Cambridge Assessment International Education

Cambridge O Level

CHEMISTRY **5070/11**

Paper 1 Multiple Choice **May/June 2024**

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.

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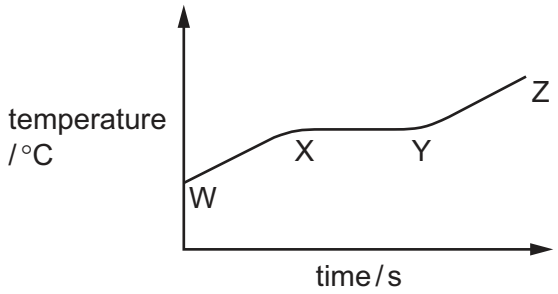
1 A scientist heats a sample of a liquid. The scientist measures the temperature of the sample and plots a graph of the temperature against time.



Which statements are correct?

1 Between points W and X, the temperature increases and the particles move faster.

2 Between points X and Y, there is no change in the temperature because energy is needed to change a liquid into a gas.

3 Between points Y and Z, the particles move further apart.

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

2 A sample of substance X contains iron and sulfur only.

[A_r: Fe, 56; S, 32]

In which row is it possible for both statements about X to be correct?

	statement 1	statement 2
A	X is a mixture with the ratio 4 : 7 by mass of iron and sulfur	X is a compound with the ratio 4 : 7 by mass of iron and sulfur
B	X is a mixture with the ratio 7 : 4 by mass of iron and sulfur	X is a compound with the ratio 7 : 4 by mass of iron and sulfur
C	X is a mixture with the formula FeS	X is a compound with the formula FeS
D	X is a mixture with the formula $FeSO_4$	X is a compound with the formula $FeSO_4$

3 A chlorine atom, Z, has a nucleon number of 37.

Which row is correct?

	number of neutrons in Z	number of electrons in the second shell of Z
A	17	7
B	17	8
C	20	7
D	20	8

4 Which particles are isotopes of the same element?

particle	electrons	neutrons	protons
W	22	28	25
X	23	28	25
Y	26	30	26
Z	26	28	26

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

5 Statements about graphite and silicon(IV) oxide, SiO_2, are given.

Which statement is correct?

A Silicon(IV) oxide is found as an impurity in iron ore.

B The angles between the atoms in silicon(IV) oxide and graphite are the same.

C The melting points of silicon(IV) oxide and graphite are high because ionic bonds are stronger than covalent bonds.

D When graphite acts as a lubricant, the covalent bonds between the layers are broken.

6 Statements about empirical and molecular formulae are given.

Which statement is correct?

A The empirical and molecular formulae of a compound are always different.

B The empirical formulae of ethyne, C_2H_2, and of benzene, C_6H_6, are the same.

C The molecular formula always shows the simplest whole-number ratio of the different atoms or ions in a compound.

D The empirical formula always shows the numbers and types of different atoms in one molecule of a compound.

7 What is the relative formula mass, M_r, of aluminium oxide?

A 43 **B** 75 **C** 102 **D** 113

8 How many ions are there in 16.0 g of anhydrous copper sulfate?

A 1.20×10^{23}

B 3.61×10^{23}

C 1.20×10^{24}

D 3.61×10^{24}

9 Which sample contains the most atoms?

A 0.5 mol of water

B 1.0 mol of carbon dioxide

C 1.0 mol of methane

D 2.0 mol of hydrogen chloride

10 The reactions shown all produce hydrogen.

Which reaction produces the greatest volume of hydrogen, measured at room temperature and pressure?

A 1.4 g carbon reacts with excess steam.

$$C(s) + H_2O(g) \rightarrow H_2(g) + CO(g)$$

B 2.4 g calcium hydride, CaH_2, reacts with excess water.

$$CaH_2(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + 2H_2(g)$$

C 4.0 g calcium reacts with excess dilute hydrochloric acid.

$$Ca(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2(g)$$

D 50 cm^3 of 2.0 mol / dm^3 sulfuric acid reacts with excess zinc.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

11 Four solutions of NaOH are made by dissolving solid NaOH in distilled water.

Which method makes a solution with a concentration of 0.10 mol / dm^3?

