



Cambridge IGCSE™

CO-ORDINATED SCIENCES

Paper 2 Multiple Choice (Extended)

0654/21

May/June 2025

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.
- Take the weight of 1.0 kg to be 9.8 N (acceleration of free fall = 9.8 m/s^2).

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 Which result with the biuret test shows that protein is present?
 - A blue
 - B green
 - C orange
 - D purple

- 2 Which term describes the removal of waste products?
 - A excretion
 - B growth
 - C metabolism
 - D mitosis

- 3 Which type of molecule are enzymes?
 - A carbohydrate
 - B DNA
 - C fat
 - D protein

- 4 Which substance is essential to make chlorophyll?
 - A calcium ions
 - B cellulose
 - C iron ions
 - D magnesium ions

- 5 The table shows the energy demand of males and females of different ages.

age range	energy demand / kJ per person per day	
	males	females
0–4	5520	5230
5–14	9100	7890
15–19	11 300	8870
20–59	10 290	8330
60+	8410	7450

Which conclusions can be made from this data?

- 1 The energy demand of males is greater than that of females at all ages.
- 2 The energy demand of both males and females for age range 0–4 is the lowest.
- 3 The energy demand of males and females decreases after age range 15–19.

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

- 6 Which organ produces an alkaline mixture that neutralises gastric juices?

- A** salivary glands
B large intestine
C liver
D stomach

- 7 Which row about translocation is correct?

	substances transported	source	sink
A	amino acids and glucose	region of production	region of use
B	amino acids and glucose	region of growth	region of production
C	amino acids and sucrose	region of production	region of use
D	amino acids and sucrose	region of growth	region of production

- 8 Yogurt is a food made by adding bacteria to milk. The bacteria feed on sugars in the milk and produce lactic acid. The lactic acid denatures the milk protein.

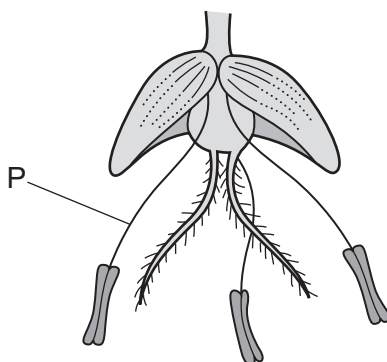
Which process produces the lactic acid?

- A aerobic respiration
- B anaerobic respiration
- C assimilation
- D decomposition

- 9 What is secreted by the pancreas?

- A glucagon
- B glucose
- C glycerol
- D glycogen

- 10 The diagram shows a flower.

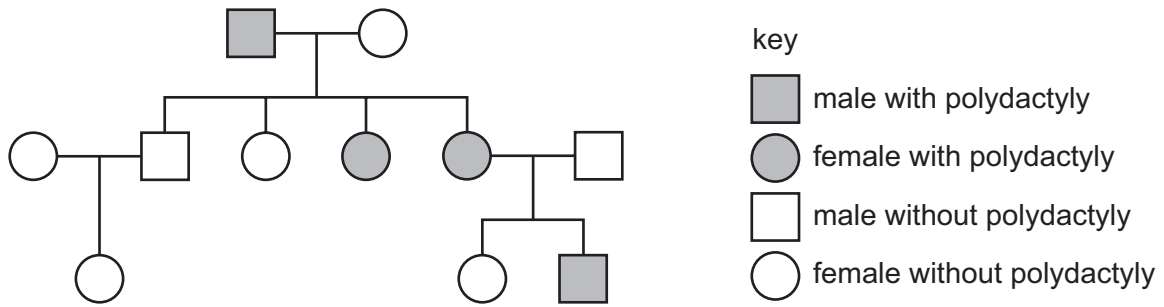


What is structure P and which type of pollination is used by the flower?

	structure P	type of pollination
A	filament	insect
B	filament	wind
C	stigma	insect
D	stigma	wind

- 11** Polydactyly is the possession of additional fingers or toes. It is caused by a dominant allele.

The pedigree diagram shows the inheritance of polydactyly by a family.



How many people in this family are heterozygous?

- A** 3 **B** 4 **C** 6 **D** 7
- 12** In the food chain shown, 10% of the energy is transferred between each trophic level.

grass → grasshopper → frog → snake → buzzard

How much energy is transferred to the tertiary consumer for every 100 kJ of energy in the herbivore?

