Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CHEMISTRY **0620/21**

Paper 2 Multiple Choice (Extended) **May/June 2019**

45 minutes

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

* 7 3 1 1 4 1 1 1 6 3 *

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.
DO **NOT** WRITE IN ANY BARCODES.

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 separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 16.
Electronic calculators may be used.

This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **16** printed pages.

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1 Which statement explains why ammonia gas, NH_3, diffuses at a faster rate than hydrogen chloride gas, HCl?

A Ammonia expands to occupy all of the space available.

B Ammonia has a smaller relative molecular mass than hydrogen chloride.

C Ammonia is an alkali and hydrogen chloride is an acid.

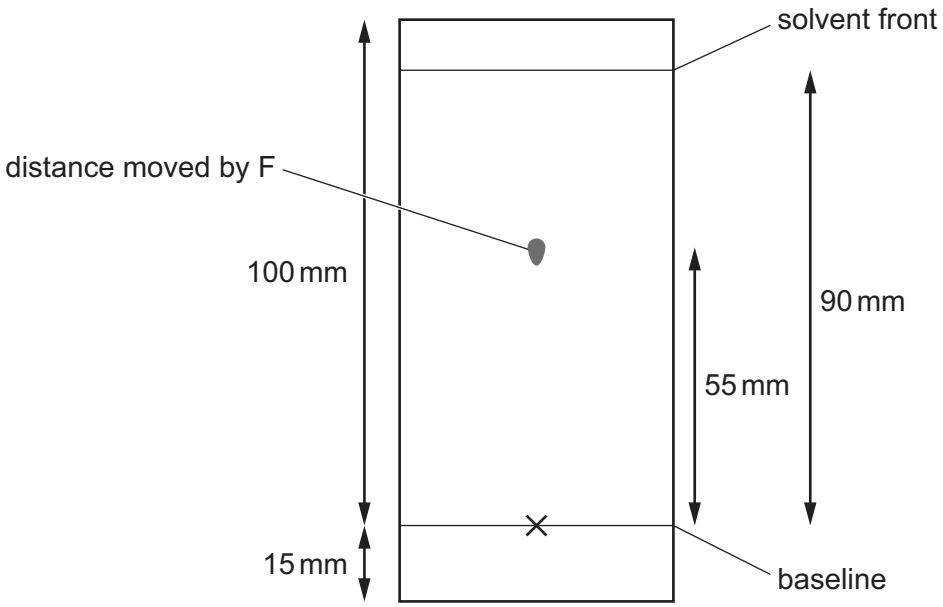
D Ammonia molecules diffuse in all directions at the same time.

2 2.00 g of powdered calcium carbonate is added to 50.0 cm^3 of hydrochloric acid.

Which apparatus is used to measure the calcium carbonate and the hydrochloric acid?

	calcium carbonate	hydrochloric acid
A	balance	burette
B	balance	thermometer
C	pipette	burette
D	pipette	thermometer

3 The measurements from a chromatography experiment using substance F are shown. The diagram is not drawn to scale.



What is the R_f value of F?

A 0.55 **B** 0.61 **C** 0.90 **D** 1.64

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4 Which statement about an atom of fluorine, $^{19}_{9}F$, is correct?

A It contains more protons than neutrons.

B It contains a total of 28 protons, neutrons and electrons.

C Its isotopes contain different numbers of protons.

D Its nucleus contains 9 neutrons.

5 Which row describes the formation of single covalent bonds in methane?

A	atoms share a pair of electrons	both atoms gain a noble gas electronic structure
B	atoms share a pair of electrons	both atoms have the same number of electrons in their outer shell
C	electrons are transferred from one atom to another	both atoms gain a noble gas electronic structure
D	electrons are transferred from one atom to another	both atoms have the same number of electrons in their outer shell

6 Which statement describes the structure of an ionic compound?

A It is a giant lattice of oppositely charged ions.

B It is a giant lattice of positive ions in a 'sea' of electrons.

C It is a giant molecule of oppositely charged ions.

D It is a simple molecule of oppositely charged ions.

