



Cambridge O Level

CANDIDATE
NAME

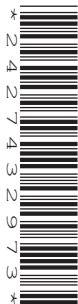
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CENTRE
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COMBINED SCIENCE

5129/22

Paper 2 Theory

May/June 2023

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

This document has **20** pages.

1 A rock on the Moon has a mass of 2.5 kg.

The gravitational field strength g on the Moon is equal to 1.6 N/kg.

(a) State what is meant by 'gravitational field strength'.

..... [1]

(b) Calculate the weight of the rock on the Moon.

weight = N [2]

(c) (i) An astronaut drops the rock from a height of 0.50 m.

State the acceleration of the rock. Include the unit of acceleration in your answer.

acceleration = unit [1]

(ii) Explain why the rock changes speed as it falls.

.....
..... [1]

[Total: 5]

2 Fig. 2.1 shows a section through a leaf as seen with a light microscope.

Some features are identified by the letters **W**, **X**, **Y** and **Z**.

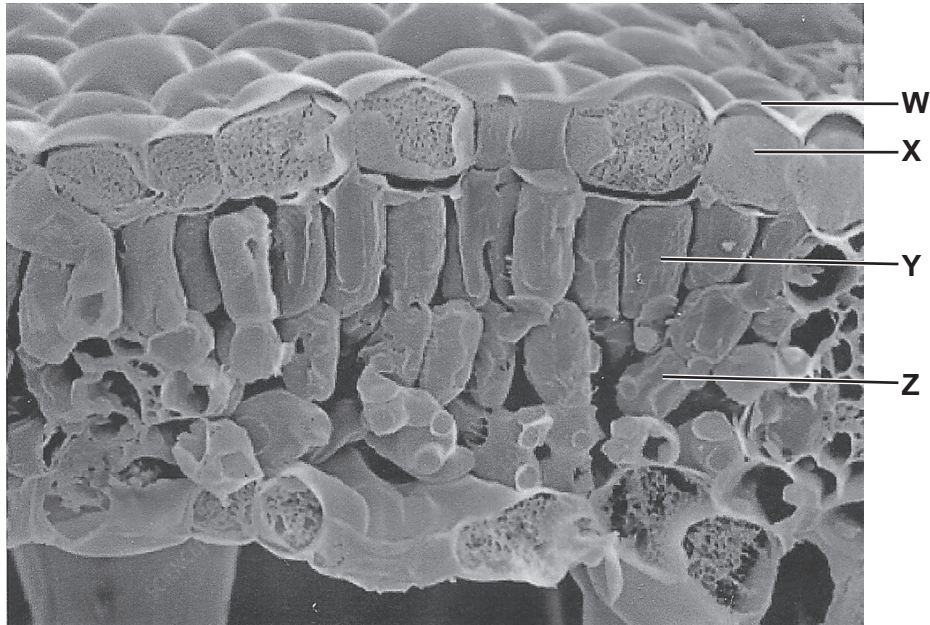


Fig. 2.1

Complete Table 2.1 by writing the names of the features shown by the letters **W**, **X**, **Y** and **Z**.

Choose your answers from the list of words or phrases.

- air space
- cuticle
- guard cell
- lower epidermis cell
- palisade mesophyll cell
- spongy mesophyll cell
- upper epidermis cell

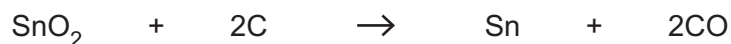
Table 2.1

letter on Fig. 2.1	name of feature
W
X
Y
Z

[4]

- 3 Tin metal is obtained by the reaction between tin(IV) oxide and carbon.

The equation for the reaction is:



[A_r : C, 12; O, 16; Sn, 119]

- (a) (i) Calculate the relative formula mass M_r of tin(IV) oxide.

$$M_r = \dots\dots\dots [1]$$

- (ii) Complete the following sentence.

15.1 g of tin(IV) oxide reacts with g of carbon and

produces g of tin.

[2]

- (b) Carbon monoxide is produced in the reaction.

State an adverse effect of carbon monoxide.

.....

..... [1]

[Total: 4]

Question 4 begins over the page.

