



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CHEMISTRY

0620/23

Paper 2 Multiple Choice (Extended)

October/November 2018

45 minutes

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

* 9 4 0 4 3 2 8 9 2 5 *

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.

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

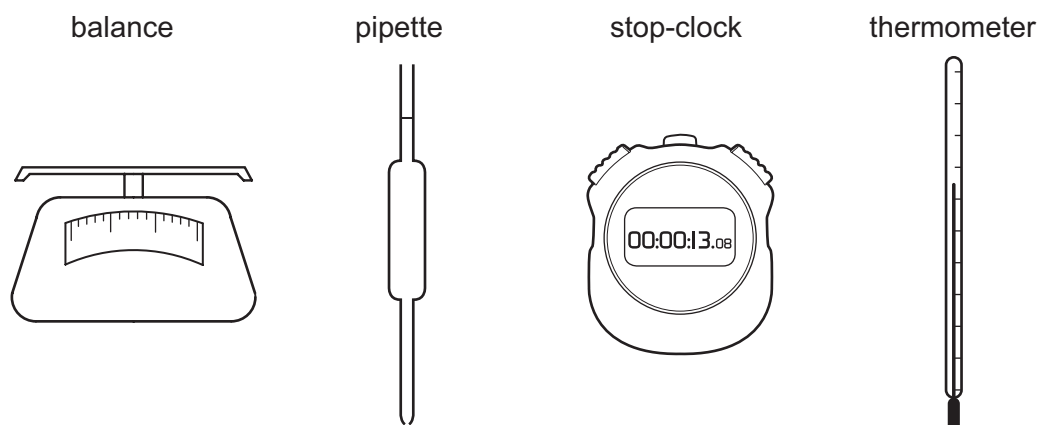
This document consists of **15** printed pages and **1** blank page.

- 1 Gases are separated from liquid air by fractional distillation. The boiling points of four gases are shown.

Which gas is both monatomic and a liquid at $-200\text{ }^{\circ}\text{C}$?

| | gas | boiling point/ $^{\circ}\text{C}$ |
|----------|----------|-----------------------------------|
| A | argon | -186 |
| B | helium | -269 |
| C | neon | -246 |
| D | nitrogen | -196 |

- 2 The diagrams show four pieces of laboratory equipment.



Which equipment is essential to find out if dissolving a salt in water is an exothermic process?

| | balance | pipette | stop-clock | thermometer |
|----------|----------|----------|------------|-------------|
| A | <i>x</i> | <i>x</i> | <i>x</i> | ✓ |
| B | ✓ | <i>x</i> | <i>x</i> | ✓ |
| C | <i>x</i> | ✓ | <i>x</i> | ✓ |
| D | ✓ | <i>x</i> | ✓ | <i>x</i> |

- 3 Which statement describes isotopes?

- A** Isotopes of the same element have different electron arrangements.
B Isotopes of the same element have different nuclear charges.
C Isotopes of the same element have nuclei with masses that are the same.
D Isotopes of the same element have the same number of protons.

- 4 X and Y are both atoms.

X and Y have the same chemical properties as each other.

Which row describes the atomic structures of X and Y?

| | X | | | Y | | |
|----------|---------|----------|-----------|---------|----------|-----------|
| | protons | neutrons | electrons | protons | neutrons | electrons |
| A | 6 | 6 | 6 | 6 | 6 | 7 |
| B | 6 | 6 | 6 | 6 | 8 | 6 |
| C | 6 | 6 | 6 | 16 | 16 | 16 |
| D | 7 | 6 | 7 | 6 | 6 | 7 |

- 5 Which covalent molecule contains two atoms bonded together by exactly four shared electrons?

A N₂ **B** C₃H₈ **C** CH₃OH **D** CH₃COOH

- 6 The formula of ammonia is NH₃.

Which statement about a molecule of ammonia is correct?

