.t.p.).