Cambridge Assessment International Education

# Cambridge IGCSE™

**CHEMISTRY** **1523/22**

Paper 2 Multiple Choice (Extended) **May/June 2021**

**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.





IB21 06_1523_22/FP

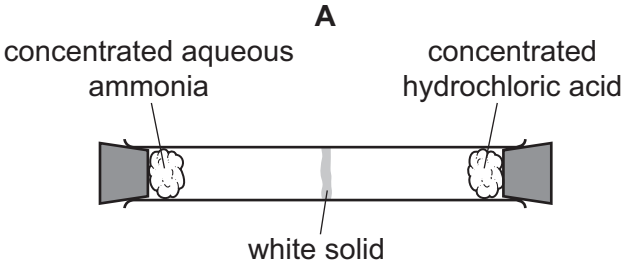

**[Turn over**

**1** Gaseous ammonia and gaseous hydrogen chloride react to form ammonium chloride, a white solid.

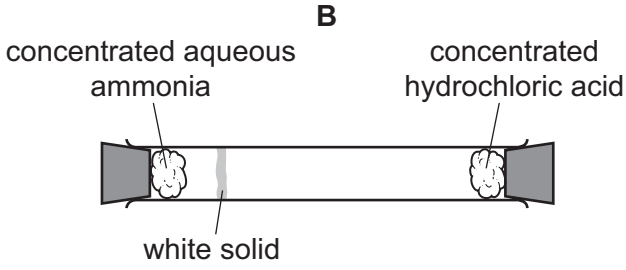
Cotton wool soaked in concentrated aqueous ammonia is placed in one end of a glass tube and at the same time cotton wool soaked in concentrated hydrochloric acid is placed at the other end of the tube. The tube is sealed.

Where in the tube does the white solid initially appear?

**A**




**B**

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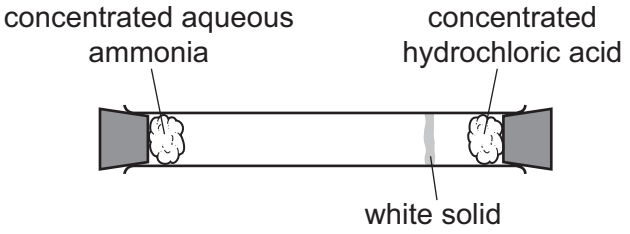
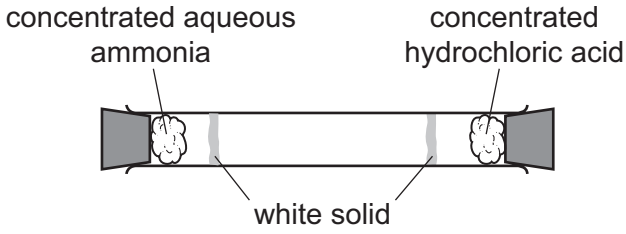
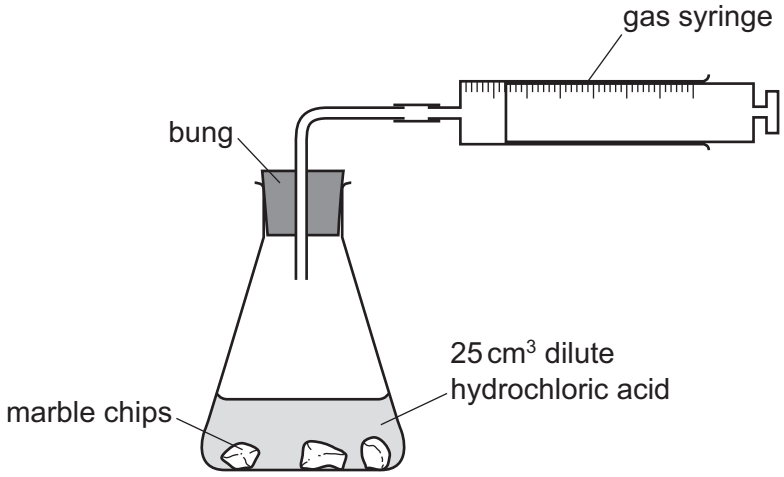



**D**




**2** A student uses the apparatus shown to measure the volume of carbon dioxide gas made when different masses of marble chips are added to 25 $cm^3$ of dilute hydrochloric acid.




