Cambridge Assessment International Education

# 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.



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**[Turn over**

**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 |
|---|---|---|---|
| **A** | 2,4 | 2,7 | 2,8,4 |
| **B** | 2,4 | 2,7 | 2,8,7 |
| **C** | 2,4 | 2,8,4 | 2,8,7 |
| **D** | 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

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**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.

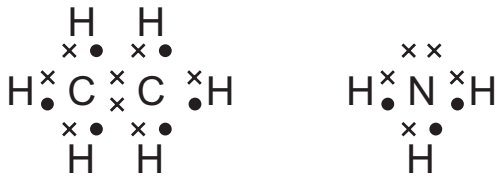
4 Magnesium forms an ion with a 2+ charge.

Which statements are correct?

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

**5** Ethane, $C_2H_6$, and ammonia, $NH_3$, 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** $Ag^+(aq) + Cu(s) \rightarrow Ag(s) + Cu^{2+}(aq) + e^-$

**B** $2Ag^+(aq) + Cu(s) \rightarrow 2Ag(s) + Cu^{2+}(aq)$

**C** $2AgNO_3(aq) + Cu(s) \rightarrow 2Ag(s) + Cu(NO_3)_2(aq)$

**D** $2Ag(s) + Cu^{2+}(aq) \rightarrow 2Ag^+(aq) + Cu(s)$

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**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?

[$A_r$: 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 |
|---|---|---|---|
| **A** | calcium | oxygen | oxygen |
| **B** | calcium | oxygen | zinc |
| **C** | oxygen | potassium | zinc |
| **D** | oxygen | potassium | oxygen |

**8** Two aqueous solutions, Q and R, have the same concentration in mol / $dm^3$.

Solution Q contains 4.0 g of NaOH in 500 $cm^3$ of solution.

Which solution could be solution R?

[$A_r$: Na, 23; O, 16; H, 1]

**A** 0.2 mol of $Ca(OH)_2$ in 250 $cm^3$ of solution

**B** 0.2 mol of HC$l$ in 100 $cm^3$ of solution

**C** 0.05 mol of $H_2SO_4$ in 250 $cm^3$ of solution

**D** 0.1 mol of KOH in 1000 $cm^3$ of solution

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**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 $FeSO_4 \bullet xH_2O$ gives 2.17 g anhydrous $FeSO_4$.

2.88 g $CaSO_4 \bullet yH_2O$ gives 2.27 g anhydrous $CaSO_4$.

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

[$M_r$: $FeSO_4$, 152; $CaSO_4$, 136; $H_2O$, 18]

| | *x* | *y* |
|---|---|---|
| **A** | 5 | 2 |
| **B** | 5 | 5 |
| **C** | 7 | 5 |
| **D** | 7 | 2 |

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

**A** 24 $dm^3$ 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 |
|---|---|---|
| **A** | oxygen is discharged at the anode | $OH^-$(aq) loses electrons more easily than $Cl^-$(aq) |
| **B** | during electrolysis the pH of the electrolyte increases | the electrolysis in aqueous solution involves the reduction of $H^+$(aq) ions |
| **C** | solid sodium is produced at the cathode | $Na^+$(aq) is present in aqueous solution |
| **D** | the products stay the same if the aqueous sodium chloride is replaced by molten sodium chloride | $Na^+$ and $Cl^-$ are present in both molten and aqueous sodium chloride |

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**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.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -197\,kJ/mol$$

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 $SO_3$ in the equilibrium mixture | rate of the forward reaction |
|---|---|---|
| **A** | decrease | no change |
| **B** | decrease | decrease |
| **C** | increase | increase |
| **D** | increase | decrease |

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

$$\underset{\text{colour X}}{\text{IndOH(aq)}} + \text{H}^+\text{(aq)} \rightleftharpoons \underset{\text{colour Y}}{\text{Ind}^+\text{(aq)}} + \text{H}_2\text{O(l)}$$

A few drops of universal indicator solution are added to 50 $cm^3$ 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 |
|---|---|---|
| **A** | decreases | colour X |
| **B** | decreases | colour Y |
| **C** | increases | colour X |
| **D** | increases | colour Y |

**17** The combustion of methane is a redox reaction.

$$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$$

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** $\text{MgCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2\text{O} + \text{CO}_2$

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**19** Samples of HC$l$(aq) and $HNO_3$(aq) are tested using universal indicator paper.

The sample of HC$l$(aq) has a pH of 4 and the sample of $HNO_3$(aq) has a pH of 2.

Which statement is correct?

**A** HC$l$(aq) is a weak acid and $HNO_3$(aq) is a strong acid.

**B** $HNO_3$(aq) has a lower formula mass than HC$l$(aq).

**C** The $HNO_3$(aq) is more concentrated than the HC$l$(aq).

**D** The HC$l$(aq) has dissociated more than the $HNO_3$(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 |
|---|---|---|---|
| **A** | the number of electrons in the outer shell | the number of occupied shells | increasing proton number |
| **B** | the number of occupied shells | the number of electrons in the outer shell | increasing mass number |
| **C** | the number of electrons in the outer shell | the number of occupied shells | increasing mass number |
| **D** | 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.