[M_r: NaOH, 40]

A 1.6 g of NaOH(s) to make 400 cm^3 of solution

B 3.2 g of NaOH(s) to make 250 cm^3 of solution

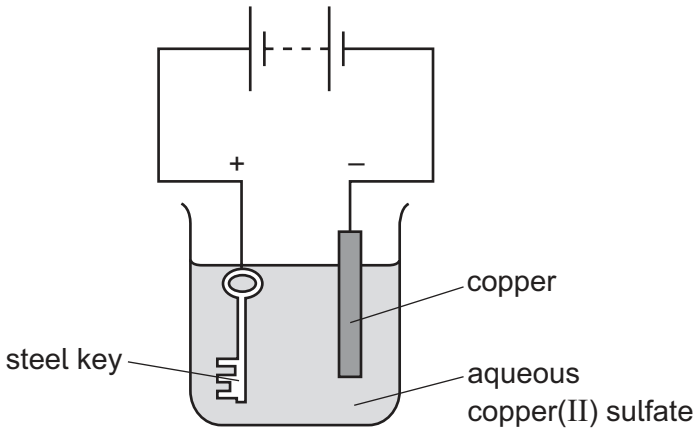
C 4.0 g of NaOH(s) to make 100 cm^3 of solution

D 8.0 g of NaOH(s) to make 500 cm^3 of solution

12 Which row shows the substances that can be electrolysed?

	aqueous sodium chloride	copper	graphite	molten lead(II) bromide
A	✓	✓	✗	✓
B	✓	✗	✗	✓
C	✗	✓	✓	✗
D	✗	✓	✗	✓

13 The apparatus shown is set up to electroplate a steel key with copper.



The key does **not** get coated with copper.

Which change needs to be made to electroplate the key?

A increase the concentration of the aqueous copper(II) sulfate

B increase the electric current

C replace the solution with dilute sulfuric acid

D reverse the electrical connections

14 Ammonium nitrate dissolves in water.

$$NH_4NO_3(s) \xrightarrow{H_2O} NH_4NO_3(aq) \qquad \Delta H = +25\,kJ/mol$$

Which statements are correct?

1 The process is endothermic.

2 The water gets colder during the process.

3 Thermal energy is absorbed by the ammonium nitrate from the water.

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

15 Hydrogen reacts with oxygen to produce water.

$$\begin{matrix} H–H \\ H–H \end{matrix} + O=O \rightarrow \begin{matrix} H–O–H \\ H–O–H \end{matrix}$$

Some bond energies are shown.

bond	bond energy in kJ / mol
H–H	436
O–O	146
O=O	496
O–H	463

Using the data in the table, what is the enthalpy change of reaction?

A –920 kJ / mol

B –834 kJ / mol

C –484 kJ / mol

D +442 kJ / mol

16 Silicon(IV) chloride, $SiCl_4$, boils at 58 °C.

Which row shows the type of change when silicon(IV) chloride boils and the explanation?

	type of change	explanation
A	chemical	intermolecular forces break
B	chemical	Si–Cl covalent bonds break
C	physical	intermolecular forces break
D	physical	Si–Cl covalent bonds break

17 A 2 g sample of calcium carbonate reacts with dilute hydrochloric acid as shown.

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

Which change in conditions makes the reaction proceed more slowly?

A increasing the acid concentration

B increasing the size of the solid particles

C increasing the surface area of the solid particles

D increasing the temperature

18 Excess aluminium reacts with dilute hydrochloric acid.

$$2Al + 6HCl \rightarrow 3H_2 + 2AlCl_3$$

The hydrogen given off is collected in a gas syringe. The total volume of hydrogen in the gas syringe is recorded every two minutes. The results of this experiment are shown.

time / min	total volume / cm^3
0	0
2	3
4	53
6	103
8	131
10	141
12	143
14	143

Which statement is correct?

A The mass of aluminium added is 0.107 g.

B The mass of aluminium added cannot be determined from the information given.

C The highest rate of reaction is 71.5 cm^3 / min.

D The highest rate of reaction is when the acid concentration is highest.

[Turn over

19 157.75 g of bismuth(III) chloride, $BiCl_3$, is used to make 500 cm^3 of solution using distilled water.

