



Cambridge IGCSE™

CHEMISTRY

0620/21

Paper 2 Multiple Choice (Extended)

October/November 2022

45 minutes

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.

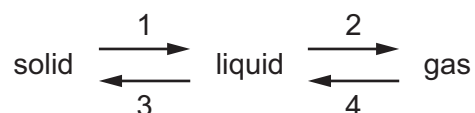
INFORMATION

- 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.



- 1 The diagram shows the changes of state between a solid, a liquid and a gas.



In which changes of state is energy being given out?

- A** 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4
- 2 A coloured dye is separated by chromatography.

One component of the dye moves a distance of 13 cm and has an R_f value of 0.86.

Which distance did the solvent front move?

- A** 6.6 cm **B** 11.9 cm **C** 15.1 cm **D** 21.6 cm
- 3 A mixture contains salt, sand and sulfur.

Salt dissolves in water but not in xylene.

Sulfur dissolves in xylene but not in water.

Sand does not dissolve in water or xylene.

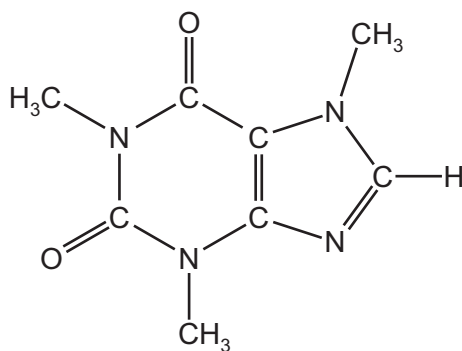
What is the order of the processes used to separate the salt, the sand and the sulfur from the mixture?

- A** add water → filter → add xylene to the filtrate → filter
- B** add water → filter → add xylene to the residue → filter
- C** add xylene → filter → add water to the filtrate → filter
- D** add xylene → filter → add xylene to the residue → filter
- 4 Which statements about isotopes of the same element are correct?

- 1 They are atoms which have the same chemical properties because they have the same number of electrons in their outer shell.
- 2 They are atoms which have the same number of electrons and neutrons but different numbers of protons.
- 3 They are atoms which have the same number of electrons and protons but different numbers of neutrons.

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

- 5 Which type of structure and bonding is present in an element that is malleable and conducts electricity?
- A** covalent molecular
B ionic lattice
C covalent macromolecular
D metallic lattice
- 6 Which statements about potassium bromide are correct?
- 1 It has a high melting point.
 2 It dissolves in water.
 3 It conducts electricity when solid.
- A** 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 only
- 7 Which substance has a similar structure to silicon(IV) oxide?
- A** carbon dioxide
B diamond
C graphite
D sodium oxide
- 8 Caffeine is a stimulant found in coffee.



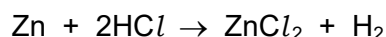
caffeine

Which formula represents caffeine?

- A** $C_7H_{10}N_4O_2$ **B** $C_8H_{10}N_3O_2$ **C** $C_8H_{10}N_4O_2$ **D** $C_8H_{11}N_4O_2$

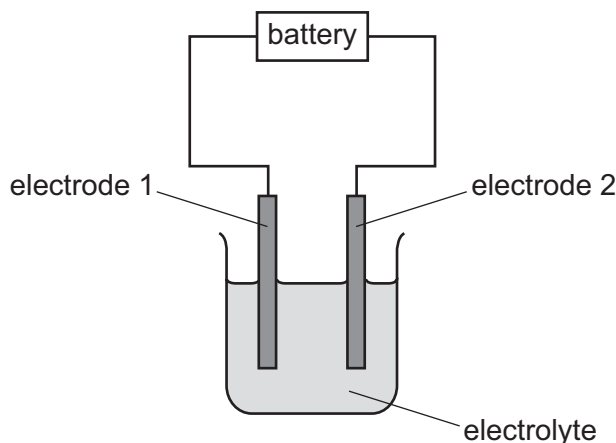
- 9 4.55 g of zinc is reacted with 50 cm³ of 2.25 mol/dm³ dilute hydrochloric acid.

The equation for the reaction is shown.



Which volume of hydrogen gas, at room temperature and pressure, is produced in the reaction?

