Cambridge IGCSE

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/42**

Paper 4 (Extended) **May/June 2019**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 20.

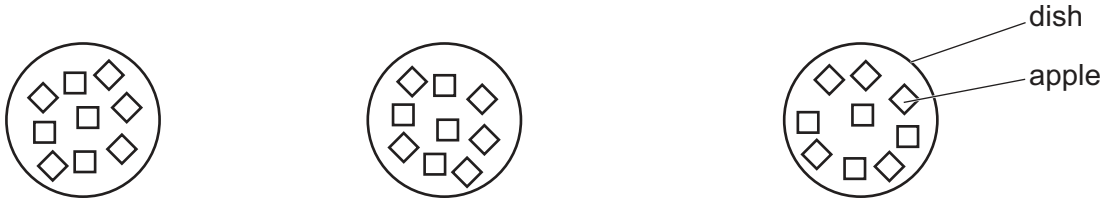
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **20** printed pages.

Cambridge Assessment International Education

1 **(a)** When apples are cut open the exposed surface turns from white to brown. This happens because an enzyme inside the apples causes a brown substance to be produced in the presence of oxygen.

Fig. 1.1 shows an investigation of various treatments on freshly cut apple pieces to see if the browning of apples can be prevented. The dishes of apple pieces and each treatment are shown.



dish **A**
untreated

dish **B**
previously soaked in lemon juice for five minutes

dish **C**
previously placed in boiling water for 20 seconds

Fig. 1.1

After treatment the dishes are left uncovered for 10 minutes.

Table 1.1 shows the results of the investigation.

Table 1.1

dish	appearance of apple after 10 minutes	explanation
A	brown	
B	unchanged	the acid in the lemon juice denatured the enzyme
C	unchanged	

(i) Complete Table 1.1 to explain the appearance of the apples after 10 minutes in dish **A** and dish **C**. [2]

(ii) Explain in detail how denaturation affects enzyme molecules.

.....

.....

..... [2]

(b) Hydrochloric acid is another acid that could be used to stop the apples from turning brown. Hydrochloric acid is contained in gastric juice in the stomach.

(i) State **two** functions of hydrochloric acid in gastric juice.

1. .....

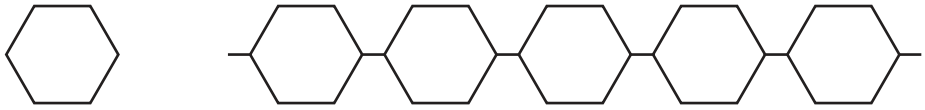
2. .....
[2]

(ii) Suggest why it is dangerous to use hydrochloric acid to stop the apples from turning brown before eating them.

..... [1]

(c) Apples contain starch.

Fig. 1.2 shows a molecule of glucose, and how glucose molecules join together to make starch.



glucose molecule small part of a starch molecule

Fig. 1.2

(i) Suggest **one other** large molecule that can be made by glucose molecules joining together.

..... [1]

(ii) Name the smaller molecules that form proteins.

..... [1]

(iii) State the elements present in proteins.

.....

..... [1]

[Total: 10]

2 Catalytic cracking breaks down large saturated hydrocarbon molecules into smaller hydrocarbon molecules. This process produces some unsaturated hydrocarbon molecules.

(a) State what is meant by the term *hydrocarbon*.

.....

..... [1]

(b) Fig. 2.1 shows apparatus used for catalytic cracking.

