



Cambridge IGCSE™

CHEMISTRY

0620/23

Paper 2 Multiple Choice (Extended)

October/November 2022

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.



1 Which gas diffuses the most slowly?

A CH₄

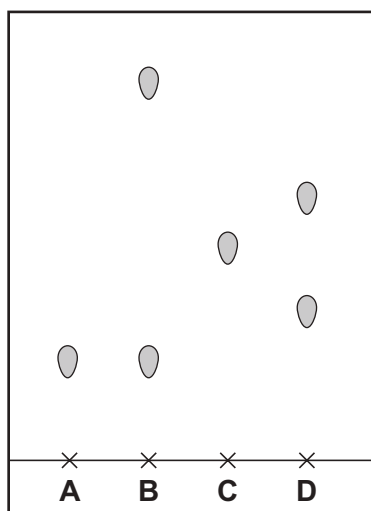
B CO₂

C H₂

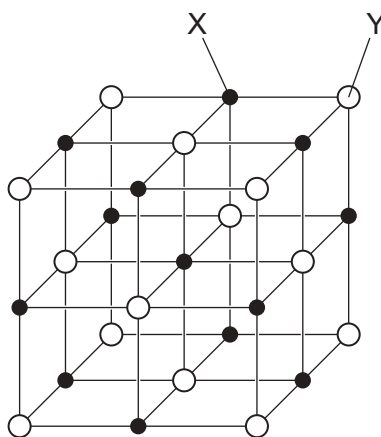
D NH₃

2 The chromatogram from four different substances is shown.

Which pure substance has the largest R_f value?



3 The structure of sodium chloride can be represented as shown.



What are X and Y?

| | X | Y |
|---|--------------|----------------|
| A | metal atom | non-metal atom |
| B | negative ion | electron |
| C | positive ion | negative ion |
| D | positive ion | electron |

4 Which two particles have the same electronic structure?

- A C and O^{2-}
- B F^- and Na
- C K^+ and S^{2-}
- D Mg and Na^+

5 Which statements about isotopes of the same element are correct?

- 1 They are atoms which have the same chemical properties because they have the same number of electrons in their outer shell.
- 2 They are atoms which have the same number of electrons and neutrons but different numbers of protons.
- 3 They are atoms which have the same number of electrons and protons but different numbers of neutrons.

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

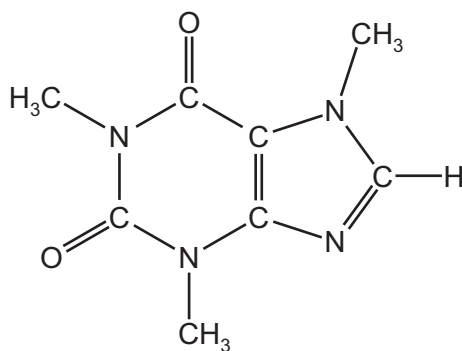
6 What is the total number of shared electrons in a molecule of methanol, CH_3OH ?

- A 4 B 5 C 8 D 10

7 Which row about the structures and uses of diamond and graphite is correct?

| | structure | use |
|----------|--|--|
| A | diamond has a giant covalent structure | diamond is used to make electrodes |
| B | diamond has a simple covalent structure | diamond is used to make cutting tools |
| C | graphite has a giant covalent structure | graphite is used as a lubricant |
| D | graphite has a simple covalent structure | graphite is used to make cutting tools |

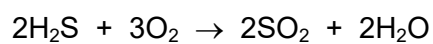
- 8 Caffeine is a stimulant found in coffee.



caffeine

Which formula represents caffeine?

