Cambridge IGCSE

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7995396585

COMBINED SCIENCE **0653/43**

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 **19** printed pages and **1** blank page.

Cambridge Assessment International Education

[Turn over

1 **(a)** Fig. 1.1 is a bar chart which shows some differences in the composition of inspired air and expired air.

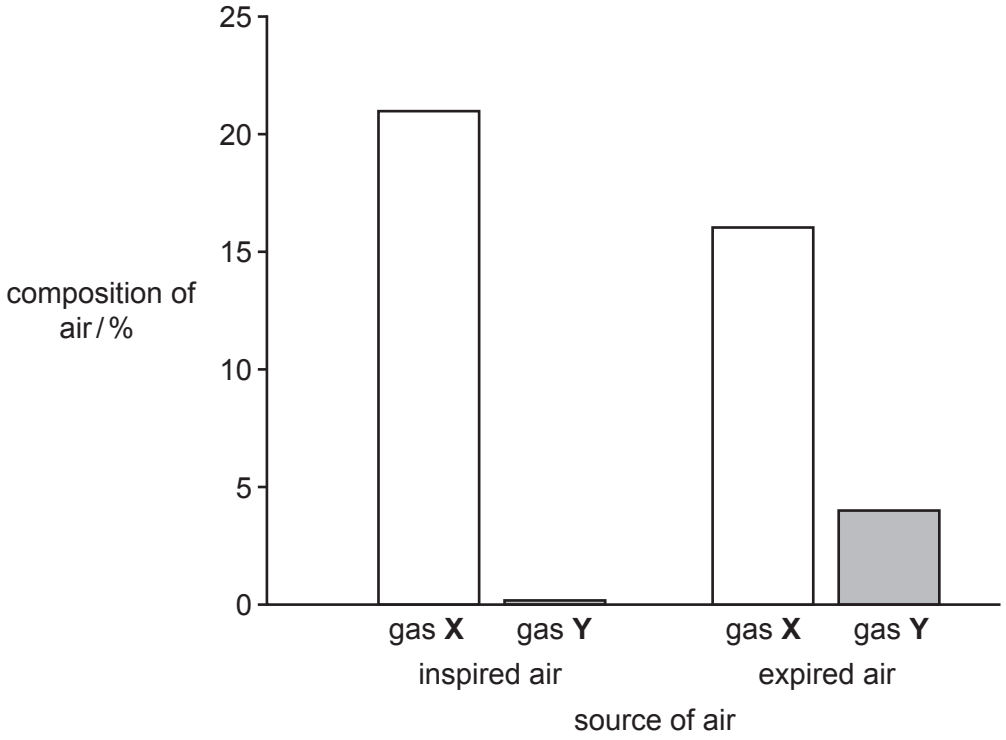

Fig. 1.1

Identify gas **X** and gas **Y** in Fig. 1.1.

Give a reason for each answer using data from Fig. 1.1.

gas **X** .....

reason .....

.....

gas **Y** .....

reason .....

.....

[2]

(b) Gaseous exchange takes place in the alveoli of the lungs.

State **two** features of the alveoli that allow efficient gas exchange.

1. .....

2. .....

[2]

(c) Fig. 1.2 is a diagram showing some cells which line the trachea.

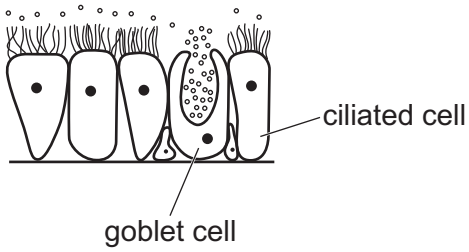

Fig. 1.2

Describe how the goblet cells and ciliated cells protect the gas exchange system from pathogens and particles.

.....

.....

.....

.....

..... [3]

(d) State **two** diseases caused by tobacco smoking.

1. .....

2. .....

[2]

[Total: 9]

2 **(a)** A simple example of cracking is the cracking of ethane to produce ethene and hydrogen.

$$C_2H_6 \rightarrow C_2H_4 + H_2$$

The energy level diagram for this reaction is shown in Fig. 2.1.

