



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

**COMBINED SCIENCE**

**0653/21**

Paper 2 Multiple Choice (Extended)

**May/June 2017**

**45 minutes**

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

\* 4 6 6 7 0 6 2 3 5 8 \*

**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 20.

Electronic calculators may be used.

This document consists of **17** printed pages and **3** blank pages.

1 Process Q happens in cells.

carbohydrates → process Q → energy released

What is process Q?

- A growth
- B nutrition
- C respiration
- D sensitivity

2 Which row shows the site of chemical reactions in a cell and identifies the selectively permeable structure in a cell?

	site of chemical reactions	selectively permeable structure
<b>A</b>	cytoplasm	cell membrane
<b>B</b>	cytoplasm	cell wall
<b>C</b>	vacuole	cell membrane
<b>D</b>	vacuole	cell wall

3 Which statements about enzymes are correct?

- 1 Enzymes are proteins.
- 2 Some enzymes carry out chemical digestion.
- 3 Enzymes speed up the rate of chemical reactions.
- 4 All enzymes work fastest at pH 7.

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

4 Which substance in leaves traps light energy for use in photosynthesis?

- A carbohydrate
- B carbon
- C carbon dioxide
- D chlorophyll

5 The statements show how a person's diet can be unbalanced.

- 1 eating too much fibre
- 2 eating too much saturated fat
- 3 eating too much salt

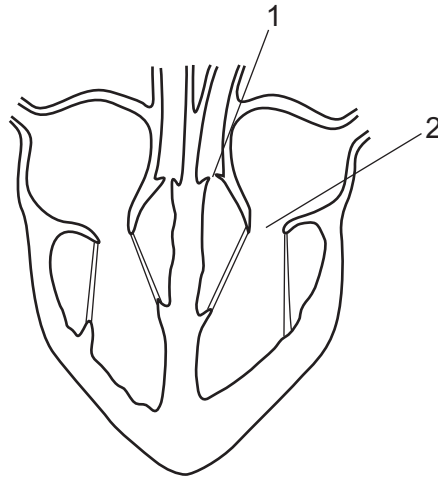
Which of these increase the risk of coronary heart disease?

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

6 Which row matches the adaptation of a root hair cell to its function?

	adaptation	function
<b>A</b>	large surface area	uptake of water and glucose
<b>B</b>	large surface area	uptake of water and ions
<b>C</b>	small surface area	uptake of water and glucose
<b>D</b>	small surface area	uptake of water and ions

7 The diagram shows a section through the heart.



The ventricles contract and blood is forced into the arteries.

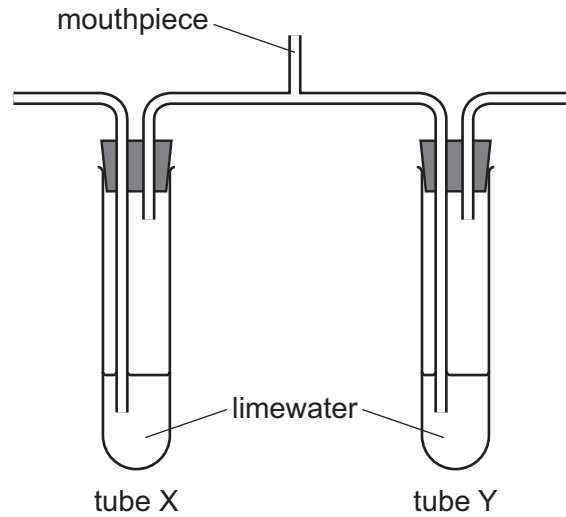
What is the state of valves 1 and 2 when this happens?

	valve 1	valve 2
<b>A</b>	closed	closed
<b>B</b>	closed	open
<b>C</b>	open	closed
<b>D</b>	open	open

8 Which molecule contains the energy that is released in aerobic respiration?

- A**  $C_6H_{12}O_6$       **B**  $CO_2$       **C**  $H_2O$       **D**  $O_2$

9 The diagram shows apparatus at the start of a breathing experiment.



A person breathes in and out through the mouthpiece for a short time.