- A** The bonding in a molecule of ammonia is ionic.
B The nitrogen atom has a noble gas configuration, the hydrogen atoms do not.
C The nitrogen atom shares all of its electrons with hydrogen atoms.
D There are six shared electrons in a molecule of ammonia.

- 7 Which gas sample has the greatest mass?

- A** 5.0 moles of Cl₂
B 10.0 moles of O₂
C 15.0 moles of N₂
D 20.0 moles of H₂

- 8 Which sample of magnesium chloride, MgCl₂, contains the same number of moles as 69.6 g of potassium sulfate, K₂SO₄?

A 19.0 g **B** 28.5 g **C** 38.0 g **D** 47.5 g

- 9 Iron(III) chromate is a yellow solid. It contains the ions Fe³⁺ and CrO₄²⁻.

What is the formula of iron(III) chromate?

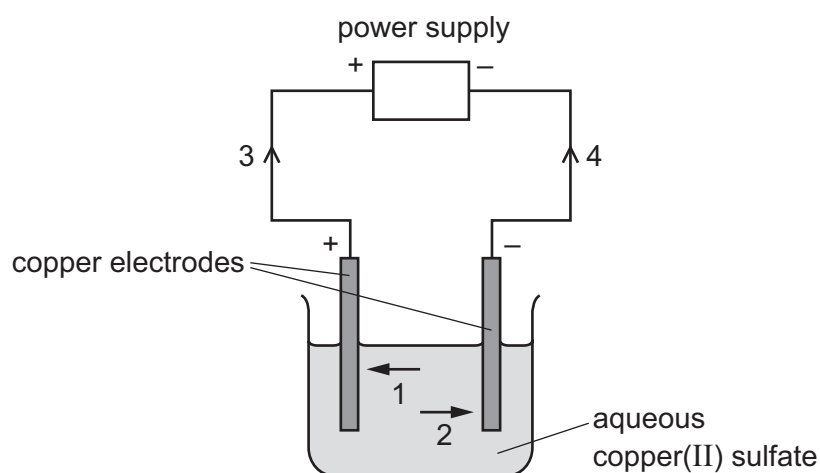
A FeCrO₄ **B** Fe₃(CrO₄)₂ **C** Fe₂CrO₄ **D** Fe₂(CrO₄)₃

- 10 Electrolysis of copper(II) sulfate can be done using either carbon electrodes or copper electrodes.

Which statement describes what happens at the positive electrode?

- A Copper is deposited if the electrode is made from carbon.
- B Copper is deposited if the electrode is made from copper.
- C Oxygen gas is produced if the electrode is made from carbon.
- D Oxygen gas is produced if the electrode is made from copper.

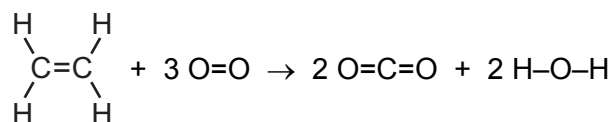
- 11 The diagram shows a circuit used to electrolyse aqueous copper(II) sulfate.



Which arrows indicate the movement of the copper ions in the electrolyte and of the electrons in the external circuit?

| | copper ions | electrons |
|----------|-------------|-----------|
| A | 1 | 3 |
| B | 1 | 4 |
| C | 2 | 3 |
| D | 2 | 4 |

12 Ethene burns in oxygen to form carbon dioxide and water vapour.



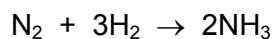
The bond energies are shown in the table.

| bond | bond energy in kJ/mol |
|------|--------------------------|
| C=C | +610 |
| C-H | +410 |
| O=O | +497 |
| C=O | +805 |
| O-H | +460 |

