Cambridge Assessment International Education

Cambridge O Level

CHEMISTRY **5070/11**

Paper 1 Multiple Choice **October/November 2023**

1 hour

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.

IB23 11_5070_11/3RP

1 In which changes do the particles move further apart?

1 A gas is heated from 0 °C to 25 °C.

2 Pressure is applied to a gas at a constant temperature.

3 Steam condenses to form water.

4 Water evaporates at room temperature.

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

2 Data about two compounds is given. Both compounds have a simple molecular structure.

compound	melting point / °C	boiling point / °C
H_2S	–85	–61
PCl_3	–112	76

Two bottles are placed, close together, inside a large container at a temperature of 90 °C. One bottle contains 1.0 g of H_2S, the other bottle contains 1.0 g of PCl_3.

A detector is placed in the container 2.0 m away from the two bottles. The two bottles are opened at the same time.

Which row is correct?

	compound that reaches detector first	explanation
A	H_2S	gases diffuse faster than liquids
B	H_2S	H_2S has a lower M_r than PCl_3
C	PCl_3	gases diffuse faster than liquids
D	PCl_3	PCl_3 has a lower M_r than H_2S

3 Substances can be elements, compounds or mixtures.

Which row is correct?

	element	compound	mixture
A	copper	brass	zinc
B	methane	carbon	petroleum
C	nitrogen	carbon dioxide	water vapour
D	oxygen	glucose	air

4 The letters X, Y and Z represent different atoms.

$^{40}_{19}X$ $^{39}_{19}Y$ $^{40}_{20}Z$

Which statement is correct?

A X and Y are the same element.

B X and Z are the same element.

C X has more protons than Y.

D Z has more neutrons than Y.

5 A student makes three statements.

1 Calcium ions have a 2+ charge and oxide ions have a 2– charge.

2 Magnesium ions and oxide ions have the same electronic configuration as neon.

3 Calcium ions have three full electron shells and magnesium ions have two full electron shells.

Which statements are correct?

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

6 Four statements about graphite, diamond and silicon(IV) oxide are listed.

1 Diamond and silicon(IV) oxide are both very hard and have similar structures.

2 In diamond, each carbon atom is joined to four other carbon atoms.

3 Silicon(IV) oxide forms a giant structure of silicon and oxygen atoms.

4 Diamond and graphite both conduct electricity because they are both forms of carbon.

Which statements are correct?

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

7 Which row is correct?

	compound	molecular formula
A	ammonia	NH_4
B	ethene	C_2H_6
C	methanol	CH_4O
D	propanoic acid	$C_3H_8O_2$

8 Compound Y is the only substance formed when 500 cm^3 of ammonia reacts with 250 cm^3 of carbon dioxide. All measurements are at r.t.p.

What is the formula of Y?

A $(NH_4)_2CO_3$

B NH_2COONH_4

C $(NH_2)_2CO$

D NH_4COONH_4

9 How many sodium ions are there in 30 g of sodium sulfate?

A 1.52×10^{23} **B** 2.54×10^{23} **C** 6.02×10^{23} **D** 1.20×10^{24}

10 Three compounds are listed.

copper(II) nitrate, $Cu(NO_3)_2$

zinc sulfate, $ZnSO_4$

sodium thiosulfate, $Na_2S_2O_3$

Which row shows the element that is present in the greatest percentage by mass in each compound?

[relative formula masses, M_r: $Cu(NO_3)_2$, 188; $ZnSO_4$, 161; $Na_2S_2O_3$, 158]

	copper(II) nitrate	zinc sulfate	sodium thiosulfate
A	copper	oxygen	oxygen
B	copper	oxygen	sulfur
C	oxygen	zinc	sodium
D	oxygen	zinc	sulfur

11 The complete combustion of 20 cm^3 of a gaseous alkane, X, requires 130 cm^3 of oxygen. Both volumes are measured at r.t.p.

What could be the identity of X?

A butane

B ethane

C methane

D propane

12 Aqueous copper(II) sulfate is electrolysed with copper electrodes.

What is the equation for the reaction occurring at the anode?