- A** 0.1 kJ **B** 1 kJ **C** 10 kJ **D** 100 kJ
- 13** The table shows the dates that different antibiotics were introduced and the dates that antibiotic-resistant bacteria were first reported.

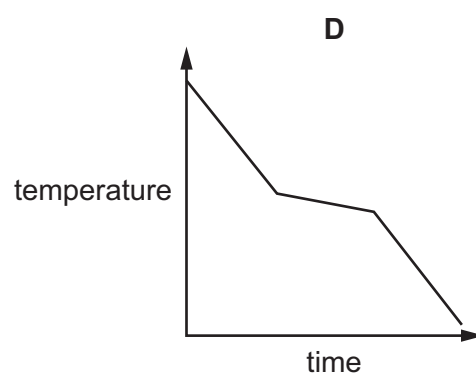
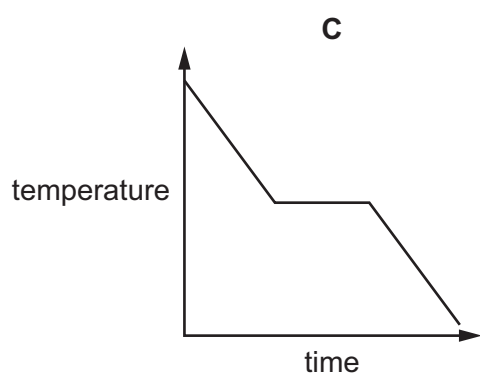
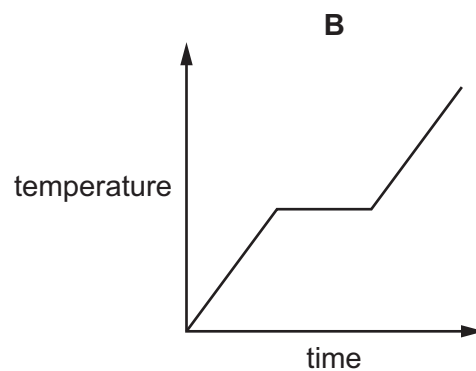
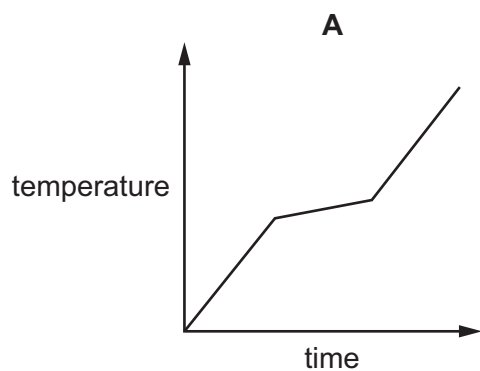
antibiotic	date introduced	date resistance first reported
penicillin	1943	1946
tetracycline	1948	1953
erythromycin	1952	1988
ampicillin	1961	1973

Which statements about the development of antibiotic resistance are supported by the data?

- 1 Tetracycline was the last antibiotic to be introduced.
- 2 Erythromycin took the longest time for bacteria to become resistant.
- 3 Penicillin had the shortest time between introduction and the first report of resistance.

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

14 Which graph shows the temperature change when an impure, solid substance is heated?



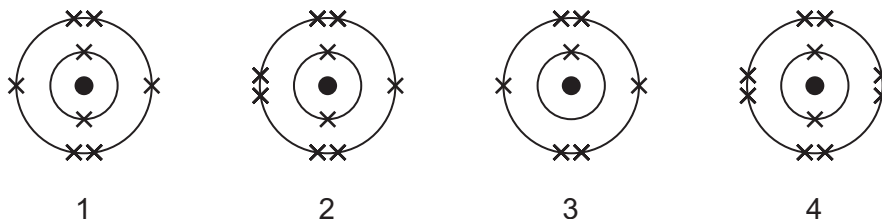
15 Information about four gases is shown.

gas	molecular formula
ammonia	NH_3
butane	C_4H_{10}
carbon dioxide	CO_2
chlorine	Cl_2

Which gas has the greatest rate of diffusion?

- A** ammonia
- B** butane
- C** carbon dioxide
- D** chlorine

16 The electronic configurations of four particles are shown.



Which diagrams represent the electronic configurations of a Group VI atom and its ion?