- A 1.35 dm³ B 1.67 dm³ C 2.70 dm³ D 3.34 dm³
- 10 In the electrolysis diagram, oxidation is occurring at electrode 1 and reduction at electrode 2.



Which row shows the directions of movement of the electrons in the external circuit and of the positive ions in the electrolyte?

| | direction of movement of electrons in external circuit | direction of movement of positive ions in electrolyte |
|----------|--|---|
| A | 1 → 2 | 1 → 2 |
| B | 1 → 2 | 2 → 1 |
| C | 2 → 1 | 1 → 2 |
| D | 2 → 1 | 2 → 1 |

- 11 When an acid is added to an alkali, the temperature of the reaction mixture rises.

Which words describe this reaction?

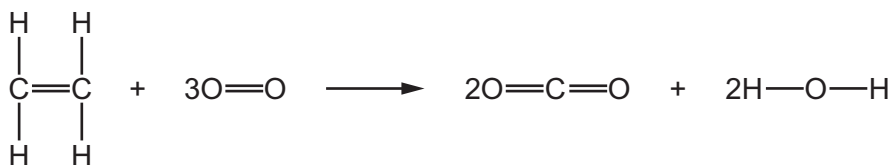
- A decomposition and endothermic
 B decomposition and exothermic
 C neutralisation and endothermic
 D neutralisation and exothermic

12 Some properties of four fuels are shown.

Which fuel is a gas at room temperature and makes two products when it burns in a plentiful supply of air?

| | fuel | formula | melting point /°C | boiling point /°C |
|----------|----------|---------------------------------|-------------------|-------------------|
| A | hydrogen | H ₂ | -259 | -253 |
| B | methane | CH ₄ | -182 | -164 |
| C | octane | C ₈ H ₁₈ | -57 | 126 |
| D | wax | C ₃₁ H ₆₄ | 60 | 400 |

13 Ethene can undergo complete combustion, as shown.



Some bond energies are given in the table.

| bond | bond energy in kJ/mol |
|------|-----------------------|
| C=C | 612 |
| C-H | 412 |
| O-H | 463 |
| O=O | 496 |

The energy change of the reaction is -1408 kJ/mol.

What is the bond energy of the C=O bond in CO₂?

- A** 454 kJ/mol **B** 673 kJ/mol **C** 826 kJ/mol **D** 1619 kJ/mol

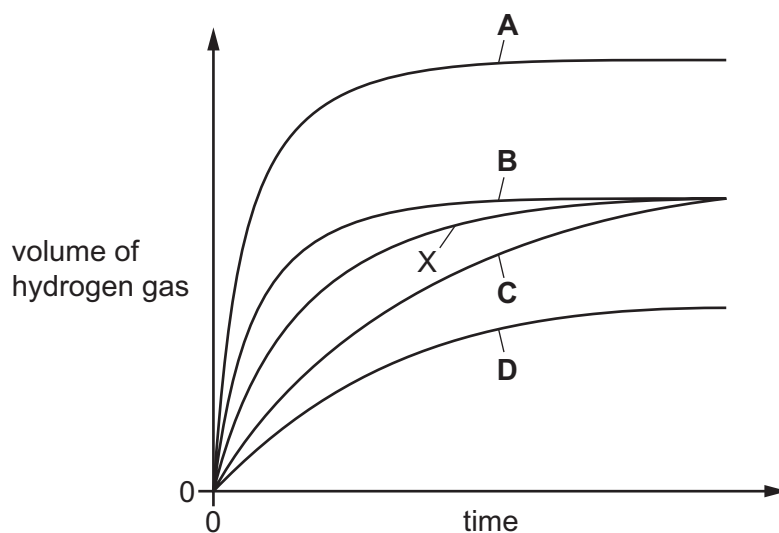
14 A student adds excess zinc to dilute hydrochloric acid at 25 °C.

The hydrogen gas produced is collected and measured at room temperature and pressure.

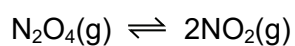
The results are plotted and labelled as curve X on the graph.

The experiment is repeated at 50 °C with all other conditions remaining the same.

Which graph shows the results at 50 °C?