Which row shows the results?

	limewater in tube X	limewater in tube Y
<b>A</b>	stays clear	stays clear
<b>B</b>	stays clear	turns cloudy
<b>C</b>	turns cloudy	stays clear
<b>D</b>	turns cloudy	turns cloudy

10 A shoot is illuminated from one side only.

What collects on the dark side of the shoot?

- A** auxin  
**B** chlorophyll  
**C** glucose  
**D** starch

11 Materials are exchanged between a mother and her fetus across the placenta.

Which row shows the overall direction of movement of these materials?

	mother to fetus	fetus to mother
<b>A</b>	amino acids	glucose
<b>B</b>	amino acids	urea
<b>C</b>	carbon dioxide	glucose
<b>D</b>	carbon dioxide	urea

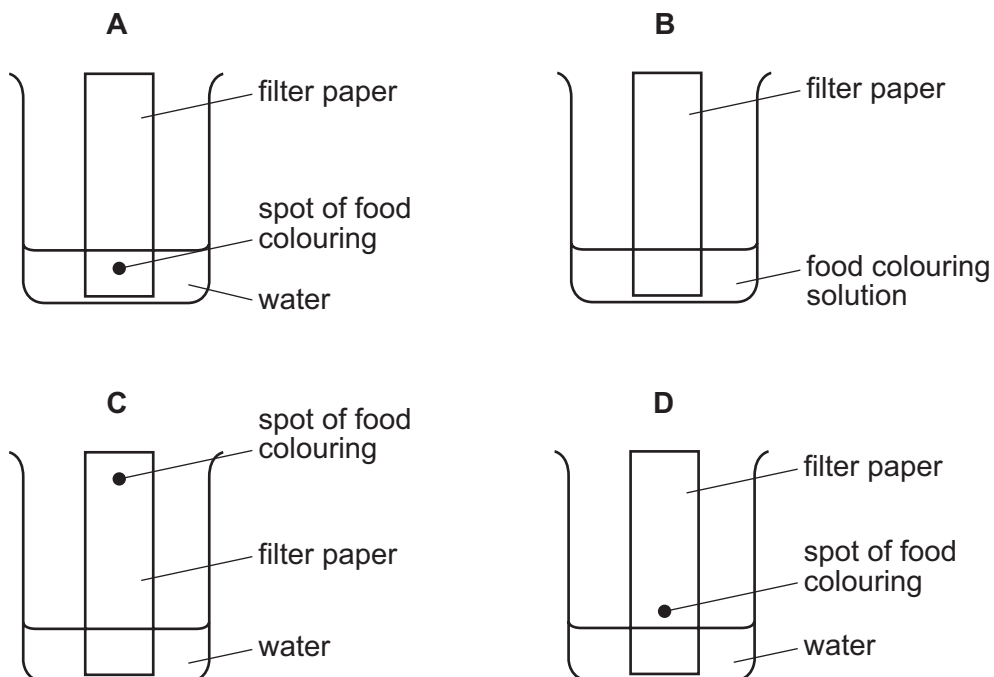
12 Which type of organism makes its own organic nutrients?

- A** carnivore
- B** consumer
- C** herbivore
- D** producer

13 What is an undesirable effect of overuse of fertilisers in agriculture?

- A** acid rain
- B** deforestation
- C** eutrophication
- D** global warming

14 Which diagram shows how a mixture of dyes in a food colouring are separated?



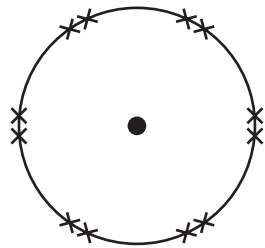
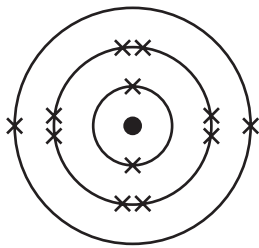
15 Which statement describes a mixture?

- A It contains molecules made from the same type of atom.
- B It contains only one type of atom.
- C It contains two different types of atom joined by chemical bonds.
- D It contains two different types of atom that can be separated by physical processes.

