Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

6430702157

COMBINED SCIENCE **0653/41**

Paper 4 Theory (Extended) **May/June 2023**

1 hour 15 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 **24** pages. Any blank pages are indicated.

DC (LK/CT) 316982/2

1 **(a)** Fig. 1.1 shows the circulatory system of frogs and the circulatory system of humans.

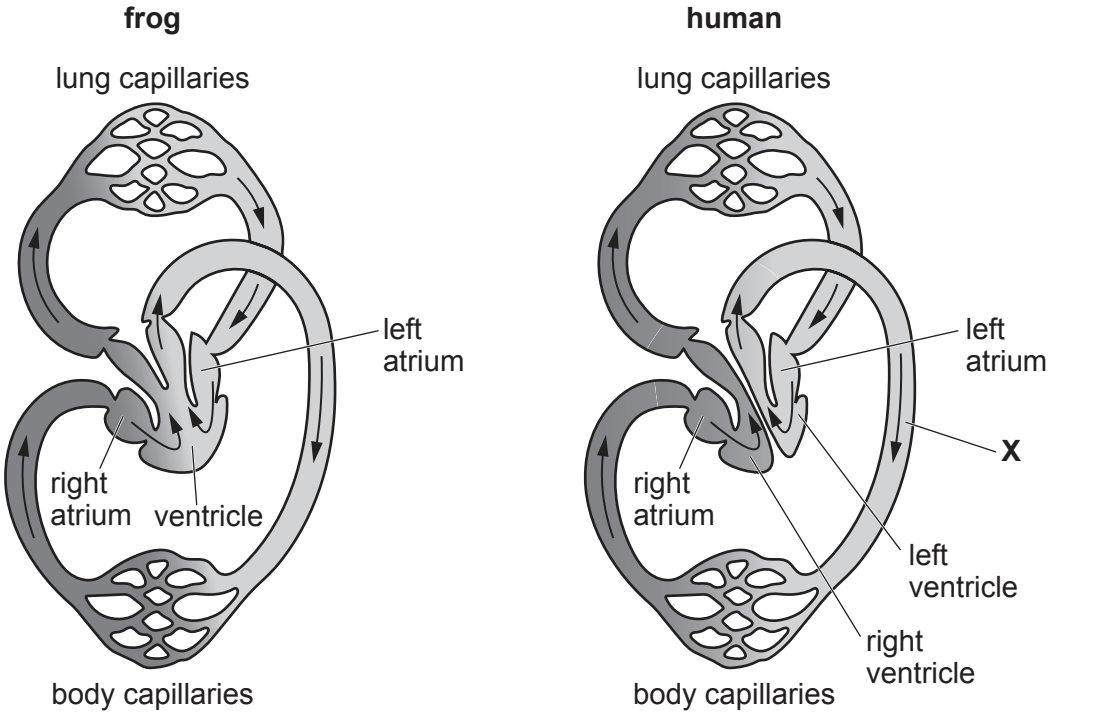

Fig. 1.1

(i) Identify the **type** of blood vessel labelled **X** in Fig. 1.1.

..... [1]

(ii) Describe **one** difference between the frog heart and the human heart shown in Fig. 1.1.

.....

..... [1]

(iii) Humans have a double circulatory system.

Explain the advantages of a double circulatory system.

.....

.....

..... [2]

(b) A study investigates the risk factors for coronary heart disease (CHD).

A sample of people with CHD record the risk factors they have.

Some people in the study record more than one risk factor.

Table 1.1 shows the results.

Table 1.1

risk factor	percentage of people recording risk factor
current smoker	24
diet with few fruit and vegetables	64
high alcohol intake	42
lack of physical activity	70
overweight	54

(i) Identify the risk factor recorded by the highest percentage of people.

..... [1]

(ii) There are 350 people in the study.

Calculate the number of people that record being overweight.

number of people = ... [2]

(iii) The risk factors in Table 1.1 are linked to lifestyle and can be changed.

State **one** risk factor for CHD that is **not** linked to lifestyle.

..... [1]

(c) Eating more fruit and vegetables is one way to help reduce the risk of CHD.

Explain why eating more fruit and vegetables can also reduce the risk of scurvy and constipation.

scurvy .....

.....

constipation .....

.....

[2]

[Total: 10]

2 An electric current is passed through concentrated aqueous sodium chloride using inert electrodes, as shown in Fig. 2.1.