15 Dinitrogen tetroxide, N_2O_4 , is converted into nitrogen dioxide, NO_2 , in a reversible reaction.



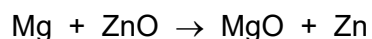
The forward reaction is endothermic.

Which conditions give the highest equilibrium yield of nitrogen dioxide?

| | pressure /atmospheres | temperature |
|----------|--------------------------|-------------|
| A | 2 | high |
| B | 2 | low |
| C | 50 | high |
| D | 50 | low |

16 When magnesium is heated with zinc oxide a reaction occurs.

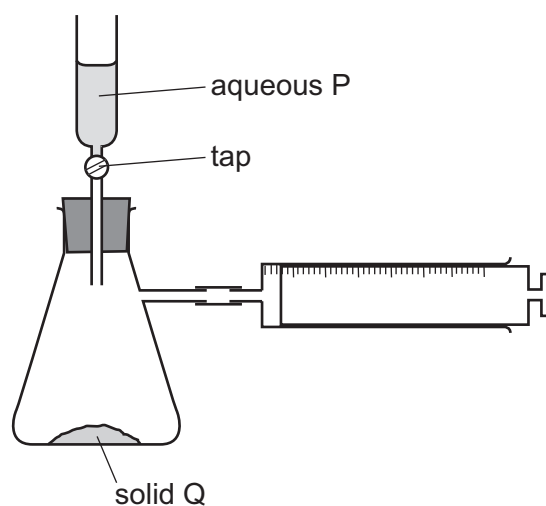
The equation is shown.



Which substance is oxidised?

- A magnesium
- B magnesium oxide
- C zinc
- D zinc oxide

17 The diagram shows an experiment.



A small volume of aqueous P is poured on to solid Q and the tap of the funnel closed.

Which pairs of substances cause the syringe to fill with gas?

| | HNO ₃ and Mg | HCl and Cu | H ₂ SO ₄ and Na ₂ CO ₃ |
|----------|-------------------------------|------------------|--|
| A | ✓ | ✓ | ✓ |
| B | ✓ | ✓ | x |
| C | ✓ | x | ✓ |
| D | x | ✓ | ✓ |

18 Ethanoic acid reacts with water to produce an acidic solution.

Which row describes the roles of ethanoic acid and water in this reaction?

| | ethanoic acid | water |
|----------|---------------------|---------------------|
| A | accepts a proton | donates a proton |
| B | accepts an electron | donates an electron |
| C | donates a proton | accepts a proton |
| D | donates an electron | accepts an electron |

19 Aqueous ammonium sulfate is made by reacting aqueous ammonia with dilute sulfuric acid.

How is solid ammonium sulfate obtained from the resulting solution?

- A** crystallisation
- B** distillation
- C** filtration
- D** solvent extraction

20 Carbon forms two oxides: carbon monoxide, CO, and carbon dioxide, CO₂.

Which row describes these two oxides?

| | CO | CO ₂ |
|----------|---------|-----------------|
| A | acidic | acidic |
| B | acidic | neutral |
| C | neutral | acidic |
| D | neutral | neutral |

21 Group II elements show the same trends as Group I elements.

Which statement about elements in Group II is correct?

- A** The melting point of barium is higher than the melting point of calcium.
- B** Barium is more reactive than beryllium.
- C** Strontium would not react with oxygen.
- D** Magnesium is more dense than barium.

22 Some information about properties of Group I elements is shown.

| element | melting point / °C | density in g/cm ³ |
|-----------|--------------------|------------------------------|
| lithium | 181 | 0.53 |
| sodium | 98 | 0.97 |
| potassium | X | |
| rubidium | Y | Z |

What are the values for X, Y and Z?

| | X | Y | Z |
|----------|----|-----|------|
| A | 63 | 252 | 0.26 |
| B | 63 | 39 | 0.26 |
| C | 39 | 63 | 1.53 |
| D | 63 | 39 | 1.53 |

23 Which statements describe properties of transition elements?

- 1 They form coloured compounds.
- 2 They have variable oxidation states.
- 3 They have low densities.
- 4 They are volatile.

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

24 Which statement about the extraction of aluminium by electrolysis is correct?

- A** Aluminium is extracted from its ore, cryolite.
- B** Aluminium is formed at the positive electrode.
- C** Bauxite is used to lower the temperature of the extraction process.
- D** Graphite is used for both the positive and negative electrodes.

