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Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4593879835

COMBINED SCIENCE **0653/43**

Paper 4 Theory (Extended) **October/November 2024**

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 **20** pages. Any blank pages are indicated.

[Turn over

1 Fig. 1.1 shows a food web.

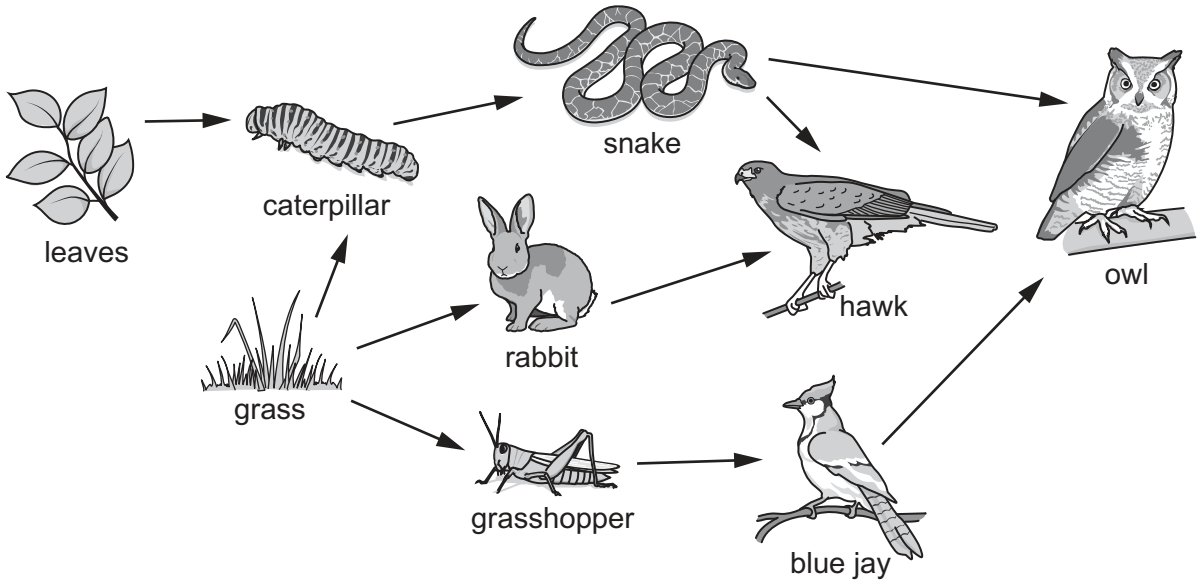


Fig. 1.1

(a) (i) Identify **one** herbivore shown in Fig. 1.1.

..... [1]

(ii) Identify **all** the animals that eat the snake.

..... [1]

(iii) Identify **all** the animals that occupy trophic level 3.

..... [1]

(b) The food web in Fig. 1.1 contains food chains with fewer than five trophic levels.

Explain why food chains usually have fewer than five trophic levels.

.....

.....

.....

.....

..... [3]

[Total: 6]

2 **(a)** Excess solid zinc is added to dilute hydrochloric acid in a conical flask.

(i) Complete the equation for the reaction.

$$Zn(s) + ...HCl(aq) \rightarrow ZnCl_2(aq) + ...(g)$$

[2]

(ii) Describe what is observed during this reaction.

.....

.....

..... [2]

(iii) The mixture in the flask at the end of the reaction contains unreacted solid zinc and aqueous zinc chloride.

State how unreacted solid zinc is removed from this mixture.

.....

..... [1]

(iv) Describe how crystals of zinc chloride are obtained from aqueous zinc chloride.

.....

.....

..... [2]

(b) The formula for sodium chloride is $NaCl$.

The formula for zinc chloride is $ZnCl_2$.

Explain why sodium chloride and zinc chloride contain different numbers of chloride ions.

Use ideas about the charges on ions in your answer.

.....

.....

..... [2]

[Total: 9]

3 **(a)** Complete the sentences about sound. Use **one** word or a number in each gap.

Sound is produced by ..... sources.

The healthy human ear can hear frequencies of sound between ..... Hz and 20 000 Hz.

Sound travels faster in liquids than in ..... .

[3]

(b) State why a wave is refracted as it moves from one medium to another.

.....

..... [1]

(c) Table 3.1 shows some of the properties of solids, liquids and gases and how the kinetic model of matter explains these properties.

In Table 3.1, circle **one** statement in each column that relates to **gases**.

One column has been completed for you.