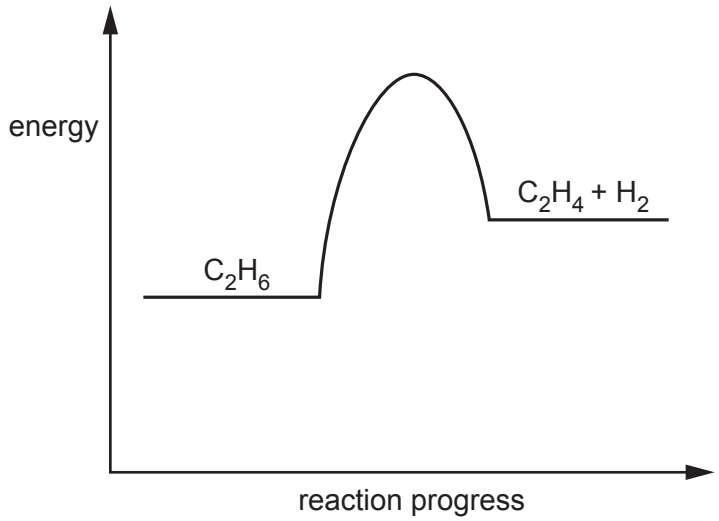

Fig. 2.1

(i) On Fig. 2.1 draw a double headed arrow (↕) to show the activation energy for this reaction. [1]

(ii) Use the energy level diagram to explain why the reaction is endothermic.

.....

..... [1]

(iii) State **one** condition required for the process of cracking.

..... [1]

(b) Ethane and ethene are not in the same homologous series.

Explain what is meant by the term *homologous series*.

.....

.....

..... [2]

(c) Draw a dot-and-cross diagram to show the bonding in a molecule of ethane, C_2H_6.

[3]

(d) When fuels are burned, carbon dioxide is released into the atmosphere.

State **one** possible negative effect of an increase in the concentration of carbon dioxide in the atmosphere.

.....

..... [1]

(e) Complete the balanced symbol equation for the complete combustion of ethene, C_2H_4, in oxygen.

C_2H_4 + ... → ..... CO_2 + ...

[2]

[Total: 11]

3 Fig. 3.1 shows a boy swimming in a swimming pool.

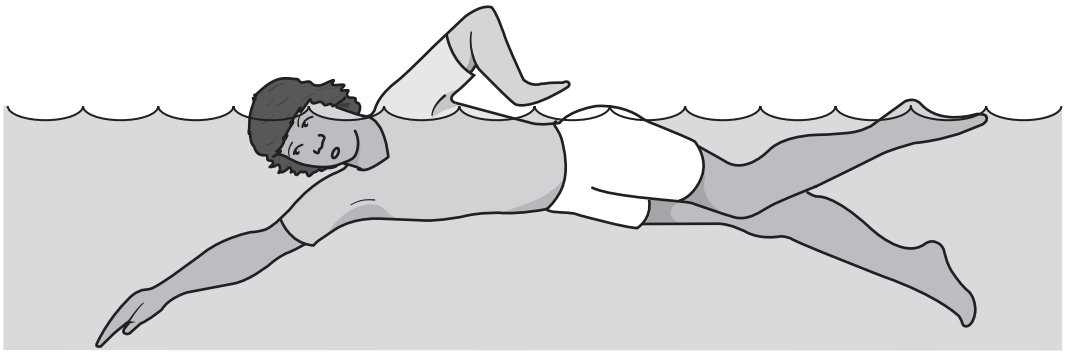

Fig. 3.1

He swims at a constant speed.

(a) (i) On Fig. 3.1 draw a force arrow to show the force pushing the swimmer through the water. [1]

(ii) A gravitational force of 600 N acts on the boy.

Suggest why the boy does not sink to the bottom of the pool as a result of this force.

.....

..... [1]

(b) The boy dives into the pool and swims.

Fig. 3.2 shows a speed–time graph for the boy.

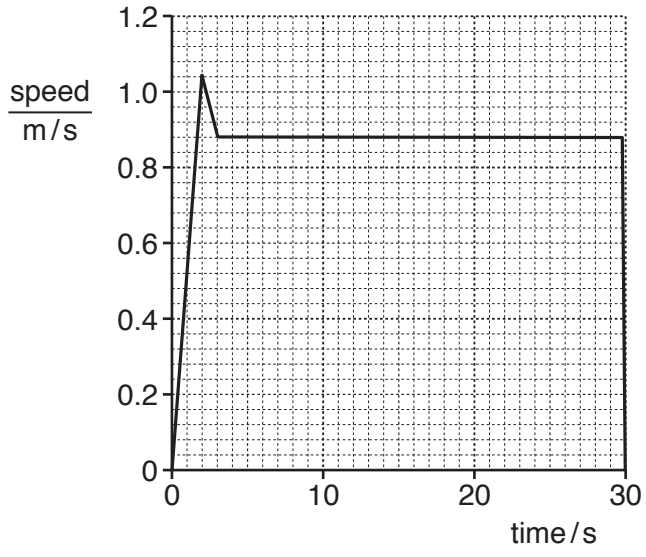

Fig. 3.2

(i) The boy dives from the side of the pool at time = 0 s on the graph and hits the water at time = 2 s.