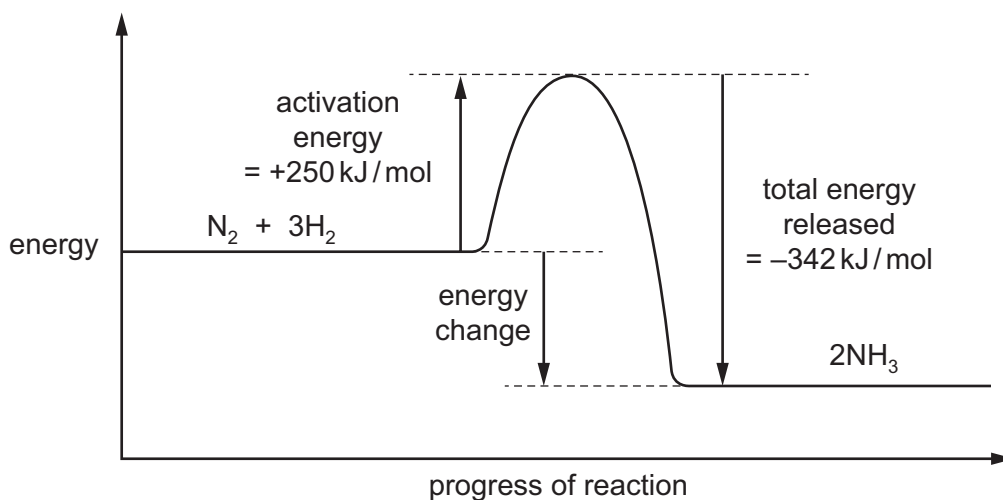
What is the energy change for the reaction?

- A -2959 kJ/mol
- B -2313 kJ/mol
- C -1319 kJ/mol
- D -399 kJ/mol

13 The equation for the formation of ammonia is shown.



The energy level diagram for the reaction is shown.



What is the energy change for the reaction?

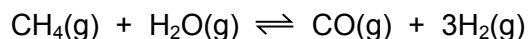
- A -592 kJ/mol
- B -92 kJ/mol
- C $+92 \text{ kJ/mol}$
- D $+592 \text{ kJ/mol}$

14 Dilute hydrochloric acid reacts with 1 g of limestone.

Which conditions produce the fastest rate of reaction?

- A 2 mol/dm^3 hydrochloric acid and a single lump of limestone
- B 4 mol/dm^3 hydrochloric acid and a single lump of limestone
- C 4 mol/dm^3 hydrochloric acid and small pieces of limestone
- D 4 mol/dm^3 hydrochloric acid and powdered limestone

- 15 The reversible reaction between methane and steam is shown.

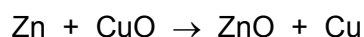


The forward reaction is endothermic.

Which changes in pressure and temperature move the equilibrium to the right?

| | pressure | temperature |
|----------|----------|-------------|
| A | decrease | decrease |
| B | decrease | increase |
| C | increase | decrease |
| D | increase | increase |

- 16 The equation for the reaction between zinc and copper(II) oxide is shown.



Which row shows the oxidising agent and the reducing agent?

| | oxidising agent | reducing agent |
|----------|-----------------|----------------|
| A | CuO | Cu |
| B | CuO | Zn |
| C | Zn | CuO |
| D | Zn | ZnO |

- 17 The results of some experiments with sulfur dioxide are shown.

| experiment | description | result |
|------------|--|----------------------------------|
| 1 | mix with dilute hydrochloric acid | does not react |
| 2 | mix with concentrated sodium hydroxide | a salt forms |
| 3 | add Universal Indicator | Universal Indicator turns purple |
| 4 | add acidified aqueous potassium manganate(VII) | purple solution turns colourless |

Which results are correct?

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

18 A white precipitate is produced when small amounts of two colourless solutions are mixed together.

Which pairs of solutions produce a white precipitate?

- 1 sodium hydroxide and zinc nitrate
- 2 sodium hydroxide and aluminium chloride
- 3 barium chloride and sulfuric acid
- 4 acidified barium nitrate and potassium sulfate

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

19 Solution Q is warmed with ammonium chloride.

In a separate experiment, solution Q is added to methyl orange.