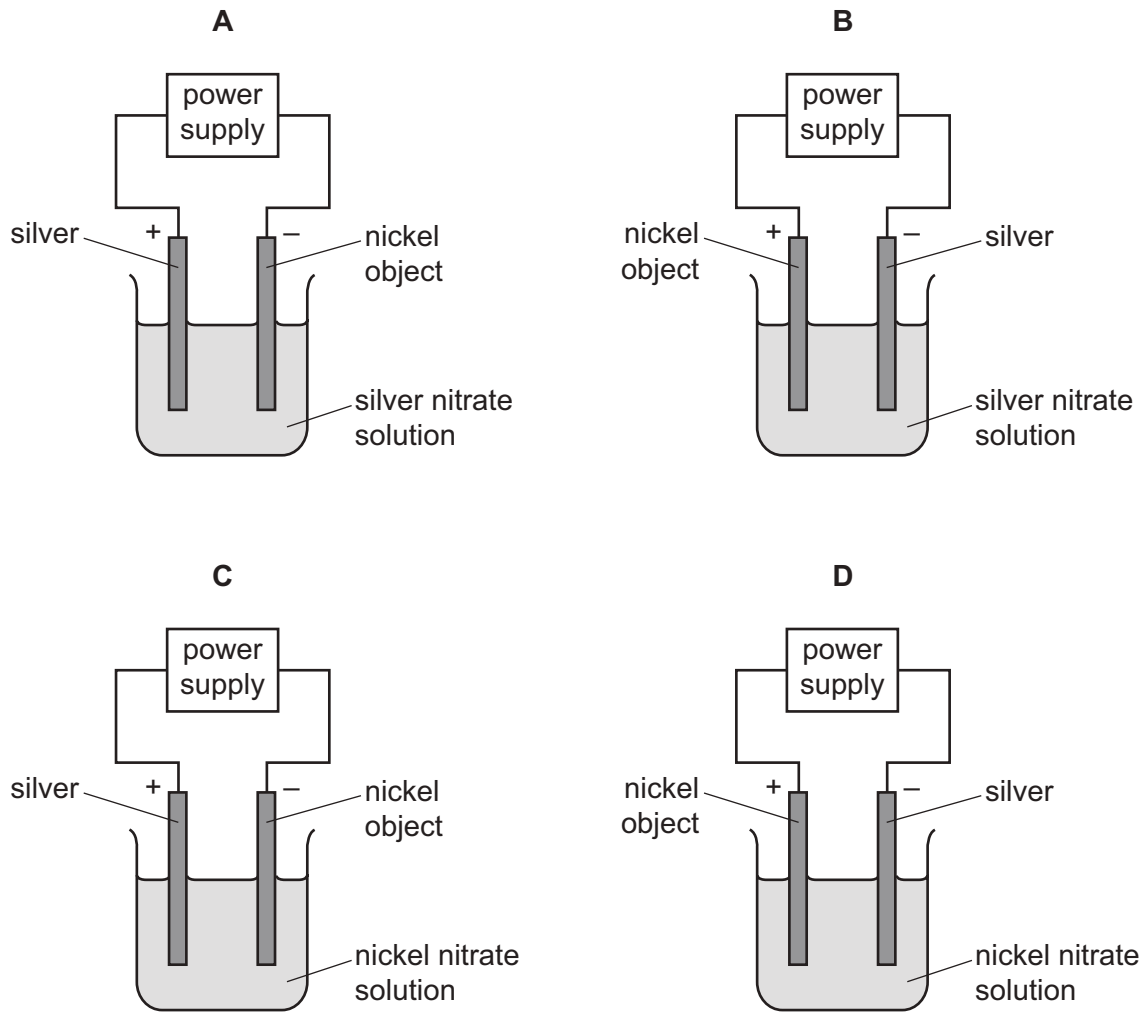
- A** C₇H₁₀N₄O₂ **B** C₈H₁₀N₃O₂ **C** C₈H₁₀N₄O₂ **D** C₈H₁₁N₄O₂
- 9 The equation for the reaction between hydrogen sulfide, H₂S, and oxygen is shown.



Which mass of oxygen is required to react with 5.1 g of hydrogen sulfide?

- A** 2.4 g **B** 4.8 g **C** 7.2 g **D** 14.4 g

10 Which apparatus is used to plate a nickel object with silver?



11 When an acid is added to an alkali, the temperature of the reaction mixture rises.

Which words describe this reaction?