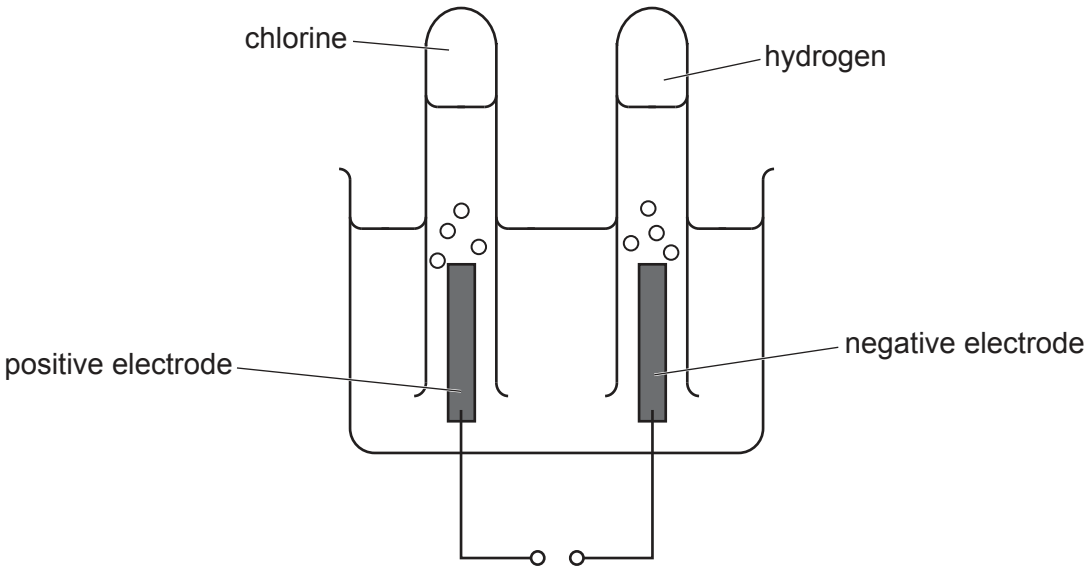

Fig. 2.1

(a) Table 2.1 shows some of the names, formulae and sources of ions in concentrated aqueous sodium chloride.

(i) Complete Table 2.1.

Table 2.1

name of ion	formula of ion	source of ion
chloride	Cl^-	sodium chloride
hydrogen		water
	OH^-	
sodium		

[3]

(ii) State how the concentration of chloride ions changes during the electrolysis.

Explain your answer.

.....

.....

..... [1]

(b) State the chemical test for hydrogen and the observation for a positive result.

test .....

observation .....
[1]

(c) A solution of blue litmus indicator is added to the aqueous sodium chloride.

When the current is first turned on, the litmus indicator at the positive electrode turns red.

(i) Explain why the litmus indicator turns red.

.....

..... [1]

(ii) As the electrolysis progresses, the red litmus indicator changes colour.

State and explain this colour change.

colour change .....

explanation .....

.....

.....
[2]

[Total: 8]

3 Fig. 3.1 shows two people keeping warm by a campfire and one is playing a guitar.

Fig. 3.1

(a) State the process by which the people are warmed by energy coming directly from the fire.

..... [1]

(b) Hot air carries smoke from the fire high into the cold air.

Explain why the hot gases rise. Use ideas about molecules in your answer.

.....

.....

.....

.....

..... [3]

(c) The person in Fig. 3.1 plays a guitar string which emits a musical note of frequency 256 Hz.

(i) State how the musical note is produced by the guitar string when played.

..... [1]

(ii) Calculate the wavelength of the musical note.

Speed of sound in air = 330 m / s.

wavelength = ... m [2]

(iii) The sound is transmitted through the air as a succession of compressions and rarefactions.

Describe what is meant by a succession of compressions and rarefactions.

.....

.....

.....

..... [2]

[Total: 9]

4 **(a)** Fig. 4.1 shows part of a food web.