A $Cu \rightarrow Cu^{2+} + 2e^-$

B $Cu^{2+} + 2e^- \rightarrow Cu$

C $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

D $2SO_4^{2-} + 2H_2O \rightarrow 2H_2SO_4 + O_2 + 4e^-$

13 Three statements about fuel cells are given.

1 A hydrogen-oxygen fuel cell requires a continuous input of fuel and oxygen.

2 In a hydrogen-oxygen fuel cell, hydrogen is burned in oxygen to produce electricity.

3 When a hydrogen-oxygen fuel cell is operating, water is the only chemical product.

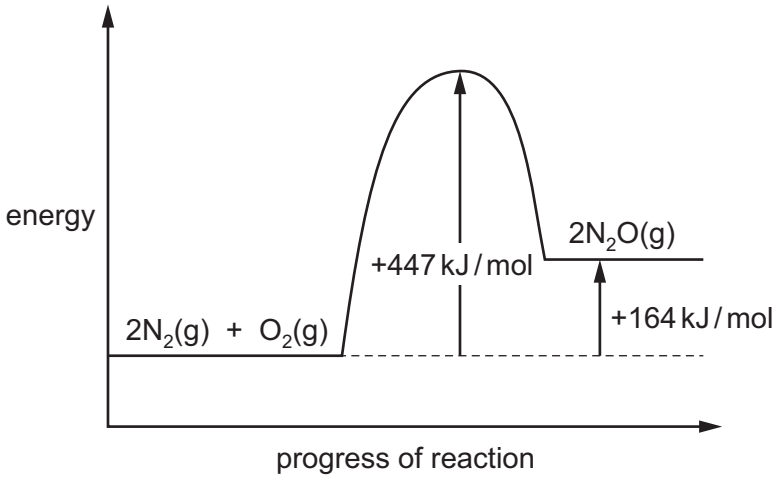
Which statements are correct?

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

14 Under certain conditions, nitrogen reacts with oxygen to form N_2O.

$$2N_2(g) + O_2(g) \rightleftharpoons 2N_2O(g)$$

The reaction pathway diagram is shown.



What is the activation energy of the reverse reaction?

A –447 kJ / mol

B –283 kJ / mol

C +141.5 kJ / mol

D +283 kJ / mol

15 Hydrogen and bromine react to form hydrogen bromide.

$$H_2 + Br_2 \rightarrow 2HBr$$

Bond energy data is given in the table.

bond	bond energy in kJ / mol
H–H	436
Br–Br	193
H–Br	366

What is the enthalpy change, ΔH, for this reaction?

A –263 kJ / mol

B –103 kJ / mol

C +103 kJ / mol

D +263 kJ / mol

16 Octane, C_8H_{18}, is a hydrocarbon.

When octane is mixed with an excess of oxygen, no change takes place unless energy is supplied.

If energy is supplied, in the form of heat or an electric spark, a change takes place quickly.

The products of this change include carbon dioxide.

Which part of this description shows that the change is a **chemical** change?

A Octane is a hydrocarbon.

B No change takes place unless energy is supplied.

C The change takes place quickly.

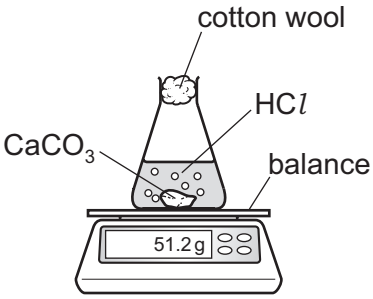
D Carbon dioxide is produced.

17 A student plans to investigate how the rate of the reaction changes when hydrochloric acid and calcium carbonate react.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

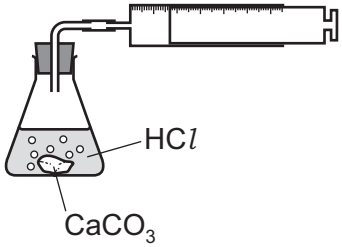
Three methods are described.

1



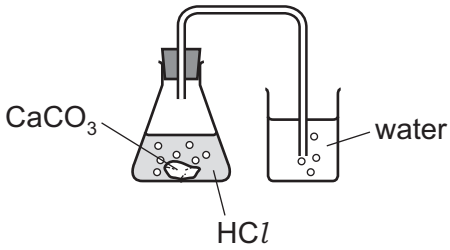
Record the mass of the flask and contents every 30 seconds for 5 minutes.

