Cambridge Assessment International Education

Cambridge O Level

CHEMISTRY **5070/12**

Paper 1 Multiple Choice **May/June 2022**

1 hour

You must answer on the multiple choice answer sheet.

9091136550

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.

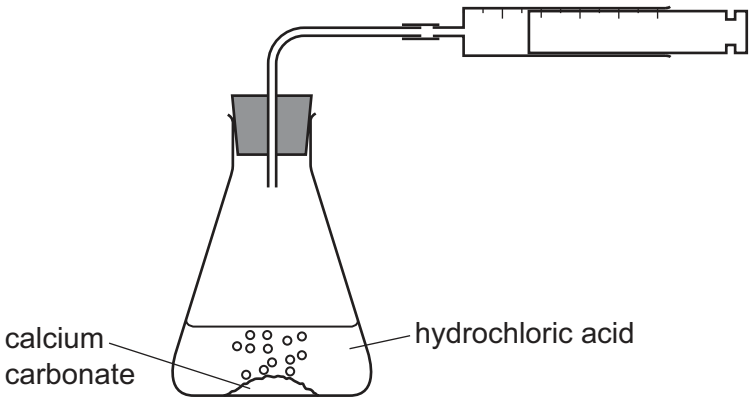
INFORMATION

- 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.

[Turn over

1 A student investigates the rate of reaction between calcium carbonate and hydrochloric acid.



The volume of gas in the syringe is recorded after one minute.

The experiment is repeated using different concentrations of hydrochloric acid.

Which additional pieces of apparatus are essential for the investigation?

1 balance

2 measuring cylinder

3 stop-clock

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

2 Which statement is correct?

A A mixture of liquids with boiling points which differ by 35 °C can be separated by distillation.

B Locating agents are needed to identify the colours present in ink.

C The desalination of sea water to produce pure water is achieved by fractional distillation.

D The R_f value of a dye in a chromatogram can be calculated using the formula:

$$R_f = \frac{\text{distance moved by solvent}}{\text{distance moved by spot}}$$

3 Some reactions of an aqueous solution of compound X are given.

- When a few drops of aqueous sodium hydroxide are added, a white precipitate is formed.
- When dilute nitric acid is added and the mixture is warmed, a gas is formed. The gas decolourises acidified potassium manganate(VII).
- When dilute nitric acid and aqueous barium nitrate are added, no visible reaction occurs.

What can be deduced about the identity of X?

A X contains only aluminium sulfate, $Al_2(SO_4)_3$.

B X contains only calcium sulfite, $CaSO_3$.

C X must contain aluminium sulfite, $Al_2(SO_3)_3$, or zinc sulfite, $ZnSO_3$.

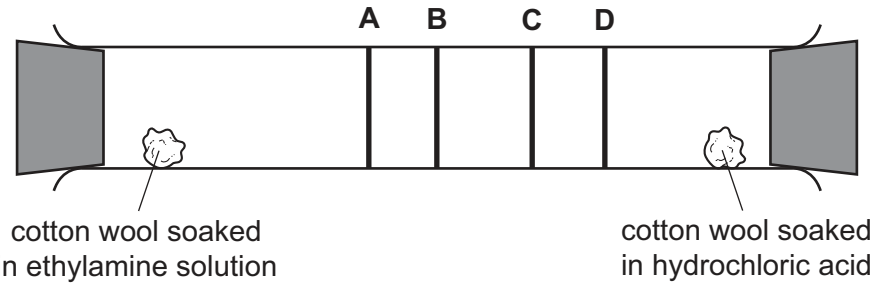
D X must contain aluminium sulfite, $Al_2(SO_3)_3$, calcium sulfite, $CaSO_3$, or zinc sulfite, $ZnSO_3$.

4 Which set of changes to the conditions increases the volume of a gas?

	pressure	temperature
A	decreases	increases
B	increases	decreases
C	increases	unchanged
D	unchanged	decreases

5 Ethylamine gas, $C_2H_5NH_2$, and hydrogen chloride gas, HCl, react together to form a white solid, ethylamine hydrochloride.

At which position in the tube would a ring of solid white ethylamine hydrochloride form?



6 Element X can be represented by the symbol $^{14}_{6}X$.

Which statements about an atom of element X are correct?

1 It has 6 electrons.

2 It has 8 protons.

3 It is an isotope of carbon.

4 It is an isotope of nitrogen.

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

7 Two isotopes of chlorine are ^{35}Cl and ^{37}Cl.

Using these isotopes and ^{12}C and ^{1}H, how many different relative molecular masses are possible for the compound with molecular formula $C_2H_3CCl_3$?

