Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

0324748755

COMBINED SCIENCE **0653/43**

Paper 4 Theory (Extended) **May/June 2021**

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.

DC (PQ/JG) 208556/2

[Turn over

1 **(a)** Fig. 1.1 shows the flowers of a wind-pollinated plant.

Fig. 1.1

(i) Identify the part labelled **X** in Fig. 1.1.

..... [1]

(ii) Describe two ways the **pollen** of a wind-pollinated flower is different to that of an insect-pollinated flower.

1 .....

2 .....
[2]

(b) A student investigates the germination of seeds by putting five bean seeds in different environmental conditions.

Table 1.1 shows the different environmental conditions for each bean seed.

Table 1.1

bean seed	environmental conditions			germinates yes/no
	warm **or** cold	water **or** no water	light **or** dark	
A	warm	water	dark	yes
B	warm	no water	light	
C	cold	no water	light	
D	cold	water	dark	
E	warm	water	light	

Complete Table 1.1 to predict if the seeds will germinate or not.
A has been done for you. [1]

(c) Table 1.2 shows information about some of the features found in the leaf of a plant.

Table 1.2

feature	adaptation to function
	small pores used for gas exchange
spongy mesophyll layer	
	contain large numbers of chloroplasts for photosynthesis

Complete Table 1.2. [3]

[Total: 7]

[Turn over

2 Apparatus used for the electrolysis of molten lead(II) bromide is shown in Fig. 2.1.

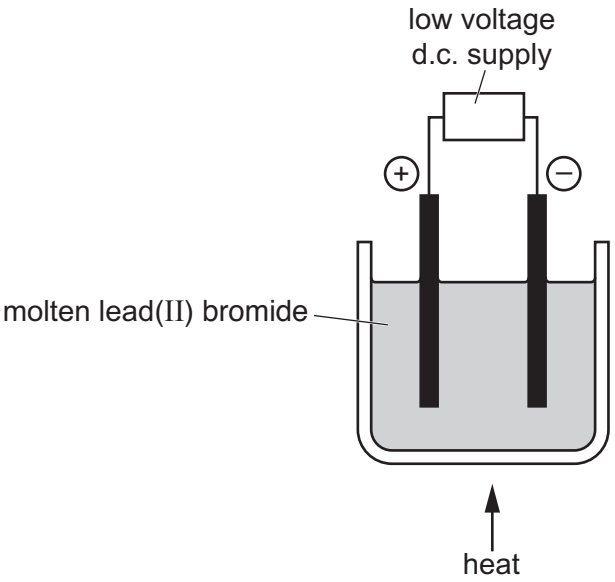


Fig. 2.1

(a) The products of the reaction are molten lead and bromine gas.

(i) Add state symbols to the equation for this reaction.

$PbBr_2$(.....) $\rightarrow$ Pb(.....) + Br_2(.....) [1]

(ii) During the electrolysis of lead(II) bromide, ions move to the positive and negative electrodes.
Describe what happens to the ions at each electrode.
Use ideas about electrons in your answer.

at the positive electrode (anode).....

.....

.....

at the negative electrode (cathode).....

.....

.....
[4]

(b) The melting point of lead(II) bromide is 373 °C.

The temperature in the electrolysis cell is 400 °C.

When the apparatus cools, lead(II) bromide solidifies first while the lead metal produced is still a liquid.

Use this information to suggest a value for the melting point of lead.

..... °C [1]

(c) The electrodes used are made from carbon. They do not change during the electrolysis.

State the word used to describe electrodes that do **not** change during electrolysis.

..... [1]

(d) The melting point of magnesium oxide is 2850 °C.

The apparatus in Fig. 2.1 reaches a maximum temperature of 1000 °C.

Explain why the apparatus in Fig. 2.1 **cannot** be used to electrolyse magnesium oxide.

.....

.....

.....