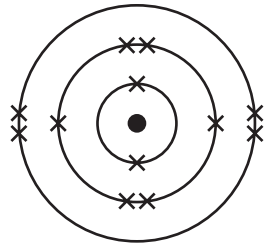
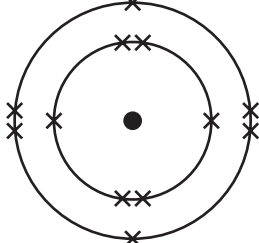
16 The atomic (proton) number of magnesium is 12.

Which diagram shows the electronic structure of a magnesium atom?

**A** **B**

**C** **D**

key  
 × = electron  
 ● = nucleus

17 Aluminium ions have the formula  $Al^{3+}$ .

Oxide ions have the formula  $O^{2-}$ .

What is the formula of aluminium oxide?

- A**  $AlO$       **B**  $AlO_2$       **C**  $Al_2O_3$       **D**  $Al_3O_2$

18 Molten sodium chloride is electrolysed.

Which equations represent the reactions at the electrodes?

	anode	cathode
<b>A</b>	$2Cl^- \rightarrow Cl_2 + 2e^-$	$Na^+ + e^- \rightarrow Na$
<b>B</b>	$Cl_2 + 2e^- \rightarrow 2Cl^-$	$Na \rightarrow Na^+ + e^-$
<b>C</b>	$Na \rightarrow Na^+ + e^-$	$Cl_2 + 2e^- \rightarrow 2Cl^-$
<b>D</b>	$Na^+ + e^- \rightarrow Na$	$2Cl^- \rightarrow Cl_2 + 2e^-$

19 Which statement about chemical reactions is **not** correct?

- A A higher temperature increases the rate of an endothermic reaction.
- B Chemical energy is converted into thermal energy in an endothermic reaction.
- C Temperature decreases in an endothermic reaction and there is an increase in chemical energy.
- D Temperature increases in an exothermic reaction because there is an increase in thermal energy.

20 Hydrogen peroxide decomposes to form water and oxygen.

Which changes in temperature and in concentration **both** reduce the rate of this reaction?

	temperature of hydrogen peroxide	concentration of hydrogen peroxide
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

21 In which word equation is copper reduced?

- A anhydrous copper sulfate + water → hydrated copper sulfate
- B copper carbonate + hydrochloric acid → copper chloride + water + carbon dioxide
- C copper oxide + hydrogen → copper + water
- D copper + oxygen → copper oxide

22 Acidified barium nitrate solution is added to solution X. A white precipitate forms.

What is X?

- A hydrochloric acid
- B limewater
- C potassium chloride
- D sulfuric acid



23 Which element is a non-metallic solid at room temperature?

	melting point /°C	number of electrons in outer shell
<b>A</b>	-210	5
<b>B</b>	-7	7
<b>C</b>	98	1
<b>D</b>	3730	4

24 What is an alloy?

- A** a compound containing two metallic elements
- B** a compound containing two non-metallic elements
- C** a mixture containing two metallic elements
- D** a mixture containing two non-metallic elements

25 X, Y and Z are three metallic elements.

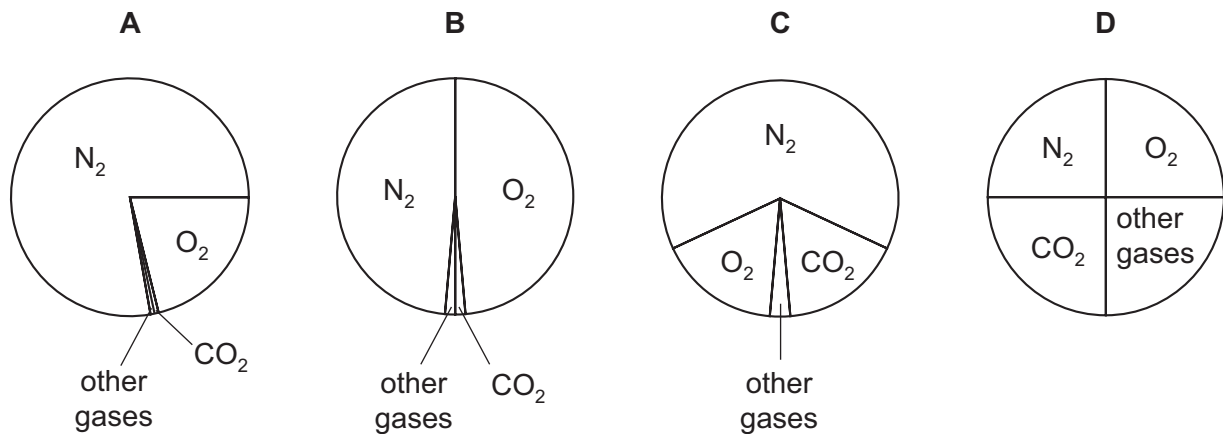
When Z is heated with the oxide of X, the element X is formed.