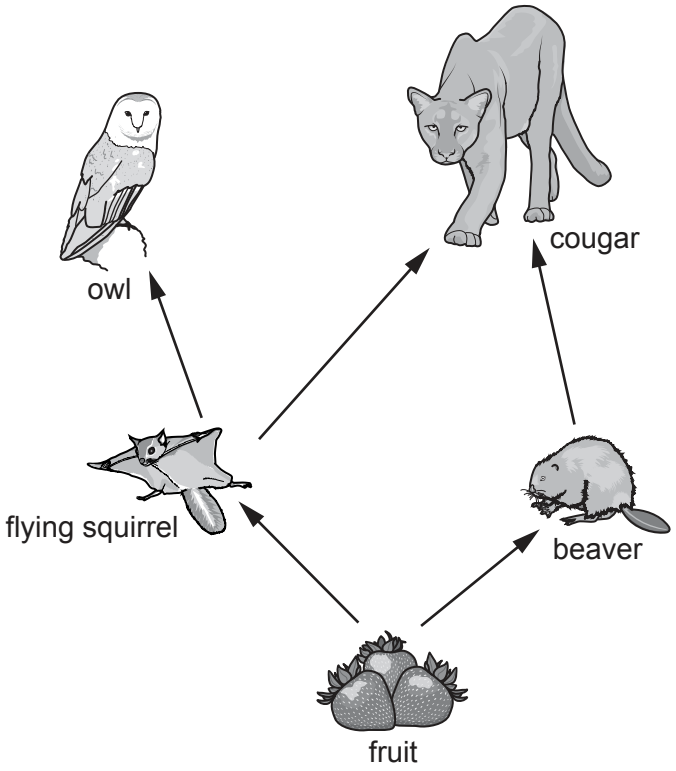

Fig. 4.1

(i) Table 4.1 shows some terms that can be used to describe the organisms in Fig. 4.1.

Complete Table 4.1 by placing ticks (✓) in the boxes to show the term used to describe each organism.

One column has been done for you.

Table 4.1

organism	producer	herbivore	secondary consumer
flying squirrel			
owl			
cougar			
beaver			
fruit	✓		

[2]

(ii) Energy flows through the food web shown in Fig. 4.1. More energy is available at the trophic level occupied by the beaver than the cougar.

Explain why.

.....

.....

.....

.....

..... [3]

(b) Most edible fruits are produced by insect-pollinated plants.

State **two** ways pollen is adapted for insect pollination.

1 .....

2 .....
[2]

[Total: 7]

5 Table 5.1 shows some information about alkanes and alkenes.

Table 5.1

number of carbon atoms per molecule	alkanes		alkenes	
	name	formula	name	formula
1	methane	CH_4	does not exist	
2	ethane		ethene	C_2H_4
3	propane	C_3H_8	propene	C_3H_6
4	butane	C_4H_{10}	butene	C_4H_8
8	octane	C_8H_{18}	octene	

(a) The general formula of alkanes is $C_nH_{(2n+2)}$.

Deduce the general formula of alkenes.

..... [1]

(b) Complete the table by filling in the formulae for ethane and for octene. [2]

(c) Fig. 5.1 shows the structures of ethene and propene.

Fig. 5.1

(i) Ethene and propene are unsaturated hydrocarbons.

State what is meant by unsaturated and hydrocarbons.

unsaturated .....

.....

hydrocarbons .....

.....

[2]

(ii) Explain why meth**ene** does not exist.

.....

.....

..... [2]

(d) Refinery gas, obtained from petroleum, contains both propane and butane.

(i) State **one** use of refinery gas.

..... [1]

(ii) Explain why propane and butane are in the same fraction.

..... [1]

[Total: 9]

6 Fig. 6.1 shows a moving conveyor belt carrying a box from the ground up to an aircraft.

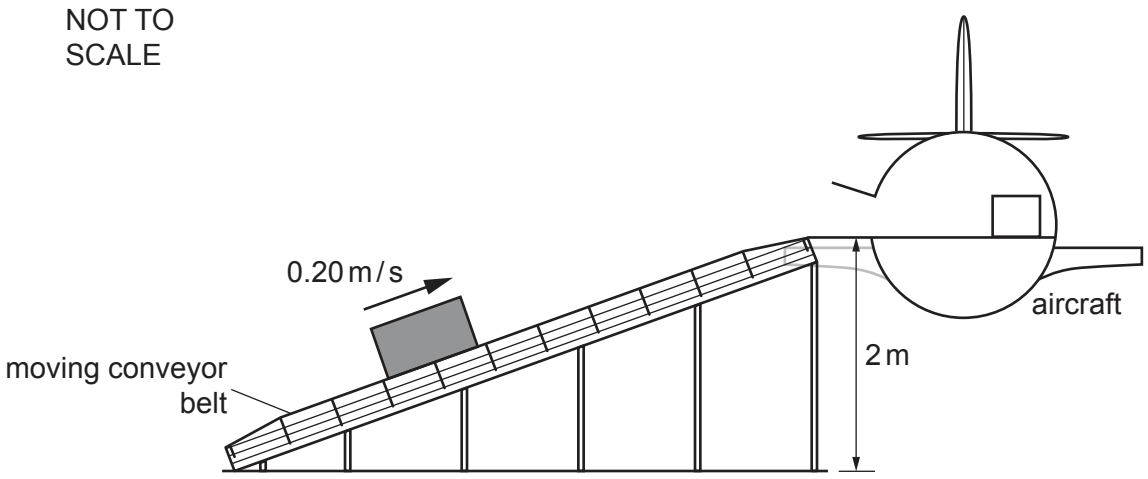

Fig. 6.1

(a) (i) Complete the sentence.