..... [2]

[Total: 9]

[Turn over

3 Fig. 3.1 shows a man lying down on a sandy beach on a sunny day.

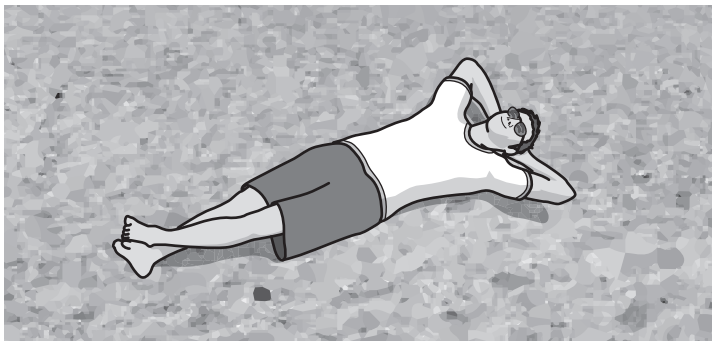


Fig. 3.1

(a) The man lies on the beach for a long time. The Sun emits electromagnetic radiation that causes the man to get painful sunburn.

(i) Name the type of electromagnetic radiation that causes sunburn.

..... [1]

(ii) Sunscreen cream can help to prevent sunburn.

Suggest what happens to the electromagnetic radiation responsible for sunburn when it meets the sunscreen cream.

.....

..... [1]

(b) The man stands up.

Pressure from his feet leaves deep footprints in the sand.

The surface area of **one** foot is 155 cm^2.

The mass of the man is 75 kg.

The gravitational field strength g is 10 N / kg.

Calculate the pressure he exerts on the sand when he stands on **two** feet.

pressure = ... Pa [4]

(c) Fig. 3.2 shows the man about to dive into the sea from a diving board.

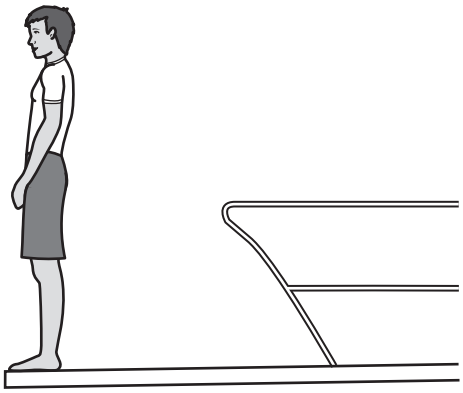


Fig. 3.2

Fig. 3.3 shows his speed-time graph as he goes down and into the water.