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

17 An aluminium atom forms an aluminium ion, Al^{3+} .

Which statement describes what happens to the aluminium atom?

- A** It gains 3 electrons.
B It gains 3 protons.
C It loses 3 electrons.
D It loses 3 protons.

18 What is the balanced equation for the combustion of hydrogen?

- A** $2\text{H} + \text{O} \rightarrow \text{H}_2\text{O}$
B $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$
C $\text{H}_2 + \text{O} \rightarrow \text{H}_2\text{O}$
D $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

19 Which description of mass is used to define relative atomic mass, A_r ?

- A** the mass of $\frac{1}{12}$ of a mole of ^{12}C atoms
B the mass of one mole of ^{12}C atoms
C the mass of $\frac{1}{12}$ the mass of one atom of ^{12}C
D the mass of one atom of ^{12}C

20 Which quantities, when measured at room temperature and pressure, contain one mole of oxygen molecules?

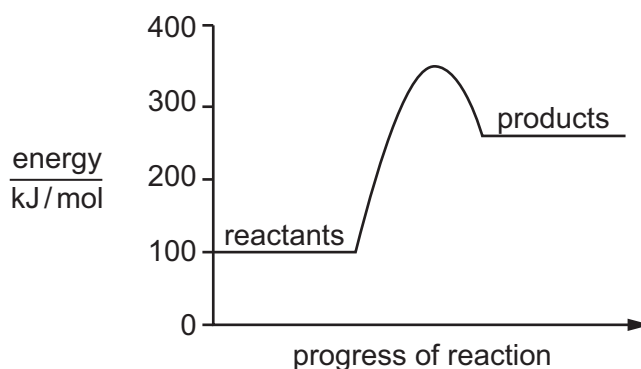
- 1 16 g of oxygen molecules
- 2 12 dm³ of oxygen molecules
- 3 the Avogadro constant number of oxygen molecules
- 4 24 dm³ of oxygen molecules

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

21 Which gas is formed at the cathode during electrolysis?

- A** carbon dioxide
- B** chlorine
- C** hydrogen
- D** oxygen

22 A reaction pathway diagram for a reaction is shown.



What is the value of the activation energy for this reaction?

- A** 100 kJ/mol **B** 150 kJ/mol **C** 250 kJ/mol **D** 350 kJ/mol

23 Compounds are made up from two or more different elements1..... bonded together.

Compounds cannot be broken down into simpler substances by2..... processes.

Compounds and their elements have3..... properties.

Which words complete gaps 1, 2 and 3?

	1	2	3
A	chemically	chemical	similar
B	chemically	physical	different
C	physically	chemical	similar
D	physically	physical	different

24 Which statement describes an amphoteric oxide?

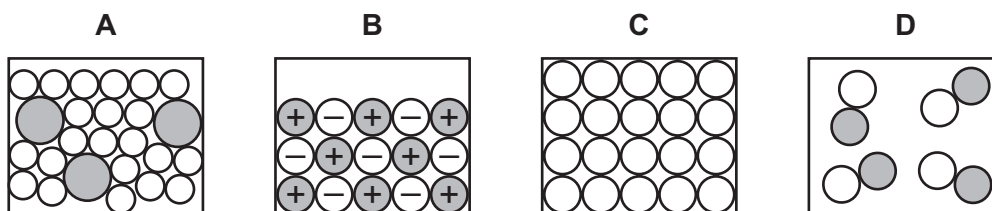
A It does not react with either sodium hydroxide or hydrochloric acid.

B It reacts with sodium hydroxide but not hydrochloric acid.

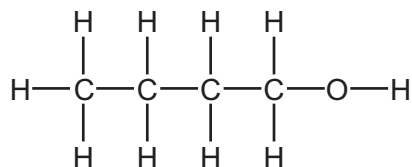
C It reacts with hydrochloric acid but not sodium hydroxide.

D It reacts with both sodium hydroxide and hydrochloric acid.

25 Which diagram represents the structure of an alloy?



26 The structure of compound P is shown.



Which type of compound is P?

