Cambridge Assessment International Education

Cambridge IGCSE™ (9–1)

CHEMISTRY **0971/22**

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.

1 The rate of diffusion of three gases, ammonia, carbon dioxide and methane, is measured.

What is the order of the rate of diffusion of the gases from slowest to fastest?

A $CO_2 \rightarrow NH_3 \rightarrow CH_4$

B $CO_2 \rightarrow CH_4 \rightarrow NH_3$

C $CH_4 \rightarrow NH_3 \rightarrow CO_2$

D $NH_3 \rightarrow CH_4 \rightarrow CO_2$

2 Which description of Brownian motion is correct?

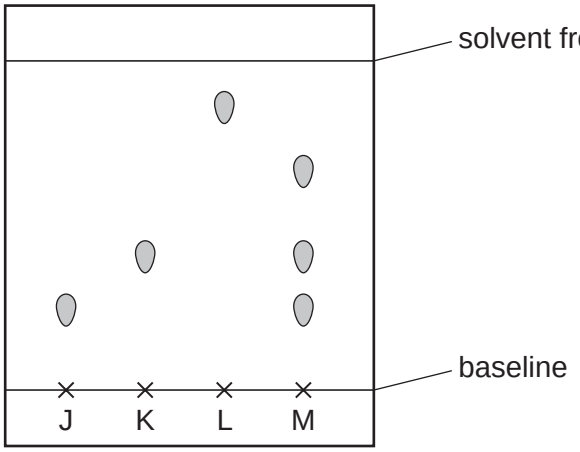
A random movement of particles due to bombardment by larger particles

B random movement of particles due to bombardment by smaller particles

C random movement of particles from a high concentration to a low concentration

D random movement of particles from a low concentration to a high concentration

3 The chromatogram obtained using four substances, J, K, L and M, is shown.



Which statement about M is correct?

A It is a mixture of J and K only.

B It is a pure substance.

C It is a mixture of J, K and L.

D It is a mixture of J, K and an unknown substance.

4 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

5 Which statement about solid magnesium oxide is correct?

A It is a giant structure made up of magnesium and oxygen atoms bonded covalently.

B It is an electrical conductor with mobile magnesium ions and oxygen ions.

C Magnesium loses electrons and these electrons move freely through a lattice.

D Oxygen ions and magnesium ions are attracted to each other in a giant lattice.

6 Which molecule contains only three shared pairs of electrons?

A CH_3OH **B** Cl_2 **C** H_2O **D** N_2

7 Which particles are present in the structure of metals?

1 positive ions

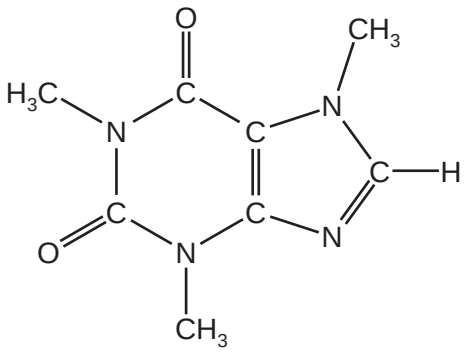
2 negative ions

3 shared pairs of electrons

4 mobile electrons

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

8 Caffeine is a stimulant found in coffee.



caffeine

Which formula represents caffeine?

