



# Cambridge IGCSE™

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## CHEMISTRY

1523/12

Paper 1 Multiple Choice (Core)

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)

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## 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

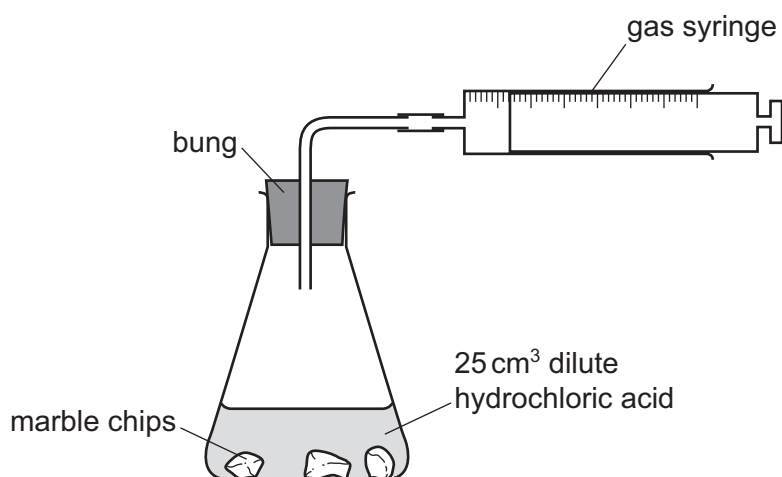
- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

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This document has **16** pages.



- 1 Which processes are involved when steam changes into ice?
- A boiling and freezing
  - B boiling and melting
  - C condensing and freezing
  - D condensing and melting
- 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<sup>3</sup> of dilute hydrochloric acid.

