



Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

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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.

- 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.

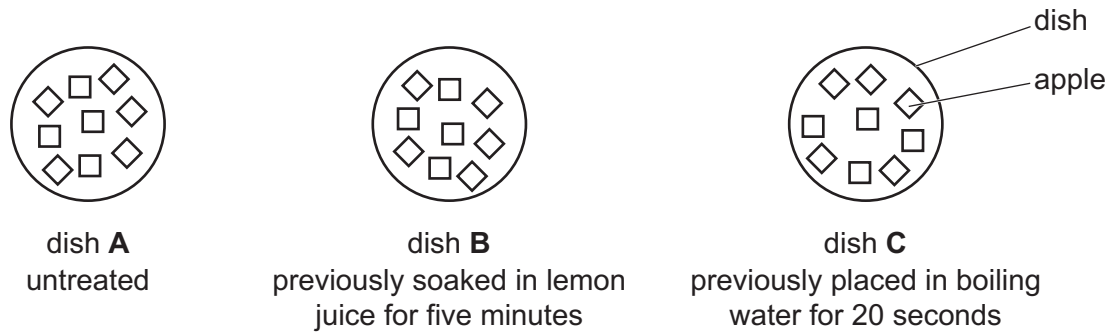


Fig. 1.1

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.

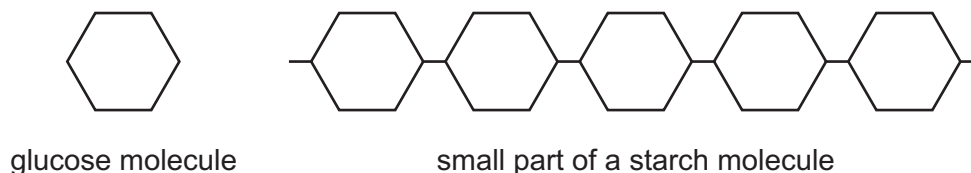


Fig. 1.2

(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.

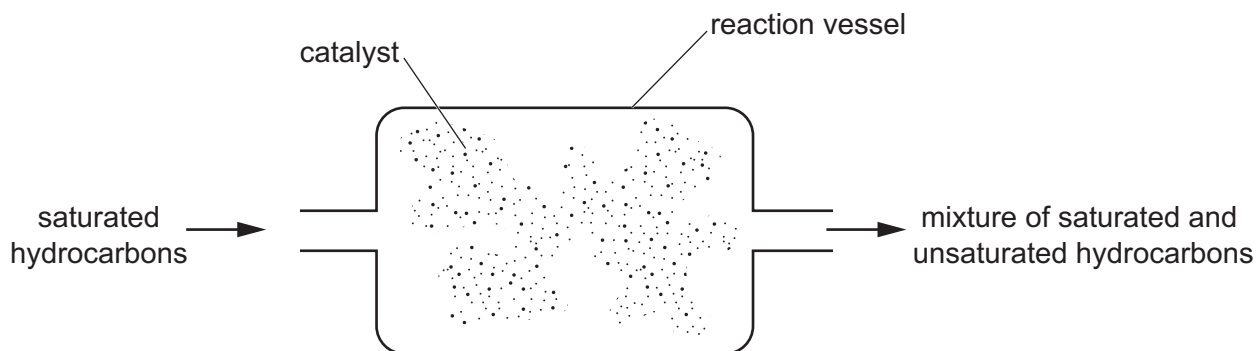


Fig. 2.1

(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.

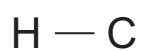


Fig. 2.2

[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.

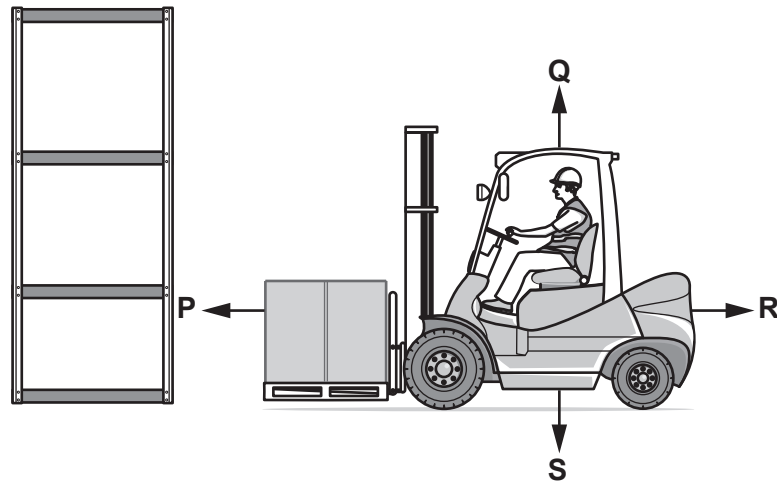


Fig. 3.1

- (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.