7 Propane burns in oxygen.

$$C_3H_8 + xO_2 \rightarrow 3CO_2 + yH_2O$$

Which values of *x* and *y* balance the equation?

	x	*y*
A	5	4
B	7	4
C	10	8
D	13	8

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[Turn over

8 A tablet contains 0.080 g of ascorbic acid (M_r = 176).

What is the concentration of ascorbic acid when one tablet is dissolved in 200 cm^3 of water?

A 9.1×10^{-5} mol / dm^3

B 4.5×10^{-4} mol / dm^3

C 9.1×10^{-2} mol / dm^3

D 2.3×10^{-3} mol / dm^3

9 Which statement about the electrolysis of copper(II) sulfate solution using carbon electrodes is correct?

A A colourless gas is produced at the anode.

B A colourless gas is produced at the cathode.

C The colour of the electrolyte remains the same.

D The mass of both electrodes remains constant.

10 Aluminium metal is extracted from aluminium oxide by electrolysis.

Which ionic half-equation describes a reaction that occurs at the named electrode?

	ionic half-equation	electrode
A	$2O^{2-} \rightarrow O_2 + 2e^-$	anode
B	$Al^{3+} + 3e^- \rightarrow Al$	anode
C	$2O^{2-} \rightarrow O_2 + 4e^-$	cathode
D	$Al^{3+} + 3e^- \rightarrow Al$	cathode

11 Which statement about the hydrogen fuel cell is **not** correct?

A Chemical energy is converted into electrical energy.

B Hydrogen is oxidised.

C The reaction that takes place is endothermic.

D Water is the only product.

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12 Nitrogen reacts with hydrogen to produce ammonia.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

The reaction is exothermic. The bond energies are shown in the table.

bond	bond energy in kJ / mol
N≡N	945
H–H	436
N–H	390

What is the energy change for this reaction?

A –1473 kJ / mol

B –87 kJ / mol

C 87 kJ / mol

D 1473 kJ / mol

13 Which change in reaction conditions increases both the collision rate and the proportion of molecules with sufficient energy to react?

A addition of a catalyst

B increasing the concentration of a reactant

C increasing the surface area of a reactant

D increasing the temperature of the reaction

14 When blue-green crystals of nickel(II) sulfate are heated, water is produced and a yellow solid remains. When water is added to the yellow solid, the blue-green colour returns.

Which process describes these changes?

A combustion

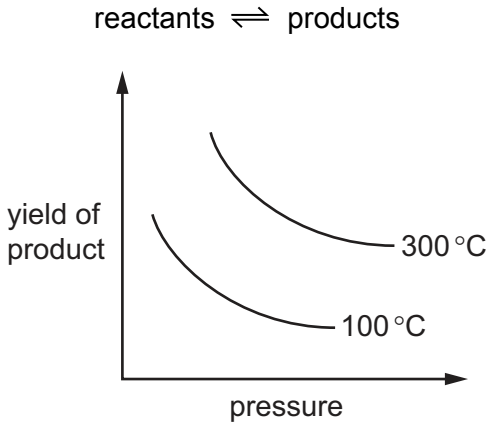
B corrosion

C neutralisation

D reversible reaction

15 The graph shows how the yield of product in a reversible reaction changes as the temperature and pressure are changed.

All reactants and products are gases.



Which row is correct for this reversible reaction?

	side of reaction with fewer moles	forward reaction
A	reactant	exothermic
B	reactant	endothermic
C	product	endothermic
D	product	exothermic

16 Which changes represent oxidation?

1 $2I^- \rightarrow I_2 + 2e^-$

2 $Cr(VI) \rightarrow Cr(III)$

3 $Fe(II) \rightarrow Fe(III)$

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

17 Nitrogen(I) oxide, N_2O, nitrogen(II) oxide, NO, and carbon monoxide, CO, are all non-metal oxides.

They do not react with acids or bases.

Which statement is correct?

A They are acidic oxides.

B They are amphoteric oxides.

C They are basic oxides.

D They are neutral oxides.