Which observations show that solution Q is basic?

| | warmed with ammonium chloride | added to methyl orange |
|----------|-------------------------------|------------------------|
| A | gas is produced | turns red |
| B | gas is produced | turns yellow |
| C | no reaction | turns red |
| D | no reaction | turns yellow |

20 Some general rules for the solubility of salts in water are listed.

- Carbonates are insoluble (except ammonium carbonate, potassium carbonate and sodium carbonate).
- Chlorides are soluble (except lead(II) chloride and silver chloride).
- Nitrates are soluble.
- Sulfates are soluble (except barium sulfate, calcium sulfate and lead(II) sulfate).

Which substances produce an insoluble salt when aqueous solutions of them are mixed?

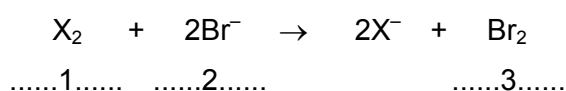
- A** barium chloride and magnesium nitrate
B calcium chloride and ammonium nitrate
C silver nitrate and zinc chloride
D sodium carbonate and potassium sulfate

21 Elements in Group I of the Periodic Table react with water.

Which row describes the products made in the reaction and the trend in reactivity of the elements?

| | products | trend in reactivity |
|----------|------------------------------|------------------------------|
| A | metal hydroxide and hydrogen | less reactive down the group |
| B | metal hydroxide and hydrogen | more reactive down the group |
| C | metal oxide and hydrogen | less reactive down the group |
| D | metal oxide and hydrogen | more reactive down the group |

22 The equation shows the reaction between a halogen and aqueous bromide ions.



Which words complete gaps 1, 2 and 3?

| | 1 | 2 | 3 |
|----------|----------|------------|------------|
| A | chlorine | brown | colourless |
| B | chlorine | colourless | brown |
| C | iodine | brown | colourless |
| D | iodine | colourless | brown |

23 An inert gas R is used to fill weather balloons.

Which descriptions of R are correct?

| | number of outer shell electrons in atoms of R | structure of gas R |
|----------|---|--------------------|
| A | 2 | diatomic molecules |
| B | 2 | single atoms |
| C | 8 | diatomic molecules |
| D | 8 | single atoms |

24 Heating copper(II) carbonate produces copper(II) oxide and carbon dioxide.

Heating the copper(II) oxide formed with carbon produces copper.

Which colour changes are observed during these reactions?

- A green → black → brown
- B green → white → brown
- C blue → black → silver
- D blue → white → brown

25 Calcium reacts with cold water to produce hydrogen.

Lead reacts slowly when heated in air to form an oxide but has almost no reaction with steam.

Silver does not react with either air or water.

Zinc reacts when heated with steam to produce hydrogen.

What is the order of reactivity starting with the least reactive?

| | least reactive → most reactive | | | |
|----------|--------------------------------|------|------|---------|
| A | calcium | lead | zinc | silver |
| B | calcium | zinc | lead | silver |
| C | silver | lead | zinc | calcium |
| D | silver | zinc | lead | calcium |

26 Which row describes the use of a metal and the property upon which the use depends?

| | metal | use | property |
|----------|-----------|-------------------|---|
| A | aluminium | aircraft bodies | aluminium is a heat conductor |
| B | aluminium | cooking utensils | aluminium has a low density |
| C | copper | cooking utensils | copper has a high density |
| D | copper | electrical wiring | copper is a good conductor of electricity |

27 Which statement about the manufacture of aluminium by electrolysis is correct?

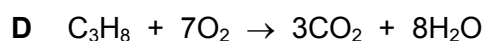
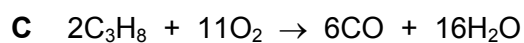
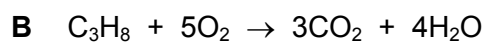
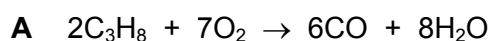
- A Aluminium ions are oxidised to aluminium by gaining electrons.
- B Aluminium is extracted from its ore hematite.
- C Molten cryolite is used to dissolve the aluminium oxide.
- D Oxygen is formed at the negative electrode.