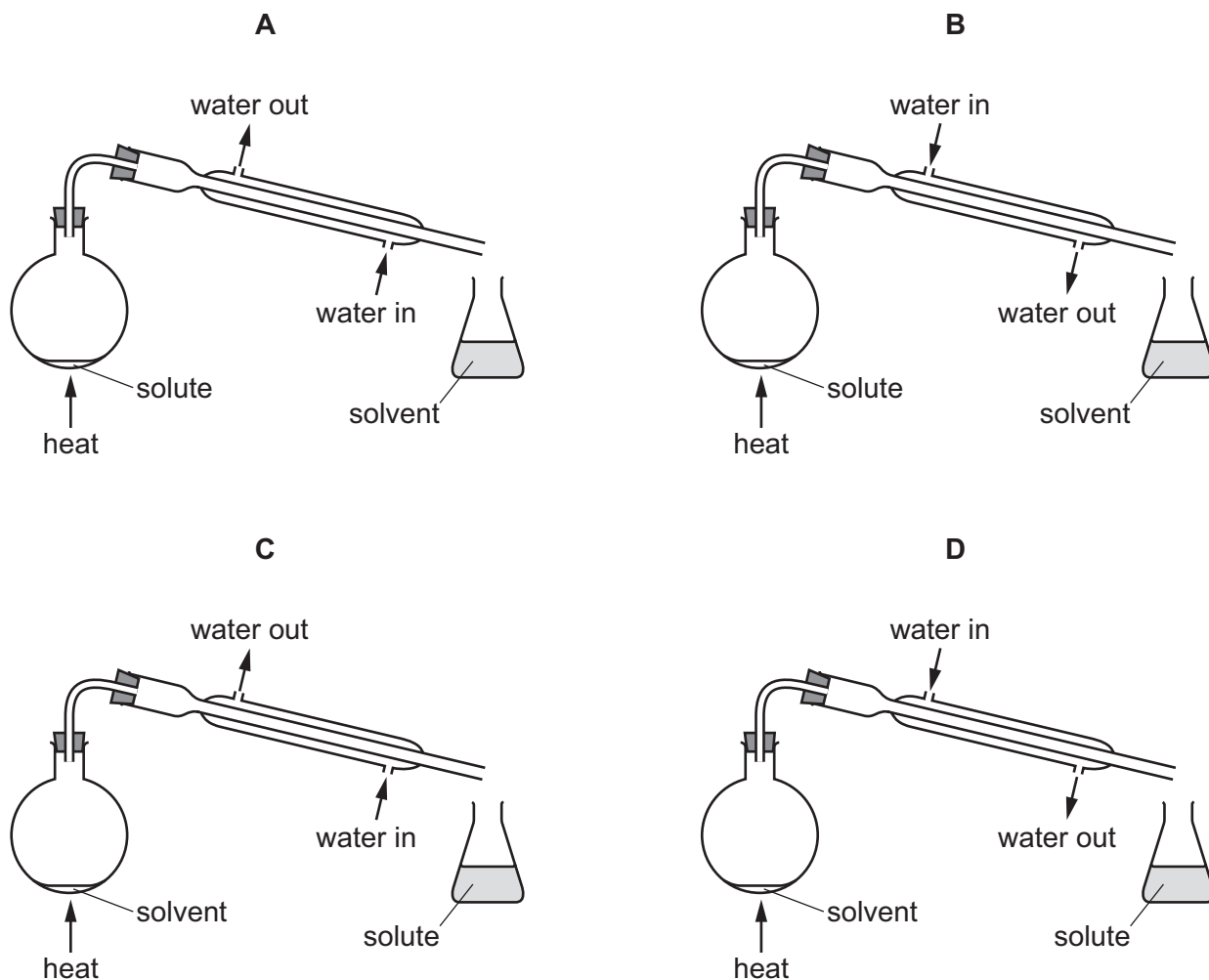


Which other items of apparatus are needed?

- 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?



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

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

	protons	neutrons	electrons
<b>A</b>	10	10	10
<b>B</b>	10	12	12
<b>C</b>	12	12	10
<b>D</b>	12	12	12

5 Hexadecane is an alkane.

The melting and boiling points of pure hexadecane are shown.

melting point = 18 °C

boiling point = 287 °C

Which row shows melting and boiling points of an impure sample of hexadecane?

	melting point / °C	boiling point / °C
<b>A</b>	14–16	282–284
<b>B</b>	14–16	290–292
<b>C</b>	20–22	282–284
<b>D</b>	20–22	290–292

6 Which substance is a compound?

**A** air

**B** methane

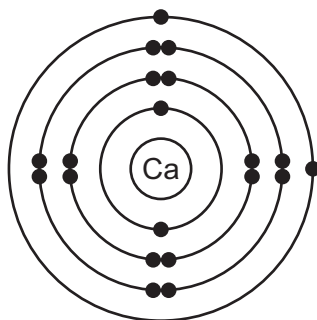
**C** nitrogen

**D** steel

7 Which row describes the properties of diamond?

	soluble in water	electrical conductivity
<b>A</b>	yes	none
<b>B</b>	yes	good
<b>C</b>	no	none
<b>D</b>	no	good

- 8 The electronic structure of a calcium atom is shown.



What is the electronic structure of a calcium ion?

- A** 2,8,8      **B** 2,8,8,2      **C** 2,8,8,4      **D** 2,8,8,8
- 9 The equation for the complete combustion of ethanethiol,  $C_2H_6S$ , is shown.



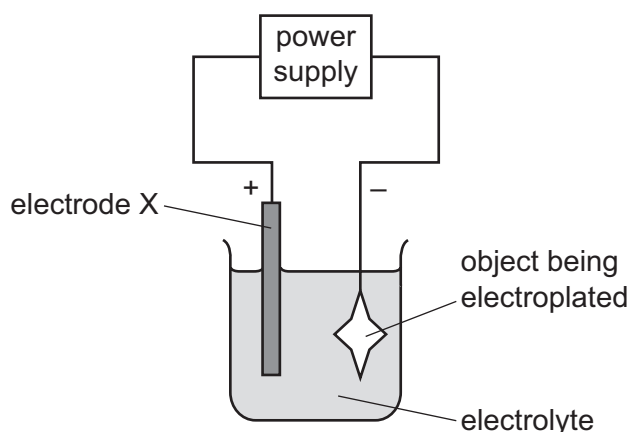
Which formula balances the equation?