Which other items of apparatus are needed?

**A** funnel and balance

**B** funnel and stop-watch

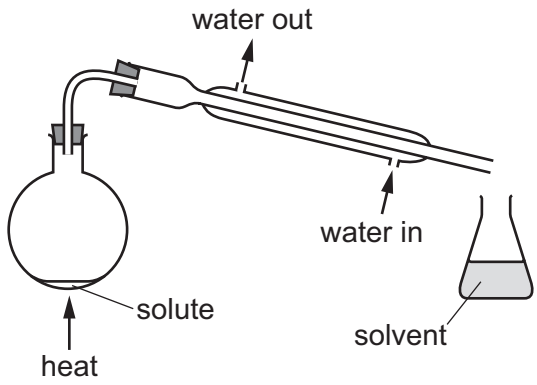
**C** measuring cylinder and balance

**D** measuring cylinder and stop-watch

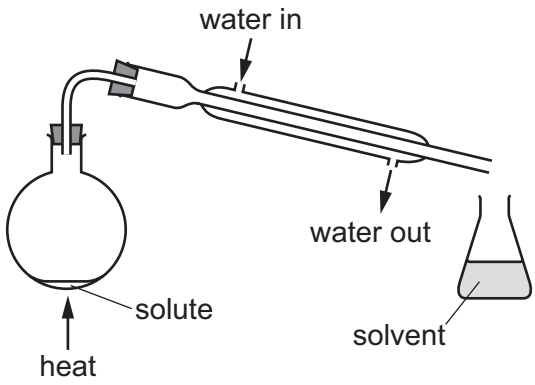
**3** A solute and a solvent are separated by distillation.

Which diagram is correctly labelled?

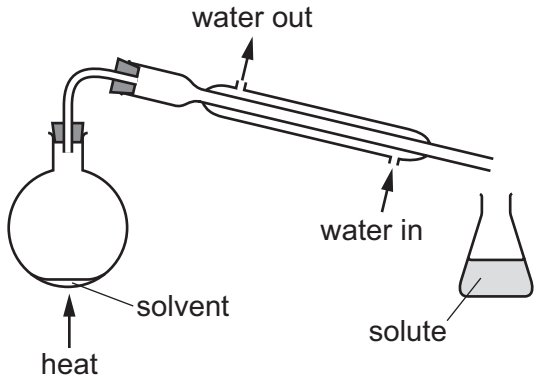
**A**



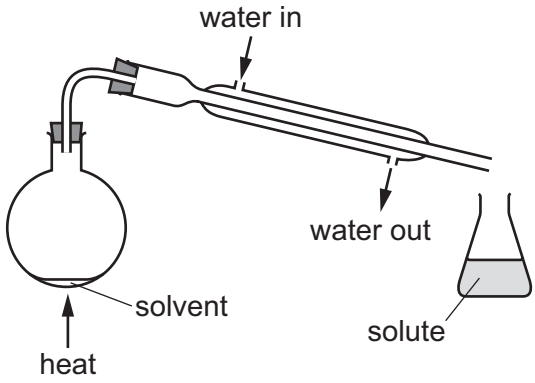

**B**




**C**




**D**




**4** A magnesium atom has the symbol $^{24}_{12}Mg$. It reacts to form a magnesium ion, $Mg^{2+}$.

Which row identifies the number of protons, neutrons and electrons in the ion?

| | protons | neutrons | electrons |
|---|---|---|---|
| **A** | 10 | 10 | 10 |
| **B** | 10 | 12 | 12 |
| **C** | 12 | 12 | 10 |
| **D** | 12 | 12 | 12 |

