



Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

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COMBINED SCIENCE

0653/43

Paper 4 (Extended)

October/November 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) Fig. 1.1 is a diagram of the carbon cycle.
The arrows show the processes involved in the carbon cycle.

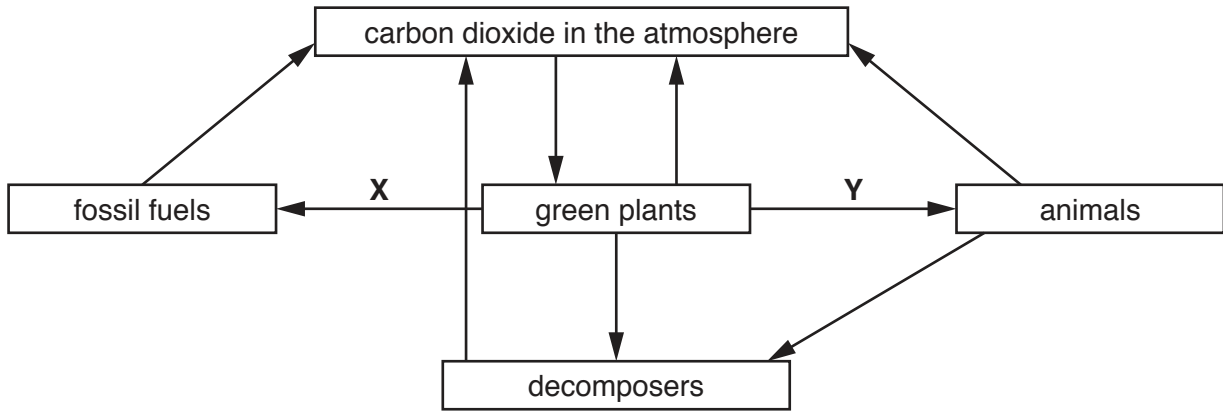


Fig. 1.1

- (i) Name processes **X** and **Y**.

X

Y

[2]

- (ii) Use Fig. 1.1 to name the group of organisms which are producers.

..... [1]

- (iii) Name a compound found in green plants which contains carbon and is used for the storage of energy.

..... [1]

- (b) Some activities of humans can affect the composition of gases of the atmosphere.

The trees in a forest are cut down and burned.

Explain in detail the effect of this deforestation on the oxygen concentration in the atmosphere.

.....

 [3]

[Total: 7]

2 (a) The formula of methanol is CH_3OH .

(i) State why methanol is **not** a hydrocarbon.

.....
 [1]

(ii) Complete the dot-and-cross diagram of a molecule of methanol.

Show all of the atoms and all of the outer shell electrons.

H C O

[3]

(b) (i) During the complete combustion of methanol, the amount of carbon dioxide in the air increases.

Suggest **one** effect of this increase on the environment.

.....
 [1]

(ii) The products of the complete combustion of methanol are the same as the products of the complete combustion of hydrocarbons.

Construct the balanced symbol equation for the complete combustion of methanol.

State symbols are **not** required.

..... [3]

[Total: 8]

3 (a) Fig. 3.1 shows children using a magnifying glass to view a butterfly.



Fig. 3.1

(i) State which child, **A** or **B**, is using the magnifying glass correctly.

Give a reason for your answer.

.....
 [1]

(ii) The magnified image of the butterfly is a virtual image.

State what is meant by a *virtual image*.

.....
 [1]

(b) Complete the sentences below using words from the list.

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

- | | | |
|---------------------|---------------------|-------------------|
| amplitude | compressions | frequency |
| longitudinal | pitch | transverse |

The boy listens to the radio. The radio transmits sound waves through the air to his ears as and rarefactions. These are waves.

He uses the volume control on the radio to make the sound louder, which alters the of the waves. [2]

(c) The girl walks from home to school.

Fig. 3.2 shows a speed–time graph of her journey.