When X is added to a solution of  $Y^{2+}$  ions no reaction takes place.

What is the order of reactivity of the metals?

	least reactive	→	most reactive
<b>A</b>	X	Y	Z
<b>B</b>	Y	X	Z
<b>C</b>	Y	Z	X
<b>D</b>	Z	Y	X

26 Which pie chart shows the proportions of gases in clean air?

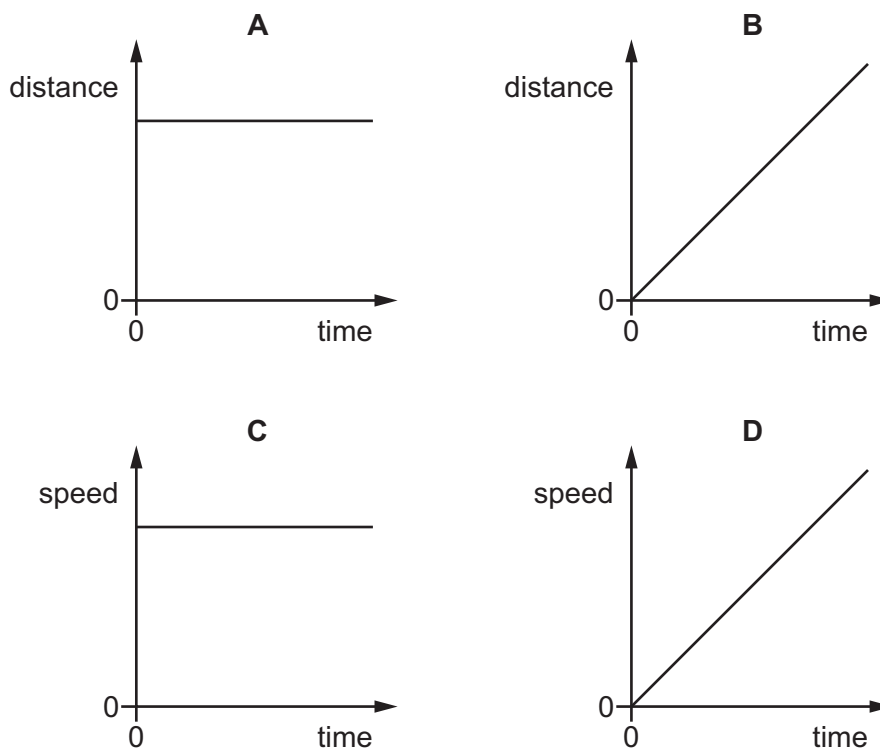


27 Which statement about the products of the fractional distillation of petroleum is **not** correct?

- A Fractions obtained from high up the fractional distillation column have low boiling points.
- B Fractions obtained from low down the fractional distillation column contain large molecules.
- C Large molecules have weak intermolecular attractive forces.
- D Refinery gas is used for heating and cooking.

28 The diagrams show two distance-time graphs and two speed-time graphs.

Which graph represents the motion of an object that is moving with constant acceleration?