**5** Which dot-and-cross diagram shows the outer-shell electron arrangement in a molecule of carbon dioxide?

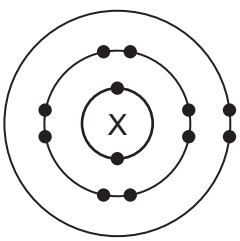
**A**

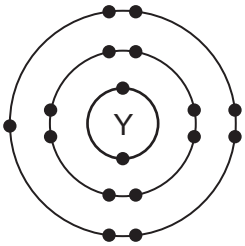
**B**

**C**

**D**

**6** The electronic structures of atoms X and Y are shown.




key
● electron

What is the formula of the molecule formed by X and Y?

**A** $XY_2$ **B** $X_3Y_2$ **C** $X_2Y_3$ **D** $X_2Y$

**7** Which row about a property of silicon(IV) oxide and the explanation of the property is correct?

| | property of silicon(IV) oxide | explanation |
|---|---|---|
| **A** | it conducts electricity | electrons can move freely through the structure |
| **B** | it is used as a lubricant | there are weak forces between the layers of silicon and oxygen atoms |
| **C** | it has a high melting point | there is a strong attraction between silicon and oxide ions |
| **D** | it is a hard solid | it is a macromolecule with strong bonds |

**8** These two statements are about metals, their properties and bonding.

statement 1 Metals conduct electricity when solid.

statement 2 In metals, a lattice of positive ions exists in a 'sea of electrons' which can move throughout the metal.

Which answer 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 incorrect.

**D** Statement 2 is correct but statement 1 is incorrect.

**9** The equation for the complete combustion of ethanethiol, $C_2H_6S$, is shown.

$$2C_2H_6S + 9O_2 \rightarrow ..... + 2SO_2 + 6H_2O$$

Which formula balances the equation?

**A** $2CO_2$ **B** $4CO_2$ **C** $2CO$ **D** $4CO$

**10** The equation for the formation of ethanol from glucose is shown.

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

In an experiment, 36 g of glucose produces 9.2 g of ethanol.

[$M_r$: $C_6H_{12}O_6$, 180; $C_2H_5OH$, 46]

What is the percentage yield of ethanol in this experiment?

**A** 20 **B** 26 **C** 50 **D** 100

**11** Four electrolysis experiments are described.

| electrolyte | electrodes |
|---|---|
| aqueous copper(II) sulfate | copper |
| aqueous copper(II) sulfate | graphite |
| concentrated aqueous sodium chloride | graphite |
| dilute sulfuric acid | graphite |

Which statement is correct for **all** four electrolysis experiments?

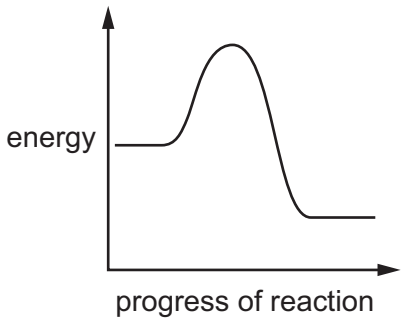
**A** Hydrogen gas is formed at the cathode.

**B** Ions gain electrons at the cathode.

**C** The electrodes are inert.

**D** Two or more products are formed.

**12** An energy level diagram for a reaction is shown.




Which statement and explanation about this reaction are correct?

| | statement | explanation |
|---|---|---|
| **A** | the reaction is endothermic | the products have more energy than the reactants |
| **B** | the reaction is endothermic | the products have less energy than the reactants |
| **C** | the reaction is exothermic | the products have more energy than the reactants |
| **D** | the reaction is exothermic | the products have less energy than the reactants |

**13** Which product is made in a fuel cell?

**A** carbon dioxide

**B** ethanol

**C** hydrogen

**D** water

**14** Which processes are physical changes?

1 melting ice

2 reduction of copper(II) oxide

3 burning sulfur

4 boiling ethanol

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

**15** A chemical reaction is carried out at a fixed temperature.

It is repeated at a higher concentration. All other conditions remain the same.