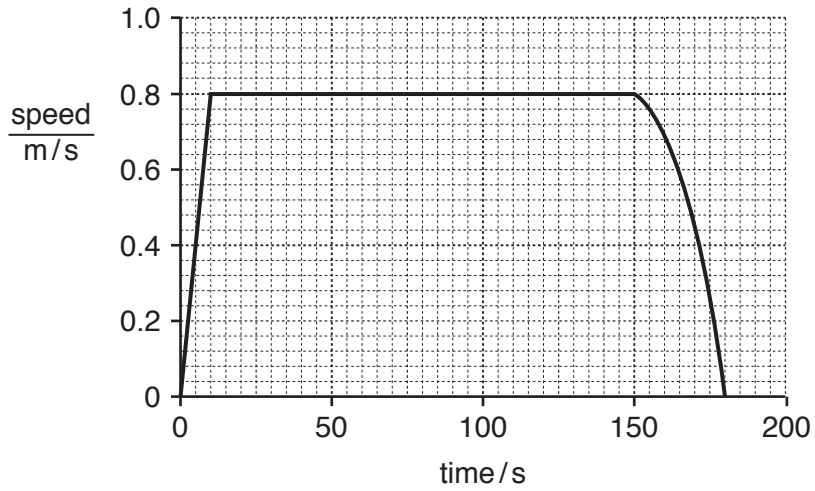


Fig. 3.2

(i) Calculate the distance she travels between 0 s and 150 s.

Show your working.

distance = m [3]

(ii) Explain the difference in the shape of the graph between 0 s and 10 s and between 150 s and 180 s.

.....

 [2]

(d) The boy climbs a hill when he goes to school.

The mass of the boy is 40 kg. The hill is 50 m high.

Calculate the gravitational potential energy gained by the boy when he reaches the top of the hill.

Show your working.

gravitational field strength $g = 10 \text{ N/kg}$

gravitational potential energy gained = J [2]

[Total: 11]

Question 4 starts on the next page.

4 (a) Define the term *enzyme*.

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

(b) Enzymes are found in the digestive system where they help in the chemical digestion of food.

Fig. 4.1 shows some digestive enzymes listed in the boxes on the left.

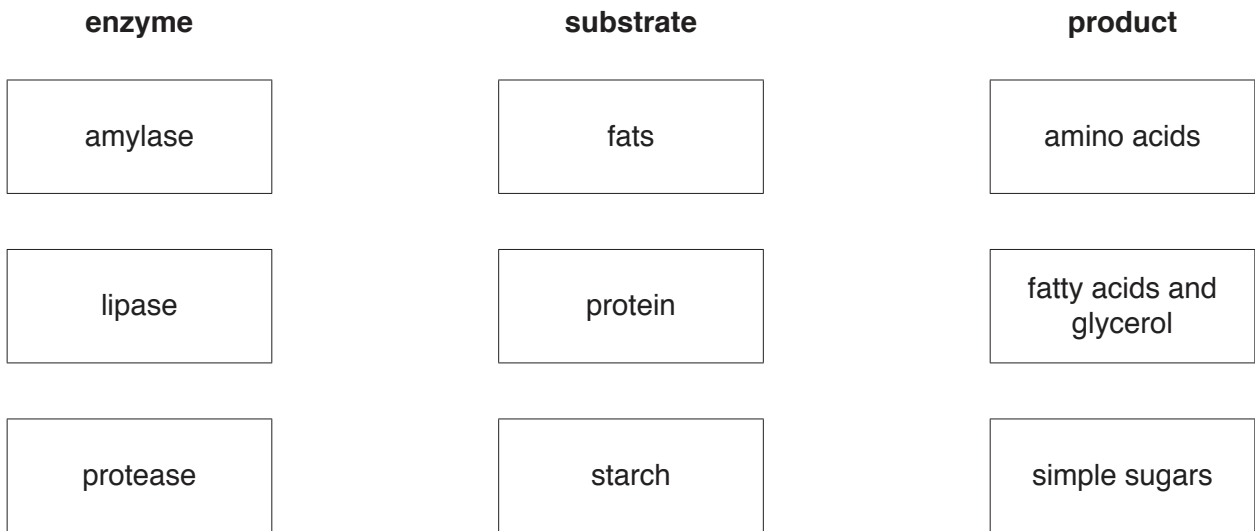


Fig. 4.1

(i) On Fig. 4.1:

- draw one straight line to connect each enzyme with its substrate
- draw one straight line to connect each substrate with its product.