The gravitational force acting on the box is called the ..... of the box. [1]

(ii) The conveyor belt carries the box upwards by the force of friction exerted by the belt on the box.

On Fig. 6.1, draw an arrow to show the direction of the force due to friction of the belt on the box. The arrow must be in contact with the box. [1]

(b) The conveyor belt is 5.0 m long and moves the box at 0.2 m / s.

Calculate the time taken by the box to travel from the ground to the top of the conveyor belt.

time = ... s [2]

(c) The box has a mass of 45 kg. The conveyor belt carries it to the aircraft, 2 m above the ground.

Gravitational force on unit mass is 10 N / kg.

(i) Calculate the gain in gravitational potential energy of the box when it reaches the aircraft.

energy gained = ... J [2]

(ii) When the box reaches the aircraft, it is placed on the floor inside.

The base of the box measures 60 cm × 50 cm.

Calculate the pressure exerted by the box on the floor of the aircraft.

Give the units of your answer.

pressure = ... units ..... [4]

[Total: 10]

7 **(a)** Two young potted plants are left to grow in a room with **no** light.

Plant **A** is placed standing upright.

Plant **B** is placed on its side.

Fig. 7.1 shows the two plants after 10 days.

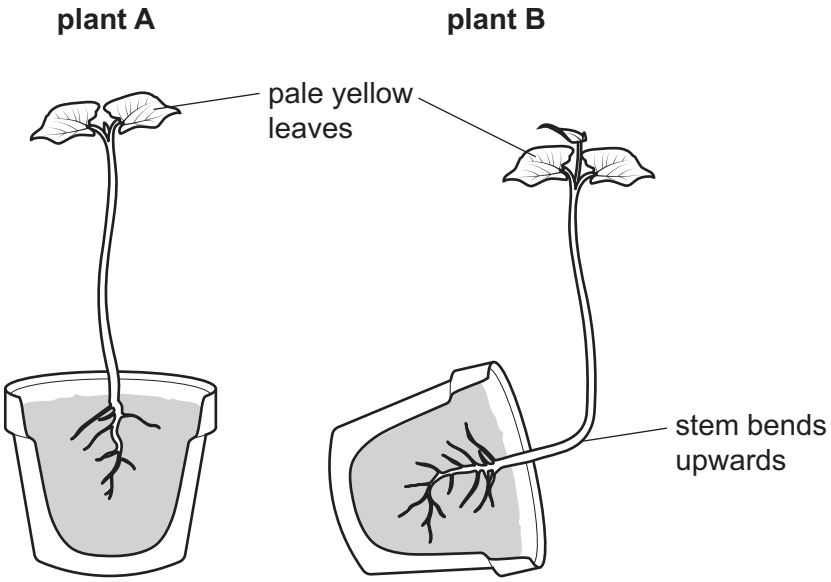

Fig. 7.1

(i) Lack of light causes the leaves to turn yellow.

Complete the sentences.

The yellow colour of the leaves in Fig. 7.1 is due to a decrease in the green pigment called ..... .

Less light energy is converted to ..... energy in the chloroplasts.

This results in reduced synthesis of ..... .

[3]

(ii) Explain why the stem of plant **B** bends upwards.

.....

.....

.....

..... [3]

(b) Fig. 7.2 shows part of a plant root.

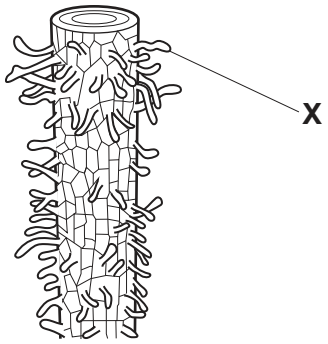

Fig. 7.2

Describe how the cell labelled **X** is adapted for its function.

.....

.....

..... [2]

(c) During eutrophication aquatic plants die. This decreases the concentration of dissolved oxygen in lakes.

One reason for this is a reduction in photosynthesis.

Explain one **other** way the death of aquatic plants reduces the concentration of dissolved oxygen in lakes.

.....

.....

.....