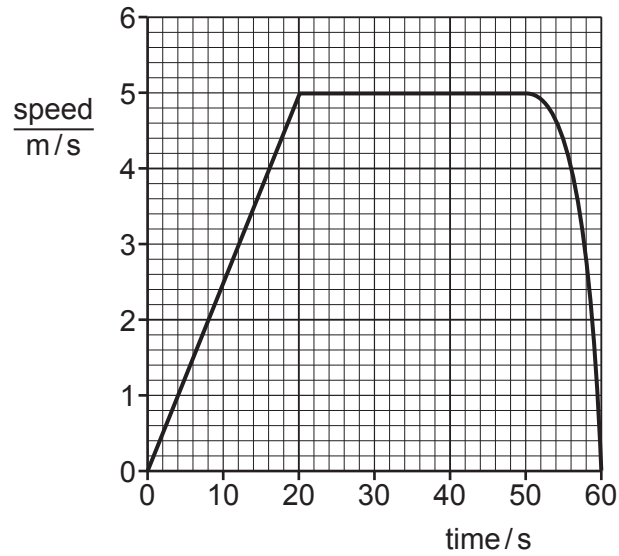


Fig. 3.2

- (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.

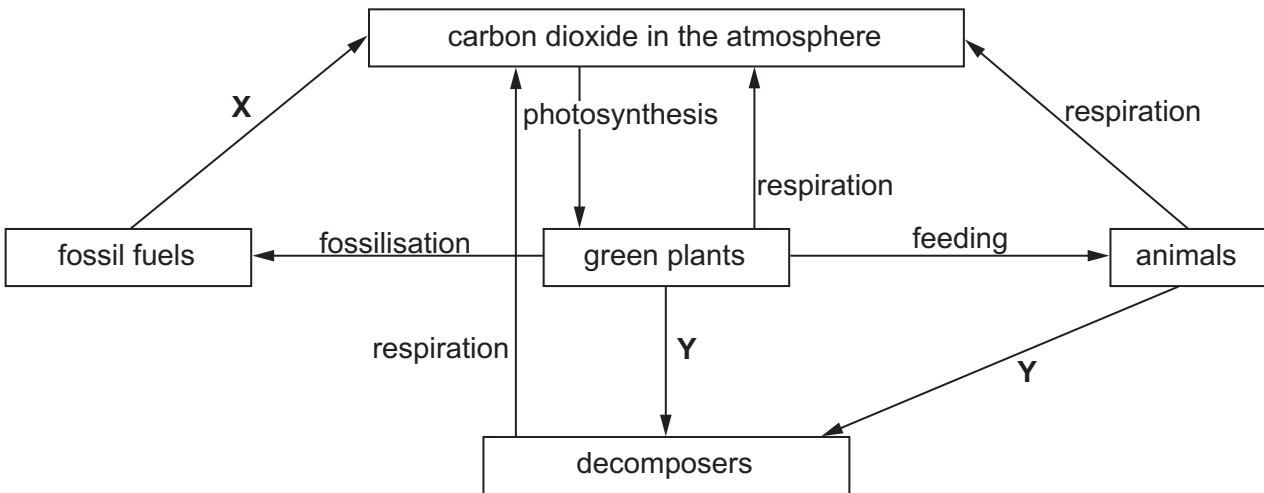


Fig. 4.1

(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.

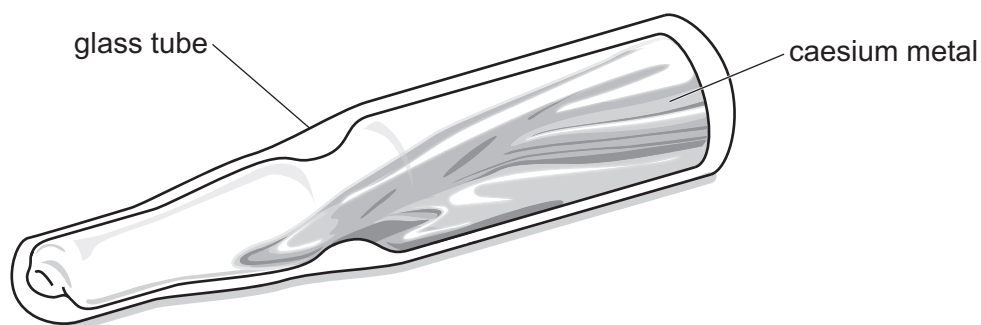


Fig. 5.1

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^- .

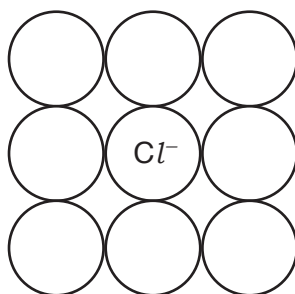


Fig. 5.2

[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.

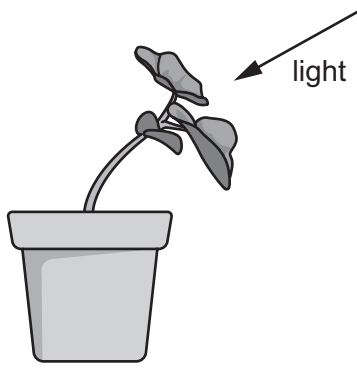


Fig. 7.1

(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.



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.