Describe the motion of the boy during the dive.

.....

..... [2]

(ii) Suggest why the boy's speed slowed down between time = 2 s and time = 3 s.

.....

..... [1]

(iii) The mass of the boy is 60 kg.

Use data from Fig. 3.2 to calculate the kinetic energy of the swimmer at time = 20 s.

Show your working.

kinetic energy = ... J [2]

(iv) The boy takes 30 s to swim 25 m.

Calculate the average speed of the swimmer.

Show your working.

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

[Total: 9]

4 Plants need a supply of mineral ions which they get from water in the soil.

(a) (i) State why plants need magnesium ions.

..... [1]

(ii) Describe the effect on plants if they are deficient in magnesium ions.

..... [1]

(b) Farmers add fertilisers containing nitrate ions to their land. Some of these nitrate ions enter lakes. This can lead to eutrophication.

Use words from the list to complete the flow diagram about eutrophication.

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

consumers **death** **decomposition** **decrease** **growth**

increase **producers**

increase in availability of nitrate ions

↓

increase in ..... of producers

↓

increase in decomposition after death of .....

↓

..... in aerobic respiration by decomposers

↓

..... in dissolved oxygen

↓

death of organisms in the water. [4]

(c) A student investigates transpiration in leaves.

He attaches a piece of blue cobalt chloride paper to the upper surface of a leaf. Another piece is attached to the lower surface.

Cobalt chloride paper changes colour from blue to pink when water is present.

The cobalt chloride paper on the lower surface of the leaf turns pink before the cobalt chloride paper on the upper surface.

(i) Explain the result in terms of leaf structure.

.....

.....

..... [2]

(ii) The experiment is repeated in a warmer environment. The cobalt chloride paper on the lower surface turns pink more quickly than before.

Explain in detail why this happens.

.....

.....

..... [2]

[Total: 10]

5 **(a)** Magnesium is an element in Group II of the Periodic Table, shown on page 20.

(i) An atom of magnesium has a nucleon number of 24.

Deduce the number of protons and the number of neutrons in this atom.

number of protons .....

number of neutrons .....

[1]

(ii) Complete Fig. 5.1 to show the electronic structure of a magnesium atom.

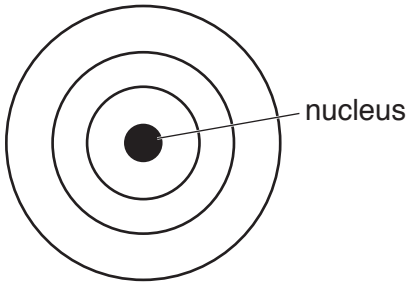

Fig. 5.1

[2]

(b) Magnesium is produced by the electrolysis of magnesium chloride.

(i) Before magnesium chloride is electrolysed it must be melted.

Explain, in terms of particles and energy changes, what happens to a solid as it is melting.

.....

.....

..... [1]

(ii) Magnesium chloride consists of magnesium ions, Mg^{2+}, and chloride ions, Cl^{-}.

Name the electrode at which magnesium forms when molten magnesium chloride is electrolysed.

..... [1]

(iii) Describe how magnesium ions are changed into magnesium atoms during electrolysis.

.....

.....

..... [2]

(c) A student investigates the reaction between dilute hydrochloric acid and excess magnesium carbonate powder.

Fig. 5.2 shows the apparatus she uses.

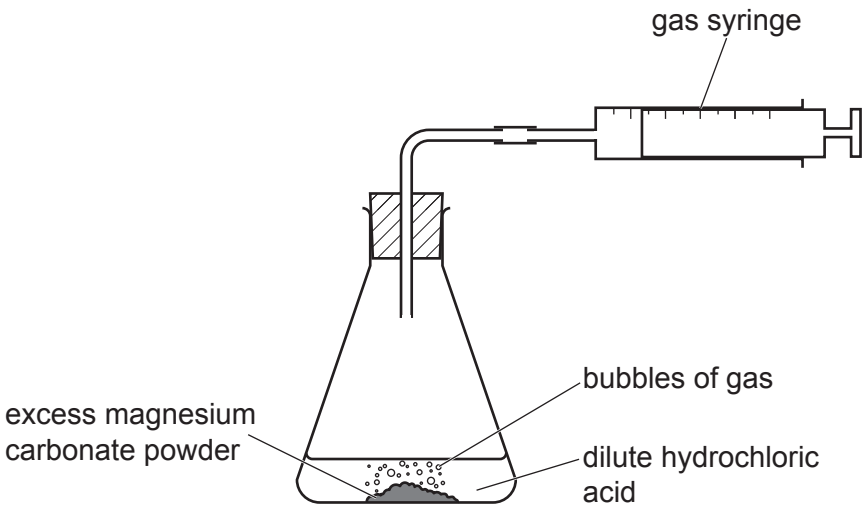

Fig. 5.2

(i) Name the salt formed during this reaction.