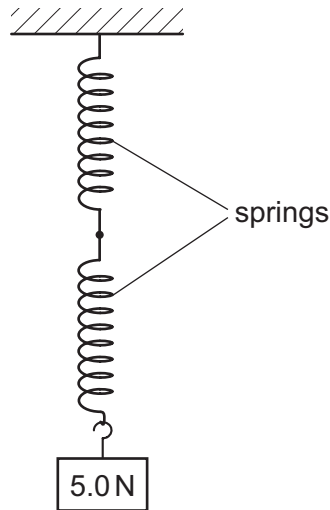


29 Which row shows the unit for force, the unit for mass and the unit for weight?

	force	mass	weight
<b>A</b>	kg	kg	N
<b>B</b>	kg	N	kg
<b>C</b>	N	kg	N
<b>D</b>	N	N	kg

30 A spring obeys Hooke's law. A load of 10N hangs from the spring and causes the spring to extend by 12 mm.

Two springs, identical to the first one, are now joined as shown. A load of 5.0 N is hung from the springs.



What is the total extension of the combination of the two springs?

- A** 3.0 mm      **B** 6.0 mm      **C** 12 mm      **D** 24 mm

- 31** A brick of mass of 3.0 kg rests on a shelf. The brick drops off the shelf. The brick hits the ground at a speed of 8.0 m/s. Air resistance can be ignored.

The acceleration of free fall  $g$  is 10 m/s<sup>2</sup>.

How much kinetic energy did the brick have just before it hit the ground, and how much potential energy did the brick have when it was on the shelf?

	kinetic energy before hitting ground/J	potential energy on shelf /J
<b>A</b>	24	24
<b>B</b>	24	96
<b>C</b>	96	0
<b>D</b>	96	96

- 32** A liquid changes into a gas and this causes the temperature of the liquid to change.

What is the name of this process, and how does the temperature change?

	name of process	temperature change
<b>A</b>	condensation	decreases
<b>B</b>	condensation	increases
<b>C</b>	evaporation	decreases
<b>D</b>	evaporation	increases

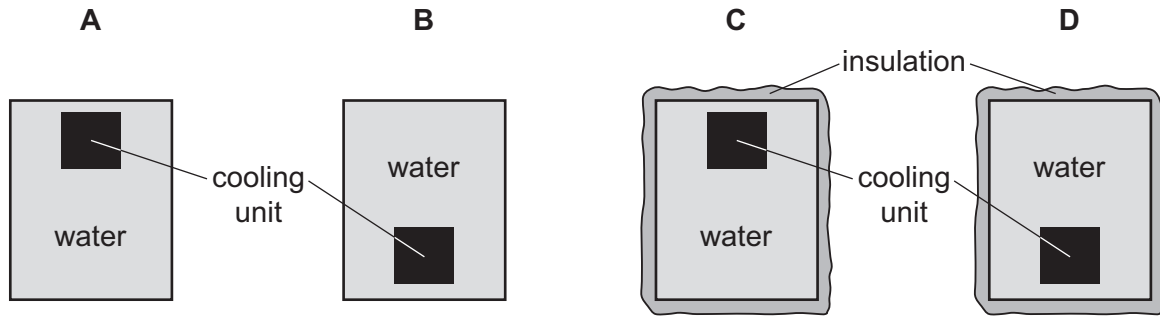
33 Four identical metal tanks in a room each contain the same amount of water.

The water is at the same temperature as the room.

Two of the tanks are insulated, and two of the tanks are not insulated.

A cooling unit is placed in each of the tanks, in the position shown.

In which tank does all the water become cool the most quickly?



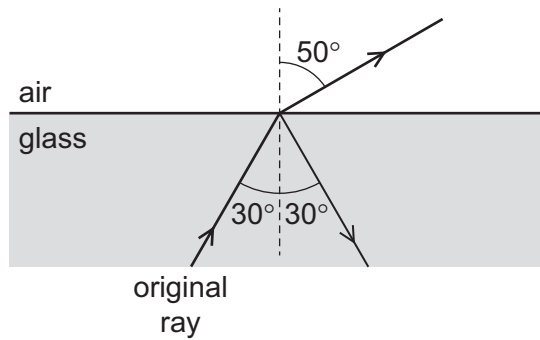
34 A wave travels through a substance from point X to point Y. The diagram shows the direction in which particles of the substance vibrate.



