Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

6078062368

COMBINED SCIENCE **5129/21**

Paper 2 Theory **May/June 2024**

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 The boxes on the left contain the names of substances found in plants.

The boxes on the right contain statements about possible uses of these substances in plants.

Complete Fig. 1.1 by drawing **one** straight line from each substance to its use in plants.

substance	**use of substance**
starch	used in respiration to provide energy in cells
sucrose	used to form cell walls
magnesium	used to make chlorophyll
cellulose	used to transport energy through the plant
glucose	used as a store of energy

Fig. 1.1

[4]

2 A student stands on a diving board at the edge of a swimming pool.

The student throws a ball high into the air and uses a stop-watch to measure the time taken for the ball to land in the pool.

Fig. 2.1 shows how the height of the ball changes with time.

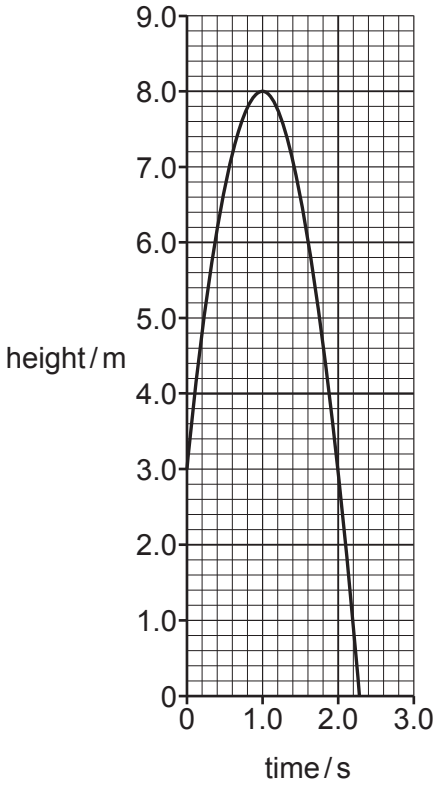

Fig. 2.1

(a) Use the information in Fig. 2.1 to determine:

(i) the height of the ball above the pool at the time that it is thrown upwards

height above the pool = ... m [1]

(ii) the maximum height above the pool that is reached by the ball

maximum height = ... m [1]

(iii) the total time taken for the ball to land in the pool.

time taken = ... s [1]

(b) Calculate the average speed of the ball as it falls from its maximum height.

average speed = ... m / s [2]

[Total: 5]

[Turn over

3 Chlorine, Cl_2, reacts with water to form a mixture of hydrochloric acid, HCl, and chloric(I) acid, HOCl.

The equation for the reaction is:

$$Cl_2 + H_2O \rightarrow HCl + HOCl$$

[A_r: Cl, 35.5; H , 1; O, 16]

(a) (i) Calculate the relative molecular mass M_r of chloric(I) acid.

M_r = ... [1]

(ii) Complete the following sentence.

142 g of chlorine reacts with ..... g of water. [1]

(b) State the colour of chlorine gas at room temperature and pressure.

..... [1]

(c) Describe a test and the result of the test that shows the presence of chlorine.

test .....

result .....

[2]

[Total: 5]

4 Use words or phrases from the list to complete the sentences about the nucleus and nuclear division in human cells.

carbohydrates **forty six** **genes** **meiosis**

mitochondria **mitosis** **proteins** **sperm ducts**

testes **twenty three**

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

(a) Human cells contain ..... pairs of chromosomes in the nucleus. [1]

(b) A chromosome contains DNA which carries genetic information in the form of ..... . These are the codes for the cells to make ..... . [2]

(c) Gametes contain one set of chromosomes only and are produced by the nuclear division called ..... . In human males this type of division occurs in the ..... . [2]

[Total: 5]