A 2 **B** 3 **C** 4 **D** 5

8 Which row is correct?

	elements	compounds	mixtures
A	graphite, iron	methane, water	air, copper
B	graphite, iron	sand, water	air, brass
C	iron, water	methane, graphite	air, brass
D	water, methane	air, graphite	iron, brass

9 Which statement about ionic compounds is correct?

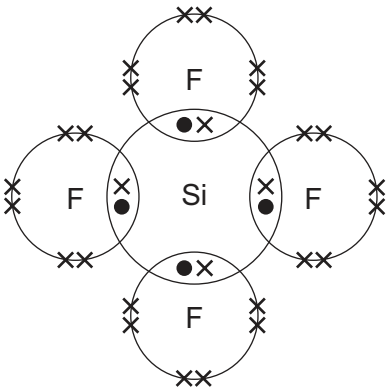
A They are all solids at room temperature.

B They all conduct electricity at room temperature.

C They are all soluble in water.

D They all have strong intermolecular forces.

10 A molecule of tetrafluorosilane, SiF_4, is shown in the dot-and-cross diagram. Only the outer shell electrons are shown.



Which statement is correct?

A Each molecule of SiF_4 has exactly 16 pairs of electrons.

B In SiF_4 both the silicon and the fluorine have the same electronic configuration as neon.

C Molten SiF_4 will conduct electricity.

D SiF_4 has a low melting point.

11 The table describes two properties associated with metals.

Which row shows a correct reason for the stated property?

	property	reason
A	malleable	the layers of metal anions can slide over each other
B	malleable	the layers of metal cations can slide over each other
C	conduct electricity	metallic structures contain mobile anions
D	conduct electricity	metallic structures contain mobile cations

12 Aqueous silver nitrate, $AgNO_3$, reacts with aqueous potassium chromate(VI), K_2CrO_4, to give a yellow precipitate.

What is the ionic equation for this reaction?

A $2AgNO_3(aq) + K_2CrO_4(aq) \rightarrow Ag_2CrO_4(s) + 2KNO_3(aq)$

B $2Ag^+(aq) + 2NO_3^-(aq) + 2K^+(aq) + CrO_4^{2-}(aq) \rightarrow Ag_2CrO_4(s) + 2NO_3^-(aq) + 2K^+(aq)$

C $2Ag^+(aq) + CrO_4^{2-}(aq) \rightarrow Ag_2CrO_4(s)$

D $Ag^+(aq) + CrO_4^-(aq) \rightarrow AgCrO_4(s)$

13 What is the relative formula mass of anhydrous sodium carbonate?

A 51 **B** 83 **C** 106 **D** 124

14 What contains the greatest mass of solute?

A 100 cm^3 of 1.00 mol / dm^3 sodium hydroxide, NaOH

B 500 cm^3 of 0.05 mol / dm^3 sulfuric acid, H_2SO_4

C 1.00 dm^3 of 0.10 mol / dm^3 potassium hydroxide, KOH

D 2.00 dm^3 of 0.01 mol / dm^3 hydrochloric acid, HCl

15 How many tonnes of aluminium oxide, Al_2O_3, are required to produce 27 tonnes of aluminium?

A 27 **B** 51 **C** 54 **D** 102

16 Dilute sulfuric acid is electrolysed. Hydrogen gas and oxygen gas are produced.

Which row correctly describes what happens?

	oxygen produced at the	hydrogen produced at the	concentration of acid
A	anode	cathode	decreases
B	anode	cathode	increases
C	cathode	anode	decreases
D	cathode	anode	increases

17 Aluminium can be extracted by the electrolysis of aluminium oxide dissolved in molten cryolite.

Which reactions take place during the electrolysis?

	reaction at the anode	reaction at the cathode
A	$\mathit{Al}^+ + e^- \rightarrow \mathit{Al}$	$O^{2-} + 2e^- \rightarrow O$
B	$\mathit{Al}^{3+} + 3e^- \rightarrow \mathit{Al}$	$2O^{2-} + 4e^- \rightarrow O_2$
C	$O^{2-} - 2e^- \rightarrow O$	$3\mathit{Al}^+ + 3e^- \rightarrow 3\mathit{Al}$
D	$2O^{2-} - 4e^- \rightarrow O_2$	$\mathit{Al}^{3+} + 3e^- \rightarrow \mathit{Al}$

18 Which reaction is exothermic?

A combustion of methane

B cracking of hydrocarbons

C decomposition of water into hydrogen and oxygen by electrolysis

D photosynthesis in plants

19 What is the correct balanced equation and enthalpy change, ΔH, for the complete combustion of butanol, C_4H_9OH?

A $C_4H_9OH(l) + 5O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$ $\Delta H = -2676\,kJ/mol$

