Cambridge Assessment International Education

# Cambridge IGCSE™

**CHEMISTRY** **0620/23**

Paper 2 Multiple Choice (Extended) **May/June 2025**

**45 minutes**

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.

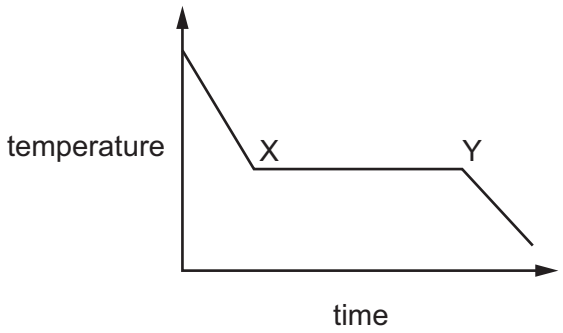

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**1** Which two changes, when applied **at the same time** to a fixed amount of gas, cause the greatest increase in volume of the gas?

| | change in pressure | change in temperature |
|---|---|---|
| **A** | decrease by 10% | decrease by 10% |
| **B** | increase by 10% | decrease by 10% |
| **C** | decrease by 20% | increase by 10% |
| **D** | increase by 20% | increase by 10% |

**2** Solid G is heated until it melts. It is then left to cool to room temperature.

The graph shows the cooling curve for G.




Four statements about the cooling curve between X and Y are listed.

1 The speed of the molecules of G decreases.

2 The molecules of G become less closely packed.

3 Thermal energy is released by the molecules of G to the surroundings.

4 G changes from solid to liquid.

Which statements are correct?

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

**3** Which atom has twice as many neutrons as protons?

**A** $^{1}_{1}H$ **B** $^{2}_{1}H$ **C** $^{3}_{1}H$ **D** $^{4}_{2}He$

**4** What is the nucleon number of an atom?

**A** the number of electrons, neutrons and protons in the nucleus

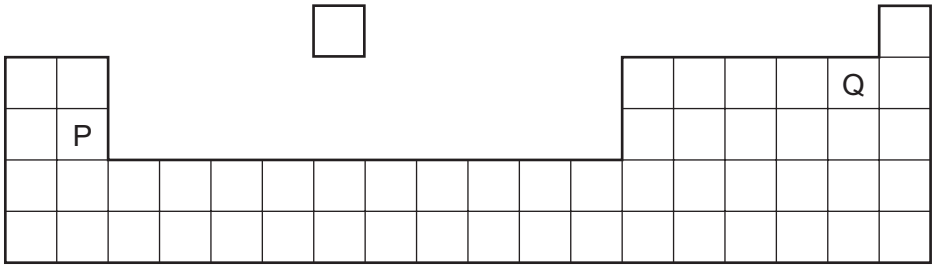
**B** the number of neutrons and protons in the nucleus

**C** the number of neutrons in the nucleus

**D** the number of protons in the nucleus

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**5** The diagram shows the positions of elements P and Q in the Periodic Table.




What is the formula of the compound that is formed between P and Q?

**A** PQ **B** $P_2Q$ **C** $PQ_2$ **D** $P_2Q_7$

**6** Which statement about ionic compounds is correct?

**A** Giant lattices are formed when ionic compounds crystallise from solution.

**B** In all ionic compounds, the metal ions have fewer electrons than the non-metal ions.

**C** In a giant lattice, ions of the same charge are closer together than ions of opposite charge.

**D** When ionic compounds melt, strong intermolecular forces are broken.

**7** The equation for the reaction between iron(III) chloride and sodium hydroxide is shown.

$$FeCl_3(aq) + 3NaOH(aq) \rightarrow Fe(OH)_3(s) + 3NaCl(aq)$$

What is the ionic equation for this reaction?

**A** $Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe^{3+}(s) + 3OH^-(s)$

**B** $Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$

**C** $3Na^+(aq) + 3Cl^-(aq) \rightarrow 3Na^+(aq) + 3Cl^-(aq)$

**D** $3Na^+(aq) + 3Cl^-(aq) \rightarrow 3NaCl(aq)$

**8** A compound is analysed and found to contain 85.7% carbon and 14.3% hydrogen only.

What is its empirical formula?