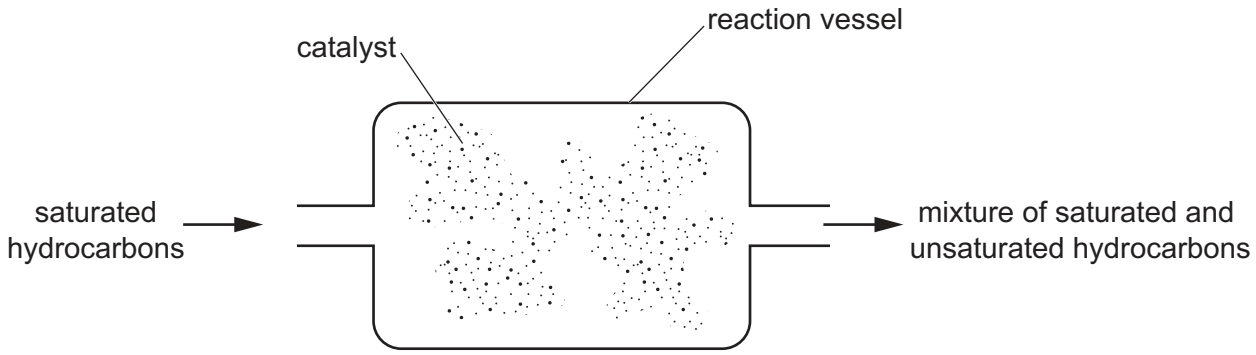


Fig. 2.1

(i) State **one** other reaction condition, apart from a catalyst, used in the reaction vessel.

..... [1]

(ii) Cracking is an endothermic reaction.

Describe what is meant by an *endothermic reaction*. Use ideas about chemical energy and thermal energy in your answer.

.....

.....

.....

..... [2]

(iii) Describe how aqueous bromine is used to show that this cracking process produces unsaturated hydrocarbons from saturated hydrocarbons.

.....

.....

.....

..... [2]

(c) One of the products of cracking hydrocarbons is propene, C_3H_6.

(i) Complete the diagram in Fig. 2.2 to show the structure of one molecule of propene.

H — C

Fig. 2.2

[3]

(ii) Construct the balanced symbol equation for the complete combustion of propene.

..... [2]

[Total: 11]

3 Fig. 3.1 shows a forklift truck moving a large heavy box towards a shelf.

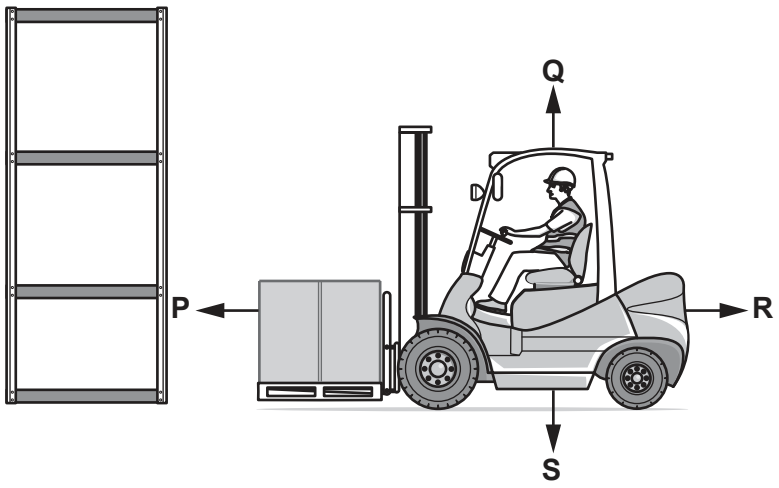


Fig. 3.1

(a) The arrows labelled **P**, **Q**, **R** and **S** show four forces acting on the forklift truck.

State which letter represents the driving force moving the truck.

..... [1]

(b) The forklift truck lifts the box upwards from the ground to a shelf 3.0 m above the ground.

The upwards force on the box as it moves is equal to the weight of the box.

The box has a mass of 500 kg.

The gravitational field strength *g* is 10 N / kg.

Calculate the work done on the box.

Show your working.

work done = ... J [3]

(c) The forklift truck is driven to collect another box.

Fig. 3.2 shows the speed–time graph for this journey.