A polymer

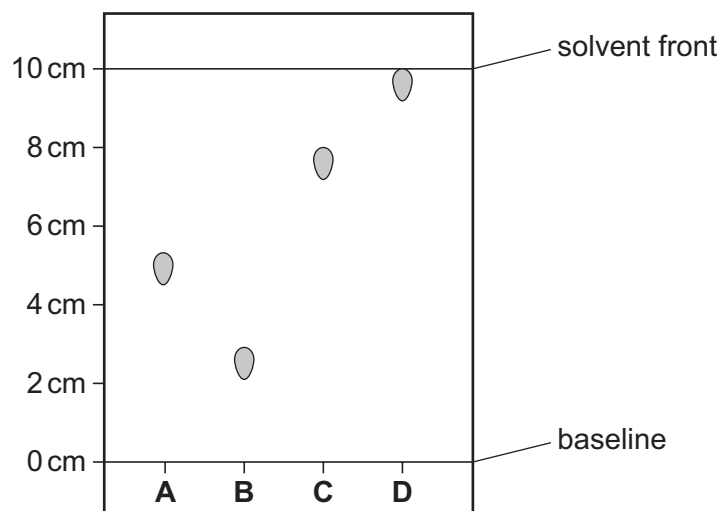
B alcohol

C alkane

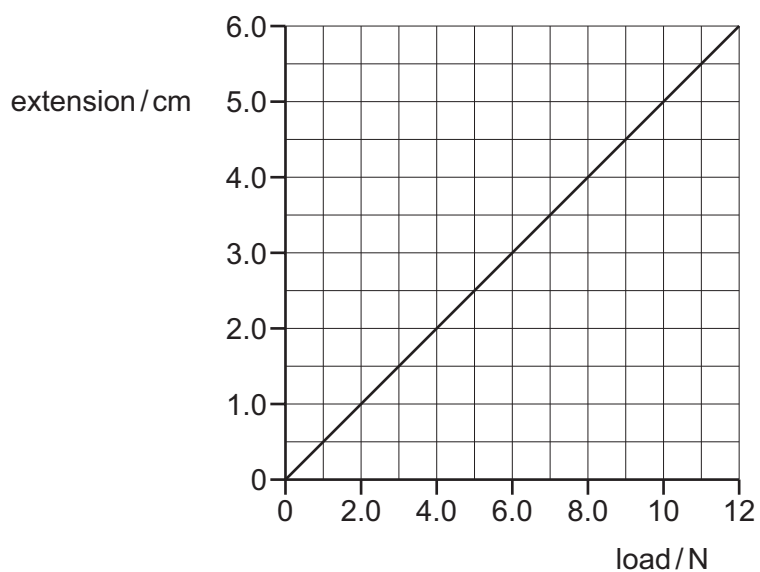
D alkene

27 The chromatogram of four substances is shown.

Which substance has an R_f value of 0.25?



28 The diagram shows the extension-load graph for a spring. The length of the unloaded spring is 4.0 cm.



A load is suspended from the spring and the length of the spring increases to 5.0 cm.

What is the value of the load?

- A** 0.50 N **B** 2.0 N **C** 8.0 N **D** 10 N

29 What is the unit of work and what is an equivalent combination of units?

	unit	equivalent combination
A	joule	newton metre
B	joule	newton / metre
C	newton	joule metre
D	newton	joule / metre

30 The total energy input to an electric lamp is 20 J.

The useful energy output is 12 J.

What is the efficiency of the lamp?

- A** 33% **B** 40% **C** 60% **D** 66%

31 Which statement explains why smoke particles are made to move by other particles in Brownian motion?

- A** The other particles are larger and move faster than smoke particles.
B The other particles are larger and move slower than smoke particles.
C The other particles are smaller and move faster than smoke particles.
D The other particles are smaller and move slower than smoke particles.

32 Some materials use atomic or molecular lattice vibrations and some materials use the movement of delocalised electrons for thermal conduction.

Which row shows the correct materials?