**A** CH **B** $CH_2$ **C** $C_2H_4$ **D** $C_6H$

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**9** Aqueous barium hydroxide, $Ba(OH)_2$, reacts with dilute nitric acid, $HNO_3$. The products are aqueous barium nitrate, $Ba(NO_3)_2$, and water.

In a titration, $15.2\,cm^3$ of $0.75\,mol/dm^3$ aqueous barium hydroxide is required to neutralise $20.0\,cm^3$ of dilute nitric acid.

What is the concentration of the nitric acid?

**A** $0.29\,mol/dm^3$

**B** $0.57\,mol/dm^3$

**C** $1.14\,mol/dm^3$

**D** $2.03\,mol/dm^3$

**10** Which particles are responsible for the transfer of charge in the external circuit during the electrolysis of molten lead(II) bromide?

**A** anions

**B** atoms

**C** cations

**D** electrons

**11** Two statements about hydrogen are listed.

1 Hydrogen is used as a fuel.

2 When hydrogen burns in the air to form water, thermal energy is produced.

Which conclusion about these statements is correct?

**A** Both statements are correct, and statement 2 explains statement 1.

**B** Both statements are correct, but statement 2 does **not** explain statement 1.

**C** Statement 1 is correct, but statement 2 is **not** correct.

**D** Statement 2 is correct, but statement 1 is **not** correct.

**12** Concentrated aqueous copper(II) chloride is electrolysed using carbon electrodes.

What is formed at each electrode?

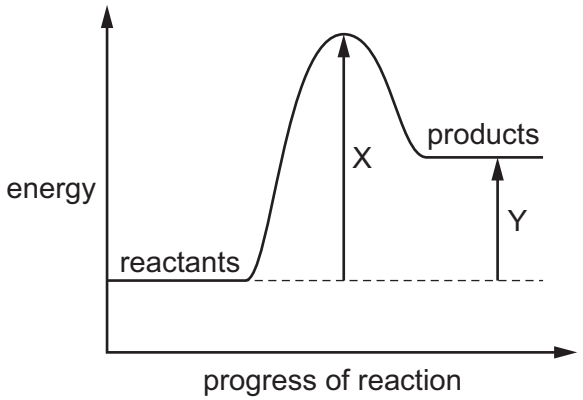
| | negative electrode | positive electrode |
|---|---|---|
| **A** | chlorine | copper |
| **B** | copper | chlorine |
| **C** | copper | oxygen |
| **D** | oxygen | copper |

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**13** Which row describes an exothermic reaction?

| | sign of enthalpy change, $\Delta H$ | temperature of the surroundings |
|---|---|---|
| **A** | positive | decreases |
| **B** | positive | increases |
| **C** | negative | decreases |
| **D** | negative | increases |

**14** A reaction pathway diagram is shown.




Which row shows the correct labels for X and Y and the type of reaction taking place?

| | X | Y | type of reaction |
|---|---|---|---|
| **A** | enthalpy change | activation energy | exothermic |
| **B** | activation energy | enthalpy change | endothermic |
| **C** | activation energy | enthalpy change | exothermic |
| **D** | enthalpy change | activation energy | endothermic |

**15** The rate of reaction between magnesium and dilute hydrochloric acid is increased by increasing the concentration of the acid.

How does this affect the reacting particles?

| | collision rate of particles | proportion of particles with sufficient energy to react |
|---|---|---|
| **A** | increases | increases |
| **B** | increases | stays the same |
| **C** | stays the same | increases |
| **D** | stays the same | stays the same |

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**[Turn over**

**16** The reaction between aqueous iron(III) ions, $Fe^{3+}$, and aqueous thiocyanate ions, $SCN^-$, is reversible.

The equation for the reaction is shown.

$$Fe^{3+}(aq) + SCN^-(aq) \rightleftharpoons FeSCN^{2+}(aq)$$

yellow colourless red

At equilibrium, the concentrations of $Fe^{3+}$ ions, $SCN^-$ ions, and $FeSCN^{2+}$ ions are identical, and the mixture appears orange.