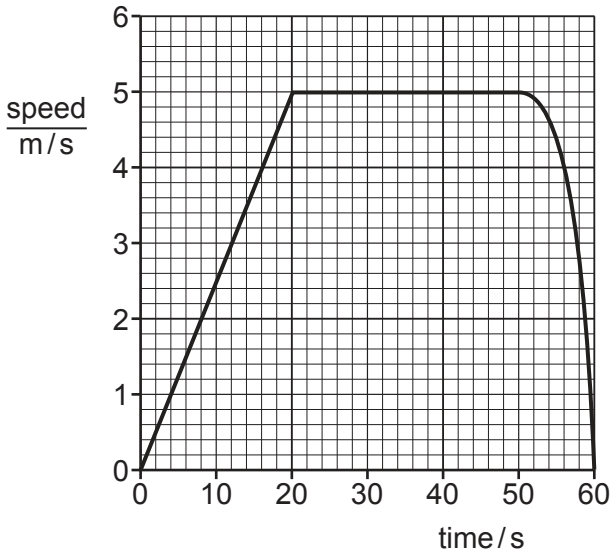


Fig. 3.2

(i) Describe the motion of the truck between 50 s and 60 s.

.....

..... [2]

(ii) The truck travels 40 m between 50 s and 60 s.

Use this information and Fig. 3.2 to find the total distance travelled by the truck.

Show your working.

distance = ... m [2]

(iii) The mass of the forklift truck is 1500 kg.

Use data from Fig. 3.2 to calculate the kinetic energy of the truck at time = 30 s.

kinetic energy = ... J [2]

[Total: 10]

4 **(a)** Fig. 4.1 shows a simplified diagram of the carbon cycle.

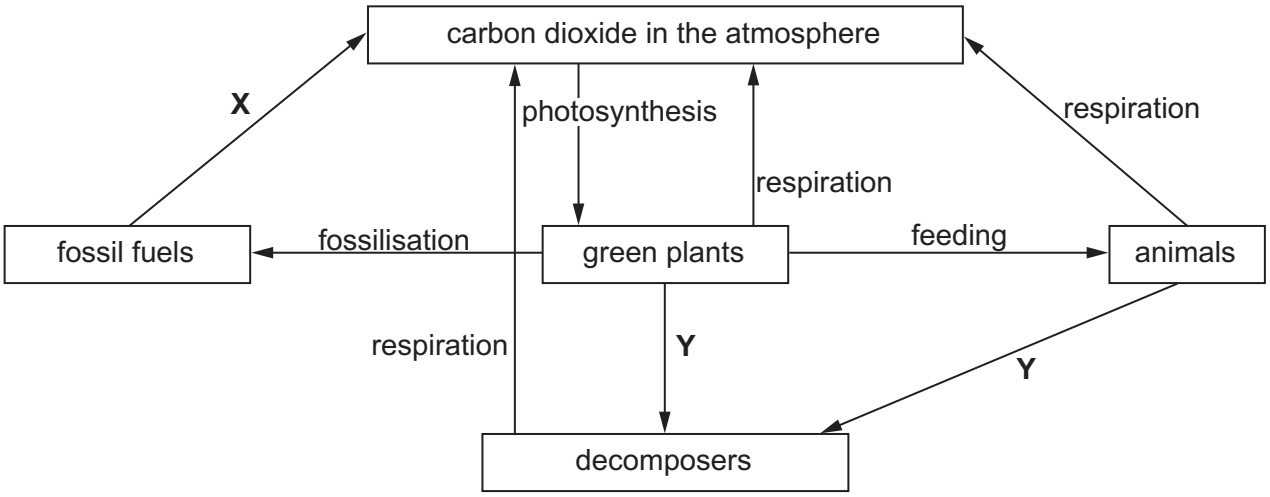


Fig. 4.1

(i) Name process **X**.

..... [1]

(ii) Name process **Y**.

..... [1]

(iii) Explain the effect of clearing forests on the concentration of carbon dioxide in the atmosphere.

.....

.....

..... [2]

(b) Nitrate ions can be added to water in a lake accidentally. The effects of this can lead to the death of organisms living in the water.

Use the words in the list to complete the sentences which explain how this happens.