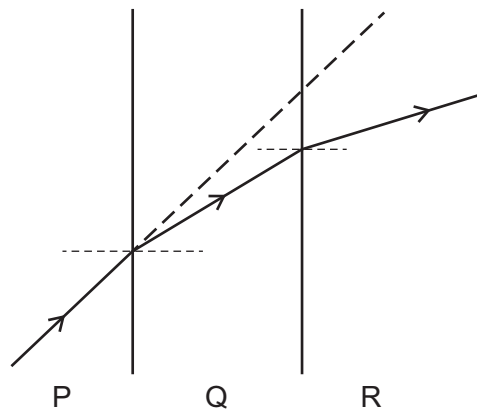
	atomic or molecular lattice vibrations	movement of delocalised electrons
A	metals only	metals and plastics
B	plastics only	metals and plastics
C	metals and plastics	metals only
D	metals and plastics	plastics only

33 Which surface is the best absorber of thermal radiation?

- A** dull black
- B** dull white
- C** shiny black
- D** shiny white

34 The diagram shows a ray of light passing from medium P to medium Q and then to medium R.

The speeds of light in each of the mediums P, Q and R are c_P , c_Q and c_R respectively.



Which list compares the speeds of light in the three mediums in order from lowest to highest?

- A** $c_P \rightarrow c_Q \rightarrow c_R$
- B** $c_P \rightarrow c_R \rightarrow c_Q$
- C** $c_Q \rightarrow c_P \rightarrow c_R$
- D** $c_R \rightarrow c_Q \rightarrow c_P$

35 What is the speed of X-rays in a vacuum?

- A** $3.0 \times 10^2 \text{ m/s}$
- B** $3.0 \times 10^4 \text{ m/s}$
- C** $3.0 \times 10^6 \text{ m/s}$
- D** $3.0 \times 10^8 \text{ m/s}$

- 36** An electric kettle is rated at 3.0 kW and is connected to a 250 V supply. The kettle is switched on for 2.0 minutes.

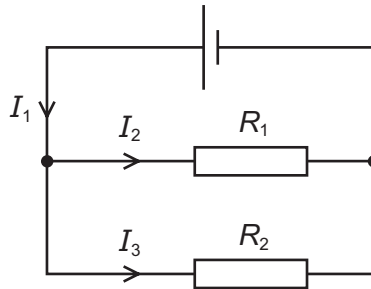
Which row shows the current in the kettle and the energy transferred by the kettle?

	current / A	energy / J
A	12	6000
B	12	360 000
C	750	6000
D	750	360 000

- 37** The diagram shows resistors of resistance R_1 and R_2 connected in parallel.

The combined resistance of the resistors is R_T .

Currents I_1 , I_2 and I_3 are labelled.

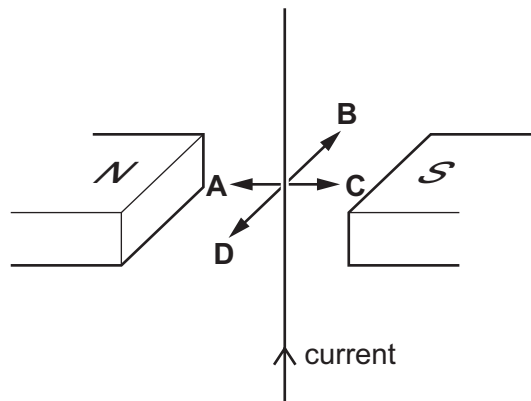


Which row is correct?

	current I_1	resistance R_T
A	larger than I_3	smaller than R_2
B	larger than I_3	larger than R_1
C	smaller than I_2	smaller than R_2
D	smaller than I_2	larger than R_1

- 38** The diagram shows the direction of the current in a wire. The wire is placed between the poles of a magnet and this causes a force to act on the wire.

In which labelled direction does the force act?



- 39** Which statement about background radiation is correct?

- A** All of it comes from the ground.
- B** None of it comes from the air.
- C** Only people who fly long distances are exposed to it.
- D** Some of it comes from food and drink.

- 40** Planet X and planet Y orbit the Sun and are at different distances from the Sun.

The gravitational field strength of the Sun is greater at the position of planet X than it is at the position of planet Y.

Which row compares the distances from the Sun and the orbital speeds of planet X and planet Y?

	distance from the Sun	orbital speed
A	greater for planet X	greater for planet X
B	greater for planet X	less for planet X
C	less for planet X	greater for planet X
D	less for planet X	less for planet X

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The Periodic Table of Elements

Group																				
I	II											III	IV	V	VI	VII	VIII			
		1 H hydrogen 1																		
		Key atomic number atomic symbol name relative atomic mass																		
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		
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		
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	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 —	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 oganeson —			

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.).