- 4 The plastic block shown in Fig. 4.1 has a mass of 7.5 kg.

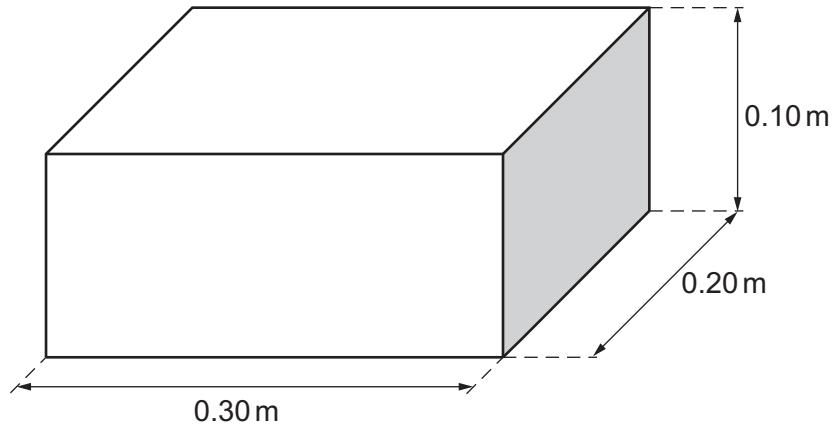


Fig. 4.1

- (a) Calculate the density of the block.

Show your working and state the unit.

density = unit = [4]

- (b) The plastic block is attached to a spring and suspended as shown in Fig. 4.2.

The spring extends 6.0 cm.

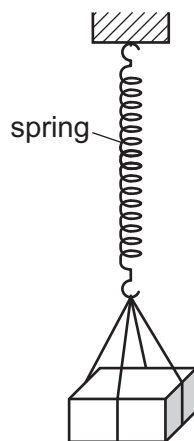


Fig. 4.2

When the block is removed, the spring returns to its original length.

Determine the extension of the spring due to a mass of 5.0 kg.

extension = cm [1]

[Total: 5]

5 Use words from the list to complete the sentences.

	endothermic	exothermic	hydrogen		
oxidation	reduction	saturated	unsaturated	water	

Each word can be used once, more than once or not at all.

Chemical energy is transferred to thermal energy in the surroundings by reactions.

Alkanes are hydrocarbons.

The loss of oxygen in a reaction is

An acid and an alkali react to form and a salt.

[4]

6 Fig. 6.1 shows a person using an electronic cigarette.



Fig. 6.1

Electronic cigarettes allow people to inhale nicotine without inhaling other chemicals normally present in cigarette smoke.

(a) Fig. 6.2 shows how the use of electronic cigarettes has changed in one country over a period of six years.