Table 3.1

volume and shape	fluidity	molecular motion	molecular separation	intermolecular forces
fixed volume and fixed shape		molecules move only by vibrating about fixed positions		no forces between molecules
	can flow		molecules are close together	
fixed volume and no fixed shape		molecules move around while still touching each other		moderate forces between molecules
	cannot flow		molecules are far apart	
no fixed volume and no fixed shape		molecules move quickly in all directions		strong forces between molecules

[2]

(d) A radio signal of frequency 1.2×10^7 Hz is sent from a satellite in space to the Moon.

Calculate the wavelength of the radio signal.

The speed of electromagnetic waves in a vacuum is 3.0×10^8 m/s.

wavelength = ... m [2]

[Total: 8]

4 **(a)** The photosynthesis reaction in plants is controlled by enzymes.

(i) The rate of photosynthesis in a submerged aquatic plant is measured by counting the number of gas bubbles released by the plant in 5 minutes.

Table 4.1 shows the effect of temperature on the rate of photosynthesis in an aquatic plant.

Table 4.1

temperature of water / °C	number of gas bubbles released in 5 minutes
10	30
20	72
30	96
40	42
50	28
60	2

Explain the result for 60 °C in Table 4.1.

Use ideas about enzymes in your answer.

.....

.....

.....

.....

.....

..... [3]

(ii) Describe the importance of stomata in the process of photosynthesis.

.....

.....

..... [2]

(iii) Carbohydrates produced in photosynthesis are stored as starch in plants.

State the solution used to test for the presence of starch and the observation for a positive result.

solution .....

observation .....

[2]

(b) Starch is part of a balanced diet for humans.

Complete the sentences about starch digestion in the human alimentary canal.

Starch is digested by an enzyme called ..... .

The enzyme breaks down starch molecules into smaller carbohydrate molecules called ..... .

The enzyme is secreted into the mouth from the ..... glands and into the small intestine from the ..... .

[4]

[Total: 11]

5 Dilute sulfuric acid is electrolysed using inert electrodes as shown in Fig. 5.1.

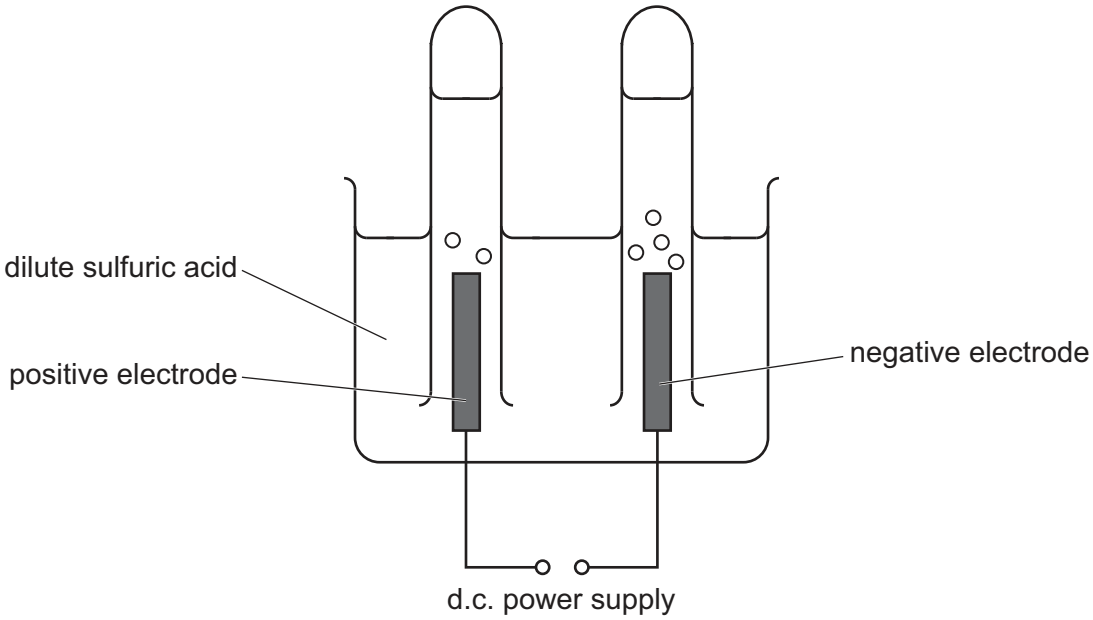


Fig. 5.1

(a) Use **one** word in each gap to complete the definition of electrolysis.

Electrolysis is the breakdown of an ionic ..... when molten or in aqueous solution by the passage of ..... .

[2]

(b) Hydrogen gas forms at the negative electrode.

Complete the ionic equation for the reaction.

$2H^+$ + ... → .....

[2]

(c) Dilute sulfuric acid contains water.