28 Ammonia is manufactured by the Haber process from nitrogen and hydrogen.

Which row gives the main sources of these two gases?

| | hydrogen | nitrogen |
|----------|-------------|-------------|
| A | air | air |
| B | air | natural gas |
| C | natural gas | air |
| D | natural gas | natural gas |

29 Which equation represents the incomplete combustion of propane, C₃H₈?



30 Argon is a noble gas used to fill light bulbs.

What is the approximate percentage of argon in air?

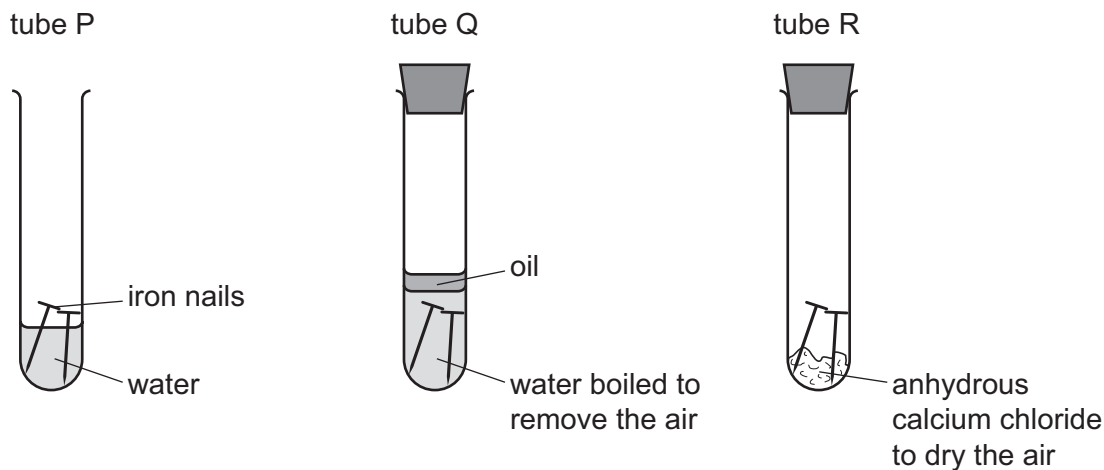
A 1%

B 20%

C 79%

D 99%

31 The diagrams show experiments involving the rusting of iron.



A student predicted the following results.

- 1 In tube P, the iron nails rust.
- 2 In tube Q, the iron nails do not rust.
- 3 In tube R, the iron nails do not rust.

Which predictions are correct?

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

32 Which statement about the carbon cycle is correct?

- A** Animals and plants need carbon dioxide for respiration.
B Combustion of plants and natural gas produces carbon dioxide.
C Plants produce glucose from carbon dioxide and oxygen.
D Oxygen is produced by both animals and plants.

33 Which statement about sulfur or one of its compounds is correct?

- A** Sulfur occurs naturally as the element sulfur.
B Sulfur dioxide is used to kill bacteria in drinking water.
C Sulfuric acid is a weak acid.
D Dilute sulfuric acid is a dehydrating agent.

34 Which equation represents the formation of lime?

- A $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
 B $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$
 C $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2$
 D $\text{Ca(OH)}_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$

35 Which equation representing a reaction of methane is correct?

- A $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$
 B $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_4\text{Cl}_2$
 C $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_2\text{Cl}_2 + \text{H}_2$
 D $2\text{CH}_4 + 2\text{Cl}_2 \rightarrow 2\text{CH}_3\text{Cl} + \text{Cl}_2 + \text{H}_2$

36 Which two compounds are molecules which both contain a double bond?

- A ethane and ethanoic acid
 B ethane and ethanol
 C ethene and ethanoic acid
 D ethene and ethanol

37 Ethanol can be formed by:

- 1 fermentation
- 2 reaction between steam and ethene.