A $C_7H_{10}N_4O_2$ **B** $C_8H_{10}N_3O_2$ **C** $C_8H_{10}N_4O_2$ **D** $C_8H_{11}N_4O_2$

9 Which sample does **not** contain a number of atoms equal to the Avogadro constant?

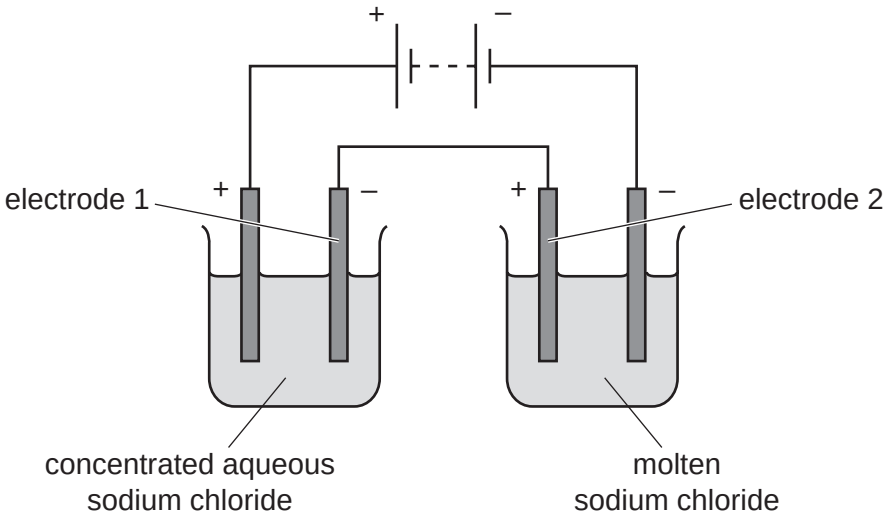
A 14 g of nitrogen, N_2

B 6 g of water, H_2O

C 4 g of helium, He

D 28 g of carbon monoxide, CO

10 The electrolysis of concentrated aqueous sodium chloride and molten sodium chloride is shown.



What are the products at electrodes 1 and 2?

	electrode 1	electrode 2
A	chlorine	chlorine
B	hydrogen	chlorine
C	hydrogen	sodium
D	sodium	sodium

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

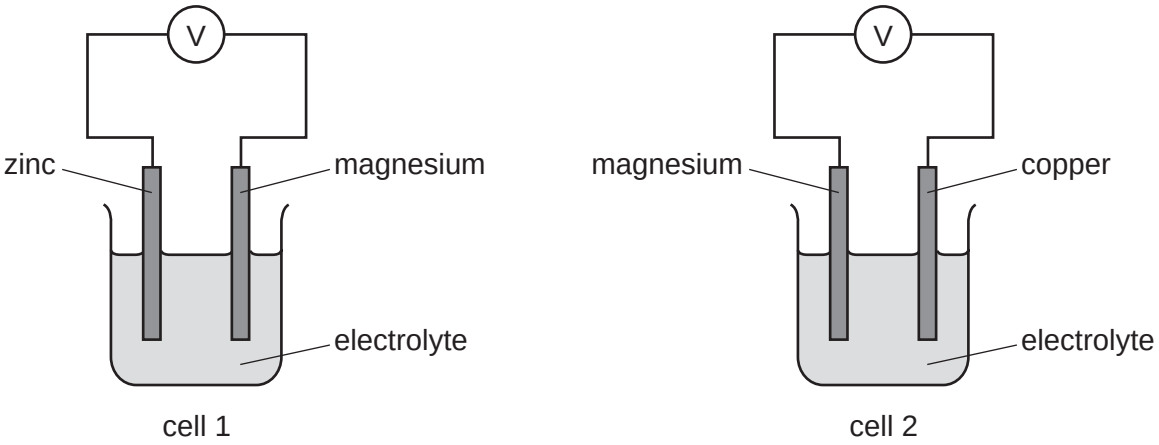
D neutralisation and exothermic

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_8H_{18}	–57	126
D	wax	$C_{31}H_{64}$	60	400

13 The electrical energy, or voltage, of two simple cells is measured.



statement 1 The voltage of cell 1 is greater than cell 2.

statement 2 Zinc is more reactive than copper.

statement 3 Magnesium is oxidised in both cells.

statement 4 Magnesium atoms lose electrons to form magnesium ions.

Which option is correct?

A All the statements are correct.

B Only statements 1 and 3 are correct.

C Statement 2 is correct and explains statement 1.

D Statement 4 is correct and explains statement 3.

14 Dilute aqueous sodium chloride is electrolysed using carbon electrodes.

What is the product at the anode?

A carbon dioxide

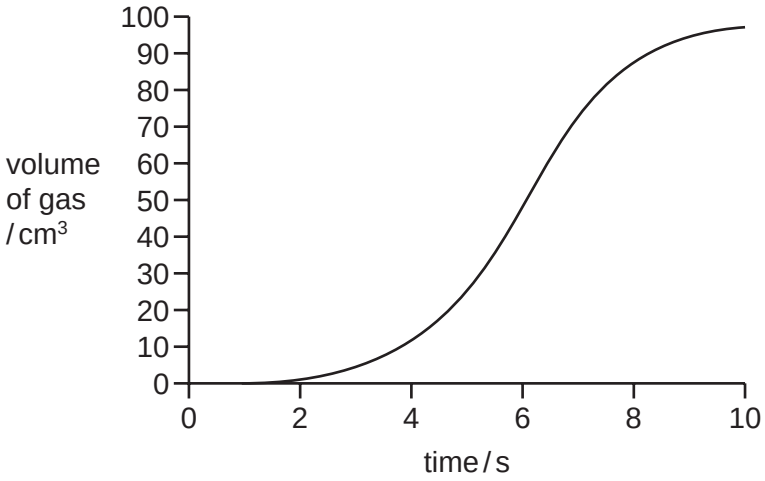
B hydrogen

C oxygen

D sodium

15 The volume of gas given off in a chemical reaction is measured over time.

The results are shown.