25 Copper(II) nitrate and zinc carbonate are heated strongly in separate test-tubes.

Which row identifies the gases produced?

| | copper(II) nitrate | zinc carbonate |
|----------|-----------------------------|---------------------------|
| A | oxygen and nitrogen dioxide | carbon dioxide only |
| B | oxygen and nitrogen dioxide | carbon dioxide and oxygen |
| C | nitrogen dioxide only | carbon dioxide and oxygen |
| D | nitrogen dioxide only | carbon dioxide only |

26 Iron from a blast furnace can be converted to steel.

Which statements about steel are correct?

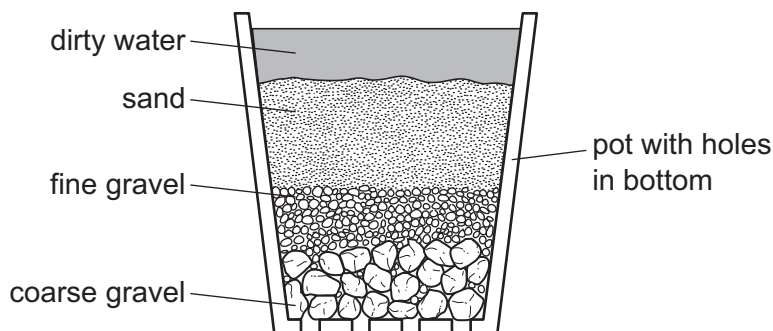
- 1 Steel contains more carbon than the iron obtained from the blast furnace.
- 2 Steel is produced by blowing oxygen through the iron.
- 3 Calcium oxide is added to molten iron to remove basic oxides.

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

27 Which metal is used to galvanise steel?

- A** copper
- B** lead
- C** tin
- D** zinc

28 The diagram shows a stage in the purification of dirty water.



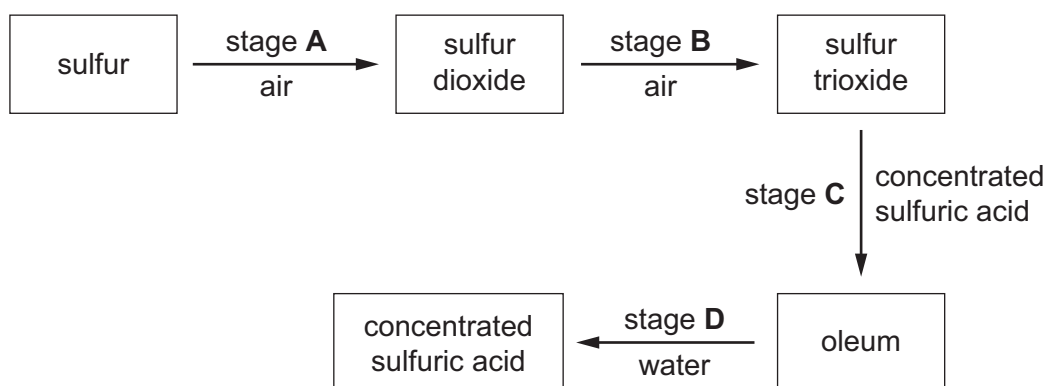
Which process does this apparatus show?

- A chlorination
 - B condensation
 - C distillation
 - D filtration
- 29 Which substance in polluted air damages stonework and kills trees?
- A carbon dioxide
 - B carbon monoxide
 - C lead compounds
 - D sulfur dioxide
- 30 Which row explains why a high temperature and an iron catalyst are used in the manufacture of ammonia by the Haber process?

| | high temperature | iron catalyst |
|----------|--|--|
| A | increases the rate of the reaction | increases the equilibrium yield of ammonia |
| B | increases the rate of the reaction | increases the rate of the reaction |
| C | increases the equilibrium yield of ammonia | increases the equilibrium yield of ammonia |
| D | increases the equilibrium yield of ammonia | increases the rate of the reaction |

31 The scheme shows four stages in the conversion of sulfur to sulfuric acid.

In which stage is a catalyst used?