- A**  $2CO_2$       **B**  $4CO_2$       **C**  $2CO$       **D**  $4CO$
- 10 Calcium phosphate has the formula  $Ca_3(PO_4)_2$ .

What is the relative formula mass of calcium phosphate?

- A** 135      **B** 215      **C** 230      **D** 310

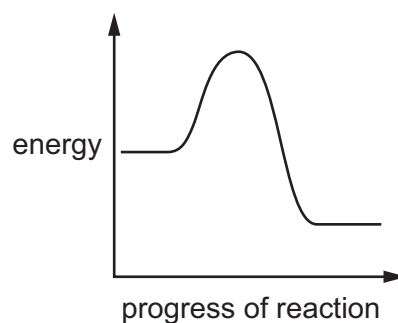
11 The apparatus used to electroplate an object with silver is shown.



Which row identifies electrode X and a suitable electrolyte?

	element from which electrode X is made	name of electrolyte
<b>A</b>	carbon	aqueous silver nitrate
<b>B</b>	carbon	dilute hydrochloric acid
<b>C</b>	silver	aqueous silver nitrate
<b>D</b>	silver	dilute hydrochloric acid

12 An energy level diagram for a reaction is shown.



Which statement and explanation about this reaction are correct?

	statement	explanation
<b>A</b>	the reaction is endothermic	the products have more energy than the reactants
<b>B</b>	the reaction is endothermic	the products have less energy than the reactants
<b>C</b>	the reaction is exothermic	the products have more energy than the reactants
<b>D</b>	the reaction is exothermic	the products have less energy than the reactants

13 Molten sodium chloride is broken down by electrolysis.

Which row identifies the product at each electrode?

	anode	cathode
<b>A</b>	chlorine	hydrogen
<b>B</b>	chlorine	sodium
<b>C</b>	hydrogen	chlorine
<b>D</b>	sodium	chlorine

14 Which processes are physical changes?

- 1 melting ice
- 2 reduction of copper(II) oxide
- 3 burning sulfur
- 4 boiling ethanol

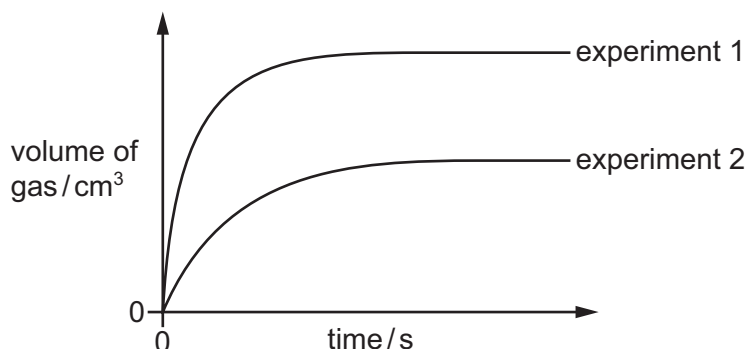
**A** 1 and 3      **B** 1 and 4      **C** 2 and 3      **D** 2 and 4

15 Which fuel does **not** produce carbon dioxide when it burns?

- A** coal
- B** hydrogen
- C** methane
- D** petrol

- 16 An excess of calcium carbonate is reacted with acid in experiments 1 and 2.

The volume of gas produced is measured over time. The results are plotted on the graph.



Which statement explains the observed results?

- A** The concentration of acid is higher in experiment 1.
- B** The mass of calcium carbonate is higher in experiment 1.
- C** The temperature of the acid is lower in experiment 1.
- D** Smaller pieces of calcium carbonate are used in experiment 1.
- 17 Which row describes the effect of adding water to blue cobalt(II) chloride and to blue copper(II) sulfate?

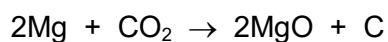
	effect of adding water to blue cobalt(II) chloride	effect of adding water to blue copper(II) sulfate
<b>A</b>	x	x
<b>B</b>	x	✓
<b>C</b>	✓	x
<b>D</b>	✓	✓

key

✓ = colour change

x = no colour change

- 18 The reaction between magnesium and carbon dioxide is shown.



Which statement describes what happens in this reaction?