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

addition **death** **decomposers** **decreased** **feeding**

growth **increased** **respiration**

- There is an increased availability of nitrate ions.
- This results in an increased ..... of producers on the surface of the lake.
- This leads to ..... decomposition after the ..... of producers.
- Increased aerobic respiration by ..... occurs which results in a reduction of dissolved oxygen.
- This causes the death of organisms in the water.

[4]

[Total: 8]

5 **(a)** Table 5.1 shows the melting points of some Group I elements.

Table 5.1

chemical symbol	melting point / °C
Li	181
Na	98
K	
Rb	39
Cs	28

(i) Suggest the melting point of potassium.

..... °C [1]

(ii) Potassium reacts rapidly with water.

Compare the reactivity of rubidium with the reactivity of potassium.

.....

..... [1]

(iii) Name the gas produced when potassium reacts with water.

..... [1]

(iv) Caesium metal is stored in a sealed glass tube as shown in Fig. 5.1.

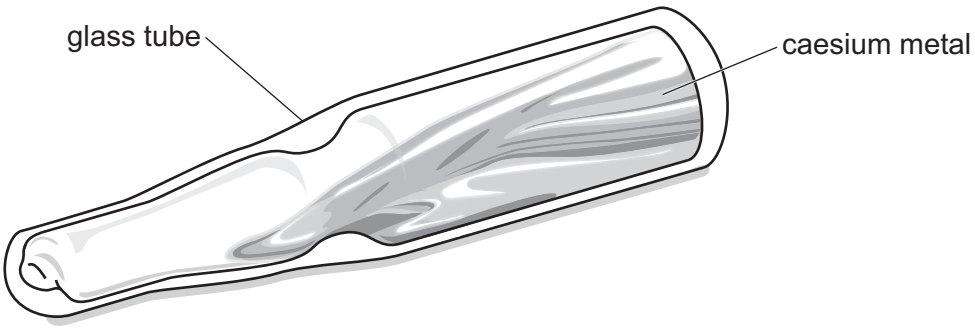


Fig. 5.1

The caesium melts when a warm hand is placed around the sealed glass tube.

Explain, in terms of particles, why thermal energy is needed to melt caesium metal.

.....

.....

..... [1]

(b) Chlorine is in Group VII of the Periodic Table.

Potassium reacts with chlorine forming potassium chloride.

(i) Describe the formation of ions from potassium atoms and chlorine atoms. You may draw a diagram if it helps your answer.

.....

.....

.....

..... [2]

(ii) Fig. 5.2 shows some ions in a potassium chloride lattice.

Complete Fig. 5.2 to show the arrangement of potassium ions, K^+, and chloride ions, Cl^-.

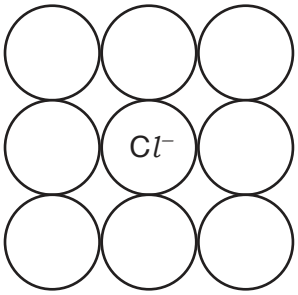


Fig. 5.2

[1]

(iii) Explain how ionic bonding keeps potassium ions and chloride ions together.

.....

..... [1]

[Total: 8]

6 **(a)** The Sun is made of very hot gases.

Near the surface of the Sun most of the thermal energy is transferred to the surface by convection.

Describe how convection is able to transfer thermal energy from inside the Sun to the surface of the Sun.

.....

.....

..... [2]

(b) Some of the energy emitted from the surface of the Sun is transferred to Earth as infrared radiation.

Infrared radiation travels between the Sun and the Earth at a speed of 3.0×10^8 m/s.

(i) The radiation travels 150 000 000 km from the Sun to Earth.

Show that it takes approximately 8 minutes to travel from the Sun to the Earth.

[3]

(ii) The shortest infrared wavelength emitted by the Sun is 7.4×10^{-7} m.

Calculate the frequency of this infrared radiation.

Show your working.

frequency = ... Hz [2]

(c) State one use of infrared radiation in the home.