32 Which element has an oxide that is used as a food preservative?

- A helium
- B hydrogen
- C iron
- D sulfur

33 Which substance gives off carbon dioxide on heating?

- A lime
- B limestone
- C limewater
- D slaked lime

34 Which formula represents ethanol?

- A CH_3CH_3
- B CH_2CH_2
- C $\text{CH}_3\text{CH}_2\text{OH}$
- D CH_3COOH

35 Which statement about structural isomers is correct?

- A They have the same structure but different reactivity.
- B They have the same general formula but a different number of carbon atoms in their molecules.
- C They have the same structure but different relative molecular masses.
- D They have different structures but the same numbers of each type of atom.

36 Which formula is the same in methanol, ethanol and propanol?

- A empirical formula
- B general formula
- C molecular formula
- D structural formula

37 Ethene reacts with water under suitable conditions.

Which statement about this reaction is correct?

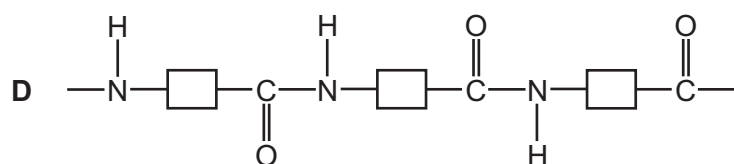
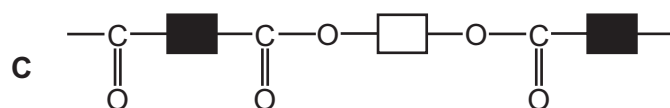
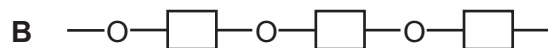
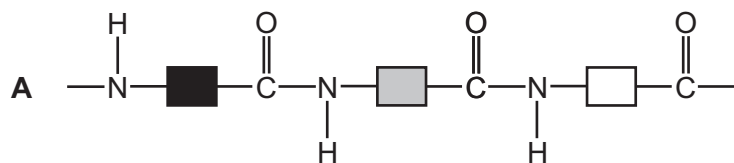
- A The product of this reaction has an M_r of 46.
- B The reaction produces two different products.
- C The reaction occurs when ethene gas is bubbled into cold water in the presence of an acid catalyst.
- D The reaction is a redox reaction.

38 Ethanoic acid is made by reacting ethanol with acidified potassium manganate(VII).

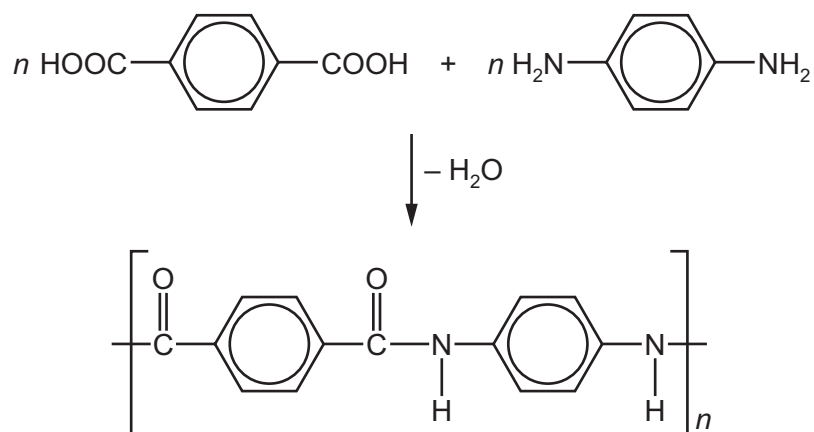
Which type of reaction occurs when ethanol reacts with acidified potassium manganate(VII)?

- A displacement
- B fermentation
- C oxidation
- D neutralisation

39 Which structure represents *Terylene*?



40 The equation shows the formation of a polymer called *Kevlar*.



Which row describes *Kevlar*?

| | how the polymer is formed | type of polymer |
|----------|-----------------------------|-----------------|
| A | addition polymerisation | polyamide |
| B | addition polymerisation | polyester |
| C | condensation polymerisation | polyamide |
| D | condensation polymerisation | polyester |

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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 |
| 19 K potassium 39 | 20 Ca calcium 40 | 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 | 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 | 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 | 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 — | 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.).