The aqueous bismuth(III) chloride slowly becomes cloudy as it reacts with water to form insoluble BiOCl.

The reaction is reversible.

$$BiCl_3(aq) + H_2O(l) \rightleftharpoons BiOCl(s) + 2HCl(aq)$$

Which statements are correct?

1 The initial concentration of the bismuth(III) chloride solution is 1.0 mol/dm^3.

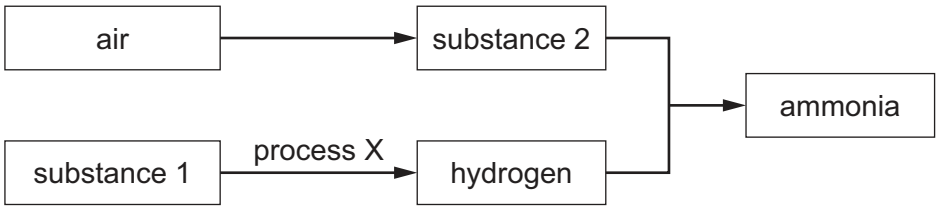
2 At equilibrium, the rate of the forward reaction equals the rate of the reverse reaction.

3 When more hydrochloric acid is added, the position of equilibrium moves to the left.

[A_r: Bi, 209; Cl, 35.5]

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

20 The flow chart shows some of the processes and reactions in the formation of ammonia.



What are the names of process X, substance 1 and substance 2?

	process X	substance 1	substance 2
A	cracking	long-chain alkanes	nitrogen
B	cracking	long-chain alkenes	oxygen
C	fractional distillation	long-chain alkanes	nitrogen
D	fractional distillation	long-chain alkenes	oxygen

21 Many reactions involve oxidation and reduction.

Which statement is correct?

A Acidified manganate(VII) ions change colour from colourless to purple when reduced.

B All reactions that involve oxidation also involve reduction.

C During a reaction, oxidising agents lose electrons.

D Reduction is the loss of hydrogen from a compound.

22 The equation for a reaction is shown.

$$Cl_2 + 2KBr \rightarrow 2KCl + Br_2$$

Which statement about this reaction is correct?

A Bromide ions are the oxidising agent.

B Bromine is the reducing agent.

C Chloride ions are the reducing agent.

D Chlorine is the oxidising agent.

23 Which row describes both the pH and the ion with the greatest concentration in an aqueous alkali?

	pH	H^+ or OH^- ion with greatest concentration
A	greater than 7	H^+
B	greater than 7	OH^-
C	less than 7	H^+
D	less than 7	OH^-

24 The water in a lake is acidic and the fish are dying. The water in the lake needs to be neutralised so that its pH is close to 7.

Which compound is added in excess to neutralise the water in the lake?

A calcium carbonate

B phosphoric acid

C potassium hydroxide

D sodium nitrate

25 Which pair of reagents is used in a school laboratory to prepare a sample of pure barium sulfate?

A barium carbonate and dilute sulfuric acid

B barium carbonate and sodium sulfate

C barium chloride and sodium sulfate

D barium hydroxide and concentrated sulfuric acid

26 The total number of electrons in one atom of element Q is 17 and in one atom of element R is 19.

Which statement about elements Q and R is correct?

A Q and R react together to form a covalent compound.

B Q forms positive ions.

C R has more outer shell electrons than Q.

D R is more metallic than Q.

27 Which statements about the Group VIII noble gases are correct?

1 They are unreactive.

2 They all have a full outer shell of electrons.

3 They are all diatomic gases at room temperature and pressure.

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

28 Iron has a high melting point.

Which statement explains the high melting point of iron?

A Each iron cation has a strong electrostatic attraction to a ‘sea’ of delocalised electrons.

B In every iron atom there is a strong attraction between the protons and the electrons.

C Iron has the same structure as diamond which has a very high melting point.

D Iron is an alloy and alloys have different physical properties from the elements they contain.

29 Which statement about alloys is correct?

A Alloys are **not** electrical or thermal conductors.

B Alloys are softer than pure metals because the layers in the alloy slip over each other more easily.