5 The concrete block in Fig. 5.1 has a density of $2.3\,g/cm^3$.

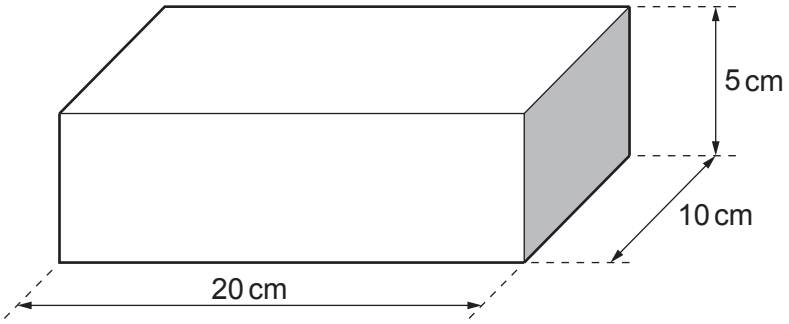

Fig. 5.1

(a) Calculate the mass of the concrete block.

Show your working. Give your answer in kg.

mass of concrete block = ... kg [3]

(b) Calculate the weight of the concrete block using your answer in **(a)**.

Gravitational field strength = 10 N / kg.

weight = ... N [1]

(c) The concrete block is attached to a spring as shown in Fig. 5.2.

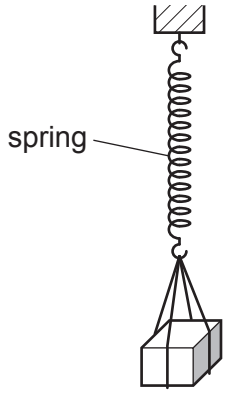

Fig. 5.2

The spring extends 2.0 cm when the concrete block is attached to it.

Calculate the spring constant k of the spring.

k = ... N / cm [2]

[Total: 6]