When a few drops of aqueous thiocyanate ions are added to the mixture, a new equilibrium forms.

How does the colour of the mixture change?

**A** It becomes colourless.

**B** It becomes a lighter orange.

**C** It becomes more yellow.

**D** It becomes more red.

**17** The equation for the reaction between iron(II) sulfate and bromine is shown.

$$6FeSO_4 + 3Br_2 \rightarrow 2Fe_2(SO_4)_3 + 2FeBr_3$$

Which row identifies the oxidising agent and the reducing agent?

| | oxidising agent | reducing agent |
|---|---|---|
| **A** | $Br_2$ | $FeSO_4$ |
| **B** | $FeSO_4$ | $Br_2$ |
| **C** | $FeBr_3$ | $Fe_2(SO_4)_3$ |
| **D** | $Fe_2(SO_4)_3$ | $FeBr_3$ |

**18** The equation represents a redox reaction.

$$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$$

What is the change in the oxidation number of iron in this reaction?

**A** from +2 to +3

**B** from +2 to 0

**C** from +3 to +2

**D** from +3 to 0

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**19** Aqueous ammonia forms an equilibrium with water.

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

In this equilibrium, which particle acts as an acid and which particle acts as a base?

| | acid | base |
|---|---|---|
| **A** | $NH_3$ | $H_2O$ |
| **B** | $NH_3$ | $OH^-$ |
| **C** | $H_2O$ | $NH_3$ |
| **D** | $H_2O$ | $NH_4^+$ |

**20** Which row identifies an acidic oxide, a basic oxide and an amphoteric oxide?

| | acidic | basic | amphoteric |
|---|---|---|---|
| **A** | ZnO | $SO_2$ | $Al_2O_3$ |
| **B** | $SO_2$ | $Al_2O_3$ | $Na_2O$ |
| **C** | ZnO | $Al_2O_3$ | $SO_2$ |
| **D** | $SO_2$ | $Na_2O$ | $Al_2O_3$ |

**21** A Group I metal (lithium or potassium) is reacted with a Group VII element (chlorine or iodine).

Which compound is formed when the Group I metal of highest density reacts with the Group VII element of lowest density?

**A** potassium chloride

**B** lithium chloride

**C** potassium iodide

**D** lithium iodide

**22** Element X is in the same group of the Periodic Table as silicon.

An atom of element X has more protons than a silicon atom.

Which element could be X?

**A** aluminium

**B** carbon

**C** germanium

**D** phosphorus

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**23** Which statement about the elements in Group VIII is correct?

**A** They all form diatomic molecules.

**B** They all have eight electrons in their outer electron shells.

**C** They all react with oxygen to form oxides.

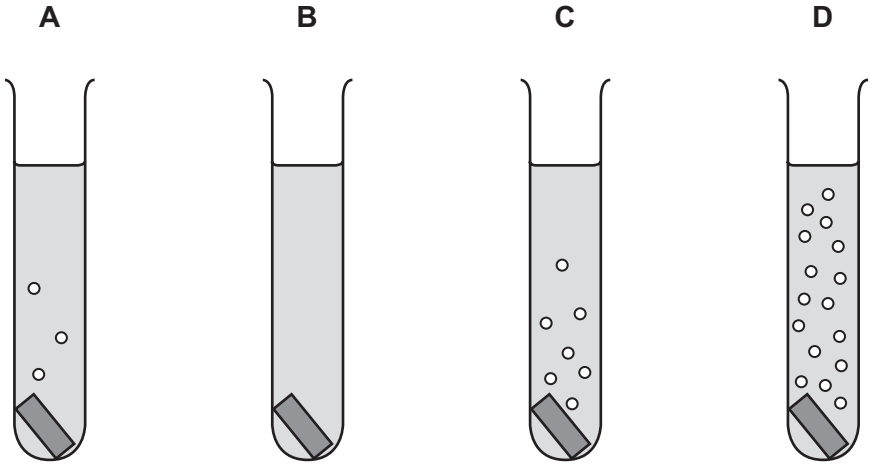
**D** They all are gases at room temperature.