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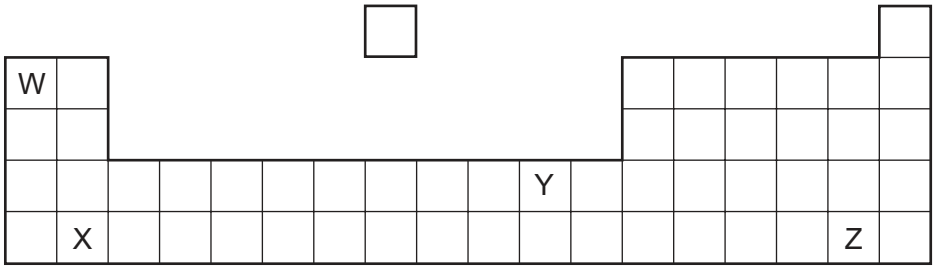
18 The positions of elements W, X, Y and Z in the Periodic Table are shown.



Which elements form basic oxides?

A W, X and Y **B** W and X only **C** Y only **D** Z only

19 Ethanoic acid is a weak acid.

Hydrochloric acid is a strong acid.

Which statements are correct?

1 Ethanoic acid molecules are partially dissociated into ions.

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.

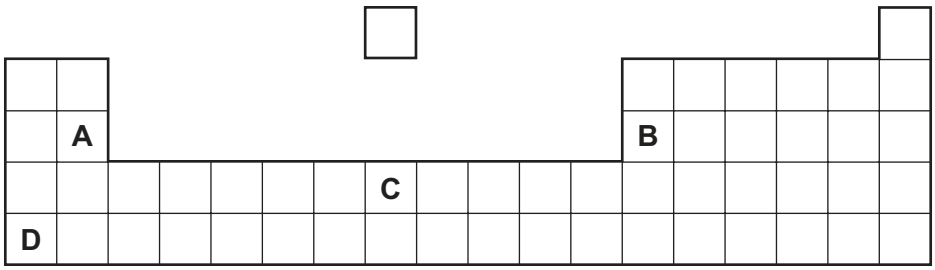
4 Ethanoic acid is a proton acceptor.

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

20 The properties of an element are shown.

electrical conductivity	density	reaction with water
high	low	reacts violently with cold water

Which element has these properties?



21 Which statement about elements in Group I and Group VII of the Periodic Table is correct?

A Bromine reacts with potassium chloride to produce chlorine.

B Iodine is a monatomic non-metal.

C Lithium has a higher melting point than potassium.

D Sodium is more reactive with water than potassium.

22 Which statement about elements in Group VIII of the Periodic Table is correct?

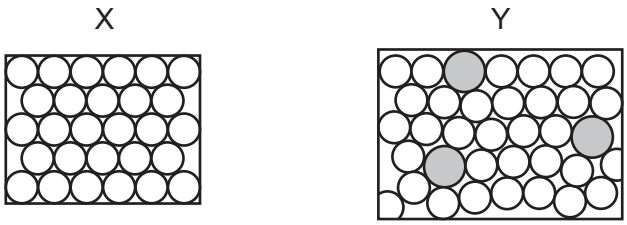
A They all have a full outer shell of electrons.

B They all react with Group I elements to form ionic compounds.

C They are all diatomic molecules.

D They are all liquids at room temperature.

23 The diagrams show the structure of two substances used to make electrical conductors.



Which statement correctly describes X and Y?

A X is a pure metal and Y is a compound.

B X is a pure metal and Y is an alloy.

C X is a solid and Y is a liquid.

D X is harder and stronger than Y.

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24 Three metal compounds, P, Q and R, are heated using a Bunsen burner.

The results are shown.

P colourless gas produced, which relights a glowing splint

Q colourless gas produced, which turns limewater milky

R no reaction

Which row shows the identity of P, Q and R?

	P	Q	R
A	magnesium carbonate	potassium carbonate	potassium nitrate
B	magnesium carbonate	potassium nitrate	potassium carbonate
C	potassium nitrate	magnesium carbonate	potassium carbonate
D	potassium nitrate	potassium carbonate	magnesium carbonate

25 Zinc is extracted from its ore, zinc blende, using two chemical reactions.

1 $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$

2 $2ZnO + C \rightarrow 2Zn + CO_2$

Which substance is reduced in reactions 1 and 2?

	reaction 1	reaction 2
A	O_2	C
B	O_2	ZnO
C	ZnS	C
D	ZnS	ZnO

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26 Four metals, zinc, M, copper and magnesium, are reacted with aqueous solutions of their nitrates.