6 Fig. 6.1 shows the factors responsible for the percentage decline in the number of species in some animal groups.

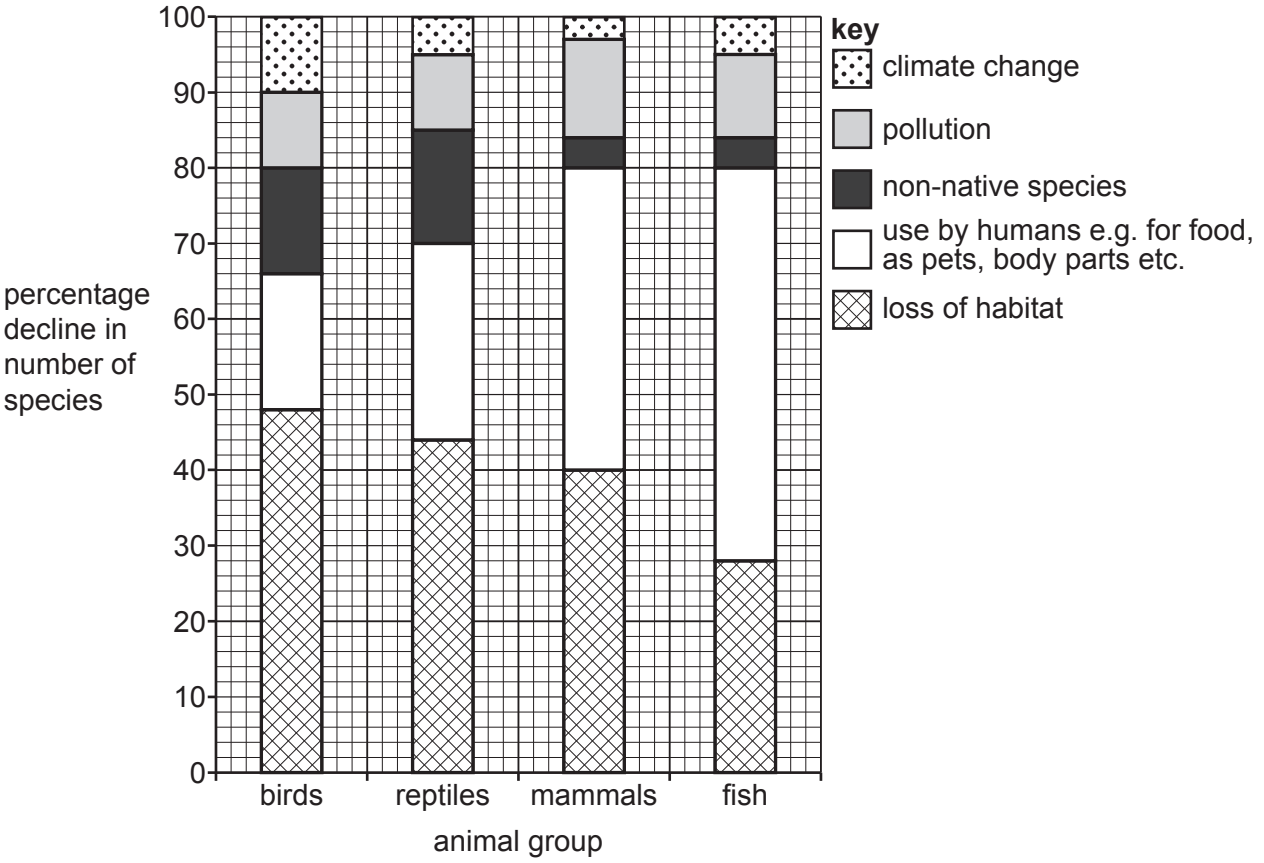

Fig. 6.1

(a) (i) State the animal group that has the largest percentage decline in number of species due to pollution.

..... [1]

(ii) State the factor which is responsible for the largest percentage decline in number of species in the reptiles animal group.

..... [1]

(iii) Determine the percentage decline in number of fish species due to use by humans.

percentage decline in fish species = ... % [1]

(b) Explain how deforestation causes an increase in the amount of carbon dioxide in the atmosphere.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 6]

7 The chemical formulae for some substances are shown.

Al C_2H_4 H_2 H_2SO_4 $MgCl_2$ NaOH

Use formulae from the list to answer the following questions.

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

State the formula of a substance that:

(a) has a very low boiling point

..... [1]

(b) conducts electricity when solid

..... [1]

(c) is an element

..... [1]

(d) has a pH above 7 when dissolved in water

..... [1]

(e) is a hydrocarbon.

..... [1]

[Total: 5]

8 Fig. 8.1 shows a winch shaft being used to lift a heavy bucket. As the handle is turned, the rope winds around the winch shaft.

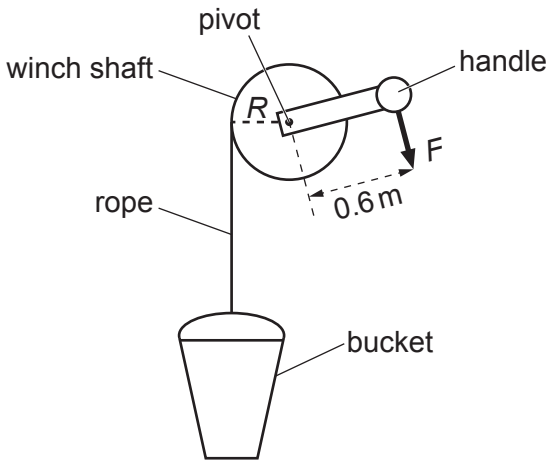

Fig. 8.1 (not to scale)

(a) The radius *R* of the winch shaft is 0.15 m. The weight of the bucket and contents is 500 N.

Calculate the moment about the pivot produced by the bucket and contents.

moment = ... N m [1]

(b) Calculate the minimum force *F* on the handle that balances this moment.

F = ... N [1]

(c) When a builder turns the handle, the bucket moves upwards.

Energy is transferred between stores.

Complete the sentences:

(i) Energy is transferred **from** the ..... energy store in the body of the builder by ..... . [2]

(ii) When the bucket is moving upwards, energy is transferred **to** the ..... energy store and the ..... energy store. [2]

[Total: 6]

9 Complete the sentences about the Periodic Table.

..... are arranged in the Periodic Table.

Alkali metals are on the ..... of the Periodic Table.

A group is a ..... in the Periodic Table.

Atomic numbers in the Periodic Table show the number of

..... in the nucleus of each atom. [4]

10 Draw **three** lines from the box on the left to **three** different boxes on the right to make **three** correct sentences about veins.

Veins …

… carry blood at a high pressure.

… carry blood away from the heart.

… contain valves.

… have a thick wall.

… have a wide lumen.

… usually contain blood with an increased concentration of carbon dioxide.