**24** Which element is a transition element?

| | melting point in °C | density at r.t.p. in g / cm$^3$ | colour of oxide at r.t.p. |
|---|---|---|---|
| **A** | 98 | 1.0 | white |
| **B** | 328 | 11.3 | yellow |
| **C** | 651 | 1.7 | white |
| **D** | 1907 | 7.2 | green |

**25** Four test-tubes contain dilute hydrochloric acid. Each test-tube has one piece of a different metal added to it. The metals are copper, iron, magnesium and zinc.

Which test-tube contains iron and dilute hydrochloric acid?




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**26** Brass is a mixture of copper and zinc.

Which statement describes and explains the relative strength of brass compared to copper?

**A** Brass is stronger than copper because the layers of atoms in brass **cannot** easily slide over each other.

**B** Brass is stronger than copper because the intermolecular forces are greater in brass than in copper.

**C** Brass is weaker than copper because the layers of atoms slide more easily over each other in brass than in copper.

**D** Brass is weaker than copper because the intermolecular forces are weaker in brass than in copper.

**27** A sample of calcium carbonate is heated strongly, and substances U and V are formed.

Substance U is a white solid. Substance V is a colourless gas.

What are substances U and V?

| | U | V |
|---|---|---|
| **A** | calcium chloride | oxygen |
| **B** | calcium hydroxide | carbon dioxide |
| **C** | calcium oxide | carbon dioxide |
| **D** | calcium sulfate | oxygen |

**28** A sample of water taken from a river contains harmful microbes.

What is a source of harmful microbes in the river water?

**A** sewage

**B** fertilisers

**C** detergents

**D** plastics

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**29** Anhydrous copper(II) sulfate and anhydrous cobalt(II) chloride change colour when water is added to them.

Which row shows the correct colour changes?

| | copper(II) sulfate | cobalt(II) chloride |
|---|---|---|
| **A** | blue to white | blue to pink |
| **B** | blue to white | pink to blue |
| **C** | white to blue | blue to pink |
| **D** | white to blue | pink to blue |

**30** Which gas contributes to increased global warming?

**A** argon

**B** carbon dioxide

**C** nitrogen

**D** oxygen

**31** Which statement describes how greenhouse gases increase global warming?

**A** Greenhouse gases absorb thermal energy from the Sun, reducing the Earth's temperature.

**B** Greenhouse gases reflect thermal energy back into space, cooling the Earth's surface.

**C** Greenhouse gases absorb and re-emit thermal energy radiated from the Earth's surface.

**D** Greenhouse gases release thermal energy from the Earth into space.

**32** Nitrogen monoxide is produced in a car engine when petrol is burned.

The gases from the car engine are passed through a catalytic converter.

In the catalytic converter, the nitrogen monoxide, NO, reacts with carbon monoxide, CO, to form nitrogen and carbon dioxide.

Which statement is **not** correct?

**A** Carbon monoxide is oxidised in the catalytic converter.

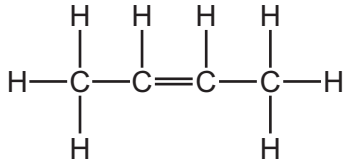
**B** Carbon monoxide is produced by the complete combustion of petrol.

**C** Nitrogen monoxide is formed by the reaction of nitrogen and oxygen.

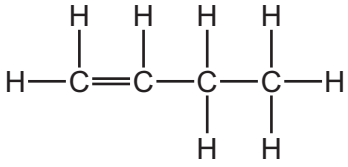
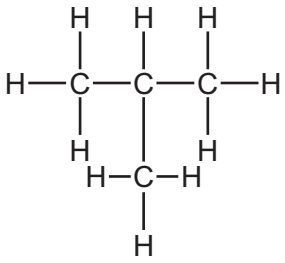
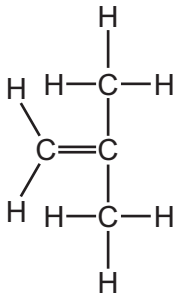
**D** Nitrogen monoxide is reduced in the catalytic converter.

