



CHEMISTRY

0620/23

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)

* 2 5 1 8 9 6 6 7 5 4 *

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 **15** printed pages and **1** blank page.

- 1 Hydrogen chloride gas ($M_r = 36.5$) is released at P in the apparatus shown.

The Universal Indicator paper turns red after 38 s.



The experiment is repeated using sulfur dioxide ($M_r = 64$).

What is the result for sulfur dioxide?

| | Universal Indicator turns | time for Universal Indicator to change colour / s |
|----------|---------------------------|---|
| A | blue | 26 |
| B | blue | 51 |
| C | red | 26 |
| D | red | 51 |

- 2 Which piece of apparatus is used to measure 24.8 cm^3 of gas produced during a reaction?

- A** beaker
- B** conical flask
- C** measuring cylinder
- D** pipette

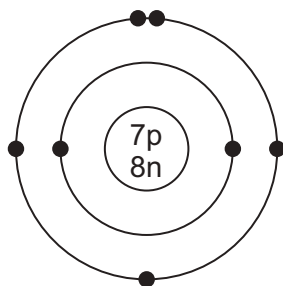
- 3 R_f values are used to identify unknown substances using paper chromatography.

Which statements about R_f values are correct?

- 1 R_f values are always less than 1.0.
- 2 R_f value = distance travelled by solvent \div distance travelled by unknown substance.
- 3 The higher the R_f value, the further the unknown substance travels.
- 4 R_f values are not affected by the solubility of the unknown substance.

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

4 The structure of an atom is shown.



key

● = electron

n = neutron

p = proton

Which element is the atom an isotope of?

- A nitrogen
- B oxygen
- C phosphorus
- D titanium

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?

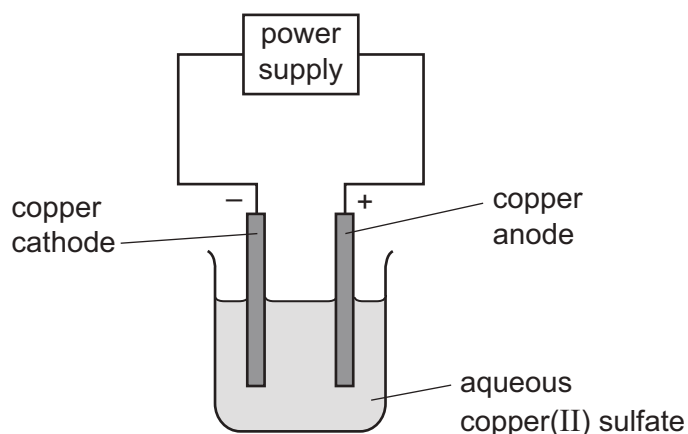
- A It is a giant lattice of oppositely charged ions.
- B It is a giant lattice of positive ions in a 'sea' of electrons.
- C It is a giant molecule of oppositely charged ions.
- D It is a simple molecule of oppositely charged ions.

7 When propane burns in air, carbon dioxide and water are formed.

What is the chemical equation for this reaction?

- A $C_3H_8 + 2O_2 \rightarrow CO_2 + 2H_2O$
- B $C_3H_8 + 3O_2 \rightarrow 3CO_2 + H_2O$
- C $C_3H_8 + 4O_2 \rightarrow 3CO_2 + 4H_2O$
- D $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

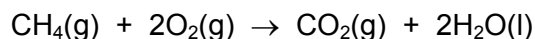
- 8 What is the concentration of a solution that contains 25.0 g NaOH in 500 cm³ of water?
- A 0.125 mol/dm³
B 0.800 mol/dm³
C 1.25 mol/dm³
D 3.20 mol/dm³
- 9 An aqueous solution of copper(II) sulfate was electrolysed using copper electrodes.



Which equation for the reaction at the anode is correct?