..... [1]

(ii) Carbon dioxide is released during this reaction. State the chemical test and the positive result for carbon dioxide.

test .....

positive result .....

.....
[2]

[Total: 10]

6 **(a)** Fig. 6.1 shows a cylinder of compressed air (air at high pressure) used by a scuba diver in the sea.

Fig. 6.1

The diver opens a valve on the cylinder to let the compressed air escape into her face mask.

(i) Describe how the forces and distances between the molecules in the air change as the air leaves the cylinder.

forces .....

.....

distances .....

.....

[2]

(ii) As the air leaves the cylinder, the temperature of the air decreases slightly.

Describe what happens to the motion of the molecules in the air.

..... [1]

(b) The diver returns to her boat after a dive. On the boat, she hangs up her wet diving suit to dry.

Describe how the weather conditions will affect evaporation from the wet diving suit.

Explain your answer in terms of water molecules escaping from the surface of the diving suit.

.....

.....

.....

.....

..... [3]

(c) The wind causes waves on the sea. Fig. 6.2 shows a boat anchored and going up and down as the waves pass.

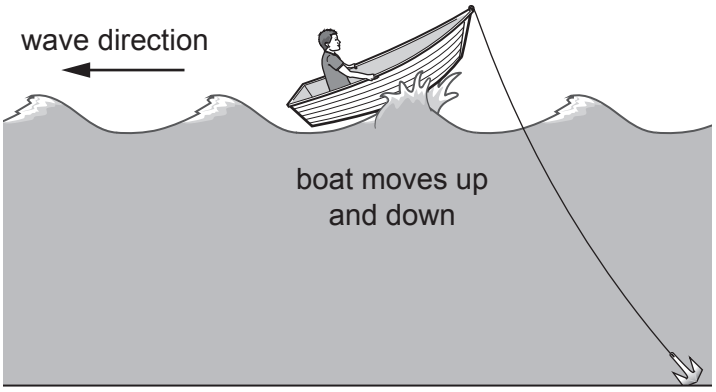

Fig. 6.2

Between each wave the boat moves a vertical distance of 2 m from the top of a wave to the bottom of a wave.

The speed of the waves is 3 m / s.

The time taken for the boat to go from the top of one wave to the top of the next wave is 5 s.

(i) Determine the amplitude of these waves.

amplitude = ... m [1]

(ii) Determine the frequency of the waves.

frequency = ... Hz [1]

(iii) Calculate the wavelength of these waves.

Show your working.

wavelength = ... m [2]

[Total: 10]

7 **(a)** Enzymes are proteins that function as biological catalysts.

Fig. 7.1 shows a representation of an enzyme molecule and some possible substrate molecules.

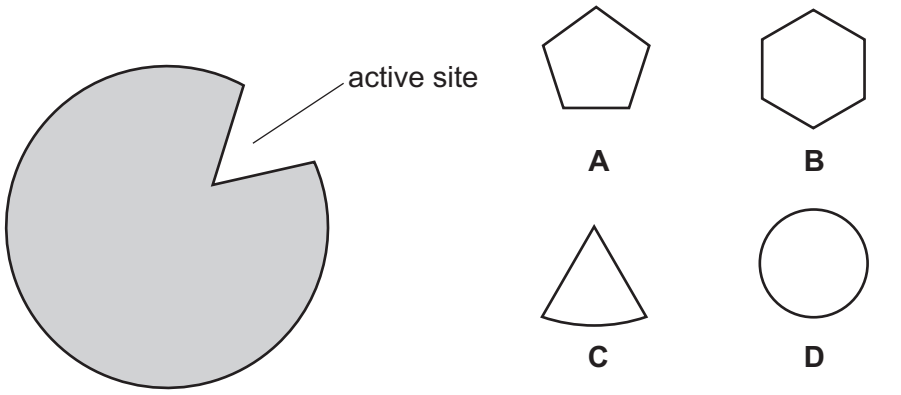

Fig. 7.1

State the letter of the correct substrate for the enzyme shown in Fig. 7.1.