At which time is the rate of reaction greatest?

A 0 s **B** 4 s **C** 6 s **D** 10 s

16 Dinitrogen tetroxide, N_2O_4, is converted into nitrogen dioxide, NO_2, in a reversible reaction.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

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

17 When magnesium is heated with zinc oxide a reaction occurs.

The equation is shown.

$$Mg + ZnO \rightarrow MgO + Zn$$

Which substance is oxidised?

A magnesium

B magnesium oxide

C zinc

D zinc oxide

18 X and Y are oxides of two different elements.

- X reacts with water to produce aqueous solution Z.
- Z turns universal indicator paper blue.
- An aqueous solution of Y reacts with sodium carbonate to produce carbon dioxide gas.

Which statement is correct?

A X and Y are both the oxides of metals.

B X and Y are both the oxides of non-metals.

C X is the oxide of a metal and Y is the oxide of a non-metal.

D X is the oxide of a non-metal and Y is the oxide of a metal.

19 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

20 Copper(II) sulfate is a soluble salt.

Calcium sulfate is an insoluble salt.

Which row shows suitable reactants for preparing a pure sample of the named salt?

	salt	reactants
A	calcium sulfate	calcium carbonate + dilute sulfuric acid
B	calcium sulfate	aqueous calcium chloride and aqueous sodium sulfate
C	copper(II) sulfate	copper + dilute sulfuric acid
D	copper(II) sulfate	aqueous copper(II) chloride and aqueous sodium sulfate

21 Strontium displaces magnesium from molten magnesium chloride.

Bromine displaces iodine from aqueous potassium iodide.

Which row describes the change in reactivity down both Group II and Group VII of the Periodic Table?

	reactivity down the group	
	Group II	Group VII
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

22 Elements J and K are in the same period in the Periodic Table.

J reacts with acids to produce a salt and hydrogen.

K reacts with sodium to form an ionic compound.

Which statement about J and K is correct?

A An atom of J has more electrons than an atom of K.

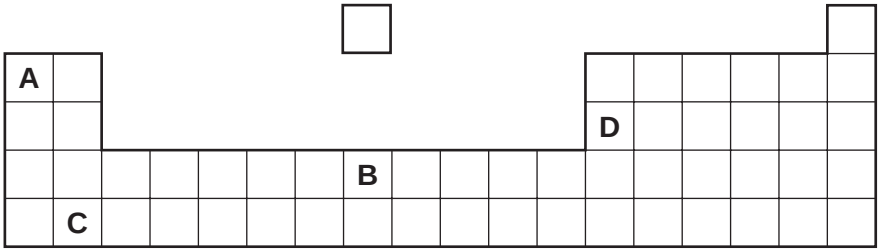
B J and K are both metals.

C J and K are both non-metals.

D J is to the left of K in the Periodic Table.

23 Part of the Periodic Table is shown.

Which element has a high density, a high melting point and forms a brown oxide?



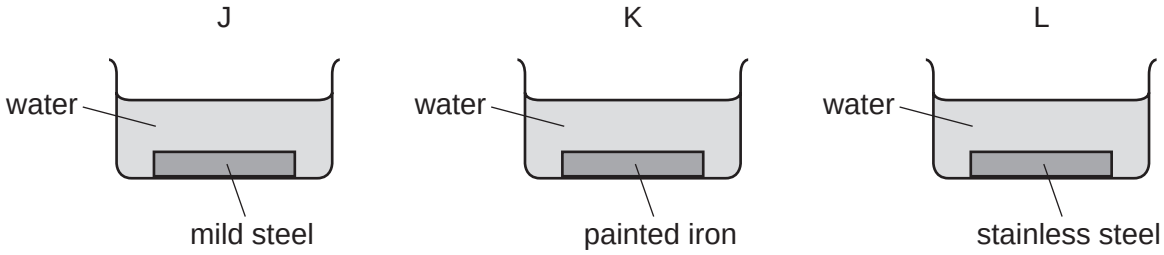
24 The reactions of four metals, W, X, Y and Z, are listed.