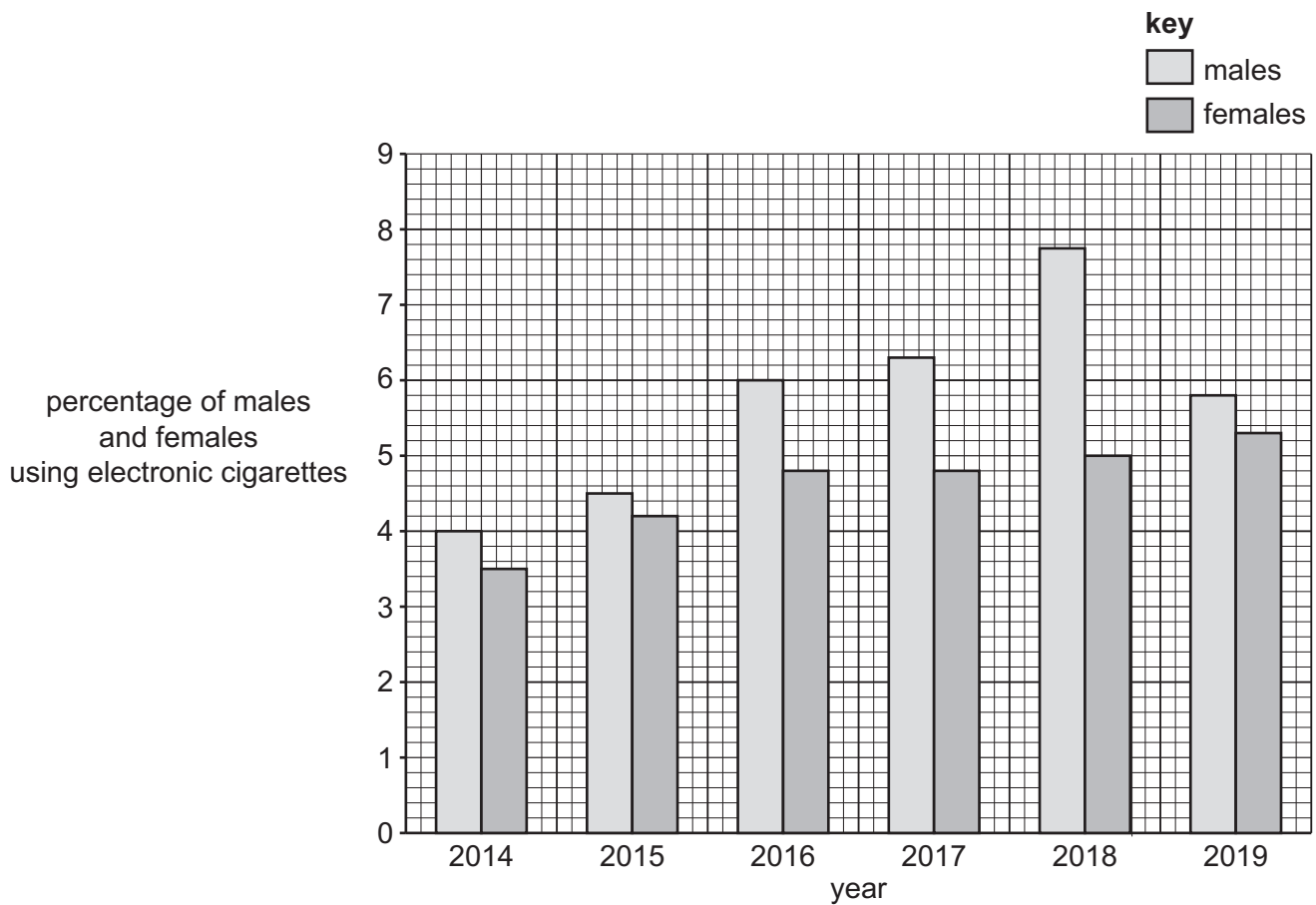


Fig. 6.2

Describe **two** trends shown by the data in Fig. 6.2.

1

.....

2

.....

[2]

(b) Table 6.1 shows some components of tobacco cigarette smoke and their harmful effects on the human body.

Complete Table 6.1 by filling in the missing information.

Table 6.1

component of cigarette smoke	harmful effect on the body
.....	increase in heart rate
tar
.....	toxic

[3]

(c) People use electronic cigarettes when they are trying to stop smoking tobacco cigarettes.

Suggest why people who are trying to give up smoking still need to inhale nicotine.

.....

..... [1]

[Total: 6]

7 Solar radiation can be used as an energy source.

(a) Describe **one** advantage and **one** disadvantage of using solar energy.

advantage

.....

disadvantage

.....

[2]

(b) State the name of **one** other energy source that has the same advantage as solar energy.

..... [1]

(c) Fig. 7.1 shows a device that uses solar energy to heat water.

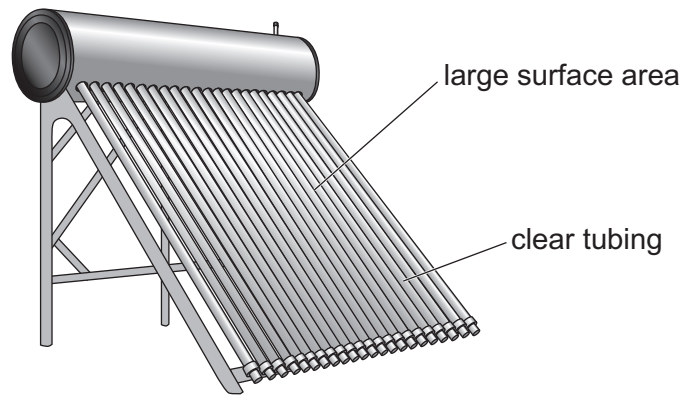


Fig. 7.1

The device heats more water in every hour if the surface area is made larger and if the tubing is painted black.