..... [2]

[Total: 10]

8 An iron nail is placed in a test-tube, as shown in Fig. 8.1.

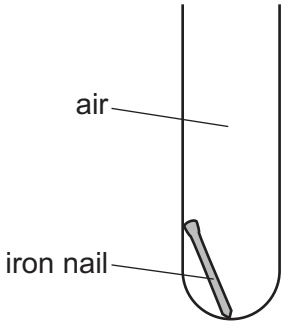

Fig. 8.1

(a) After one week, a layer of rust has formed on the nail.

The equation for the reaction that forms rust is shown.

$$4Fe + ...O_2 \rightarrow .....Fe_2O_3$$

(i) Balance the equation. [1]

(ii) The symbol for an oxide ion is O^{2-}.

Deduce the symbol for the iron ion in Fe_2O_3.

..... [1]

(b) Rusting can be prevented by using a barrier method.

(i) Describe how a barrier method prevents rusting.

.....

..... [2]

(ii) State an example of a barrier method used to prevent rusting.

..... [1]

(c) The arrangement of bonds in a molecule of oxygen is shown in Fig. 8.2.

Fig. 8.2

State the number of electrons which are shared between the oxygen atoms in this molecule.

Give a reason for your answer.

number of electrons .....

reason .....

.....

[2]

(d) At room temperature, iron oxide is a solid and oxygen is a gas.

Explain why iron oxide and oxygen have different physical states.

Use ideas about bonding and forces in your answer.

.....

.....

..... [2]

[Total: 9]

9 Fig. 9.1 shows a student using a laptop computer. There is a lamp beside the student.

Fig. 9.1

(a) Fig. 9.2 is a diagram of the student, lamp and computer from the same viewpoint as Fig. 9.1. The ray in Fig. 9.2 shows how the student sees the light from the lamp reflected in the laptop computer screen.

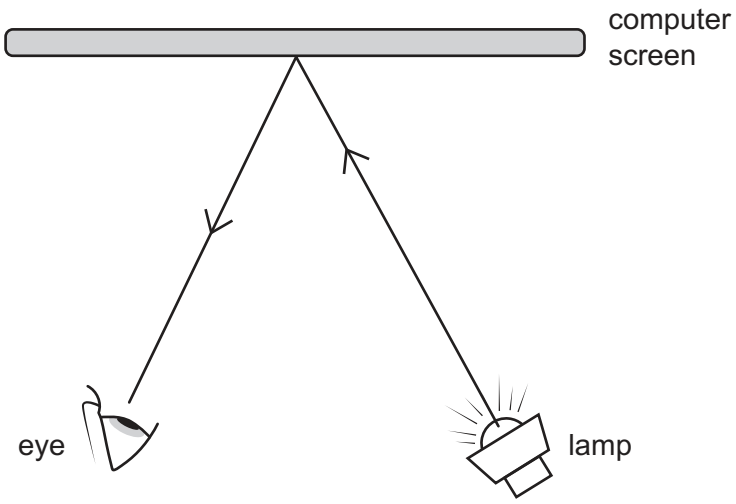

Fig. 9.2

State the law of reflection of light.

Your answer should include the word **normal**.

.....

.....

..... [1]

(b) The lamp is connected to the laptop computer by a cable to supply power at 5.0 V. The current in the lamp is 0.020 A.

(i) Calculate the resistance of the lamp.

resistance = ... Ω [2]

(ii) Calculate the power rating of the lamp.

power = ... W [2]

(iii) The lamp contains two identical components called LEDs (light-emitting diodes) connected in parallel.

A switch and resistor are connected in series with the LEDs.

The symbol for an LED is shown in Fig. 9.3.

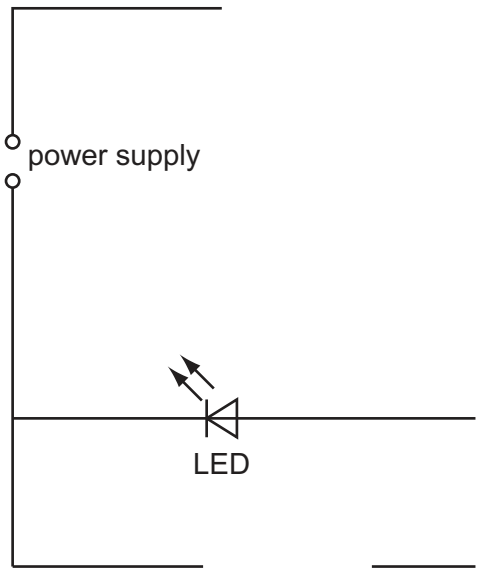

Fig. 9.3

On Fig. 9.3, complete the circuit diagram for the lamp circuit using the correct circuit symbols.

[3]

[Total: 8]

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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.).