Explain your answer.

letter .....

explanation .....

.....

.....

[2]

(b) Fig. 7.2 shows the effect of temperature on enzyme activity for an enzyme.

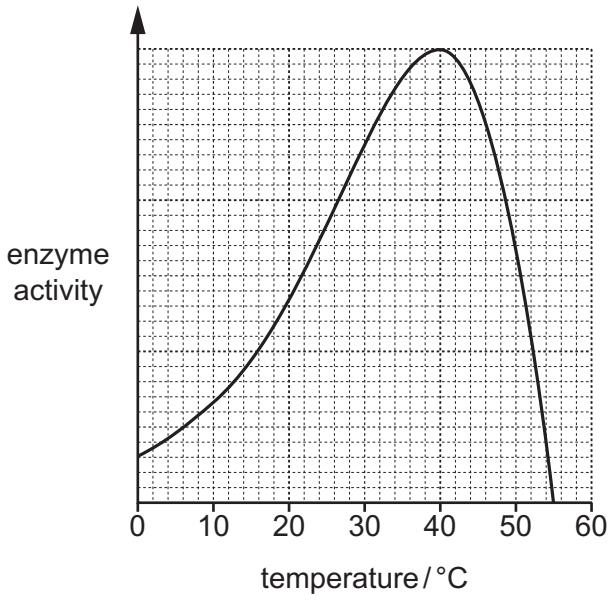

Fig. 7.2

(i) State the optimum temperature of the enzyme.

optimum temperature = ... °C [1]

(ii) Explain in detail why the enzyme activity decreases at higher temperatures.

.....

.....

.....

..... [3]

(c) The enzymes secreted by the human digestive system are responsible for the chemical digestion of food.

Define the term *chemical digestion*.

.....

.....

..... [2]

[Total: 8]

8 **(a)** Complete the sentence:

An electric current in a metal is a flow of ..... , which carry negative ..... . [2]

(b) A battery has an e.m.f. of 24 V.

(i) Use the formula $E = IVt$ to calculate the energy E transferred from the battery when a current of 50 A flows for 1 hour.

Show your working.

energy = ... J [2]

(ii) Calculate the electric charge that flows when a current of 25 A flows for 60 s.

Show your working and state the unit of your answer.

charge = ... unit ..... [3]

(c) The battery is used to operate the starter motor on a truck.

The battery is also used to operate the lights on the truck.

The starter motor must have its own switch and operate independently from the lights.

Fig. 8.1 shows part of the electrical circuit of the truck.

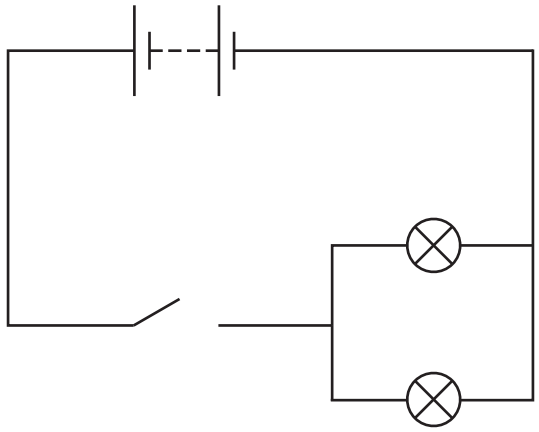

Fig. 8.1

The symbol for the starter motor is

On Fig. 8.1, complete the circuit diagram to show how the starter motor and a switch should be included in this circuit. [1]

[Total: 8]

9 **(a)** Rubidium and caesium are Group I metals.

In the Periodic Table, there is a trend in the properties of the Group I metals.

Rubidium melts at 39 °C.

Caesium is a solid at 20 °C.

(i) Suggest the melting point of caesium.

..... °C [1]

(ii) Describe the trend in the reaction of Group I metals with water.

.....

..... [1]

(b) Iron is extracted from its ore in a blast furnace.

Explain why Group I metals cannot be extracted from their ores by reduction with carbon in a blast furnace.

.....

..... [1]

(c) Table 9.1 shows the elements in Period 2 of the Periodic Table and their electronic structures.

Table 9.1

group	I	II	III	IV	V	VI	VII	VIII
element	Li lithium	Be beryllium	B boron	C carbon	N nitrogen	O oxygen	F fluorine	Ne neon
electronic structure	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8

(i) Describe the relationship between group number and the number of outer shell electrons.

.....

..... [1]

(ii) Describe the trend in the metallic character of the elements within Period 2.

.....

..... [1]

[Total: 5]

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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											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.).