Which row describes how the collision rate and the proportion of molecules with the activation energy changes in the second reaction?

| | collision rate | proportion of molecules with the activation energy |
|---|---|---|
| **A** | increases | increases |
| **B** | increases | no change |
| **C** | no change | increases |
| **D** | no change | no change |

**16** The equation for the reaction between aqueous potassium iodide and aqueous bromine is shown.

$$2KI(aq) + Br_2(aq) \rightarrow 2KBr(aq) + I_2(s)$$

Which statement about the reaction is correct?

**A** Bromine is reduced.

**B** The potassium ions act as an oxidising agent.

**C** The potassium ions are oxidised.

**D** The iodide ions gain electrons.

**17** Hydrogen and iodine gases react together to produce gaseous hydrogen iodide in a reversible reaction.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

The forward reaction is exothermic.

Hydrogen and hydrogen iodide are colourless gases. Iodine gas is purple.

Which statement is correct?

**A** The forward and reverse reactions both stop when equilibrium is reached.

**B** The position of equilibrium is not affected by pressure changes.

**C** The position of equilibrium is not affected by temperature changes.

**D** The reaction mixture continues to change colour after equilibrium is reached.

**18** Ethanoic acid is a weak acid.

Hydrochloric acid is a strong acid.

Which statements are correct?

1 Ethanoic acid molecules are partially dissociated in aqueous solution.

2 1.0 mol / $dm^3$ ethanoic acid has a higher pH than 1.0 mol / $dm^3$ hydrochloric acid.

3 Ethanoic acid is always more dilute than hydrochloric acid.

4 Ethanoic acid is a proton acceptor.

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

**19** Which oxide neutralises aqueous sodium hydroxide?

**A** calcium oxide

**B** carbon monoxide

**C** sulfur dioxide

**D** water

**20** An excess of aqueous sodium sulfate was added to aqueous barium chloride and the mixture was filtered.

Which row shows the identity of the residue and the substances present in the filtrate?

| | residue | substances in filtrate |
|---|---|---|
| **A** | barium sulfate | barium chloride and sodium chloride |
| **B** | barium sulfate | sodium chloride and sodium sulfate |
| **C** | sodium chloride | barium chloride and sodium sulfate |
| **D** | sodium chloride | barium sulfate and sodium sulfate |

**21** Compound X is tested and the results are shown.

| test | result |
|---|---|
| aqueous sodium hydroxide is added, then heated gently | gas given off which turns damp red litmus paper blue |
| dilute hydrochloric acid is added | effervescence, gas given off which turns limewater milky |

Which ions are present in compound X?

**A** ammonium ions and carbonate ions

**B** ammonium ions and chloride ions

**C** calcium ions and carbonate ions

**D** calcium ions and chloride ions

**22** Which statement about elements in the Periodic Table is correct?

**A** Elements are arranged in order of increasing nucleon number.

**B** Elements in Group VII are diatomic non-metals.

**C** Elements with similar properties are in the same period.

**D** Transition elements are a collection of metals and non-metals.

**23** Which statement explains why the noble gas helium is unreactive?

**A** It has a complete outer shell of electrons.

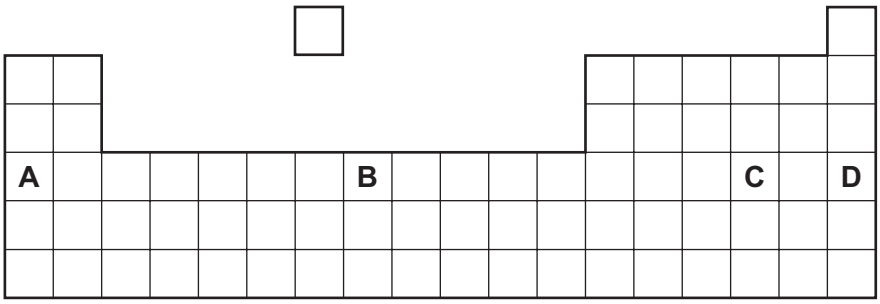
**B** It has two protons in the nucleus.