..... [1]

[Total: 8]

7 Fig. 7.1 shows a plant responding to light coming from one side.

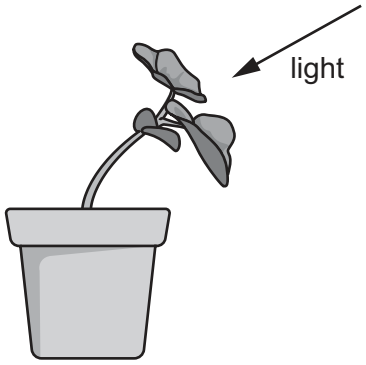


Fig. 7.1

(a) Name this plant response.

..... [1]

(b) Explain in detail why the plant bends towards the light.

Refer to the hormone auxin in your answer.

.....

.....

.....

..... [3]

(c) Hormones are also present in animals.

Give an example of a specific situation when the secretion of adrenaline is increased by a large amount.

..... [1]

(d) The word equation for respiration is shown.

glucose + oxygen ⟶ carbon dioxide + water

Two effects of the secretion of adrenaline are an increase in breathing rate and an increase in heart rate.

Describe how these two effects of adrenaline enable the cells of the body to increase their rate of respiration.

increase in breathing rate .....

.....

.....

increase in heart rate .....

.....

.....

[2]

(e) State **two** ways in which the energy released by respiration is used by the body.

1. .....

2. .....

[2]

[Total: 9]

8 **(a)** A scientist analyses solution **Q** using chromatography.

She thinks that it contains cobalt ions, Co^{2+}, copper ions, Cu^{2+}, and nickel ions, Ni^{2+}.

She places a sample of solution **Q** and samples of solutions containing Co^{2+}, Cu^{2+}, and Ni^{2+} ions onto a piece of chromatography paper.

The chromatogram she obtains is shown in Fig. 8.1.

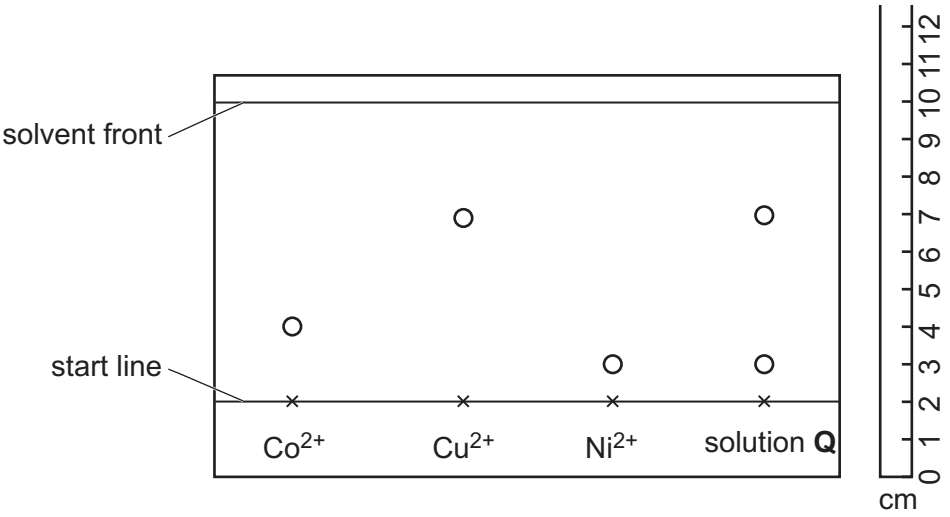


Fig. 8.1

(i) State which metal ions are present in solution **Q**.

..... [1]

(ii) Calculate the R_f value for the copper ions (Cu^{2+}).

Show your working.

R_f value = ... [2]

(b) Cobalt, copper and nickel are in Period 4 of the Periodic Table, shown on page 20.

Name the collection of metals that contains cobalt, copper and nickel.

..... [1]

(c) Copper can be extracted from aqueous copper(II) chloride using the apparatus shown in Fig. 8.2.