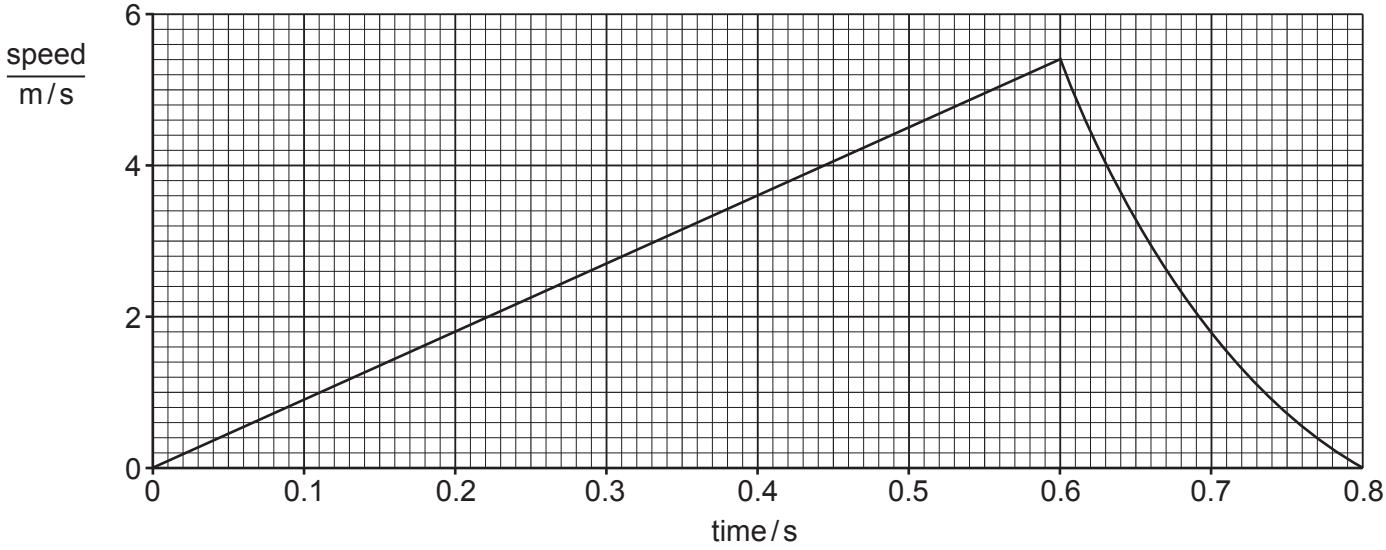


Fig. 3.3

The diver enters the water at 0.60 s.

(i) Use Fig. 3.3 to calculate the height of his dive.

height = ... m [2]

(ii) Use Fig. 3.3 to calculate his acceleration before he enters the water.

acceleration = ...m / s^2 [2]

[Total: 10]

[Turn over

4 **(a)** Fig. 4.1 is a diagram of a section through a human heart.

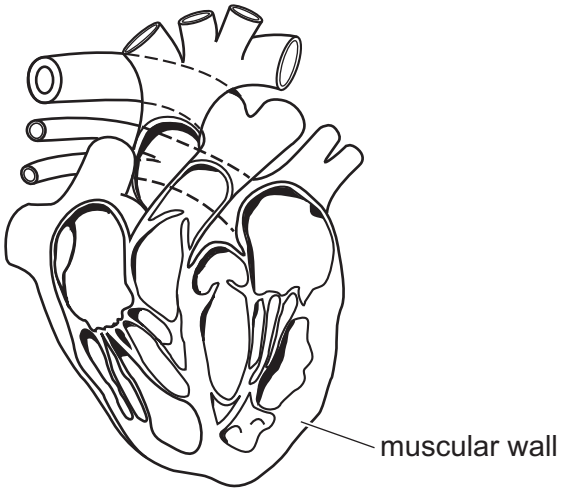


Fig. 4.1

(i) On Fig. 4.1 use a label line and the letter **R** to identify the right ventricle of the heart. [1]

(ii) Describe the role of the muscular wall in the function of the heart.

.....

.....

..... [2]

(b) Fig. 4.2 is a graph that compares the number of males and females with coronary heart disease in different age categories.