[3]

11 The changes in sea level due to tides are an energy source.

Fig. 11.1 shows the movement of water through a tide barrier from a high sea level to a low sea level.

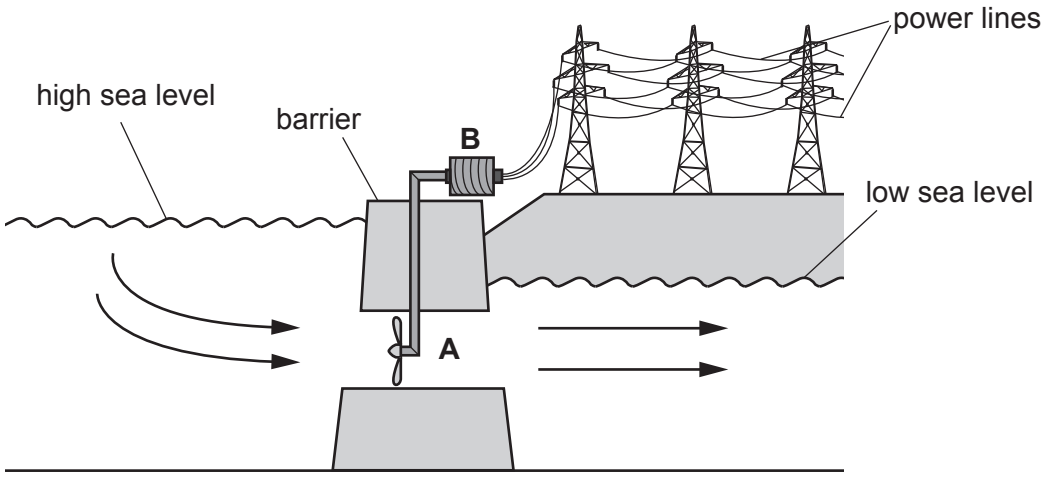

Fig. 11.1

(a) (i) State the name of the machine labelled **A**.

..... [1]

(ii) Describe what happens to this machine when water passes through it.

..... [1]

(b) (i) State the name of the machine labelled **B**.

..... [1]

(ii) State how energy is transferred from **B** along the power lines to appliances in the home.

..... [1]

[Total: 4]

12 **(a)** Water can be purified by distillation.

Fig. 12.1 shows the apparatus used for the distillation of water.

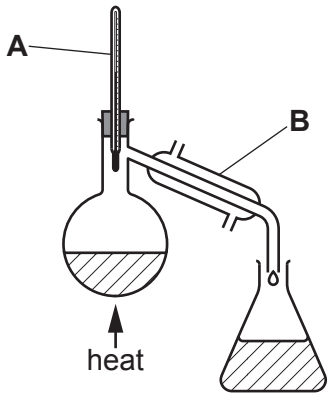

Fig. 12.1

(i) Name the piece of apparatus labelled **A** in Fig. 12.1.

..... [1]

(ii) Describe the change of state that takes place in apparatus **B**.

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

(b) Describe the separation and motion of water particles in liquid water.

separation .....

.....

motion .....

.....

[2]

(c) Complete Fig. 12.2 to show the outer electrons in a molecule of water.

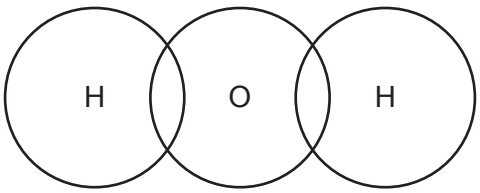

Fig. 12.2

[2]

(d) Domestic water supplies are treated to make them safe to drink.

Name the chemical that is added to the water to kill microbes.

..... [1]

[Total: 7]

13 Fig. 13.1 shows the human digestive system.

Some of the parts are identified by letters.