- Metal W displaces metal X from the oxide of metal X.
- Metal Y has a greater tendency to form positive ions than metal W.
- Aqueous ions of metal Z are reduced by metal X.

What is the order of reactivity of the metals?

	least reactive →			most reactive
A	Y	W	X	Z
B	Y	X	W	Z
C	Z	W	X	Y
D	Z	X	W	Y

25 Three experiments, J, K and L, are set up to investigate rusting.



In which experiments does rusting occur?

	J	K	L
A	✗	✓	✓
B	✗	✓	✗
C	✓	✗	✗
D	✓	✗	✓

key
✓ = yes
✗ = no

26 Silver is below copper in the reactivity series.

Which row describes the reactions of silver?

	reaction with steam	reaction with dilute hydrochloric acid
A	no reaction	no reaction
B	no reaction	reacts to produce hydrogen gas
C	reacts to produce hydrogen gas	no reaction
D	reacts to produce hydrogen gas	reacts to produce hydrogen gas

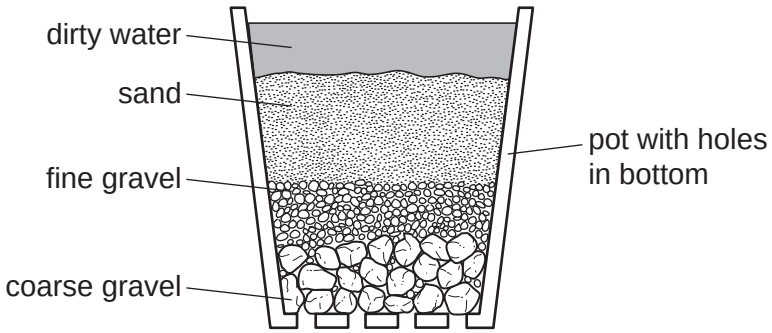
27 Iron is galvanised by coating it in zinc.

Brass is made by mixing copper with zinc.

Which row gives the reasons for each of these uses of zinc?

	reason for galvanising iron	reason for making brass
A	prevents corrosion	produces a softer metal
B	prevents corrosion	produces a harder metal
C	produces a harder metal	produces a softer metal
D	produces a harder metal	produces a harder metal

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 Ammonium nitrate, NH_4NO_3, is a fertiliser and is added to fields to help crops grow.

Slaked lime, $Ca(OH)_2$, is an alkali and is added to fields to reduce the acidity of the soil.

Ammonium nitrate and slaked lime should not be added to a field at the same time because they react with each other to form a gas, Z.

What is Z?

A ammonia

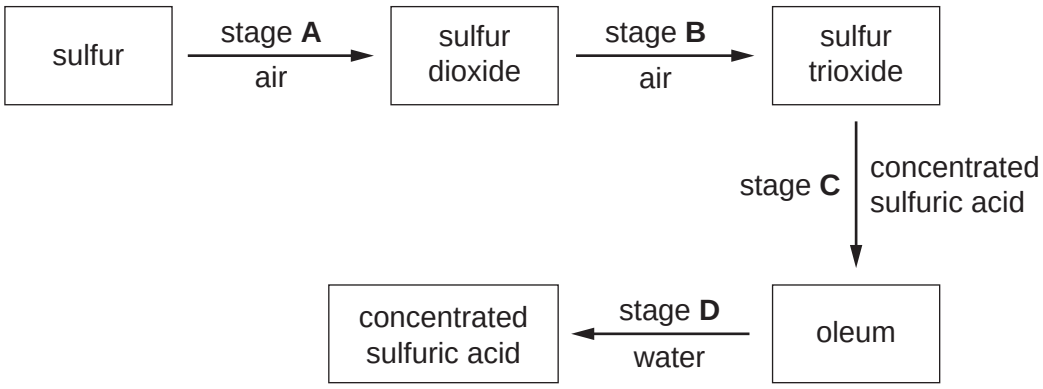
B hydrogen

C nitrogen

D 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 compound has the most $–CH_2–$ groups in one molecule?

A butane

B butanoic acid

C butan-1-ol

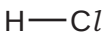
D but-1-ene

35 Methane reacts with chlorine in the presence of ultraviolet light.

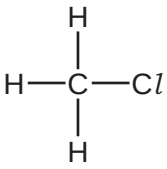
Which substance is **not** produced in this reaction?