2



Measure and record the volume of gas in the syringe after 30 seconds.

3



Count and record the total number of bubbles of gas in the water every 30 seconds for 5 minutes.

Which methods could be used to measure how the rate of reaction changes?

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

18 Aqueous bromine is an equilibrium mixture.

$$Br_2(aq) + H_2O(l) \rightleftharpoons OBr^-(aq) + Br^-(aq) + 2H^+(aq)$$

Aqueous bromine is orange in colour. The species on the right-hand side of the equation are colourless.

Changes are made to three separate portions of the equilibrium mixture.

Which row shows how the colour of the mixture changes when a small amount of each substance is added?

	adding sulfuric acid	adding solid sodium bromide	adding water
A	darker orange	darker orange	darker orange
B	darker orange	darker orange	paler orange
C	darker orange	paler orange	darker orange
D	paler orange	darker orange	paler orange

19 In which substance does the nitrogen atom have the same oxidation number as the nitrogen atom in HNO_2?

Assume the following oxidation numbers for the other elements in these compounds: H, +1; F, –1; O, –2.

A NF_3 **B** NH_4^+ **C** NO **D** NO_2^+

20 Limewater is aqueous calcium hydroxide.

Which statement about limewater is correct?

A It has a pH below 7.

B It gives a blue-green colour in the flame test.

C It reacts with ammonia to form an ammonium salt.

D It turns yellow when methyl orange is added.

21 Which two oxides will both react with aqueous sodium hydroxide?

A calcium oxide and copper(II) oxide

B calcium oxide and zinc oxide

C copper(II) oxide and sulfur dioxide

D sulfur dioxide and zinc oxide

22 A solution of sodium carbonate is added to tap water.

A white precipitate forms.

Which ion present in the tap water causes the precipitate to form?

A chloride

B magnesium

C potassium

D sulfate

23 The characteristic properties of elements change from left to right across Period 2 of the Periodic Table.

On the left of the period, the charge on the ion formed by an element is:

1 the same as the group number

2 negative.

Which statements are correct?

A both 1 and 2

B 1 only

C 2 only

D neither 1 nor 2

24 Which statement about the Group VII halogens is correct?

A Bromine consists of Br_2 molecules at room temperature and pressure.

B Iodine will displace bromine from aqueous potassium bromide.

C The halogens become darker in colour as the relative molecular mass decreases.

D The halogens become more volatile as the relative molecular mass increases.

25 A power cable requires an element that:

1 conducts electricity

2 has a relatively low density

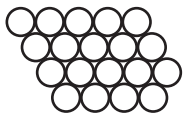
3 is ductile.

Which of these properties does aluminium have?

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

26 Which diagram represents the structure of an alloy?

A



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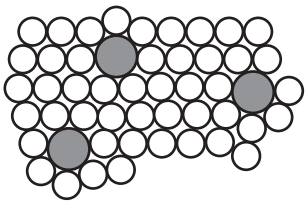

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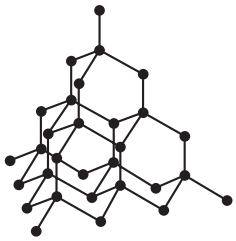

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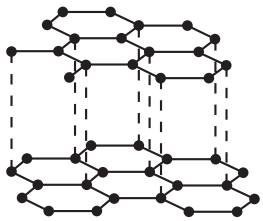


27 Most metals react with oxygen in the air to form a metal oxide.

Which metal forms a metal oxide layer that reduces its apparent reactivity?

A aluminium

B copper

C iron

D silver

28 Which statement about corrosion of metals is correct?

A A barrier method is needed to prevent the corrosion of stainless steel.

B Iron corrodes to produce hydrated iron(I) oxide.

C Sacrificial protection uses a less reactive metal attached to the metal object that is being protected.

D When corrosion occurs, the metal loses electrons to become positive ions.

29 Some metals and the compounds in their ores are shown.

metal	A*l*	Ca	Pb	Na	Fe	Mg
compound in ore	Al_2O_3	$CaCO_3$	PbS	NaC*l*	Fe_2O_3	$MgCO_3$

Which type of reaction occurs in the extraction of each of these metals from its ore?