- A** Carbon is oxidised.
- B** Magnesium is reduced.
- C** Neither oxidation nor reduction happens.
- D** The carbon in carbon dioxide is reduced.



19 Which statements about alkaline solutions are correct?

- 1 When reacted with an acid, the pH of the alkali increases.
- 2 When tested with litmus, the litmus turns blue.
- 3 When warmed with an ammonium salt, ammonia gas is given off.

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

20 Nickel(II) sulfate is made by reacting insoluble nickel(II) carbonate with dilute sulfuric acid.

The method used is shown.

- step 1 Add excess nickel(II) carbonate to dilute sulfuric acid.
- step 2 Filter the mixture and collect the filtrate.
- step 3 Heat the filtrate in an evaporating basin until crystals start to form.
- step 4 Leave the solution formed to cool.

Which substances are removed from the mixture in step 2 and in step 3?

	step 2	step 3
<b>A</b>	nickel(II) carbonate	sulfuric acid
<b>B</b>	nickel(II) carbonate	water
<b>C</b>	nickel(II) sulfate	sulfuric acid
<b>D</b>	nickel(II) sulfate	water

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 Which row describes a typical transition element?

	density	colour of oxide
A	high	green
B	high	white
C	low	green
D	low	white

- 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 reactions of four metals are described.

Cu has no reaction with water, steam or warm dilute hydrochloric acid.

Li reacts with cold water.

Mg reacts very slowly with water, and reacts with both steam and cold dilute hydrochloric acid.

Sn reacts slowly with warm dilute hydrochloric acid.

What is the order of reactivity of the metals?

	most reactive <span style="font-size: 2em;">→</span> least reactive			
<b>A</b>	Li	Mg	Sn	Cu
<b>B</b>	Li	Sn	Mg	Cu
<b>C</b>	Cu	Sn	Mg	Li
<b>D</b>	Cu	Mg	Sn	Li

27 A farmer moves his cows into a concrete shelter for protection.

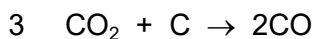
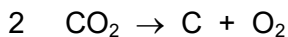
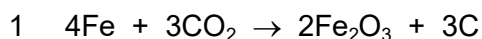
There is little access to fresh air once the door is closed.

Which gases would increase in amount in the shelter?

- A** carbon dioxide and carbon monoxide
- B** carbon dioxide and methane
- C** carbon monoxide and oxygen
- D** methane and oxygen

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

The equations for four different reactions are shown.



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 Which row about aluminium is correct?

	name of ore	properties of aluminium
<b>A</b>	bauxite	resistant to corrosion and low density
<b>B</b>	bauxite	good electrical conductor and high density
<b>C</b>	hematite	resistant to corrosion and low density
<b>D</b>	hematite	good electrical conductor and high density

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 three elements are needed in fertilisers?

- A** calcium, nitrogen and phosphorus
- B** carbon, potassium and nitrogen
- C** potassium, nitrogen and phosphorus
- D** potassium, phosphorus and carbon

32 Which statements describe uses for calcium oxide?

- 1 flue gas desulfurisation
- 2 treating alkaline soil
- 3 reducing iron oxide in the blast furnace

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

33 What are uses of sulfur dioxide?

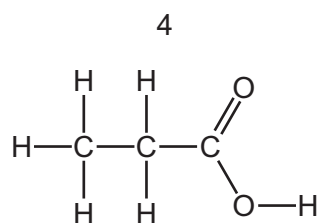
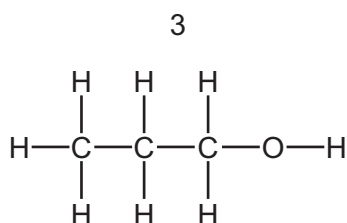
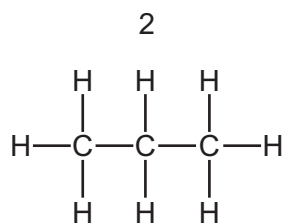
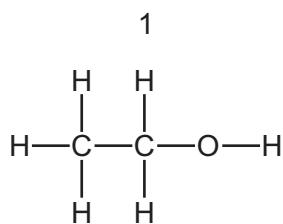
- 1 as a bleach in the manufacture of wood pulp
- 2 as a food preservative
- 3 in the conversion of iron to steel
- 4 to kill bacteria in water treatment