Hydroxide ions from the water react at the positive electrode to form oxygen gas.

Describe what happens to the hydroxide ions in this reaction.

.....

.....

..... [2]

(d) Universal indicator is added to the dilute sulfuric acid at the beginning of the electrolysis. The universal indicator turns red.

Explain why the universal indicator does **not** change colour when the dilute sulfuric acid is electrolysed.

.....

..... [1]

[Total: 7]

6 Fig. 6.1 shows an ox pulling a plough along horizontal ground.

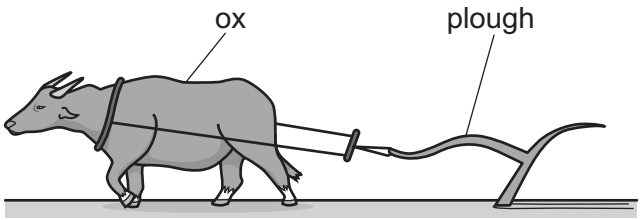


Fig. 6.1

(a) Fig. 6.2 shows a speed–time graph for the motion of the ox and plough on one journey.

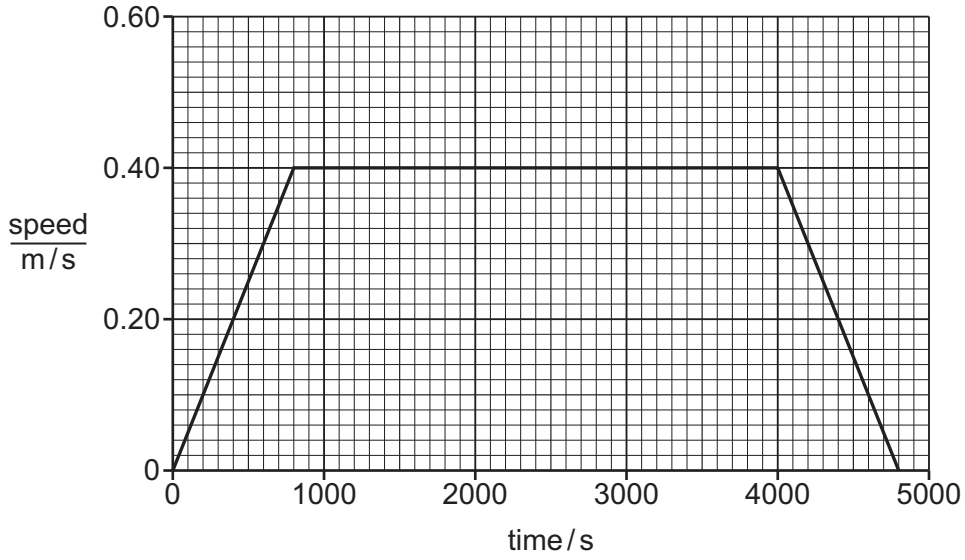


Fig. 6.2

(i) Use Fig. 6.2 to state the maximum speed of the ox and plough on this journey.

maximum speed = ... m / s [1]

(ii) Use Fig. 6.2 to calculate the total distance, **in kilometres**, travelled by the ox and plough.

distance = ... km [3]

(b) On a different journey, the ox pulls the plough along horizontal ground with a constant force of 1100 N for 330 s.

The work done on the plough is 462 000 J.

The total energy output of the ox is 792 000 J.

(i) Calculate the distance, **in metres**, moved by the plough.

distance = ... m [2]

(ii) Suggest why the total energy output of the ox is greater than the work done on the plough.

.....

..... [2]

(iii) Calculate the total power output of the ox.

Give the unit of your answer.

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

[Total: 11]

7 **(a)** Fig. 7.1 shows a diagram of the double circulatory system in humans.

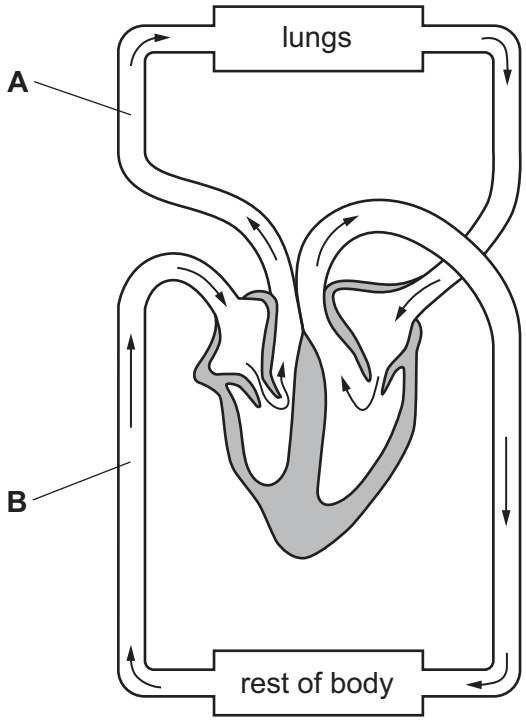


Fig. 7.1

The arrows show the direction of blood flow.