The results are shown.

metal	magnesium nitrate	M nitrate	copper nitrate	zinc nitrate
magnesium		✓	✓	✓
zinc	✗	✓	✓	
M	✗		✓	✗
copper	✗	✗		✗

key

✓ = reacts

✗ = no reaction

What is the order of reactivity of these four metals starting with the most reactive?

A copper → zinc → M → magnesium

B copper → M → zinc → magnesium

C magnesium → M → zinc → copper

D magnesium → zinc → M → copper

27 Why is aluminium used to make containers for storing food?

A It conducts electricity.

B It has a high melting point.

C It is resistant to corrosion.

D It is strong.

28 Water can be treated by filtration then chlorination.

Which uses do **not** need water of this quality?

1 water for cooling in industry

2 water for washing clothes

3 water for drinking

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

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29 Oxides of nitrogen are formed in car engines and are a source of air pollution.

To decrease this pollution, catalytic converters are fitted to car exhausts.

What happens to the oxides of nitrogen in the catalytic converter?

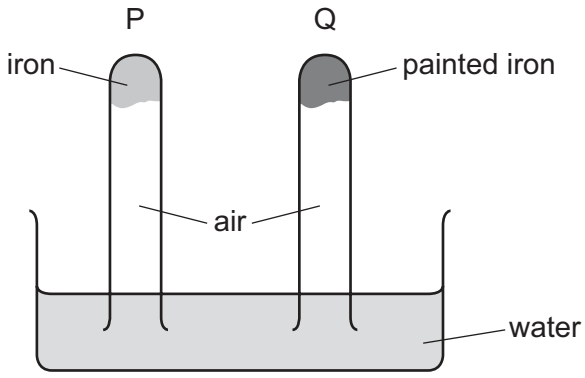
A combustion

B cracking

C oxidation

D reduction

30 The diagram shows an experiment to investigate how paint affects the rusting of iron.



What happens to the water level in tubes P and Q?

	tube P	tube Q
A	falls	rises
B	no change	rises
C	rises	falls
D	rises	no change

31 Ammonia is manufactured by the Haber Process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.

Which conditions maximise the yield of ammonia?

	pressure	temperature
A	high	high
B	high	low
C	low	high
D	low	low

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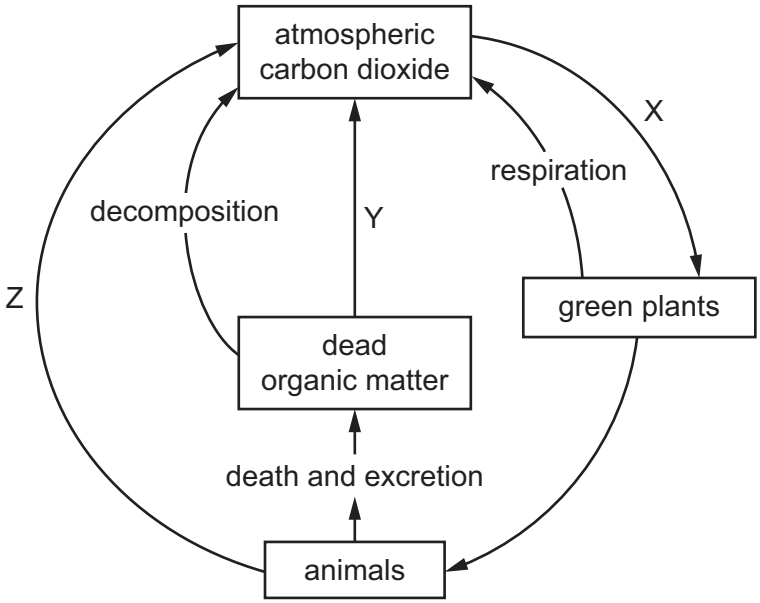
[Turn over

32 The carbon cycle is shown.



Which row describes processes X, Y and Z?