Which row states the type of wave involved, and gives an example of this type of wave?

	type of wave	example
<b>A</b>	longitudinal	radio
<b>B</b>	longitudinal	sound
<b>C</b>	transverse	radio
<b>D</b>	transverse	sound

- 35** A ray of light is travelling in glass. The ray reaches a boundary with air and splits into two rays as shown.



What has happened to the original ray?

- A** It has been partially internally reflected.
  - B** It has been partially internally refracted.
  - C** It has been totally internally reflected.
  - D** It has been totally internally refracted.
- 36** A space telescope is fitted with an infra-red detector, an ultraviolet detector and a visible light detector.

An explosion on the surface of the Sun emits infra-red, ultraviolet and visible light at the same time.

Which detector is the first to detect the explosion?

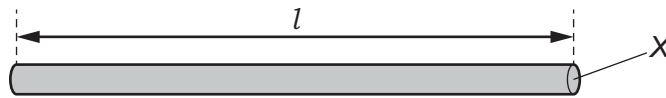
(Space is a vacuum.)

- A** the infra-red detector
  - B** the ultraviolet detector
  - C** the visible light detector
  - D** all three detect it simultaneously
- 37** An electronic circuit in a fire alarm makes a loudspeaker vibrate alternately at two different frequencies.

Which pair of frequencies is suitable to use in the alarm to alert people to the danger of fire?

- A** 1.5 Hz and 15 Hz
- B** 15 Hz and 150 000 Hz
- C** 150 Hz and 15 000 Hz
- D** 150 000 Hz and 15 000 000 Hz

- 38 The diagram shows a wire of length  $l$  and cross-sectional area  $X$ .



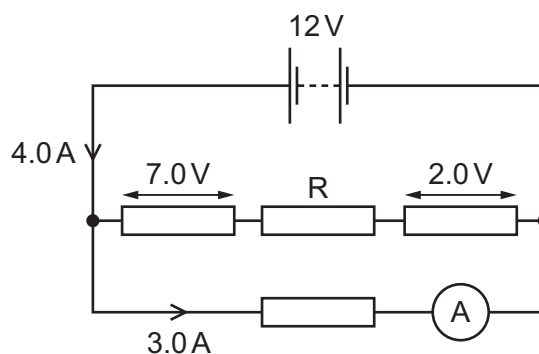
Which two changes **must** decrease the resistance of the wire?

- A** decrease  $l$  and decrease  $X$   
**B** decrease  $l$  and increase  $X$   
**C** increase  $l$  and decrease  $X$   
**D** increase  $l$  and increase  $X$
- 39 An 800 W microwave oven and a 2500 W conventional electric oven are both designed to operate from a 230 V supply.

Which row shows the rating of the fuse that should be fitted to each device?

	microwave oven	conventional electric oven
<b>A</b>	5 A	5 A
<b>B</b>	5 A	13 A
<b>C</b>	13 A	5 A
<b>D</b>	13 A	13 A

- 40 The diagram shows a circuit containing a battery and four resistors. One resistor is labelled R. Some values of p.d. and current are shown.



What is the p.d. across resistor R, and what is the current in resistor R?

	p.d./V	current/A
<b>A</b>	3.0	1.0
<b>B</b>	3.0	4.0
<b>C</b>	12	1.0
<b>D</b>	12	4.0



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The Periodic Table of Elements