A decomposition by heat

B electrolysis

C precipitation

D reduction

30 Which statement about natural sources of water and the domestic water supply is correct?

A Chlorine is used to remove tastes and odours in the treatment of the domestic water supply.

B Metal compounds from detergents can deoxygenate natural sources of water.

C Photosynthesis provides the oxygen needed for aquatic life in natural sources of water.

D Sedimentation removes nitrates in the treatment of the domestic water supply.

31 Gases that may be present in the air are listed.

1 neon

2 carbon monoxide

3 nitrogen

4 methane

Which gases are atmospheric pollutants?

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

32 Which compounds are in the same homologous series?

A $CH_3CH_2CH_2CH_3$, $CH_3CHCHCH_3$ and $CH_3CH(CH_3)CH_3$

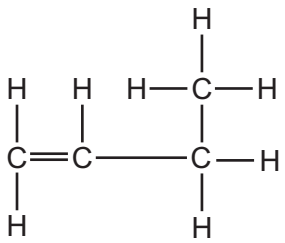
B CH_2CHCH_3, $CH_3CH_2CHCH_2$ and $CH_2CHCH_2CH_3$

C $CH_3CHOHCH_3$, $CH_3CH_2CH_2OH$ and CH_3CH_2COOH

D $CH_3CH_2CH_3$, $CH_3CH_2CH_2CH_3$ and $CH_2CHCH_2CH_2CH_3$

33 The diagrams show four structures of C_4H_8.

1



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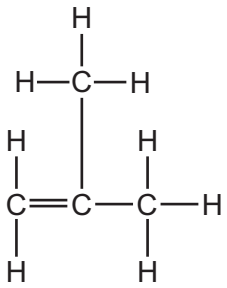

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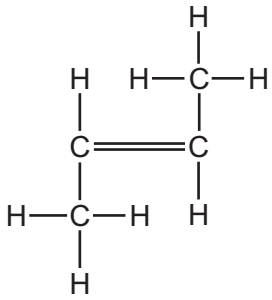

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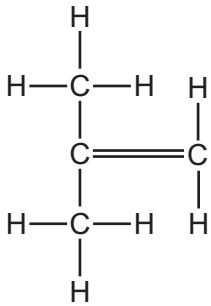
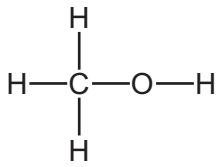


Which structures represent the same molecule?

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

34 The displayed formulae of two organic compounds are shown.

1



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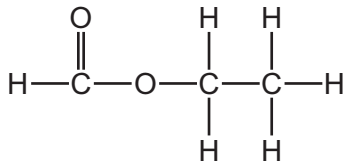


What are the names of these compounds?

	compound 1	compound 2
A	methanoic acid	ethyl methanoate
B	methanoic acid	methyl ethanoate
C	methanol	ethyl methanoate
D	methanol	methyl ethanoate

35 Two products of the separation of petroleum are the lubricating oil fraction and the kerosene / paraffin fraction.

Which statement is correct?

A The lubricating oil fraction is more viscous than the kerosene / paraffin fraction.

B The lubricating oil fraction is more volatile than the kerosene / paraffin fraction.

C The lubricating oil fraction has lower boiling points than the kerosene / paraffin fraction.

D Molecules in the lubricating oil fraction have smaller chain lengths than molecules in the kerosene / paraffin fraction.

36 An incomplete equation for the reaction of propane with chlorine is shown.

$$C_3H_8 + Cl_2 \rightarrow C_3H_7Cl + X$$

A student writes three statements about this reaction.

1 The activation energy for this reaction is provided by ultraviolet light.

2 C_3H_7Cl has two different structural formulae.

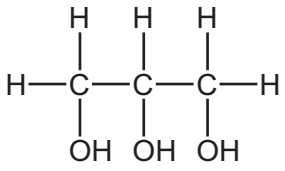
3 X is an acidic gas.

Which statements are correct?

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

37 Glycerol is an alcohol with three –OH groups per molecule.

glycerol



What is the equation for the combustion of glycerol?