C Brass is a mixture of copper with small amounts of chromium, nickel and carbon.

D The percentage of each metal in an alloy may vary.

30 The table shows the reactions of four metals, P, Q, R and S, and their oxides.

	reaction with water	reaction with dilute acid	reaction of oxide with carbon
P	reacts only with steam	reacts rapidly	no reaction
Q	no reaction	reacts slowly	reacts when heated strongly
R	no reaction	no reaction	reacts when heated
S	reacts rapidly	reacts rapidly	no reaction

What is the order of reactivity, from the most reactive to the least reactive metal?

A P > S > Q > R

B P > S > R > Q

C S > P > Q > R

D S > P > R > Q

31 Which reactions take place during the extraction of aluminium from aluminium oxide using carbon electrodes?

1 $2O^{2-} \rightarrow O_2 + 4e^-$

2 $C + O_2 \rightarrow CO_2$

3 $Al^{2+} + 2e^- \rightarrow Al$

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

32 NPK fertilisers are used to improve plant growth.

A solid NPK fertiliser has the properties listed:

- water soluble
- has an aqueous solution with pH 7.

Which substances are mixed to make a solid NPK fertiliser?

A ammonium nitrate, potassium sulfate and phosphorus oxide

B ammonium phosphate and potassium hydroxide

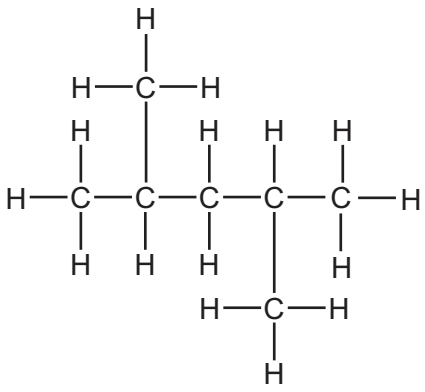
C ammonium sulfate, calcium nitrate and sodium phosphate

D potassium nitrate and sodium phosphate

33 Alkanes are saturated compounds containing carbon and hydrogen only.

Structures 1, 2, 3 and 4 are saturated hydrocarbons.

1



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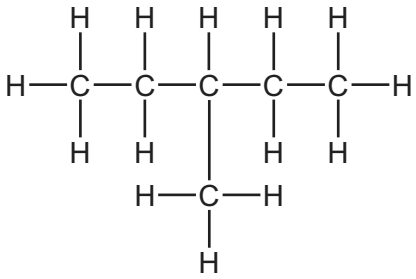

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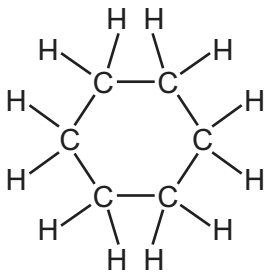

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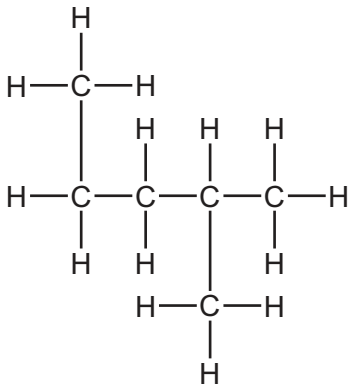


Which pair of structures are isomers?

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

34 Which statement is correct?

A Any compound that contains both hydrogen and carbon is a hydrocarbon.

B Petroleum is a compound formed from many different hydrocarbons.

C The boiling points of hydrocarbons increase when the chain length increases.

D The naphtha fraction obtained from petroleum is used for making roads.

35 Compound Q is a hydrocarbon that has no structural isomers.

Compound Q does **not** decolourise bromine in the dark.

Which compound is Q?