B $C_4H_9OH(l) + 5O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$ $\Delta H = +2676\,kJ/mol$

C $C_4H_9OH(l) + 6O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$ $\Delta H = -2676\,kJ/mol$

D $C_4H_9OH(l) + 6O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$ $\Delta H = +2676\,kJ/mol$

20 Bromate, bromide and hydrogen ions react according to the equation shown.

$$BrO_3^-(aq) + 5Br^-(aq) + 6H^+(aq) \rightarrow 3Br_2(aq) + 3H_2O(l)$$

Some apparatus for measuring how the rate of this reaction varies over time is suggested.

1 gas syringe

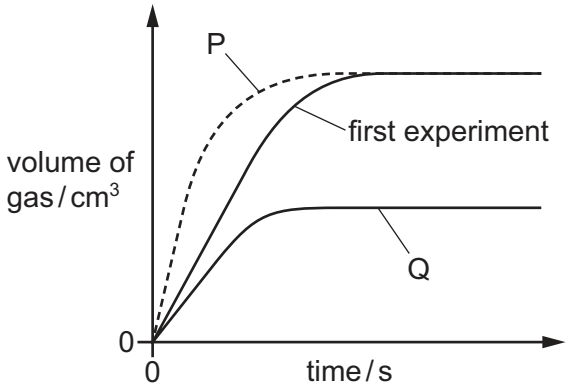
2 balance

3 pH meter

Which apparatus is suitable to measure the rate of this reaction?

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

21 25 cm^3 of 1.0 mol/dm^3 hydrochloric acid reacts with 10 g of a solid to produce a gas. The solid is in excess. The graph labelled first experiment shows the volume of gas produced over time. Graphs P and Q show the volume of gas produced under different conditions.



Which changes in conditions produce graphs P and Q, if all other conditions are kept the same?

A P uses a catalyst and Q has a lower temperature.

B P uses 25 cm^3 of more concentrated acid and Q uses smaller pieces of solid.

C P uses a higher temperature and Q uses 25 cm^3 of more dilute acid.

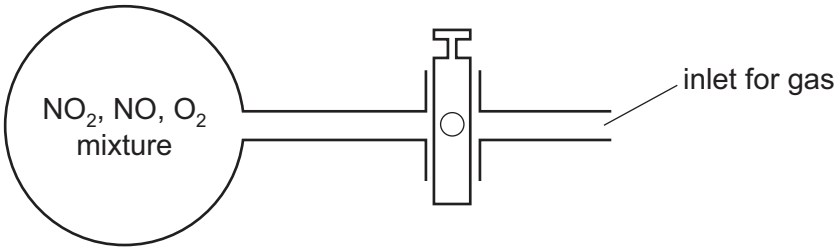
D P uses smaller pieces of solid and Q uses larger pieces of solid.

22 Nitrogen dioxide, NO_2, is a dark brown gas that decomposes as shown in the equation.

$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$$

dark brown colourless

The diagram shows a glass flask containing a mixture of the three gases. The mixture is pale brown.



More oxygen is forced into the flask.

Which colour change is seen in the mixture?

A It becomes a darker brown.

B It becomes a paler brown.

C It turns colourless.

D There is no change.

23 What is an observation of an oxidation process?

A blue copper sulfate crystals turning to white powder when heated

B copper being deposited on the cathode during electrolysis

C green gas being produced at the anode when sodium chloride is electrolysed

D white precipitate forming when aqueous silver ions react with aqueous chloride ions

24 An excess of aqueous iodide ions is added to acidified aqueous potassium manganate(VII).

Which row is correct?

	iodide ions	colour of final solution
A	oxidised	colourless
B	oxidised	brown
C	reduced	colourless
D	reduced	brown

25 When ammonia gas is dissolved in water a reversible reaction takes place.

$$NH_3(g) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

Which statements are correct?

1 Ammonia is an alkali because it produces hydroxide ions in solution.

2 The pH of this solution is 7.

3 Adding hydroxide ions to the mixture at equilibrium produces more ammonia.

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

26 Three dilute solutions of acid, each with a concentration of 0.01 mol / dm^3, are reacted separately with excess calcium carbonate until there is no further reaction. The same volume of acid is used each time.