Explain why.

.....

.....

.....

[2]

[Total: 5]

8 (a) Complete the sentences about enzymes by writing appropriate words in the spaces.

Enzymes are biological catalysts. They are made of a special type of molecule.

An example of a human enzyme found in the digestive system is

The area on a chromosome which codes for an enzyme is called a [3]

(b) Fig. 8.1 shows an incomplete substrate molecule and the enzyme which acts on it.

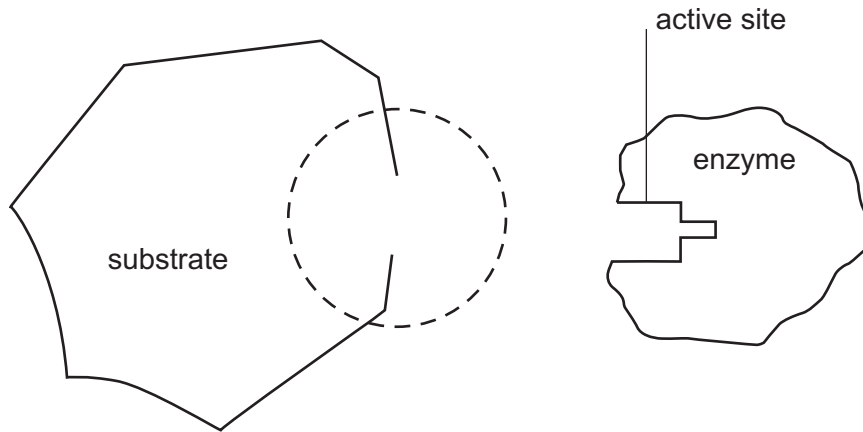


Fig. 8.1

Complete the diagram of the substrate molecule by drawing in the circle on the substrate. [1]

(c) Explain why enzymes found in the human body do not function when they are heated to 60 °C.

.....
.....
.....
.....
..... [2]

[Total: 6]

9 Petroleum contains a mixture of hydrocarbons.

The mixture is separated into different fractions using a fractionating column. Each fraction contains hydrocarbons with different numbers of carbon atoms in each molecule.

Table 9.1 shows information about some of these fractions.

Table 9.1

fraction	number of carbon atoms in each of the hydrocarbon molecules in the fraction	boiling range of the fraction/°C
refinery gas	1–4	less than 25
gasoline	5–7	25–75
naphtha	8–10	75–190
kerosene	11–16	190–250
diesel oil	250–350
fuel oil	20–30	350–400

(a) (i) Suggest the number of carbon atoms in a hydrocarbon molecule in the diesel oil fraction.

..... [1]

(ii) State the fraction in Table 9.1 which is collected nearest to the bottom of the fractionating column.

..... [1]

(iii) State a use of the kerosene fraction.

.....
 [1]

(b) Propane, C_3H_8 , is collected in the refinery gas fraction.

Draw the displayed formula of propane.

[1]

(c) Explain why large hydrocarbon molecules are cracked to form smaller hydrocarbon molecules.

.....

..... [1]

[Total: 5]

10 Use words or phrases from the list to complete the sentences about human reproduction.

diploid	embryo	female gamete	haploid	meiosis
mitosis	ovary	reproductive	vagina	uterus

Each word or phrase may be used once, more than once, or not at all.

Sperm cells are produced in the testes by a type of cell division called

When sperm are in the female, they swim up the oviduct and one sperm fertilises the

.....

The zygote formed has two sets of chromosomes and so it is a cell.

The zygote moves out of the oviduct and embeds in the wall of the

[4]

11 (a) Fig. 11.1 represents a sound wave in air.