[3]

(ii) State **one** area of the alimentary canal and its associated organs where protease is secreted.

..... [1]

(c) Explain in detail the activity of a human digestive enzyme at 70 °C.

.....
.....
.....
.....
..... [3]

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

1.

.....

2.

.....

[2]

[Total: 11]

5 (a) The elements in the Periodic Table, shown on page 20, are arranged in groups and periods.

(i) Chlorine is in Period 3.

State the number of elements in Period 3.

..... [1]

(ii) The number of outer shell electrons in the atoms of the elements changes across Period 3.

Describe the relationship between the number of outer shell electrons and the metallic character of these elements.

.....

..... [1]

(b) (i) Describe a chemical test for chlorine gas and give the positive result.

test

.....

result

..... [2]

(ii) Explain how chlorination makes water safe to drink.

.....

..... [1]

(c) Chlorine gas is bubbled through aqueous potassium bromide.

Describe the colour change during this process.

Use ideas about the reactivity of the halogens to explain your answer.

colour change

.....

explanation

.....

..... [2]

(d) Chlorine gas can be obtained by the electrolysis of molten potassium chloride using inert electrodes.

(i) Name the electrode at which chlorine forms.

..... [1]

(ii) Describe how chloride ions are changed into chlorine atoms.

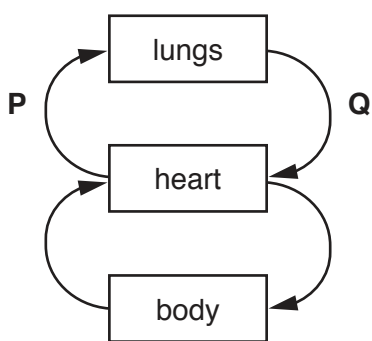
.....
.....
..... [2]

(iii) State the **other** product of this electrolysis.

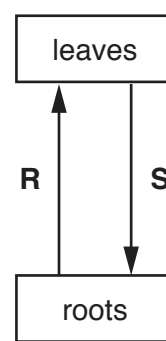
..... [1]

[Total: 11]

6 Fig. 6.1 shows simple diagrams of the human and plant transport systems. The arrows show the direction of flow of substances.



human transport system



plant transport system

Fig. 6.1

(a) (i) Use Fig. 6.1 to explain why the human circulation is described as a *double circulation*.

.....

.....

.....

..... [2]

(ii) State **two** ways in which the composition of the blood flowing in direction **P** is different from the blood flowing in direction **Q**.

1.

2. [2]

(b) (i) Name the tissue which transports food substances in direction **S**.

..... [1]

(ii) Explain why food is transported in direction **S**.

.....

..... [1]

(iii) Water passes through the roots to the leaves in direction **R** in the xylem.

Some of the water from the xylem replaces water lost during transpiration.

Explain in detail why the rate of transpiration decreases when the humidity of the air increases.

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

(iv) State **one other** function of the xylem apart from transport.

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

[Total: 9]

- 7 (a) In hot climates, some foods such as milk must be kept cool to ensure they stay fresh.

Fig. 7.1 shows a cooler made of pottery used to keep a bottle of milk cool.

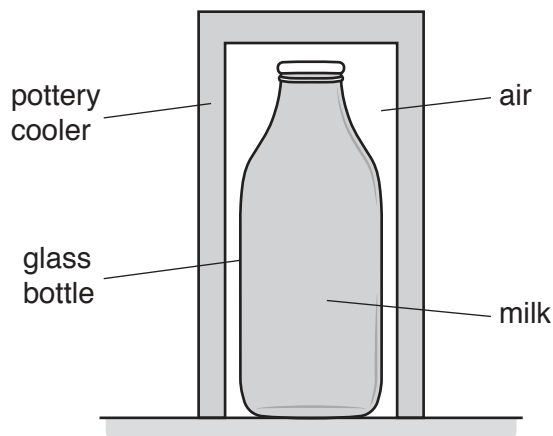


Fig. 7.1

The cooler is soaked with cold water and placed over the glass bottle containing milk.