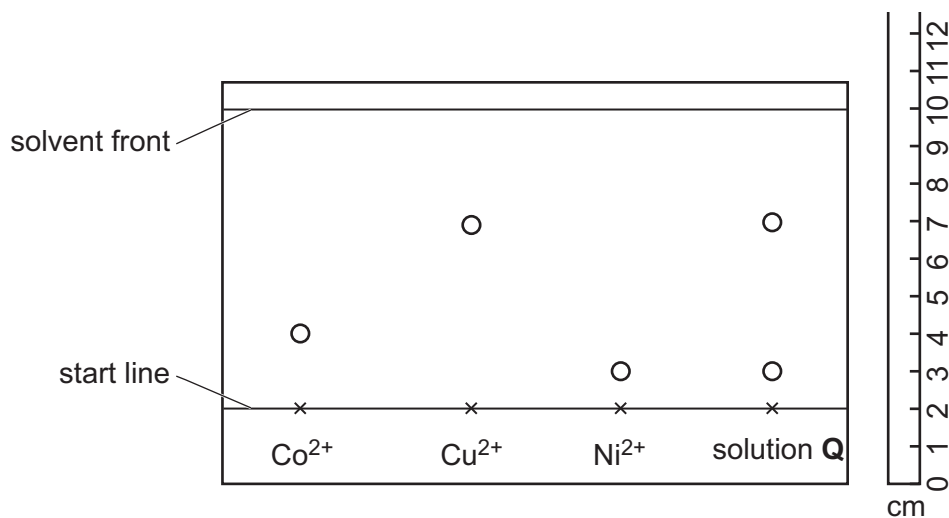


Fig. 8.1

- (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.

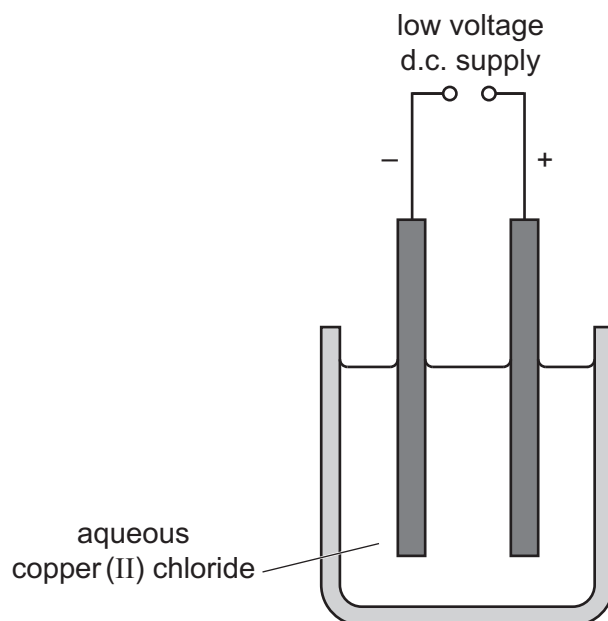


Fig. 8.2

(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.

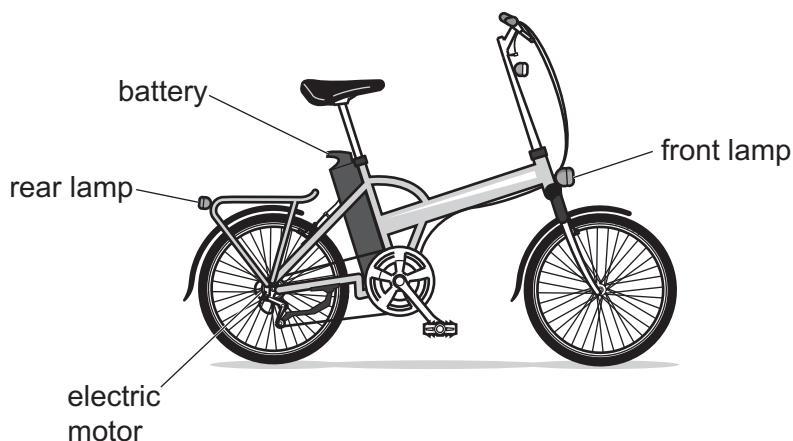


Fig. 9.1

- (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.

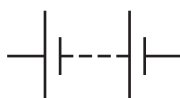


Fig. 9.2

[4]

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

(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]

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The Periodic Table of Elements

| Group | | | | | | | | | | | | | | | | | |
|-----------------------------------|------------------------------------|--|--|------------------------------------|-------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|---------------------------------------|--------------------------------------|--------------------------------------|------------------------------------|--------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|----------------------------------|
| I | II | III | | | | | | | | | | IV | V | VI | VII | VIII | |
| 3 Li lithium 7 | 4 Be beryllium 9 | Key atomic number atomic symbol name relative atomic mass | | | | | | | | | | 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 — | — | — | — | — |

| | | | | | | | | | | | | | | |
|-------------------------------------|-----------------------------------|--|-------------------------------------|------------------------------------|------------------------------------|------------------------------------|--------------------------------------|-----------------------------------|--------------------------------------|-------------------------------------|----------------------------------|--------------------------------------|-------------------------------------|-------------------------------------|
| 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 — |

lanthanoids

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).