		Group															
I	II	III	IV	V	VI	VII	VIII										
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9	5 <b>B</b> boron 11	6 <b>C</b> carbon 12	7 <b>N</b> nitrogen 14	8 <b>O</b> oxygen 16	9 <b>F</b> fluorine 19	10 <b>Ne</b> neon 20					2 <b>He</b> helium 4					
11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24	13 <b>Al</b> aluminium 27	14 <b>Si</b> silicon 28	15 <b>P</b> phosphorus 31	16 <b>S</b> sulfur 32	17 <b>Cl</b> chlorine 35.5	18 <b>Ar</b> argon 40					36 <b>Kr</b> krypton 84					
19 <b>K</b> potassium 39	20 <b>Ca</b> calcium 40	21 <b>Sc</b> scandium 45	22 <b>Ti</b> titanium 48	23 <b>V</b> vanadium 51	24 <b>Cr</b> chromium 52	25 <b>Mn</b> manganese 55	26 <b>Fe</b> iron 56	27 <b>Co</b> cobalt 59	28 <b>Ni</b> nickel 59	29 <b>Cu</b> copper 64	30 <b>Zn</b> zinc 65	31 <b>Ga</b> gallium 70	32 <b>Ge</b> germanium 73	33 <b>As</b> arsenic 75	34 <b>Se</b> selenium 79	35 <b>Br</b> bromine 80	36 <b>Kr</b> krypton 84
37 <b>Rb</b> rubidium 85	38 <b>Sr</b> strontium 88	39 <b>Y</b> yttrium 89	40 <b>Zr</b> zirconium 91	41 <b>Nb</b> niobium 93	42 <b>Mo</b> molybdenum 96	43 <b>Tc</b> technetium —	44 <b>Ru</b> ruthenium 101	45 <b>Rh</b> rhodium 103	46 <b>Pd</b> palladium 106	47 <b>Ag</b> silver 108	48 <b>Cd</b> cadmium 112	49 <b>In</b> indium 115	50 <b>Sn</b> tin 119	51 <b>Sb</b> antimony 122	52 <b>Te</b> tellurium 128	53 <b>I</b> iodine 127	54 <b>Xe</b> xenon 131
55 <b>Cs</b> caesium 133	56 <b>Ba</b> barium 137	57–71 lanthanoids	72 <b>Hf</b> hafnium 178	73 <b>Ta</b> tantalum 181	74 <b>W</b> tungsten 184	75 <b>Re</b> rhenium 186	76 <b>Os</b> osmium 190	77 <b>Ir</b> iridium 192	78 <b>Pt</b> platinum 195	79 <b>Au</b> gold 197	80 <b>Hg</b> mercury 201	81 <b>Tl</b> thallium 204	82 <b>Pb</b> lead 207	83 <b>Bi</b> bismuth 209	84 <b>Po</b> polonium —	85 <b>At</b> astatine —	86 <b>Rn</b> radon —
87 <b>Fr</b> francium —	88 <b>Ra</b> radium —	89–103 actinoids	104 <b>Rf</b> rutherfordium —	105 <b>Db</b> dubnium —	106 <b>Sg</b> seaborgium —	107 <b>Bh</b> bohrium —	108 <b>Hs</b> hassium —	109 <b>Mt</b> meitnerium —	110 <b>Ds</b> darmstadtium —	111 <b>Rg</b> roentgenium —	112 <b>Cn</b> copernicium —	114 <b>Fl</b> flerovium —	116 <b>Lv</b> livermorium —	118 <b>Og</b> oganeson —	119 <b>Uu</b> ununium —	120 <b>Uub</b> ununium —	121 <b>Uut</b> ununium —

Key

atomic number
atomic symbol
name
relative atomic mass

1	<b>H</b>	hydrogen	1
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lanthanoids	57 <b>La</b> lanthanum 139	58 <b>Ce</b> cerium 140	59 <b>Pr</b> praseodymium 141	60 <b>Nd</b> neodymium 144	61 <b>Pm</b> promethium —	62 <b>Sm</b> samarium 150	63 <b>Eu</b> europium 152	64 <b>Gd</b> gadolinium 157	65 <b>Tb</b> terbium 159	66 <b>Dy</b> dysprosium 163	67 <b>Ho</b> holmium 165	68 <b>Er</b> erbium 167	69 <b>Tm</b> thulium 169	70 <b>Yb</b> ytterbium 173	71 <b>Lu</b> lutetium 175
actinoids	89 <b>Ac</b> actinium —	90 <b>Th</b> thorium 232	91 <b>Pa</b> protactinium 231	92 <b>U</b> uranium 238	93 <b>Np</b> neptunium —	94 <b>Pu</b> plutonium —	95 <b>Am</b> americium —	96 <b>Cm</b> curium —	97 <b>Bk</b> berkelium —	98 <b>Cf</b> californium —	99 <b>Es</b> einsteinium —	100 <b>Fm</b> fermium —	101 <b>Md</b> mendelevium —	102 <b>No</b> nobelium —	103 <b>Lr</b> lawrencium —

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).