The cooler slowly dries.

As the water evaporates, the temperature of the cooler falls below the temperature of the surroundings.

- (i) Describe in terms of molecules of water how this process results in the temperature of the cooler decreasing.

.....

.....

.....

..... [2]

- (ii) Explain in terms of the motion of the molecules why the water evaporates more quickly when the temperature of the surroundings is higher.

.....

.....

.....

.....

..... [2]

(iii) The temperature of the milk in the glass bottle also decreases.

Describe in terms of molecular movement how thermal energy is transferred from the milk through the glass bottle by conduction.

.....

.....

.....

..... [2]

(b) Fig. 7.2 shows a solar-powered freezer used in sunny climates. The freezer can also use a mains supply at night.

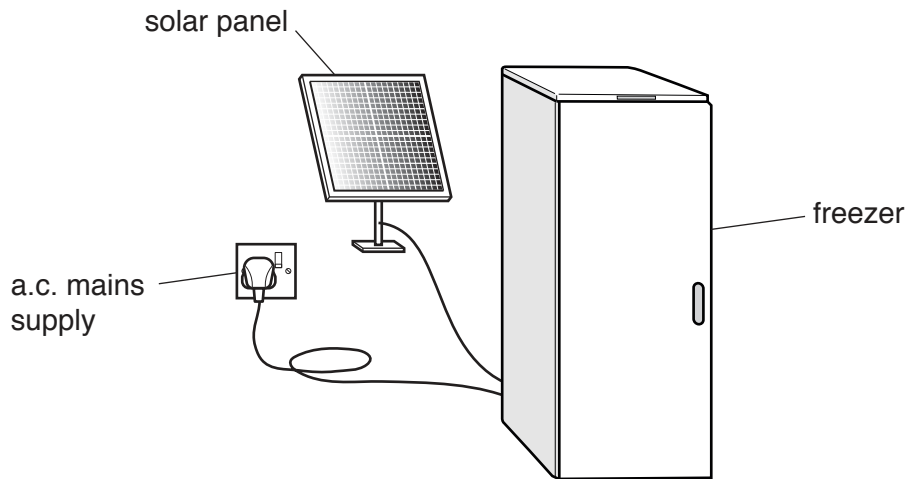


Fig. 7.2

The solar panel provides a 12V supply to power the freezer.

At night, the mains supply powers the appliance at 240 V instead of the solar panel.

The power supplied is only 80W when operating at 240 V and is 90W when operating at 12 V.

The freezer has two fuses, one marked 10A, the other marked 1 A.

Suggest why the freezer needs two separate fuses with these different values.

Show calculations as part of your answer.

.....
.....
..... [4]

[Total: 10]

8 (a) Magnesium reacts with dilute hydrochloric acid.

(i) Explain in detail why the rate of this reaction increases when the concentration of the acid increases.

.....
.....
.....
.....
..... [3]

(ii) State **one other** change that increases the rate of this reaction.

..... [1]

(iii) The reaction between magnesium and hydrochloric acid is exothermic.

Explain why an *exothermic* reaction releases heat.

Use ideas about energy, bond breaking and bond forming in your answer.

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

(b) Iron is extracted from iron oxide in a blast furnace.

Explain why magnesium **cannot** be extracted from magnesium oxide in a blast furnace.