The carbon dioxide produced is collected and its volume measured. All measurements are at room temperature and pressure.

acid	pH	volume of carbon dioxide formed / cm^3
1	2.0	20
2	1.7	40
3	3.4	20

What are the possible identities of the acids?

	acid 1	acid 2	acid 3
A	hydrochloric	sulfuric	ethanoic
B	hydrochloric	nitric	ethanoic
C	nitric	sulfuric	hydrochloric
D	sulfuric	hydrochloric	nitric

27 The steps for the preparation of a pure sample of sodium nitrate are listed.

1 Titrate with dilute nitric acid until the end-point is seen.

2 Evaporate to concentrate the solution.

3 Rinse out the conical flask.

4 Add indicator.

5 Pipette a known volume of aqueous sodium hydroxide into a conical flask.

6 Cool and filter to remove crystals.

7 Repeat using the same volumes of aqueous sodium hydroxide and dilute nitric acid but no indicator.

Which order of steps is correct?

A $1 \rightarrow 7 \rightarrow 5 \rightarrow 4 \rightarrow 2 \rightarrow 6 \rightarrow 3$

B $3 \rightarrow 5 \rightarrow 7 \rightarrow 1 \rightarrow 2 \rightarrow 4 \rightarrow 6$

C $4 \rightarrow 1 \rightarrow 3 \rightarrow 5 \rightarrow 2 \rightarrow 6 \rightarrow 7$

D $5 \rightarrow 4 \rightarrow 1 \rightarrow 3 \rightarrow 7 \rightarrow 2 \rightarrow 6$

28 A white compound is insoluble in water.

Which cations and anions could be present in the compound?

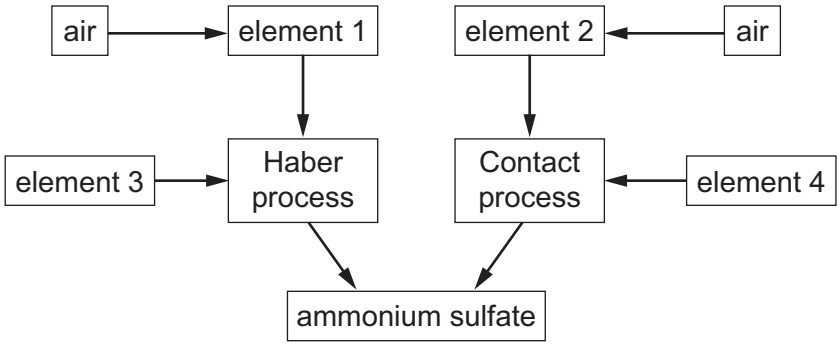
	sodium	calcium	carbonate	nitrate
A	✓	✓	✗	✓
B	✓	✗	✓	✗
C	✗	✓	✓	✗
D	✗	✓	✓	✓

key

✓ = present

✗ = absent

29 The flow chart describes the preparation of ammonium sulfate.



What are elements 1–4?

	1	2	3	4
A	nitrogen	oxygen	hydrogen	sulfur
B	nitrogen	oxygen	hydrogen	oxygen
C	oxygen	nitrogen	hydrogen	sulfur
D	oxygen	nitrogen	sulfur	hydrogen

30 Which row correctly shows the possible uses of sulfur dioxide and sulfuric acid?

	sulfur dioxide	sulfuric acid
A	as a bleach	as battery acid
B	killing bacteria in food	as a bleach
C	making detergents	as battery acid
D	making fertilisers	making fertilisers

31 Selenium is in Group VI and gallium is in Group III.

Which prediction can be made from this information?

A A gallium atom has three more protons than a selenium atom.

B Gallium is more likely to form negative ions than selenium.

C Selenium atoms have fewer valence electrons than gallium atoms.

D Selenium has more non-metallic character than gallium.

[Turn over

32 Which statement about some metals and their compounds is correct?

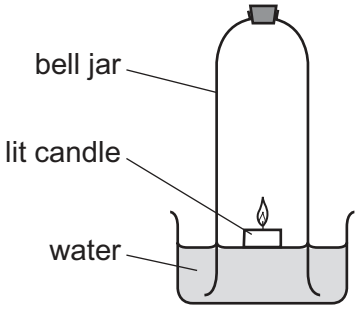
A Calcium reacts with cold water but not with steam.

B Lead carbonate decomposes at a higher temperature than zinc carbonate.

C Magnesium can be extracted from its oxide by heating strongly with carbon.

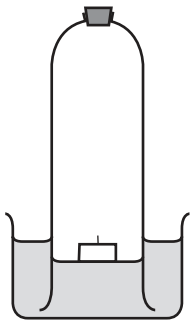
D Pure aluminium reacts with cold, dilute hydrochloric acid.