**C** It has the same number of protons and neutrons.

**D** It has the same number of protons, electrons and neutrons.

**24** The positions of four elements in the Periodic Table are shown.

Which element forms ionic compounds in which the element has different oxidation numbers (states)?




**25** The element rutherfordium, Rf, was first detected in 1964.

Rutherfordium is a metal.

What are the predicted properties of rutherfordium?

1 Rutherfordium conducts electricity when molten.

2 Rutherfordium does not conduct electricity when solid.

3 Rutherfordium has a low melting point.

4 Rutherfordium is malleable.

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

**26** The results of three reactions of metal M and its nitrate are given.

reaction 1 M reacts with dilute hydrochloric acid.

reaction 2 M displaces zinc metal from aqueous zinc salts.

reaction 3 Heat decomposes the nitrate of M into a mixture of two gases and a solid.

What is M?

**A** copper

**B** iron

**C** magnesium

**D** potassium

**27** Which statement about the extraction of aluminium from aluminium oxide is correct?

**A** Aluminium is formed at the positive electrode during electrolysis.

**B** Pure aluminium oxide is dissolved in molten cryolite.

**C** Pure aluminium oxide is electrolysed using aluminium as the positive electrode.

**D** Pure aluminium oxide is heated with carbon to form carbon dioxide and aluminium.

**28** Iron is extracted from its ore in a blast furnace.

The equations for four different reactions are shown.

1 $4Fe + 3CO_2 \rightarrow 2Fe_2O_3 + 3C$

2 $CO_2 \rightarrow C + O_2$

3 $CO_2 + C \rightarrow 2CO$

4 $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

Which equations represent reactions that occur in the blast furnace?

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

**29** Some uses of water are listed.

1 as a solvent

2 as a coolant in the chemical industry

3 to irrigate crops

4 to provide safe drinking water

During a drought, which uses are important to sustain the population of a country?

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

**30** Which substances are needed for iron to rust?

**A** carbon dioxide and oxygen

**B** oxygen only

**C** water and carbon dioxide

**D** water and oxygen

**31** Which process removes carbon dioxide from the atmosphere?

**A** cement manufacture

**B** combustion

**C** photosynthesis

**D** respiration

**32** Which statements about sulfur dioxide are correct?

1 It is produced when sulfuric acid is electrolysed.

2 It is produced when sodium sulfite reacts with dilute hydrochloric acid.

3 It is a neutral oxide.

4 It reacts with oxygen in the presence of a catalyst to form sulfur trioxide.

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

**33** What are uses of sulfur dioxide?

1 as a bleach in the manufacture of wood pulp

2 as a food preservative

3 in the conversion of iron to steel

4 to kill bacteria in water treatment

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

**34** Which type of reaction occurs when calcium oxide is formed from calcium carbonate?

**A** addition

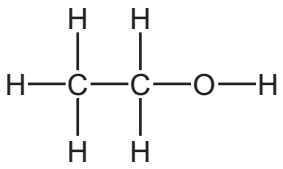
**B** combustion

**C** neutralisation

**D** thermal decomposition

**35** The structures of some organic compounds are shown.

1



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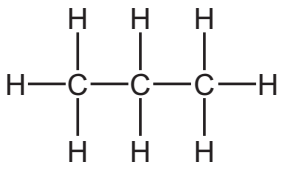

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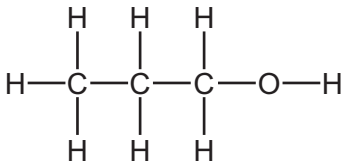