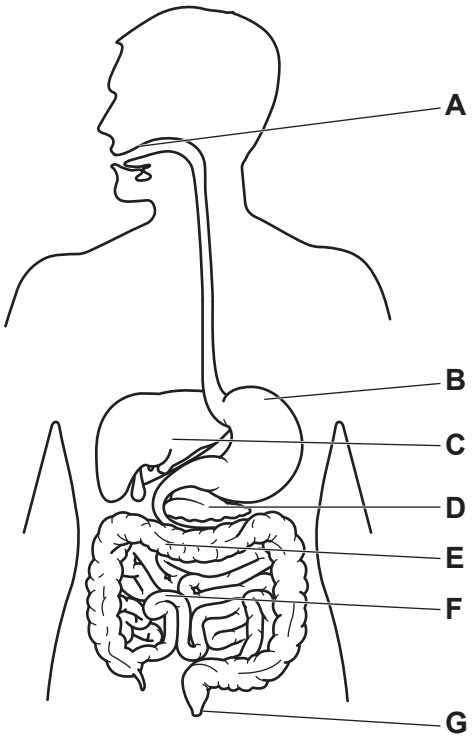

Fig. 13.1

Table 13.1 shows the functions of the some of the labelled parts.

Complete Table 13.1 by writing a letter from Fig. 13.1 to show where the function occurs.

An example has been done for you.

Table 13.1

function of part of digestive system	letter from Fig. 13.1
where absorption occurs	**F**
where amino acids are broken down to produce urea	.....
where bacteria are killed	.....
where egestion occurs	.....
where physical digestion occurs	.....

[4]

14 Fig. 14.1 shows an electrical safety device.

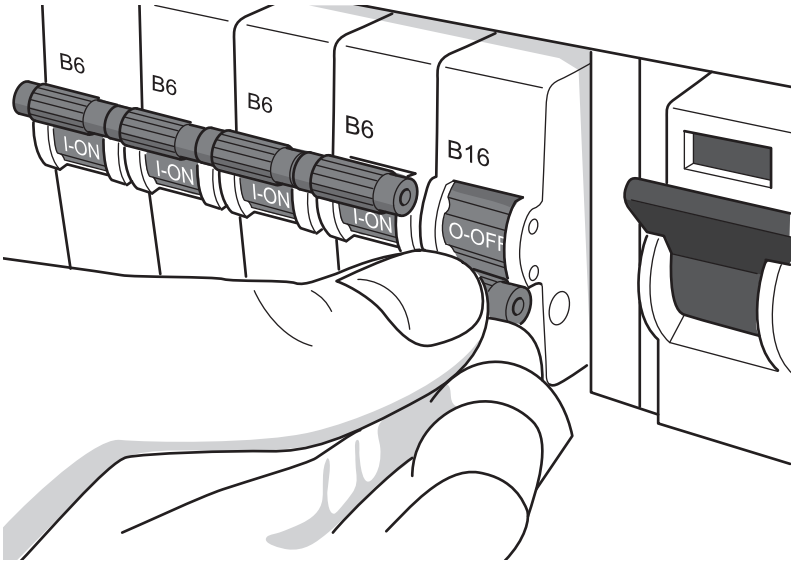

Fig. 14.1

The component labelled B16 is a type of switch. It has moved automatically to the **off** position.

The switch is reset by hand to the **on** position.

(a) State the name of this type of switch.

..... [1]

(b) Suggest why the switch has moved automatically to the off position.

..... [1]

(c) Explain why it is safe to reset the switch by hand.

..... [1]

[Total: 3]

15 Barium hydroxide is an alkali.

Aqueous solutions of ammonium chloride and barium hydroxide react to form water and two other products.

(a) **(i)** Complete the word equation for the reaction.

ammonium chloride	+	barium hydroxide	→	....	+	.....	+	water

[2]

(ii) Suggest the colour of universal indicator in aqueous barium hydroxide.

..... [1]

(b) Barium hydroxide has the formula $Ba(OH)_2$.

Deduce the number of different types of atom in barium hydroxide.

..... [1]

(c) Calculate the concentration of the solution formed when 5.0 g of barium hydroxide dissolves in 200 cm^3 of distilled water.