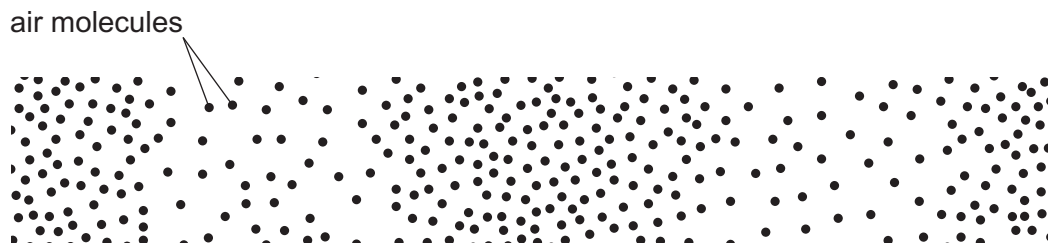


Fig. 11.1

(i) State the name of the type of wave shown in Fig. 11.1.

..... [1]

(ii) On Fig. 11.1 draw a double headed arrow (\longleftrightarrow) to show **one** wavelength of the sound wave. [1]

(b) Fig. 11.2 shows a ray of ultraviolet light incident on a plane mirror.

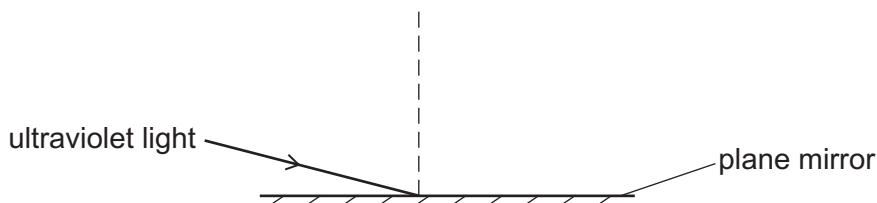


Fig. 11.2

(i) On Fig. 11.2 draw the reflected ray.

[1]

(ii) State **one** useful application of ultraviolet light.

..... [1]

[Total: 4]

12 Copper has a nucleon number of 64 and an atomic number of 29.

(a) Deduce the number of protons and number of neutrons in an atom of copper.

number of protons =

number of neutrons =

[2]

(b) State two properties of copper that make it suitable for use in electrical wiring.

property 1

property 2

[2]

(c) An aqueous solution of copper sulfate reacts with a piece of iron in a displacement reaction to form copper metal.

(i) Complete the word equation for the reaction.

copper sulfate + iron \rightarrow copper + [1]

(ii) Explain why iron displaces copper from copper sulfate.

.....

..... [1]

(iii) Describe one way to increase the rate of this reaction.

.....

..... [1]

[Total: 7]

- 13 The graph in Fig. 13.1 shows how the current in one type of electrical component varies with voltage.