- 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

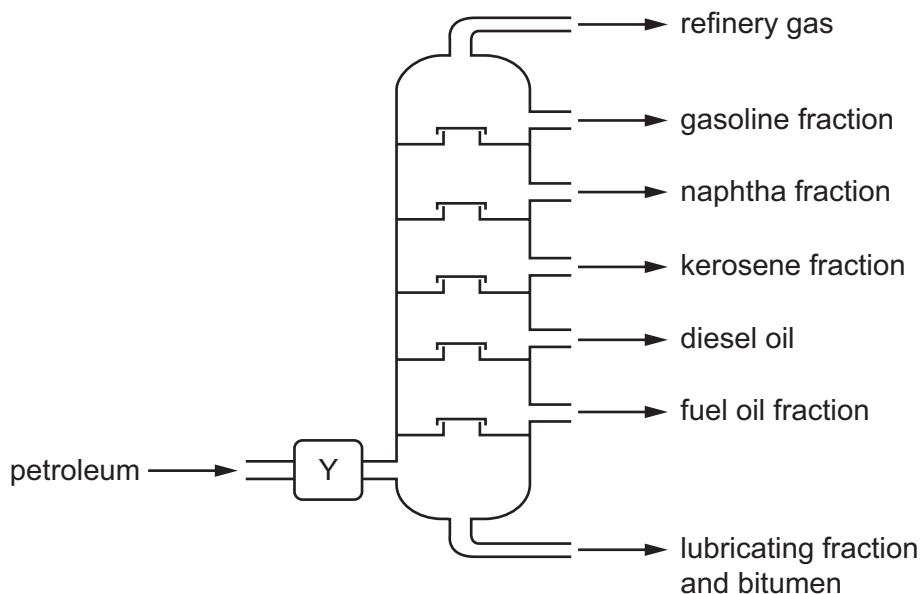
35 The structures of some organic compounds are shown.



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 description of the bonding in alkanes is correct?
- A covalent bonding, all bonds are double bonds
  - B covalent bonding, all bonds are single bonds
  - C covalent bonding, with both single and double bonds
  - D ionic bonding
- 38 Which process converts glucose into ethanol?
- A catalytic addition of steam
  - B cracking
  - C fermentation
  - D thermal decomposition

39 Which word equation represents a reaction of aqueous ethanoic acid?

- A ethanoic acid + copper  $\rightarrow$  copper ethanoate + hydrogen
- B ethanoic acid + magnesium  $\rightarrow$  magnesium ethanoate + water
- C ethanoic acid + sodium oxide  $\rightarrow$  sodium ethanoate + hydrogen
- D ethanoic acid + calcium oxide  $\rightarrow$  calcium ethanoate + water

40 Which statement describes a polymer?

- A It is a covalent molecule obtained by fractional distillation.
- B It is a large covalent molecule obtained by cracking.
- C It is a large molecule made from joining many monomer molecules together.
- D It is a small molecule formed by splitting up a larger molecule.

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The Periodic Table of Elements