[1 dm^3 = 1000 cm^3]

concentration = ... g/dm^3 [1]

[Total: 5]

16 Fig. 16.1 shows the human gas exchange system.

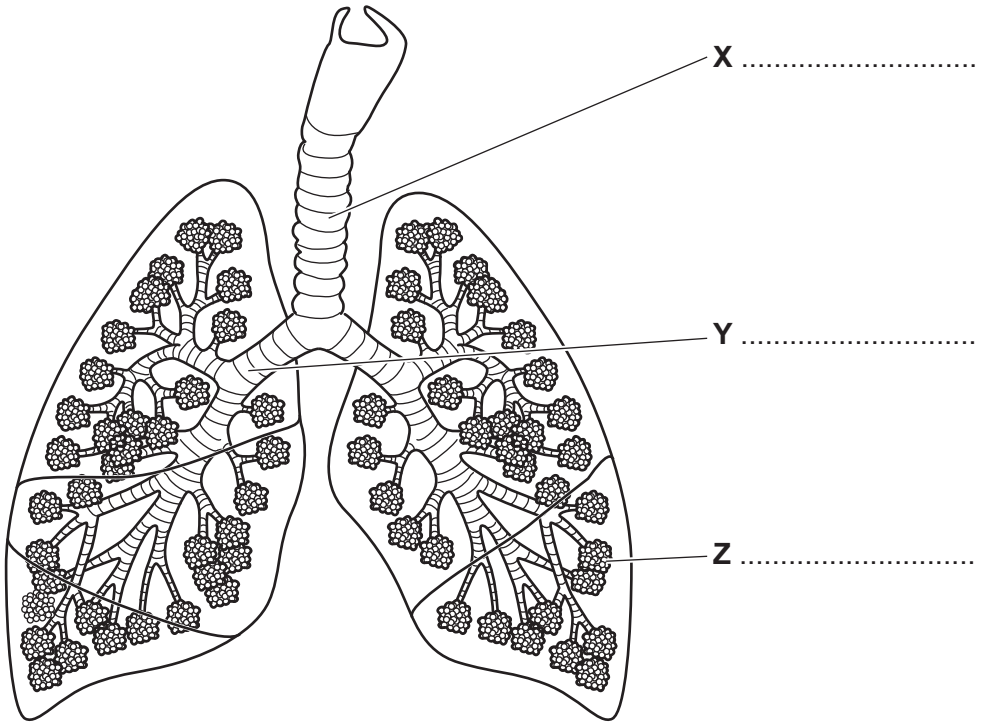

Fig. 16.1

(a) On Fig. 16.1, name the structures labelled **X**, **Y** and **Z**. [3]

(b) Fig. 16.2 shows an alveolus and a capillary surrounding it.

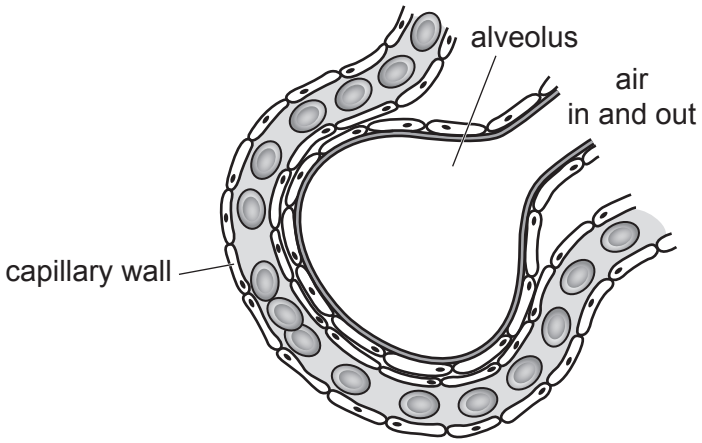

Fig. 16.2

Describe the movement of oxygen between the alveolus and the capillary.

.....

.....

..... [2]

[Total: 5]

17 Fig. 17.1 shows a pair of forceps.

Fig. 17.1

Forceps and other instruments are used in medical operations.

After the forceps are used, they are placed in a sealed chamber and irradiated with gamma radiation.

(a) Describe gamma radiation.

.....

..... [2]

(b) Explain why gamma radiation is used to irradiate forceps and other medical instruments.

.....

..... [1]

[Total: 3]

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											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
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	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 oganesson –

Key

atomic number
atomic symbol
name
relative atomic mass

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 dm^3 at room temperature and pressure (r.t.p.).