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**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

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

$$2QNO_3(aq) + Cu(s) \rightarrow 2Q(s) + Cu(NO_3)_2(aq)$$

$$R(s) + TSO_4(aq) \rightarrow T(s) + RSO_4(aq)$$

$$T(s) + H_2SO_4(aq) \rightarrow TSO_4(aq) + H_2(g)$$

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

| | most reactive ⟶ | | least reactive |
|---|---|---|---|
| **A** | Q | T | R |
| **B** | R | Q | T |
| **C** | R | T | Q |
| **D** | 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

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

How many of the ions shown cause this effect?

$Cl^-$ $CO_3^{2-}$ $Na^+$ $NO_3^-$ $PO_4^{3-}$

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

**32** Which statement about global warming is correct?

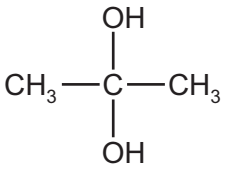
**A** Methane produced by digestion in animals has no effect on the rate of global warming.

**B** The products of burning fossil fuels have no effect on the rate of global warming.

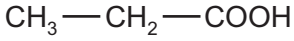
**C** The products of decomposition of vegetation have no effect on the rate of global warming.

**D** The products of photosynthesis have no effect on the rate of global warming.

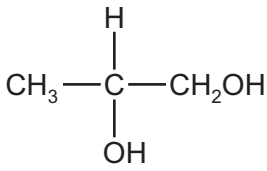
**33** The structures of three compounds, W, X and Y, are shown.



W



X



Y

Which statements about these three compounds are correct?

1 W and Y are both alcohols and X is a carboxylic acid.

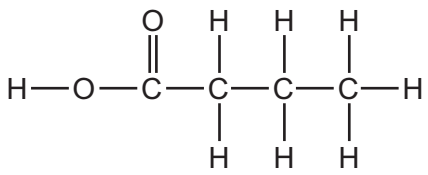
2 W, X and Y have the same molecular formula.

3 W and Y are structural isomers of each other.

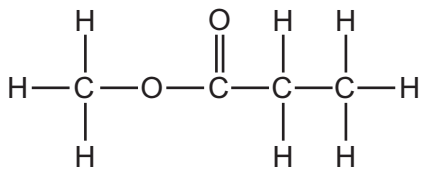
**A** 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

**34** What is the displayed formula of propyl methanoate?

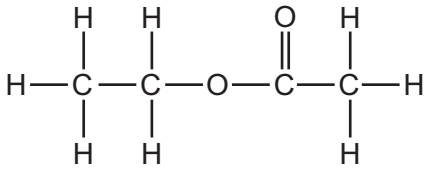
**A**



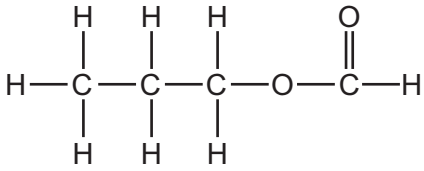
**B**



**C**



**D**



**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** $C_2H_6 + Cl_2 \rightarrow C_2H_6Cl_2$

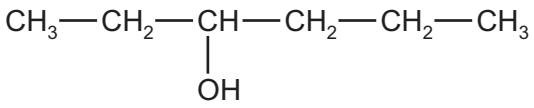
**B** $C_2H_6 + Cl_2 \rightarrow C_2H_4Cl_2 + H_2$

**C** $C_2H_6 + Cl_2 \rightarrow C_2H_5Cl + HCl$

**D** $C_2H_6 + Cl_2 \rightarrow 2CH_3Cl$

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**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 $0.1\,mol/dm^3$ and the pH is 3.

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

Which equation could represent this reaction?

**A** $2CH_3CO_2H(aq) + Mg(s) \rightarrow (CH_3CO_2)_2Mg(aq) + H_2(g)$

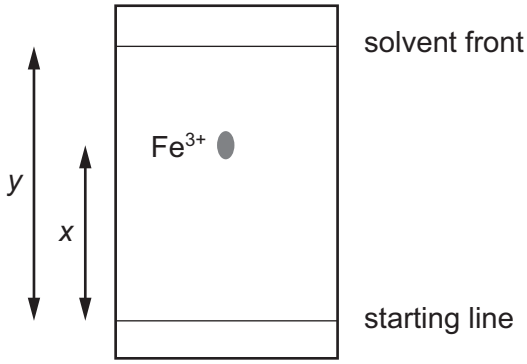
**B** $2CH_3CO_2H(aq) + 2Mg(s) \rightarrow 2CH_3CO_2Mg(aq) + H_2(g)$

**C** $2CH_3CO_2H(aq) + K_2CO_3(s) \rightarrow (CH_3CO_2)_2K(aq) + CO_2(g) + H_2O(l)$

**D** $2HCl(aq) + K_2CO_3(s) \rightarrow 2KCl(aq) + CO_2(g) + H_2O(l)$

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




To make the spot containing $Fe^{3+}(aq)$ 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 $Fe^{3+}(aq)$ is given by .....1..... and the colour of the precipitate is .....2..... .

Which row correctly completes gaps 1 and 2?

| | gap 1 | gap 2 |
|---|---|---|
| **A** | $\frac{x}{y}$ | red-brown |
| **B** | $\frac{x}{y}$ | green |
| **C** | $\frac{y}{x}$ | red-brown |
| **D** | $\frac{y}{x}$ | 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 |
| | | | | | | | 1 H hydrogen 1 | | | | | | | | | | 2 He helium 4 |
| 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 – |

**Key**

atomic number
atomic symbol
name
relative atomic mass

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 $dm^3$ at room temperature and pressure (r.t.p.).