(i) State the names of the blood vessels labelled **A** and **B** on Fig. 7.1.

A .....

B .....
[2]

(ii) Use a label line with the letter **X** to label the **left** atrium in Fig. 7.1. [1]

(iii) Describe how the heart pumps blood to the body.

.....

.....

..... [2]

(b) Coronary heart disease (CHD) has many risk factors.

One risk factor is gender.

(i) State **two** other risk factors for coronary heart disease.

1 .....

2 .....
[2]

(ii) A medical study records the number of male and female people with coronary heart disease in one country over a period of 32 years.

Fig. 7.2 shows a graph of the results.

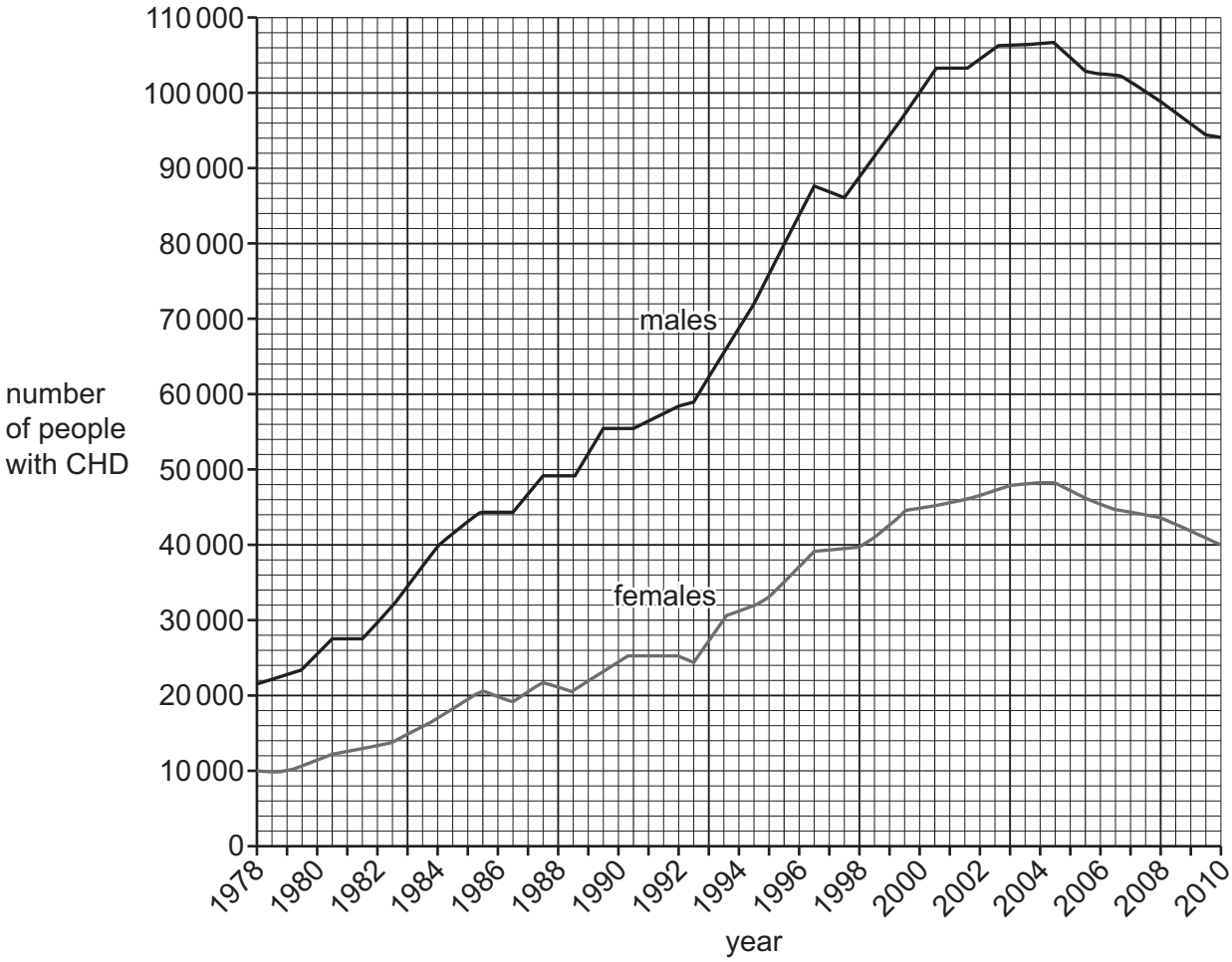


Fig. 7.2

Compare the trends for males and females shown in Fig. 7.2.