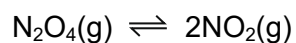
- A decomposition and endothermic
- B decomposition and exothermic
- C neutralisation and endothermic
- D neutralisation and exothermic

12 Some properties of four fuels are shown.

Which fuel is a gas at room temperature and makes two products when it burns in a plentiful supply of air?

| | fuel | formula | melting point /°C | boiling point /°C |
|----------|----------|---------------------------------|-------------------|-------------------|
| A | hydrogen | H ₂ | -259 | -253 |
| B | methane | CH ₄ | -182 | -164 |
| C | octane | C ₈ H ₁₈ | -57 | 126 |
| D | wax | C ₃₁ H ₆₄ | 60 | 400 |

13 Dinitrogen tetroxide, N₂O₄, is converted into nitrogen dioxide, NO₂, in a reversible reaction.



The forward reaction is endothermic.

Which conditions give the highest equilibrium yield of nitrogen dioxide?

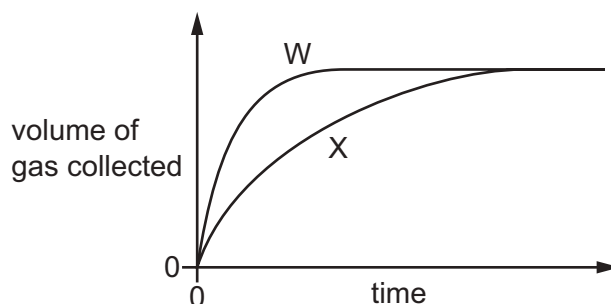
| | pressure / atmospheres | temperature |
|----------|------------------------|-------------|
| A | 2 | high |
| B | 2 | low |
| C | 50 | high |
| D | 50 | low |

- 14 Dilute hydrochloric acid is reacted with excess calcium carbonate and the total volume of gas is measured at regular intervals.

The results are shown by line W on the graph.

The experiment is repeated but with one change.

The results of the second experiment are shown by line X on the graph.



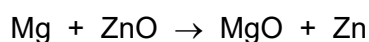
Which change is made in the second experiment?

- A A catalyst is added.
 - B The calcium carbonate is broken into smaller pieces.
 - C The concentration of the dilute hydrochloric acid is increased.
 - D The temperature of the dilute hydrochloric acid is decreased.
- 15 When hydrated copper(II) sulfate is heated, it produces white copper(II) sulfate. When water is added, the white copper(II) sulfate turns blue.

Which type of reaction is shown by these observations?

- A decomposition
 - B displacement
 - C redox
 - D reversible
- 16 When magnesium is heated with zinc oxide a reaction occurs.

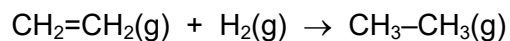
The equation is shown.



Which substance is oxidised?

- A magnesium
- B magnesium oxide
- C zinc
- D zinc oxide

17 The equation for the reaction between ethene and hydrogen is shown.



The bond energies are shown.

| bond | bond energy in kJ/mol |
|------|--------------------------|
| C=C | 612 |
| H-H | 436 |
| C-C | 348 |
| C-H | 416 |

What is the overall energy change during this reaction?

- A -284 kJ/mol
- B -132 kJ/mol
- C +132 kJ/mol
- D +284 kJ/mol

18 Ethanoic acid reacts with water to produce an acidic solution.

Which row describes the roles of ethanoic acid and water in this reaction?

| | ethanoic acid | water |
|----------|---------------------|---------------------|
| A | accepts a proton | donates a proton |
| B | accepts an electron | donates an electron |
| C | donates a proton | accepts a proton |
| D | donates an electron | accepts an electron |

19 Tests are done on an aqueous solution.

| test | a few drops of aqueous sodium hydroxide are added | aqueous sodium hydroxide is added in excess |
|-------------|---|---|
| observation | white precipitate | precipitate dissolves to give a colourless solution |

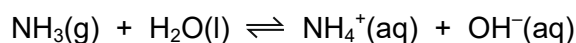
Which cations produce these observations?

- 1 aluminium, Al^{3+}
- 2 calcium, Ca^{2+}
- 3 zinc, Zn^{2+}

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

20 Ammonia, NH_3 , dissolves in water to form a dilute solution of ammonium hydroxide, NH_4OH .

The reaction is reversible and exists as an equilibrium mixture.



Which statement about the mixture is correct?