	X	Y	Z
A	respiration	combustion	photosynthesis
B	respiration	photosynthesis	combustion
C	photosynthesis	combustion	respiration
D	photosynthesis	respiration	combustion

33 Which row shows the conditions used in the Contact process?

	temperature / °C	pressure / atm	catalyst
A	25	2	iron
B	25	200	iron
C	450	2	vanadium(V) oxide
D	450	200	vanadium(V) oxide

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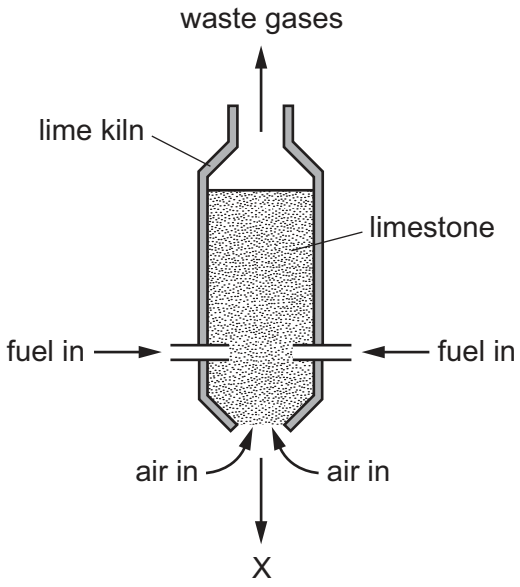
34 The diagram represents a lime kiln used to heat limestone to a very high temperature.



What leaves the kiln at X?

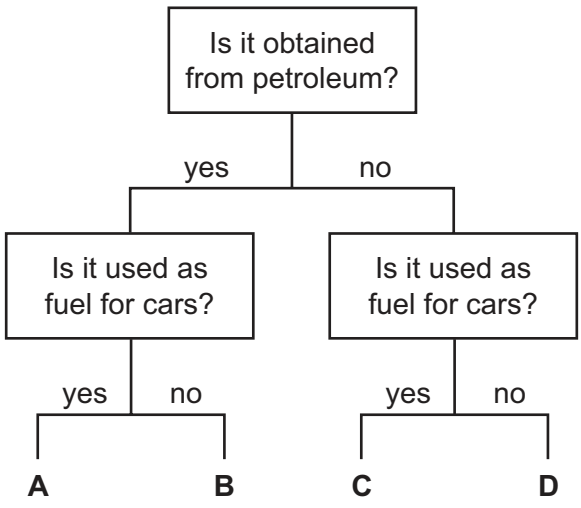
A calcium carbonate

B calcium hydroxide

C calcium oxide

D calcium sulfate

35 Which fuel could be gasoline?



36 Why is ethanol a member of the homologous series of alcohols but propane is **not**?

A Ethanol has two carbon atoms per molecule but propane has three.

B Ethanol can be made from ethene but propane is obtained from petroleum.

C Ethanol is a liquid but propane is a gas.

D Ethanol contains the same functional group as other alcohols but propane does not.

37 Chlorine reacts with methane.

Which statements are correct?

1 The reaction takes place in the dark.

2 The reaction of chlorine with methane forms chloromethane.

3 Chloromethane reacts with chlorine to produce dichloromethane.

4 The reaction of chlorine with methane is an addition reaction.

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

38 Which statements about aqueous ethanoic acid are correct?

1 Ethanoic acid contains the functional group –COOH.

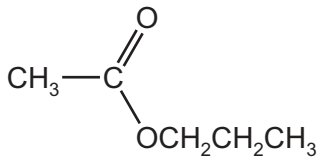
2 Ethanoic acid reacts with carbonates to produce hydrogen.

3 Ethanoic acid turns Universal Indicator paper blue.

4 Ethanoic acid has a pH lower than pH 7.

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

39 The structure of an ester is shown.



What is the name of the ester?

A ethyl propanoate

B methyl propanoate

C propyl ethanoate

D propyl methanoate

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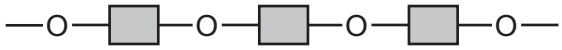
40 The structure of a polymer is shown.



Which type of polymer is shown and by which process is it formed?

	type of polymer	formed by
A	carbohydrate	addition polymerisation
B	carbohydrate	condensation polymerisation
C	polyester	addition polymerisation
D	polyester	condensation polymerisation

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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.).