A $C_3H_8O_3 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

B $2C_3H_8O_3 + 3O_2 \rightarrow 6CO_2 + 8H_2$

C $2C_3H_8O_3 + 7O_2 \rightarrow 6CO_2 + 8H_2O$

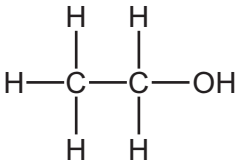
D $4C_3H_5O_3 + 11O_2 \rightarrow 12CO_2 + 10H_2O$

38 Compound X decolourises acidified aqueous potassium manganate(VII).

Compound X has the empirical formula C_2H_5O.

Some possible structures of X are shown.

1



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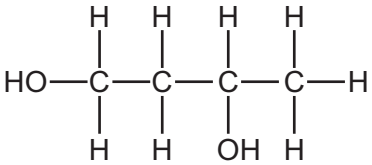

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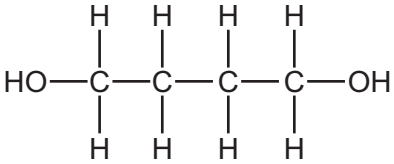

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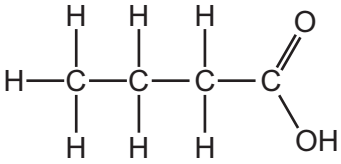


Which structures could be correct for compound X?

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

39 Which statement is correct?

A A filtrate is left on the filter paper during filtration.

B A saturated solution contains only substances with single bonds.

C A solute is a substance that dissolves a solvent.

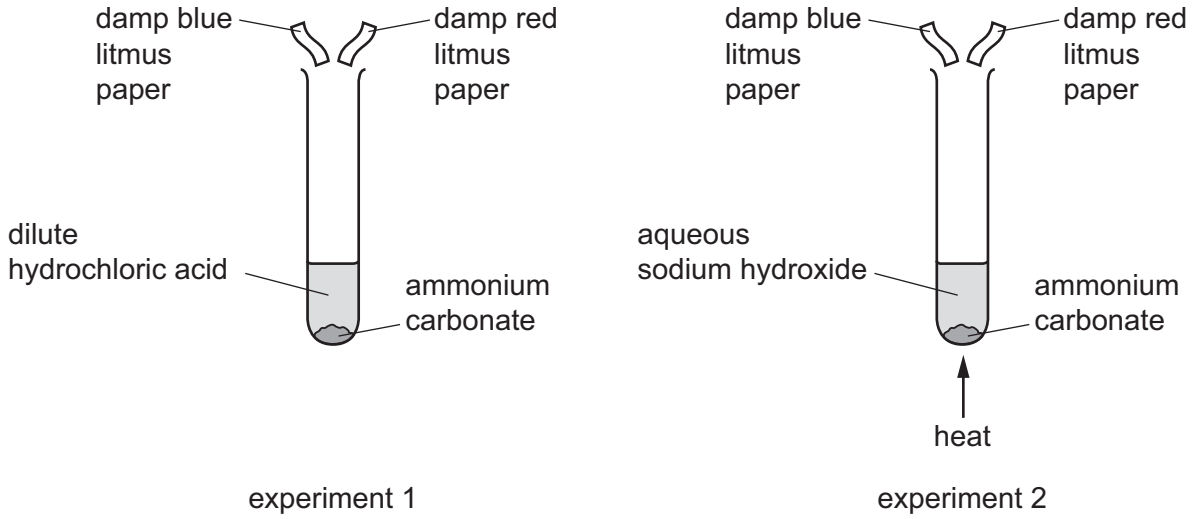
D A solution can never be described as pure.

40 A student does two experiments.

In experiment 1, ammonium carbonate is reacted with dilute hydrochloric acid.

In experiment 2, ammonium carbonate is heated with aqueous sodium hydroxide.

In each experiment, the gas evolved is tested with damp blue litmus paper and damp red litmus paper.



Which row correctly shows the colour of both pieces of litmus paper at the end of each experiment?

	experiment 1	experiment 2
A	blue	blue
B	blue	red
C	red	blue
D	red	red

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The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

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 –

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.).