Use data from Fig. 7.2 in your answer.

.....

.....

.....

.....

..... [3]

[Total: 10]

8 **(a)** The formula for methanol is CH_3OH.

Complete the dot-and-cross diagram in Fig. 8.1 to show the bonding in methanol.

Show outer-shell electrons only.

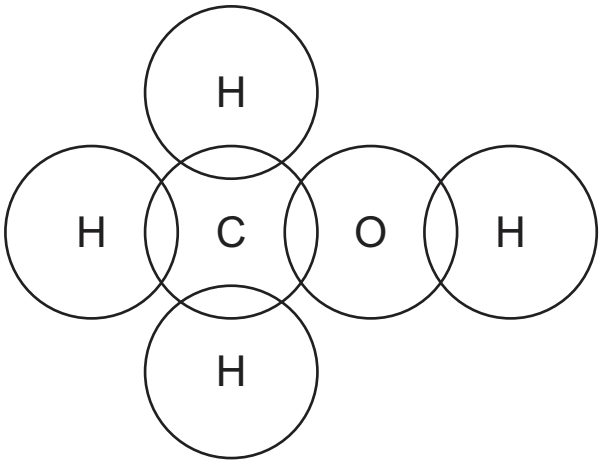


Fig. 8.1

[3]

(b) Ethene, C_2H_4, is an alkene.

Ethane, C_2H_6, is an alkane.

(i) State **one** difference in the bonding of ethene and of ethane.

.....

..... [1]

(ii) The complete combustion reactions of both ethene and ethane produce carbon dioxide and water.

Identify whether the statements are true or false.

Tick (✓) **one** box for each statement.

	true	**false**
One molecule of ethene produces the same number of molecules of carbon dioxide as one molecule of ethane.	☐	☐
One molecule of ethene produces the same number of molecules of water as one molecule of ethane.	☐	☐
The combustion reactions of ethene and ethane are both endothermic.	☐	☐

[2]

(c) The general formulae for alkenes and alkanes are shown in Table 8.1.

Table 8.1

alkenes	alkanes
C_nH_{2n}	C_nH_{2n+2}

Write the formula for:

an alkene with 10 hydrogen atoms .....

an alkane with 10 hydrogen atoms. .....

[2]

(d) Aqueous bromine is added to a sample of an alkene and to a separate sample of an alkane.

State the colour of each sample after the aqueous bromine is added.

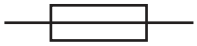
alkene .....

alkane .....

[2]

[Total: 10]

9 **(a)** State the name of the component with the electrical symbol shown.



..... [1]

(b) Fig. 9.1 shows a circuit diagram for the two headlamps and two rear lamps of a car.

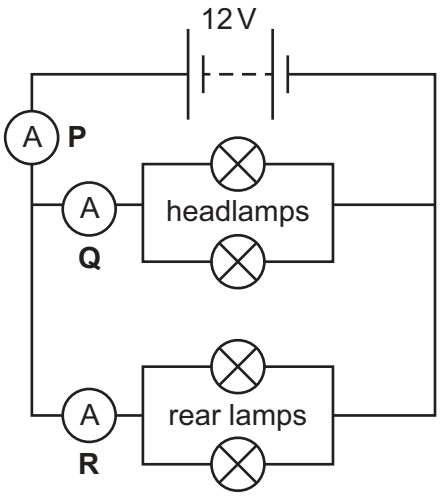


Fig. 9.1

Both headlamps are identical.

Both rear lamps are identical but different from the headlamps.

Ammeter **P** reads 11.0A.

Ammeter **R** reads 1.0A.

(i) Determine the reading on ammeter **Q**.

reading = ... A [1]

(ii) Use your answer to **(b)(i)** to determine the resistance of **one** headlamp.

resistance = ... Ω [3]

(c) A motorcycle has **one** headlamp and **one** rear lamp.

Each lamp is made from a length of filament wire.

The wires in each lamp are made of the same metal.

The wire in the rear lamp:

- is three times the length of the wire in the headlamp
- has half the cross-sectional area of the wire in the headlamp.

The resistance of the headlamp of the motorcycle is 3.0 Ω.

Determine the resistance of the rear lamp of the motorcycle.

resistance = ... Ω [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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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.).