- A** All of the ammonia and water molecules have turned into ions.
- B** The ammonia and water molecules have stopped changing into ions.
- C** The concentrations of the ammonia molecules and ammonium ions are always equal.
- D** The rate of the formation of ammonia molecules is equal to the rate of formation of the ammonium ions.

21 Elements E and F are in Group I of the Periodic Table.

E has a higher melting point than F.

Elements J and L are in Group VII of the Periodic Table.

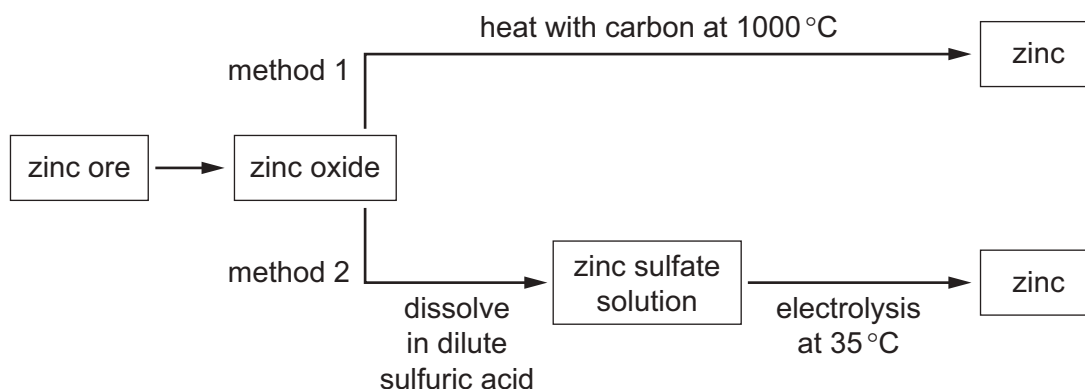
J has a higher density than L.

Which elements have the highest atomic numbers in each group?

A E and J **B** E and L **C** F and J **D** F and L

- 22 Which metal forms ions with one oxidation state?
- A aluminium
B chromium
C copper
D iron
- 23 How does the nature of the oxides change across Period 3 from sodium to chlorine?
- A basic → amphoteric → acidic
B basic → acidic → amphoteric
C amphoteric → basic → acidic
D acidic → amphoteric → basic
- 24 Zinc is a metal with a boiling point of 907 °C.

Two methods of making zinc are shown.



Which statement is correct?

- A Carbon oxidises zinc oxide in method 1.
B Zinc vapour is produced in both methods.
C Zinc is produced at the anode in method 2.
D Zinc compounds are reduced in both methods.
- 25 Which statement about the reactions of metals is correct?
- A Iron and carbon dioxide are produced when iron(III) oxide is heated with carbon.
B Magnesium reacts with dilute hydrochloric acid producing hydrogen and chlorine.
C Potassium reacts vigorously with water producing hydrogen and an acidic solution.
D Zinc reacts with dilute sulfuric acid producing sulfur dioxide.

26 12.4 g of copper(II) carbonate is heated in a test-tube. Only 50% is decomposed.

[M_r : CuCO_3 , 124; CuO , 80]

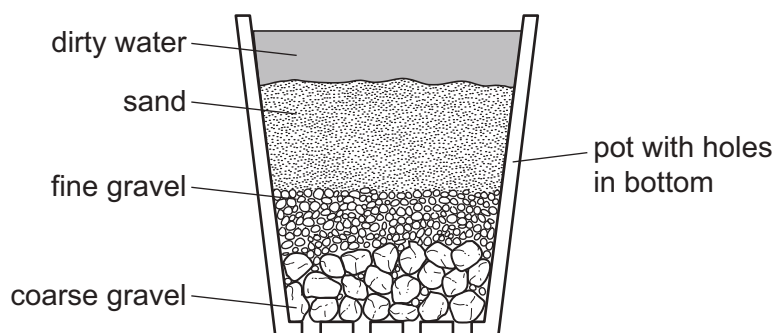
What will be the final mass of the substances in the test-tube?

- A 9.4 g B 9.8 g C 10.2 g D 10.6 g

27 Which statement about the manufacture of ammonia is correct?

- A Ammonia is manufactured by heating hydrogen and nitrogen at 50°C and 1.0 atm.
B Ammonia is obtained by heating hydrogen and nitrogen in the Contact process.
C Hydrogen for the manufacture of ammonia is extracted from air.
D The reaction between hydrogen and nitrogen to form ammonia is reversible.