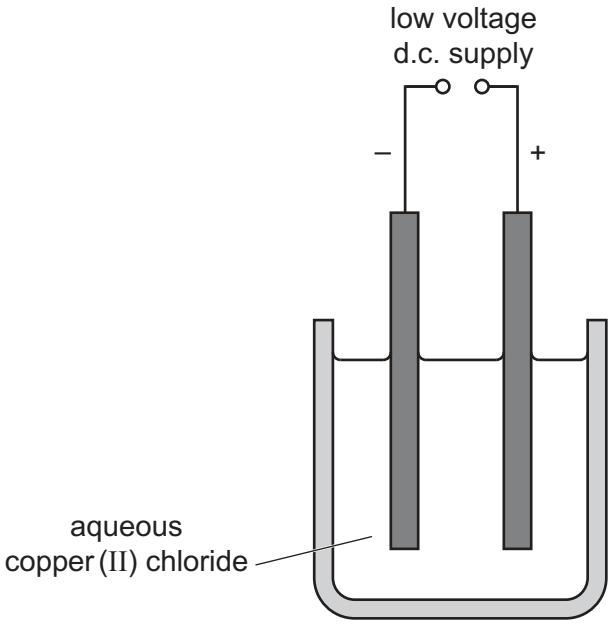


Fig. 8.2

(i) Identify the ions that move to each electrode.

to the anode .....

to the cathode .....

[2]

(ii) The scientist thinks that one compound in solution **Q** is copper(II) chloride.

Deduce the formula of copper(II) chloride.

formula of copper(II) chloride = ... [1]

[Total: 7]

9 Fig. 9.1 shows an electrically-powered bicycle.

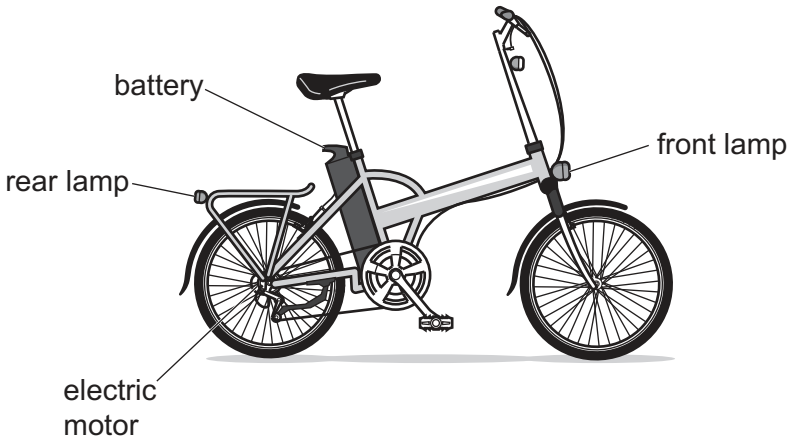


Fig. 9.1

(a) The battery has to supply power to the electric motor, and to both front and rear lamps. A switch controls the whole circuit.

The rider controls the speed of the bicycle by changing the current in the electric motor.

The two lamps are controlled by one more switch. However, if one lamp fails the other lamp is still lit.

(i) Name a circuit component that can be used to change the current in a circuit.

..... [1]

(ii) On Fig. 9.2 complete the circuit diagram for this electric bicycle. Include the component you have named in **(a)(i)** to change the speed of the motor.

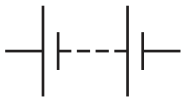


Fig. 9.2

[4]

(b) The battery has an output voltage of 36 V, and the current in the motor at maximum speed is 7.0 A.

(i) Calculate the power output of the electric motor at maximum speed.

Show your working and give the unit of your answer.

power = ... unit ..... [3]

(ii) The cyclist rides the bicycle at maximum speed for a journey.

State one further quantity required to calculate the total energy provided by the battery on this journey.

..... [1]

[Total: 9]

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 –		114 Fl flerovium –		116 Lv livermorium –		

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.).