Group																																			
I	II	III										IV	V	VI	VII	VIII																			
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <b>Key</b>                      atomic number                      atomic symbol                      name                      relative atomic mass                 </div>										6 <b>C</b> carbon 12	7 <b>N</b> nitrogen 14	8 <b>O</b> oxygen 16	9 <b>F</b> fluorine 19	10 <b>Ne</b> neon 20																			
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24	13 <b>Al</b> aluminium 27	14 <b>Si</b> silicon 28	15 <b>P</b> phosphorus 31	16 <b>S</b> sulfur 32	17 <b>Cl</b> chlorine 35.5	18 <b>Ar</b> argon 40	19 <b>K</b> potassium 39	20 <b>Ca</b> calcium 40	21 <b>Sc</b> scandium 45	22 <b>Ti</b> titanium 48	23 <b>V</b> vanadium 51	24 <b>Cr</b> chromium 52	25 <b>Mn</b> manganese 55	26 <b>Fe</b> iron 56	27 <b>Co</b> cobalt 59	28 <b>Ni</b> nickel 59	29 <b>Cu</b> copper 64	30 <b>Zn</b> zinc 65	31 <b>Ga</b> gallium 70	32 <b>Ge</b> germanium 73	33 <b>As</b> arsenic 75	34 <b>Se</b> selenium 79	35 <b>Br</b> bromine 80	36 <b>Kr</b> krypton 84										
37 <b>Rb</b> rubidium 85	38 <b>Sr</b> strontium 88	39 <b>Y</b> yttrium 89	40 <b>Zr</b> zirconium 91	41 <b>Nb</b> niobium 93	42 <b>Mo</b> molybdenum 96	43 <b>Tc</b> technetium —	44 <b>Ru</b> ruthenium 101	45 <b>Rh</b> rhodium 103	46 <b>Pd</b> palladium 106	47 <b>Ag</b> silver 108	48 <b>Cd</b> cadmium 112	49 <b>In</b> indium 115	50 <b>Sn</b> tin 119	51 <b>Sb</b> antimony 122	52 <b>Te</b> tellurium 128	53 <b>I</b> iodine 127	54 <b>Xe</b> xenon 131	55 <b>Cs</b> caesium 133	56 <b>Ba</b> barium 137	57–71 lanthanoids	72 <b>Hf</b> hafnium 178	73 <b>Ta</b> tantalum 181	74 <b>W</b> tungsten 184	75 <b>Re</b> rhenium 186	76 <b>Os</b> osmium 190	77 <b>Ir</b> iridium 192	78 <b>Pt</b> platinum 195	79 <b>Au</b> gold 197	80 <b>Hg</b> mercury 201	81 <b>Tl</b> thallium 204	82 <b>Pb</b> lead 207	83 <b>Bi</b> bismuth 209	84 <b>Po</b> polonium —	85 <b>At</b> astatine —	86 <b>Rn</b> radon —
87 <b>Fr</b> francium —	88 <b>Ra</b> radium —	89–103 actinoids	104 <b>Rf</b> rutherfordium —	105 <b>Db</b> dubnium —	106 <b>Sg</b> seaborgium —	107 <b>Bh</b> bohrium —	108 <b>Hs</b> hassium —	109 <b>Mt</b> meitnerium —	110 <b>Ds</b> darmstadtium —	111 <b>Rg</b> roentgenium —	112 <b>Cn</b> copernicium —	113 <b>Nh</b> nihonium —	114 <b>Fl</b> flerovium —	115 <b>Mc</b> moscovium —	116 <b>Lv</b> livermorium —	117 <b>Ts</b> tennessine —	118 <b>Og</b> oganesson —																		

57 <b>La</b> lanthanum 139	58 <b>Ce</b> cerium 140	59 <b>Pr</b> praseodymium 141	60 <b>Nd</b> neodymium 144	61 <b>Pm</b> promethium —	62 <b>Sm</b> samarium 150	63 <b>Eu</b> europium 152	64 <b>Gd</b> gadolinium 157	65 <b>Tb</b> terbium 159	66 <b>Dy</b> dysprosium 163	67 <b>Ho</b> holmium 165	68 <b>Er</b> erbium 167	69 <b>Tm</b> thulium 169	70 <b>Yb</b> ytterbium 173	71 <b>Lu</b> lutetium 175
89 <b>Ac</b> actinium —	90 <b>Th</b> thorium 232	91 <b>Pa</b> protactinium 231	92 <b>U</b> uranium 238	93 <b>Np</b> neptunium —	94 <b>Pu</b> plutonium —	95 <b>Am</b> americium —	96 <b>Cm</b> curium —	97 <b>Bk</b> berkelium —	98 <b>Cf</b> californium —	99 <b>Es</b> einsteinium —	100 <b>Fm</b> fermium —	101 <b>Md</b> mendelevium —	102 <b>No</b> nobelium —	103 <b>Lr</b> lawrencium —

lanthanoids

actinoids

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).