33 The diagram shows an experiment to determine the percentage of oxygen in air.

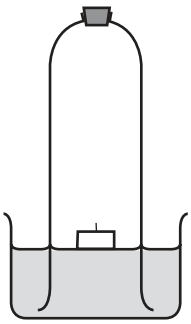


Which diagram shows the correct level of water after the candle stops burning?

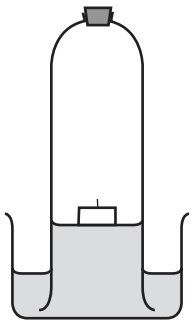
A



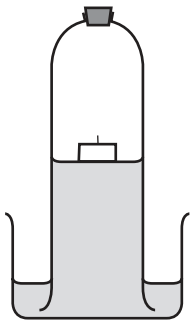
B



C



D

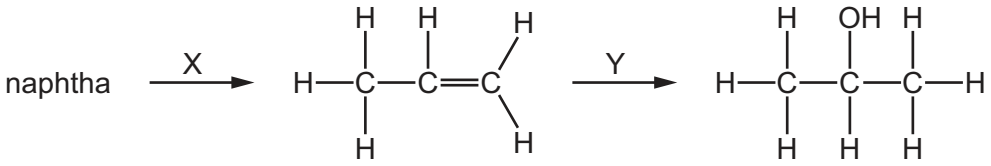


34 The addition reaction between a hydrocarbon X and bromine forms only one product.

Which compound is X?

A CH_4 **B** C_2H_4 **C** C_2H_6 **D** CH_3OH

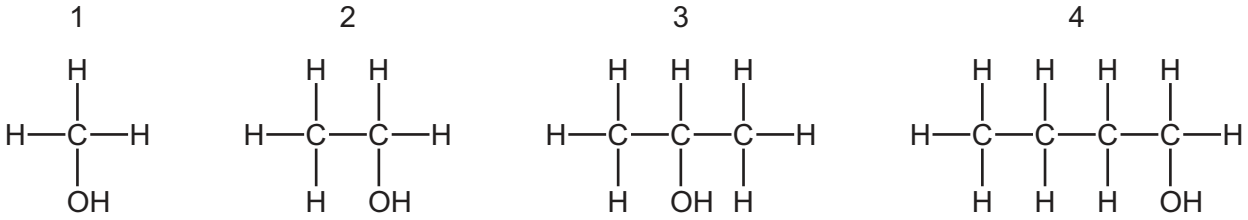
35 A series of reactions producing propanol from the naphtha fraction of petroleum (crude oil) is shown.



What are processes X and Y?

	X	Y
A	cracking	reaction with steam
B	cracking	fermentation
C	fractional distillation	reaction with steam
D	fractional distillation	fermentation

36 The structures of four alcohols are shown.



Which statement is correct?

A Alcohol 1 can be made by the addition of steam to an alkene.

B Alcohol 2 can be made from glucose.

C Alcohol 3 is a renewable energy source.

D Alcohol 4 has only one other isomer.

37 Which compounds have the molecular formula $C_3H_6O_2$?

1 methyl ethanoate

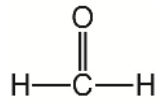
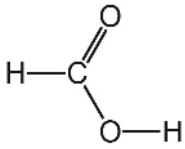
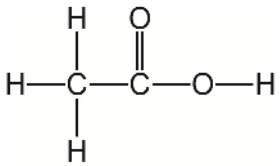
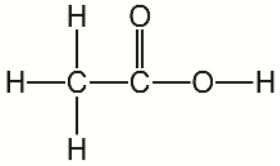
2 ethyl methanoate

3 propanoic acid

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

38 An organic compound has the empirical formula CH_2O.

Which row shows a possible correct name and structure for this compound?

	name	structure
A	methanol	
B	methanoic acid	
C	ethanol	
D	ethanoic acid	

39 Which statement is correct?

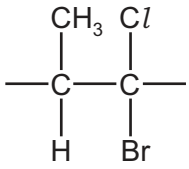
A Complex carbohydrates, such as starch, are hydrolysed to give simple sugars.

B Fats have the same amide linkages as *Terylene*.

C Proteins and nylon are polymers formed from the same monomers but with different linkages.

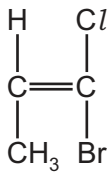
D Proteins are natural polymers and are also called polysaccharides.

40 The repeat unit of a polymer is shown.

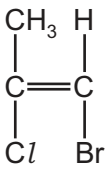


Which monomer would produce this polymer?

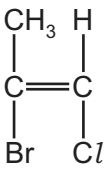
A



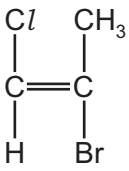
B



C



D



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.).