- A $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^{-}$
B $\text{Cu} + 2\text{e}^{-} \rightarrow \text{Cu}^{2+}$
C $\text{Cu}^{2+} \rightarrow \text{Cu} + 2\text{e}^{-}$
D $\text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu}$
- 10 In the manufacture of aluminium by electrolysis, aluminium oxide is dissolved in molten cryolite.
- Why is cryolite used?
- A It lowers the melting point of the aluminium.
B It makes the aluminium a better conductor.
C It removes impurities from the aluminium.
D The mixture has a lower melting point than pure aluminium oxide.
- 11 Which statement about a fuel cell in a car is correct?
- A The fuel cell produces heat, which powers the car.
B The fuel cell is supplied with hydrogen directly from the air.
C The only emission from a fuel cell is nitrogen gas, which is non-polluting.
D The fuel cell produces electricity, which powers an electric motor.

12 Methane burns in oxygen to form carbon dioxide and water.



The bond energies are shown in the table.

| bond | bond energy in kJ/mol |
|------|--------------------------|
| C–H | 410 |
| C–O | 360 |
| C=O | 805 |
| O–H | 460 |
| O–O | 146 |
| O=O | 496 |

What is the energy change for this reaction?

- A** –818 kJ/mol **B** –102 kJ/mol **C** +102 kJ/mol **D** +818 kJ/mol

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

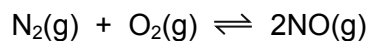
- A** addition of a catalyst
B increasing the concentration of a reactant
C increasing the surface area of a reactant
D increasing the temperature of the reaction

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 A reaction between nitrogen and oxygen is shown. The forward reaction is endothermic.



Which change increases the equilibrium yield of nitrogen monoxide, NO?

- A decreasing the pressure
- B decreasing the temperature
- C increasing the pressure
- D increasing the temperature

16 Which changes represent reduction?

- 1 $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$
- 2 $\text{Mn}(\text{VII}) \rightarrow \text{Mn}(\text{II})$
- 3 sulfate(IV) \rightarrow sulfate(VI)

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

17 Which statement about carbon monoxide and aluminium oxide is correct?

- A Carbon monoxide and aluminium oxide are both amphoteric.
- B Carbon monoxide and aluminium oxide are both neutral.
- C Carbon monoxide is amphoteric but aluminium oxide is neutral.
- D Carbon monoxide is neutral but aluminium oxide is amphoteric.

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

| | | | | | | | | | | | | | | | | | | | |
|---|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|---|
| | | | | | | | | | | | | | | | | | | | |
| W | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | X | | | | | | | | | | | | | | | | | | Z |

Which elements form basic oxides?

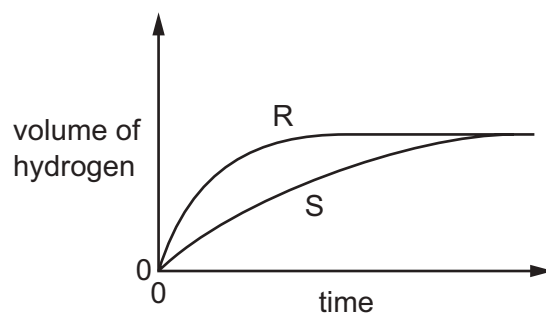
- A W, X and Y
- B W and X only
- C Y only
- D Z only

19 Solutions of acid R and acid S have the same concentration.

The same volume of each acid at the same temperature is reacted with the same mass of magnesium ribbon.

The volume of hydrogen produced is measured.

The results are shown.



Which statement about the reactions is correct?

- A Acid S reacts faster than acid R.
- B The final volume of hydrogen produced in each reaction is different.
- C Acid R is a stronger acid than acid S.
- D Acid S is a stronger acid than acid R.

20 Part of the Periodic Table is shown.

| | | | | | | | | | | | | | | | | | | |
|--|--|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|---|
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | X | | | | | | | | | | | | | | | | Z |
| | | | | | | | | | | | | | | | | | | |

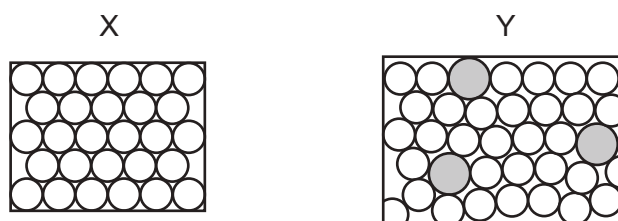
Which row describes W, X, Y and Z?