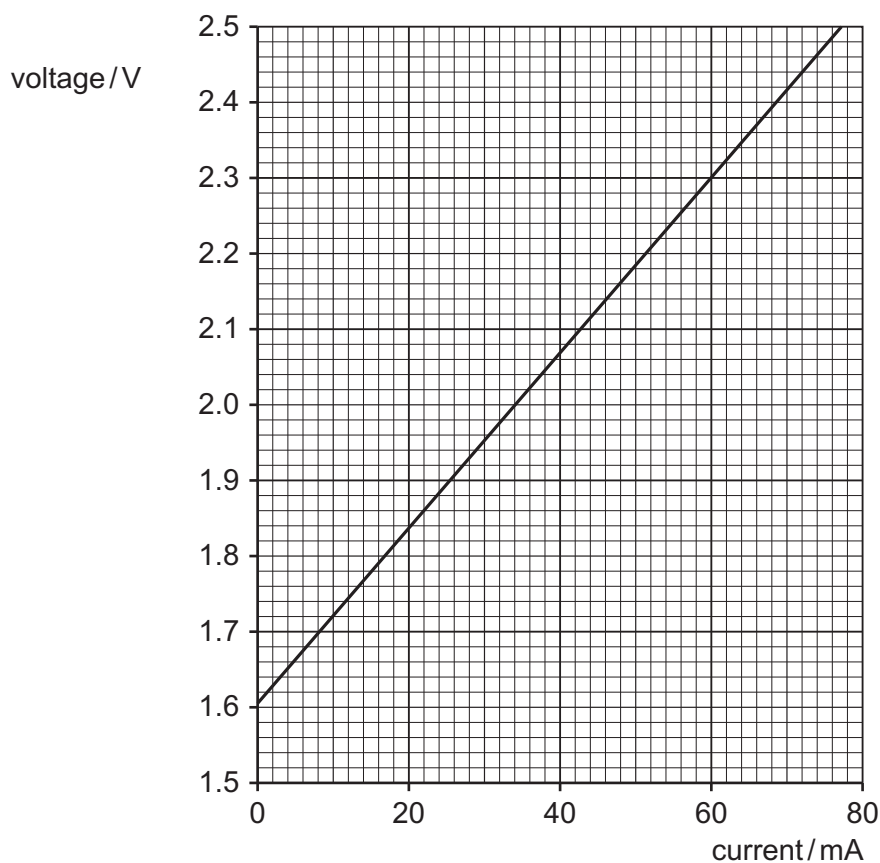


Fig. 13.1

- (a) Calculate the resistance of the component when the voltage is 2.0 V.

State the values you use and show your working.

Give your answer to 2 significant figures.

resistance = Ω [3]

- (b) The voltage is kept constant at 2.0 V.

Calculate the energy transferred by the current to the component in 10 minutes.

energy transferred = J [2]

[Total: 5]

- 14 Draw **three** lines from the box on the left to the boxes on the right to make three sentences that are correct for anaerobic respiration in humans.

Anaerobic respiration in humans ...

... occurs only in the liver.

... occurs during
vigorous exercise.

... produces carbon dioxide.

... produces lactic acid.

... releases less energy than
aerobic respiration.

... requires oxygen.

[3]

15 Lithium, Li, reacts with fluorine, F₂, to form the ionic compound lithium fluoride, LiF.

(a) Construct a balanced symbol equation, including state symbols, for the reaction.

..... [2]

(b) Draw a dot-and-cross diagram to show the electron configuration of the fluoride ion.

[2]

(c) State the test and the result of the test that shows the presence of lithium ions.

test

result

[2]

[Total: 6]

16 Fig. 16.1 shows **some** of the apparatus used to determine the types of emissions from a radioactive source.

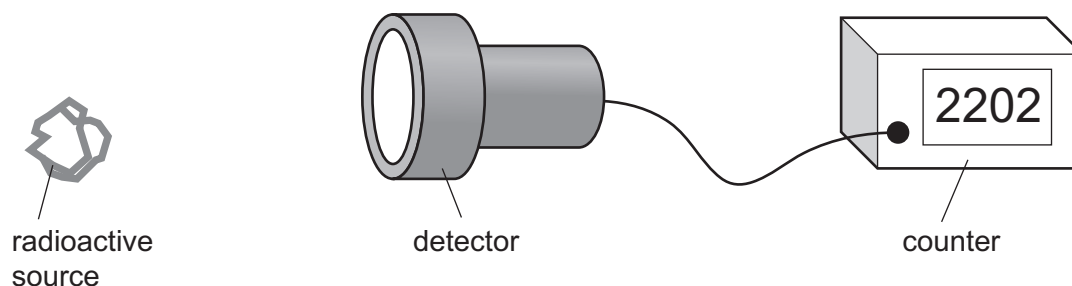


Fig. 16.1

Describe how additional apparatus is used to show that the source emits gamma radiation.

.....

[3]

17 The boxes on the left contain descriptions of activities carried out by the body.

The boxes on the right contain the names of structures where these activities take place.

Draw **one** straight line from each box on the left to link the description of the activity to the structure where it takes place.

description of activity	structure
conducts nerve impulses	alveoli
physical digestion	heart
pumps blood	liver
carbon dioxide passes out of the blood	mouth
	spinal cord

[4]

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The Periodic Table of Elements

		Group															
I	II	III	IV	V	VI	VII	VIII										
		1 H hydrogen 1											2 He helium 4				
3 Li lithium 7	4 Be beryllium 9	Key atomic number atomic symbol name relative atomic mass															
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	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				
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 —	113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganeson —

lanthanoids

actinoids

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
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.).