28 The diagram shows a stage in the purification of dirty water.



Which process does this apparatus show?

- A chlorination
B condensation
C distillation
D filtration
- 29 Which substance in polluted air damages stonework and kills trees?
- A carbon dioxide
B carbon monoxide
C lead compounds
D sulfur dioxide

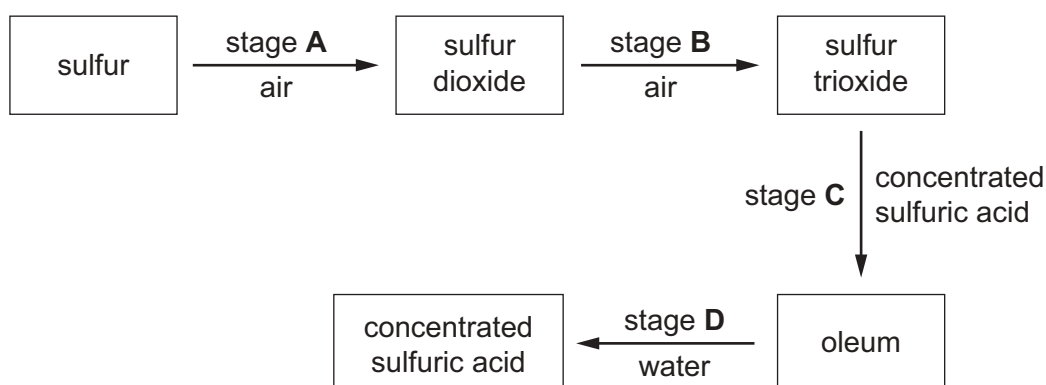
30 Petrol-fuelled cars produce oxides of nitrogen.

Which statement explains how oxides of nitrogen are formed?

- A In the catalytic converter, the elements nitrogen and oxygen combine.
- B Oxygen and nitrogen compounds in petrol combine in the car engine.
- C The high temperatures in the engine provide oxygen and nitrogen with the activation energy needed to react.
- D In the car engine, nitrogen compounds in petrol combine with oxygen.

31 The scheme shows four stages in the conversion of sulfur to sulfuric acid.

In which stage is a catalyst used?



32 Which element has an oxide that is used as a food preservative?

- A helium
- B hydrogen
- C iron
- D sulfur

33 Which substance gives off carbon dioxide on heating?

- A lime
- B limestone
- C limewater
- D slaked lime

34 Which formula represents ethyl butanoate?

- A $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_3$
- B $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- C $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_3$
- D $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

35 Methanol, CH_3OH , is a member of the homologous series of alcohols.

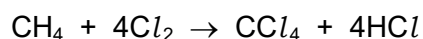
What is the formula of the alcohol in the same homologous series which contains three carbon atoms?

- A $\text{C}_3\text{H}_5\text{OH}$ B $\text{C}_3\text{H}_6\text{OH}$ C $\text{C}_3\text{H}_7\text{OH}$ D $\text{C}_3\text{H}_8\text{OH}$

36 Which type of compound reacts with hydrogen in an addition reaction?

- A alkanes
- B alkenes
- C alcohols
- D carboxylic acids

37 The equation for the reaction between methane and chlorine is shown.



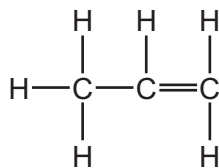
Which type of reaction does methane undergo?