A

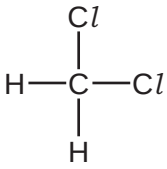
B



C



D



36 Ethene reacts with both hydrogen and steam.

Which row about these reactions is correct?

	reactant with ethene	type of reaction	catalyst used
A	hydrogen	substitution	phosphoric acid
B	hydrogen	addition	nickel
C	steam	substitution	phosphoric acid
D	steam	addition	nickel

37 Which type of reaction occurs when ethanol is converted to ethanoic acid?

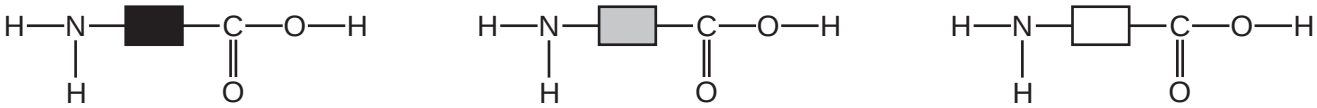
A combustion

B decomposition

C neutralisation

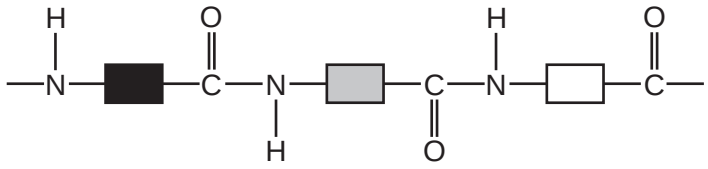
D oxidation

38 Hydrolysis of polymer P produces the three compounds shown.

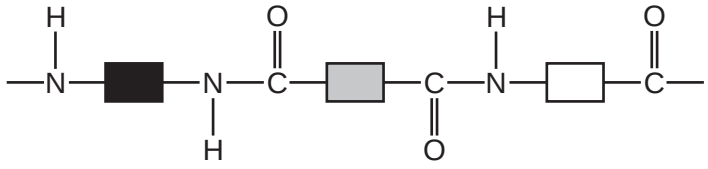


What is the structure of polymer P?

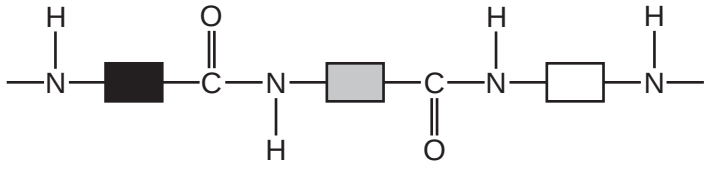
A



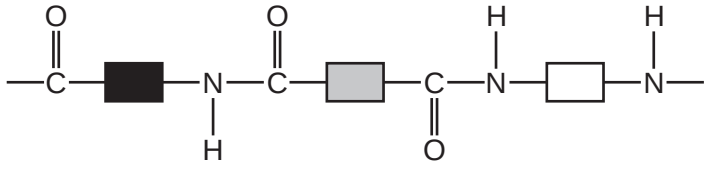
B



C



D



39 Which statement about unsaturated hydrocarbons is correct?

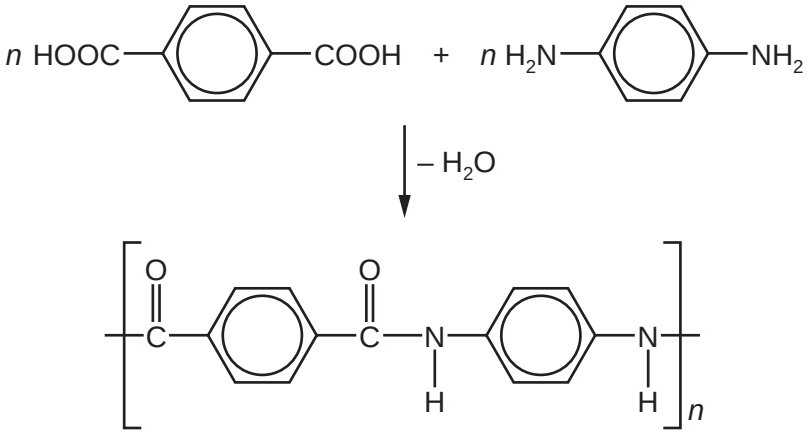
A $CH_3CH_2CH{=}CHCH_3$ is an unsaturated hydrocarbon.

B Ethene has more hydrogen atoms per molecule than ethane.

C Unsaturated hydrocarbons have double bonds between carbon and hydrogen atoms.

D Unsaturated hydrocarbons turn aqueous bromine from colourless to brown.

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
							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.).