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

[Total: 7]

9 Fig. 9.1 shows an electrically-powered bicycle.

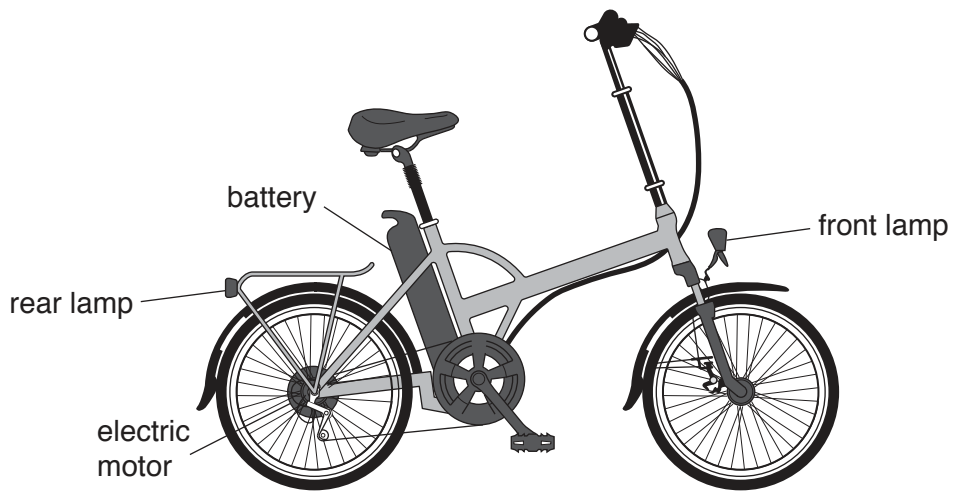


Fig. 9.1

Fig. 9.2 shows part of the circuit diagram for the lamps and electric motor on the bicycle.

The switch shown on the diagram controls only the motor and a variable resistor.

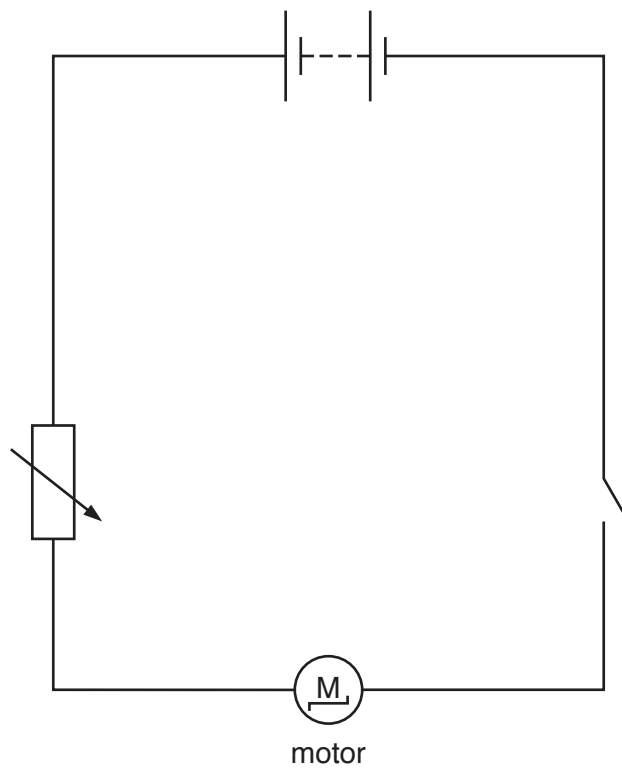


Fig. 9.2

- (a) A second switch controls the two lamps, which are connected in parallel with the motor. The two lamps are also connected in parallel with each other.

Complete the circuit diagram on Fig. 9.2 to show how the second switch and the two lamps are connected into the circuit. [3]

- (b) When both lamps are fully lit, the front lamp has a current of 2.0A and the rear lamp has a current of 1.0A.

The battery consists of eight cells, each with an e.m.f. of 1.5V.

Use the data to calculate the combined resistance of the lamps when both are fully lit.

Show your working.

resistance = Ω [3]

[Total: 6]

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The Periodic Table of Elements

| Group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| I | II | III | | | | | | | | | | IV | V | VI | VII | VIII | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 Li lithium 7 | 4 Be beryllium 9 | <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="border: 1px solid black; padding: 5px;"> 1 H hydrogen 1 </div> <div style="border: 1px solid black; padding: 5px; text-align: center;"> Key atomic number atomic symbol name relative atomic mass </div> </div> | | | | | | | | | | | | | | | | 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 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.).