Which of these processes use a catalyst?

| | 1 | 2 |
|----------|---|---|
| A | ✓ | ✓ |
| B | ✓ | x |
| C | x | ✓ |
| D | x | x |

38 Sugar can be fermented to produce ethanol.

Some of the stages in the process to produce and purify ethanol are listed.

- 1 Leave in a warm place.
- 2 Add yeast.
- 3 Fractionally distil the solution.
- 4 Dissolve the sugar in water.
- 5 Filter to remove the yeast.
- 6 Crush some sugar cane.

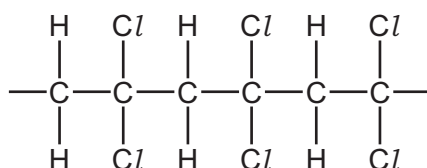
What is the correct order of these stages?

- A** 4 → 6 → 2 → 1 → 5 → 3
B 6 → 4 → 1 → 2 → 5 → 3
C 6 → 4 → 2 → 1 → 3 → 5
D 6 → 4 → 2 → 1 → 5 → 3

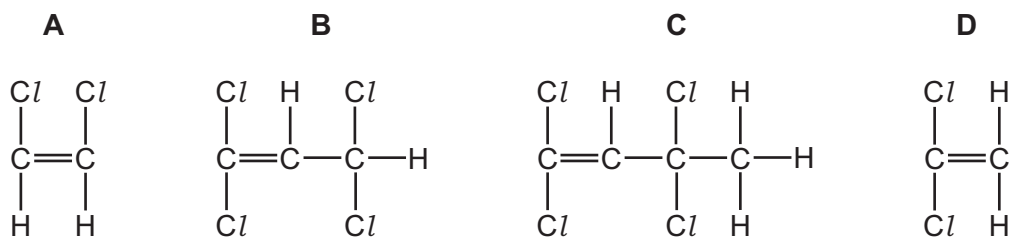
39 Which statement about ethanoic acid is correct?

- A** It contains a $-\text{C}_2\text{H}_5$ group.
B It is a strong acid.
C It is formed by the reduction of ethanol.
D It reacts with alcohols to form esters.

40 The structure of a polymer is shown.



Which monomer is used to make this polymer?



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The Periodic Table of Elements

| | | Group | | | | | | | | | | | | | | | |
|-----------------------------------|------------------------------------|--|--|------------------------------------|-------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|---------------------------------------|--------------------------------------|--------------------------------------|------------------------------------|--------------------------------------|------------------------------------|-------------------------------------|----------------------------------|----------------------------------|
| I | II | III | IV | V | VI | VII | VIII | | | | | | | | | | |
| 3 Li lithium 7 | 4 Be beryllium 9 | <div style="border: 1px solid black; padding: 5px; text-align: center;"> Key atomic number atomic symbol name relative atomic mass </div> | | | | | | | | | | 2 He helium 4 | | | | | |
| 11 Na sodium 23 | 12 Mg magnesium 24 | | | | | | | | | | | 5 B boron 11 | 6 C carbon 12 | 7 N nitrogen 14 | 8 O oxygen 16 | 9 F fluorine 19 | 10 Ne neon 20 |
| 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 — | — | — | — | — |

| | | | | | | | | | | | | | | | |
|-------------|-------------------------------------|-----------------------------------|--|-------------------------------------|------------------------------------|------------------------------------|------------------------------------|--------------------------------------|-----------------------------------|--------------------------------------|-------------------------------------|----------------------------------|--------------------------------------|-------------------------------------|-------------------------------------|
| 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 dm³ at room temperature and pressure (r.t.p.).