A C_3H_6 **B** C_3H_8 **C** C_4H_8 **D** C_4H_{10}

36 Which equations represent the reactions of alkanes?

1 $CH_4 + Cl_2 \rightarrow CH_2Cl_2 + H_2$

2 $2C_2H_6 + 5O_2 \rightarrow 4CO + 6H_2O$

3 $C_3H_8 + HCl \rightarrow C_3H_7Cl + H_2$

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

37 Ethanol is produced using either ethene or glucose as the starting material.

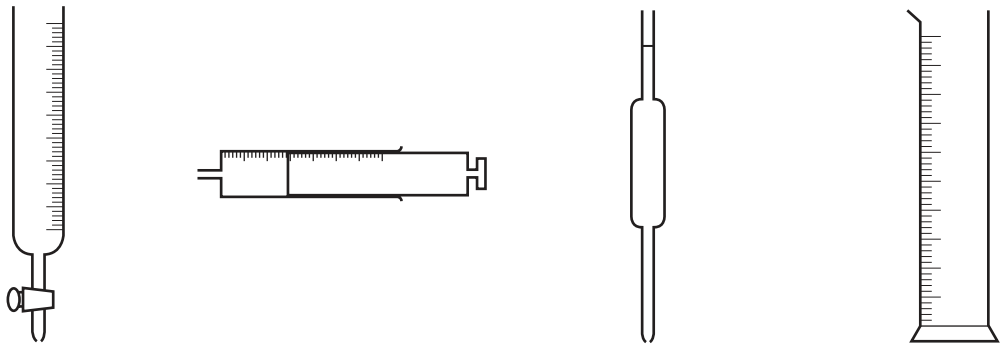
Which row is correct?

	starting material	conditions
A	ethene	catalytic addition of steam at 300 °C and 6000 kPa
B	ethene	catalytic addition of steam at 30 °C and 60 000 kPa
C	glucose	135 °C in the presence of yeast and absence of oxygen
D	glucose	35 °C in the presence of yeast and oxygen

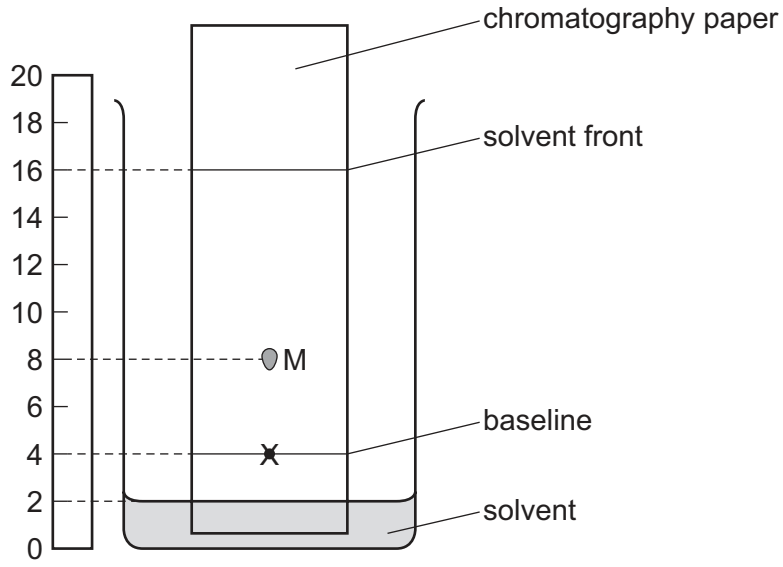
38 The diagram shows four pieces of apparatus that are used to measure the volume of liquid.

Which piece of apparatus is always filled to the same level?

A **B** **C** **D**



39 The chromatogram shown is produced using a spot of black ink placed at point X.



Spot M is produced by a blue dye in the ink.

What is the R_f value of this blue dye?

A 0.22 **B** 0.25 **C** 0.33 **D** 0.43

40 The table shows the results of a series of tests with two substances, X and Y.

test	result with X	result with Y
dilute nitric acid added	no reaction	no reaction
then aqueous silver nitrate added	white precipitate	no precipitate
aqueous sodium hydroxide added	white precipitate, insoluble in excess	no precipitate
then aluminium foil added; warmed gently	no gas produced	ammonia produced
flame test	orange-red flame	yellow flame

Which row shows the identities of the ions present in X and Y?

	X	Y
A	Ca^{2+} and Br^-	Na^+ and NO_3^-
B	Ca^{2+} and Cl^-	Na^+ and I^-
C	Ca^{2+} and Cl^-	Li^+ and NO_3^-
D	Ca^{2+} and Cl^-	Na^+ and NO_3^-

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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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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.).