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**33** The displayed formula of but-2-ene is shown.



Which displayed formulae represent structural isomers of but-2-ene?

| 1 | 2 | 3 |
|---|---|---|
|  |  |  |

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

**34** Which row describes two characteristics of members of the same homologous series?

| | characteristic 1 | characteristic 2 |
|---|---|---|
| **A** | same functional group | trend in physical properties |
| **B** | same physical properties | same functional group |
| **C** | same general formula | different chemical properties |
| **D** | differing from one member to the next by a $CH_3$ unit | similar chemical properties |

**35** Compound W is a hydrocarbon that contains single bonds only.

Which homologous series contains W?

**A** alkenes

**B** alkanes

**C** carboxylic acids

**D** alcohols

**36** Methane forms chloromethane in a photochemical reaction using ultraviolet light.

Which statement about this reaction is correct?

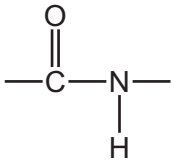
**A** Methane is mixed with hydrogen chloride gas, and ultraviolet light prevents a combustion reaction.

**B** Methane is mixed with hydrogen chloride gas, and ultraviolet light provides the activation energy for the reaction.

**C** Methane is mixed with chlorine gas, and ultraviolet light prevents a combustion reaction.

**D** Methane is mixed with chlorine gas, and ultraviolet light provides the activation energy for the reaction.

**37** Which statement about polymers is correct?

**A** Nylon contains the  linkage.

**B** Nylon is a polyester.

**C** Propane can be polymerised by addition polymerisation.

**D** The linkage in PET contains a carbon–carbon double bond.

**38** The steps used to separate a mixture of a soluble solid and an insoluble solid are listed.

- A solution is made by adding the mixture to a suitable .....1..... .
- The mixture is stirred and then poured through a filter funnel lined with filter paper.
- The insoluble solid is collected on the filter paper as the .....2..... .

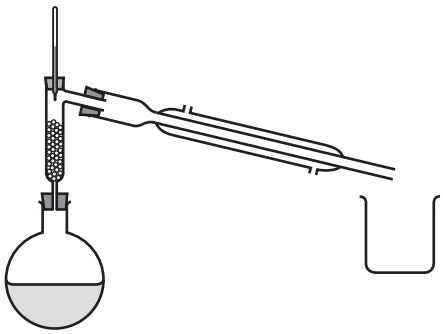
Which words complete gaps 1 and 2?

| | 1 | 2 |
|---|---|---|
| **A** | solute | filtrate |
| **B** | solute | residue |
| **C** | solvent | filtrate |
| **D** | solvent | residue |

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**39** Which items of apparatus are used to separate a mixture of liquids with different boiling points?

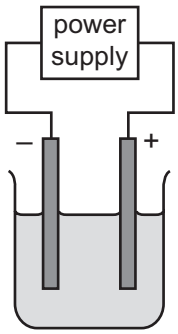
**A**



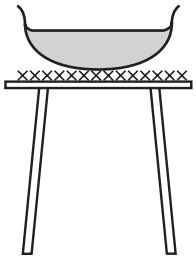
**B**



**C**




**D**



**40** In paper chromatography, what is the equation for the $R_f$ value?

**A** $R_f = \dfrac{\text{distance travelled by solvent}}{\text{distance travelled by substance}}$

**B** $R_f = \dfrac{\text{distance travelled by locating agent}}{\text{distance travelled by substance}}$

**C** $R_f = \dfrac{\text{distance travelled by substance}}{\text{distance travelled by locating agent}}$

**D** $R_f = \dfrac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$

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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.).