| | metal | non-metal |
|----------|------------|------------|
| A | X | W, Y and Z |
| B | X and Y | W and Z |
| C | W and Z | X and Y |
| D | W, Y and Z | X |

- 21 Which statement about the properties of elements in Group I and in Group VII is correct?
- A Bromine displaces iodine from an aqueous solution of potassium iodide.
- B Chlorine, bromine and iodine are diatomic gases at room temperature.
- C Lithium, sodium and potassium are soft non-metals.
- D Lithium, sodium and potassium have an increasing number of electrons in their outer shells.
- 22 Gas G has 10 electrons. Gas H has eight more electrons than gas G. Both gases are monoatomic.

Which statement about G and H is correct?

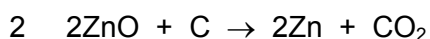
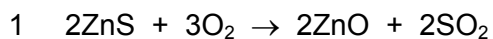
- A Both gases are in the same group of the Periodic Table.
- B Both gases are in the same period of the Periodic Table.
- C Both gases are very reactive.
- D Gas G has a higher atomic mass than gas H.
- 23 The diagrams show the structure of two substances used to make electrical conductors.



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.
- 24 Magnesium nitrate, magnesium hydroxide and magnesium carbonate all decompose when heated.
- Which statement about these decomposition reactions is correct?
- A Magnesium carbonate decomposes to release carbon dioxide and oxygen.
- B Magnesium hydroxide decomposes to release hydrogen and oxygen.
- C Magnesium hydroxide decomposes to release water vapour.
- D Magnesium nitrate decomposes to release oxygen only.

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



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 |

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 | x | ✓ | ✓ | |
| M | x | | ✓ | x |
| copper | x | x | | x |

key

✓ = reacts

x = 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 Aluminium is used to make containers for storing food.

Which property makes it suitable for this use?

- A** conducts heat
- B** low density
- C** resists corrosion
- D** shiny surface

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

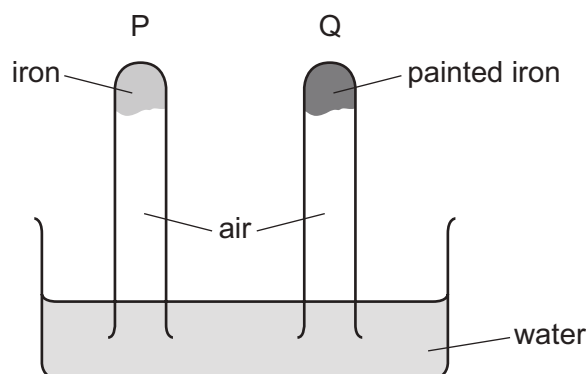
29 Catalytic converters in car exhausts change polluting gases into non-polluting gases.

Which statements about oxides of nitrogen and car engines are correct?

- 1 The nitrogen in oxides of nitrogen comes from compounds in petrol.
- 2 The oxygen in oxides of nitrogen comes from the air in the car engine.
- 3 Catalytic converters convert oxides of nitrogen into nitrogen and other gases.

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

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



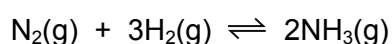
What happens to the water level in tubes P and Q?

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

31 Which row about the carbon cycle is correct?

| | process for removing carbon dioxide from the atmosphere | process for returning carbon dioxide to the atmosphere |
|----------|---|--|
| A | photosynthesis | combustion of hydrocarbons |
| B | photosynthesis | cracking of hydrocarbons |
| C | respiration | combustion of hydrocarbons |
| D | respiration | cracking of hydrocarbons |