- A substitution
- B reduction
- C condensation
- D addition

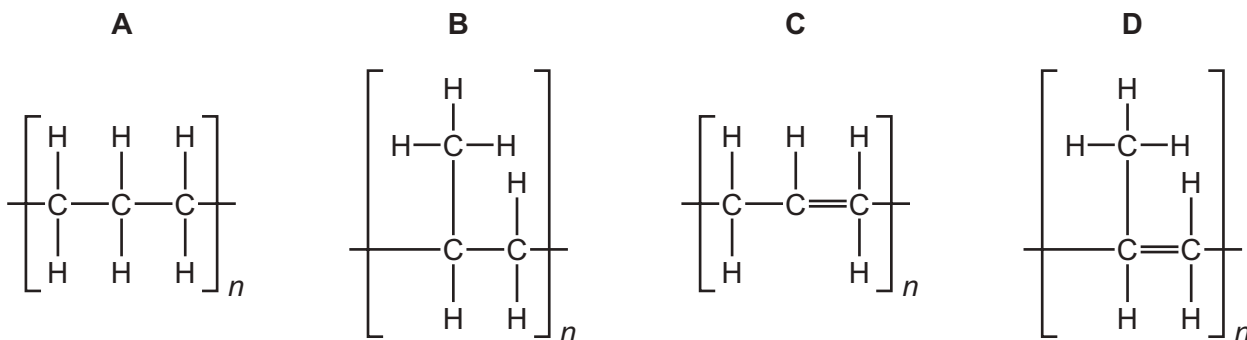
38 Which functional groups form an amide linkage?

- A $\text{H}_2\text{N}-$ and $-\text{COOH}$
- B $\text{H}_2\text{N}-$ and $\text{H}_2\text{N}-$
- C $-\text{OH}$ and $-\text{COOH}$
- D $-\text{OH}$ and $\text{H}_2\text{N}-$

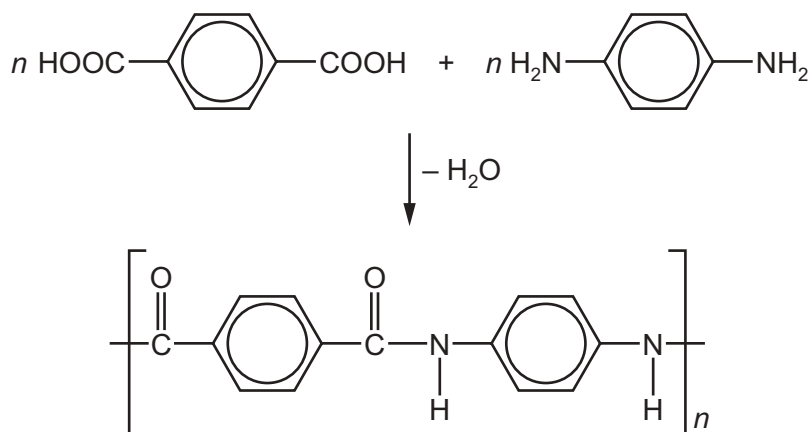
39 The structure of propene is shown.



Which diagram represents poly(propene)?



40 The equation shows the formation of a polymer called *Kevlar*.



Which row describes *Kevlar*?

| | how the polymer is formed | type of polymer |
|----------|-----------------------------|-----------------|
| A | addition polymerisation | polyamide |
| B | addition polymerisation | polyester |
| C | condensation polymerisation | polyamide |
| D | condensation polymerisation | polyester |

The Periodic Table of Elements

| | | Group | | | | | | | | | | | | | | | |
|-----------------------------------|------------------------------------|--|--|------------------------------------|-------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|---------------------------------------|--------------------------------------|--------------------------------------|------------------------------------|--------------------------------------|------------------------------------|-------------------------------------|----------------------------------|----------------------------------|
| I | II | III | IV | V | VI | VII | VIII | | | | | | | | | | |
| 3 Li lithium 7 | 4 Be beryllium 9 | <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> Key atomic number atomic symbol name relative atomic mass </div> | | | | | | | | | | 2 He helium 4 | | | | | |
| 11 Na sodium 23 | 12 Mg magnesium 24 | | | | | | | | | | | 5 B boron 11 | 6 C carbon 12 | 7 N nitrogen 14 | 8 O oxygen 16 | 9 F fluorine 19 | 10 Ne neon 20 |
| 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 — | 114 Fl flerovium — | 116 Lv livermorium — | — | — | — | — |

| | | | | | | | | | | | | | | | |
|-------------|-------------------------------------|-----------------------------------|--|-------------------------------------|------------------------------------|------------------------------------|------------------------------------|--------------------------------------|-----------------------------------|--------------------------------------|-------------------------------------|----------------------------------|--------------------------------------|-------------------------------------|-------------------------------------|
| 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.).