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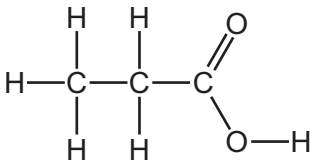
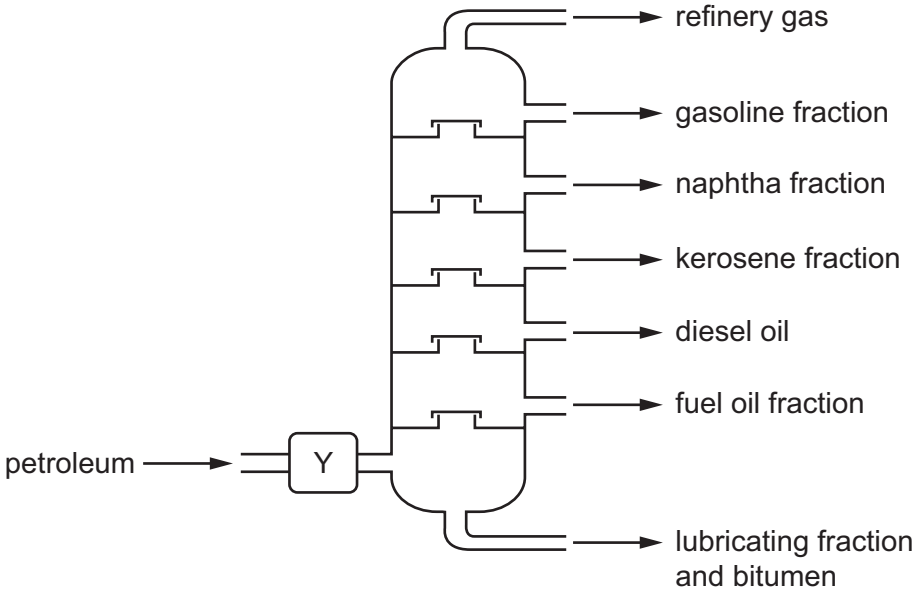


Which compounds belong to the same homologous series?

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

**36** The industrial fractional distillation of petroleum is shown.




Which process happens at Y?

**A** burning

**B** condensation

**C** cracking

**D** evaporation

**37** Which pair of compounds is used to prepare $CH_3CH_2COOCH_2CH_3$?

**A** ethanoic acid and ethanol

**B** ethanoic acid and propanol

**C** propanoic acid and ethanol

**D** propanoic acid and propanol

**38** Ethanol is oxidised to ethanoic acid by acidified potassium manganate(VII).

Which colour change is observed in the reaction?

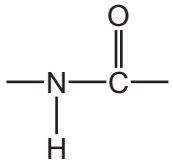
**A** colourless to purple

**B** purple to colourless

**C** colourless to orange

**D** orange to colourless

**39** The linkage between monomer units in a condensation polymer is shown.



Which types of polymer contain this linkage?

1 a complex carbohydrate

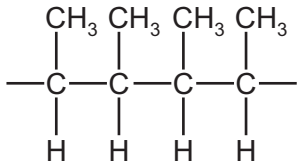
2 a polyamide

3 a polyester

4 a protein

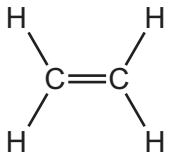
**A** 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

**40** The structure of part of a polymer is shown.

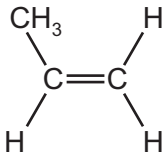


Which monomer is used to make this polymer?

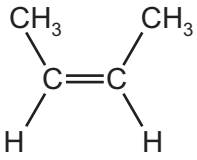
**A**



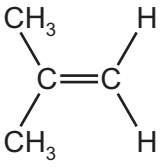
**B**



**C**



**D**



## 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 – | | 114 Fl flerovium – | | 116 Lv livermorium – | | |

**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.).