32 Ammonia is manufactured in an exothermic reaction.



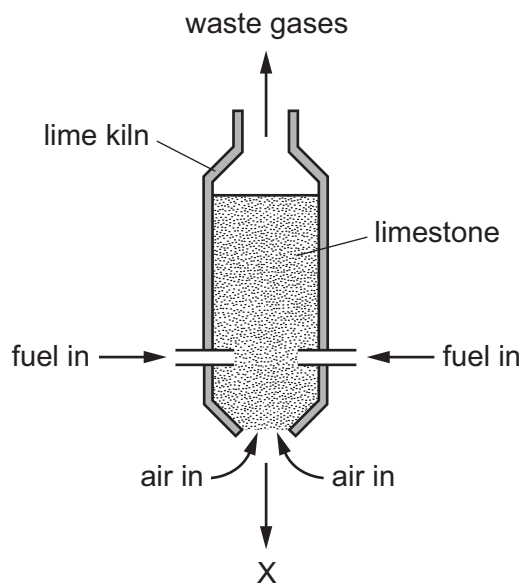
What is the effect of lowering the temperature on the rate of formation and equilibrium yield of ammonia?

| | rate of formation | equilibrium yield |
|----------|-------------------|-------------------|
| A | decreases | decreases |
| B | decreases | increases |
| C | increases | decreases |
| D | increases | increases |

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 |

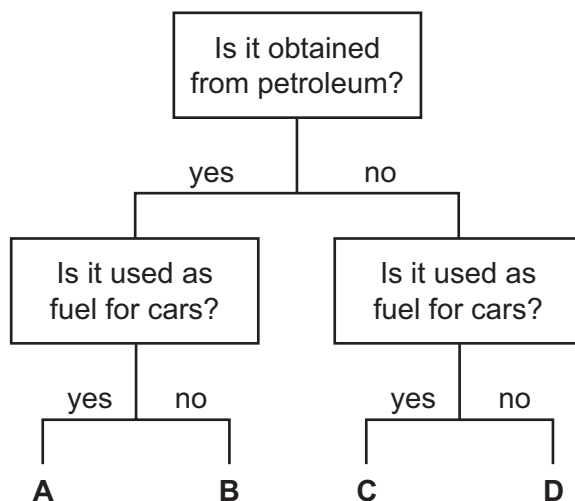
34 The diagram represents a lime kiln used to heat limestone to a very high temperature.



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 Which statements about homologous series are correct?

- 1 All members have similar chemical properties.
- 2 All members have the same molecular mass.
- 3 Ethane and ethene are members of the same homologous series.
- 4 Ethane and propane are members of the same homologous series.

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

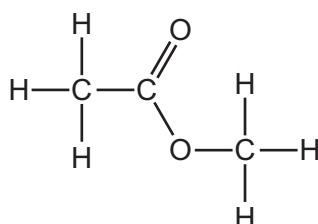
37 Which type of reaction takes place when methane reacts with chlorine in the presence of ultraviolet light?

- A** addition
- B** cracking
- C** polymerisation
- D** substitution

38 Which statement about aqueous ethanoic acid is correct?

- A** It reacts with metal carbonates to form salts, hydrogen and water.
- B** It reacts with metal oxides to form salts and oxygen.
- C** It reacts with reactive metals to form salts and hydrogen.
- D** It turns damp red litmus paper blue.

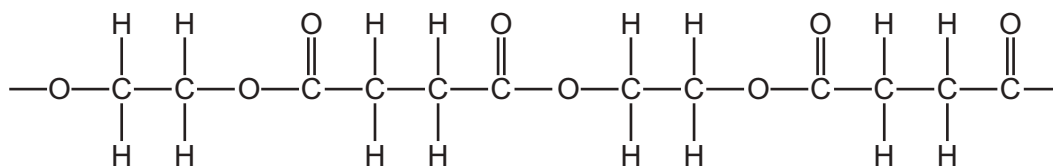
39 The structure of ester W is shown.



Which row gives the names of ester W and the carboxylic acid and alcohol from which it is made?

| | name of ester W | carboxylic acid | alcohol |
|----------|------------------|-----------------|----------|
| A | ethyl methanoate | ethanoic acid | methanol |
| B | ethyl methanoate | methanoic acid | ethanol |
| C | methyl ethanoate | ethanoic acid | methanol |
| D | methyl ethanoate | methanoic acid | ethanol |

40 A section of a polymer is shown.



How many different types of monomer units formed this section of polymer?

A 1

B 2

C 3

D 4

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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; margin: 10px auto; width: fit-content;"> 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 |
| 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.).