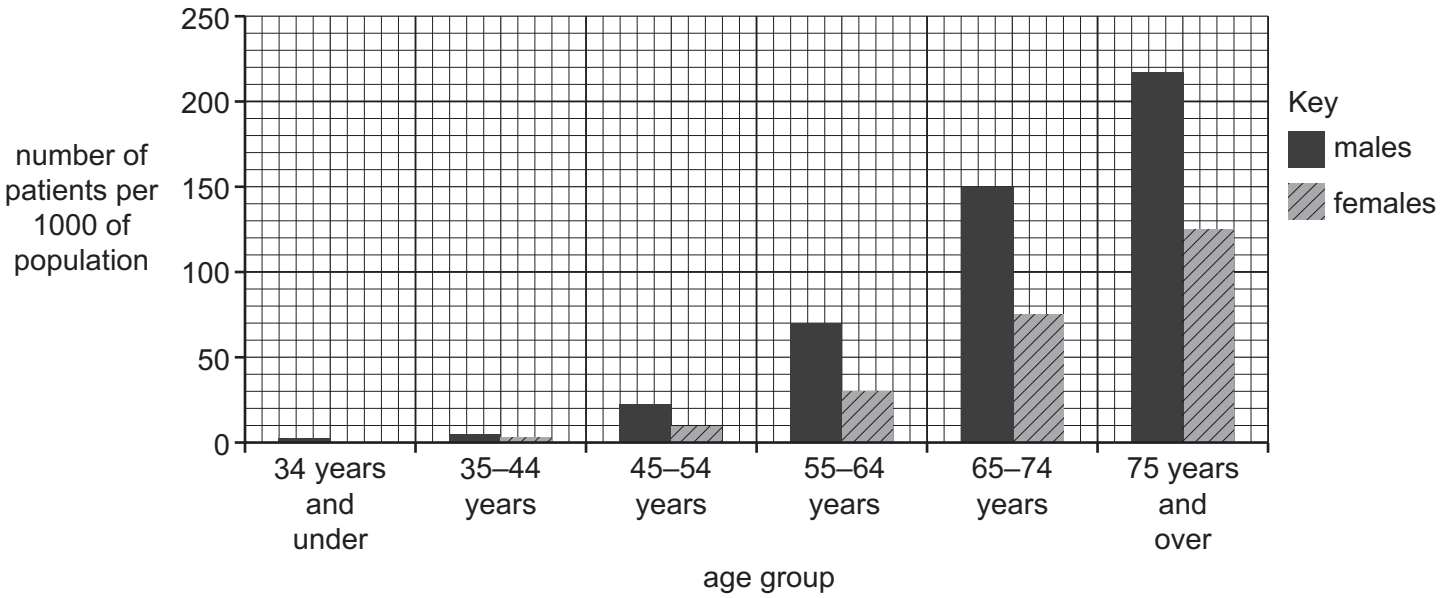


Fig. 4.2

(i) Identify the age group that has **no women** with coronary heart disease.

..... [1]

(ii) Describe **two** general trends shown in Fig. 4.2.

1 .....

.....

2 .....

.....

[2]

(c) Risk factors for coronary heart disease include age, diet and your sex.

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

1 .....

2 .....

[2]

(ii) Describe how malnutrition can cause coronary heart disease.

.....

.....

..... [2]

[Total: 10]

5 Table 5.1 shows information about the electrons in atoms of elements **V**, **W**, **X**, **Y** and **Z**. **V**, **W**, **X**, **Y** and **Z** are **not** the symbols for the elements.

Table 5.1

elements	number of electrons in the outer shell of each atom	total number of electrons in each atom
V	1	1
W	4	6
X	6	16
Y	2	4
Z	7	9

(a) Use the letters **V**, **W**, **X**, **Y** and **Z** to identify:

the element in Group VII ..... ,

the **two** elements which form negative ions ..... and ..... ,

the metallic element ..... ,

the element with the highest proton number ..... .

[5]

(b) Element **W** and element **Z** form a covalent compound.

The formula for this compound is $\mathbf{WZ_4}$.

(i) Use the information in Table 5.1 and the Periodic Table on page 20 to identify elements **W** and **Z**.

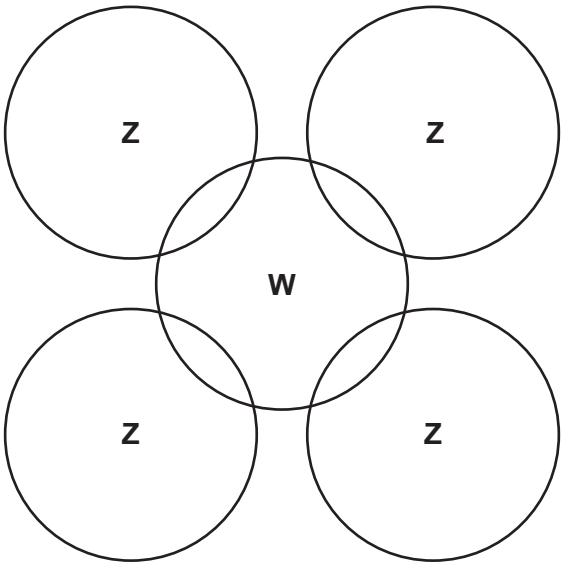
W .....

Z .....

[2]

(ii) Complete the dot-and-cross diagram to show the bonding in $\mathbf{WZ_4}$.

Show **all** the outer shell electrons.



[2]

[Total: 9]

6 **(a)** Table 6.1 shows the melting and boiling points of six substances.

Table 6.1

substance	melting point / °C	boiling point / °C
ammonia	–78	–33
benzene	6	80
bromine	–7	59
lactic acid	53	105
mercury	–39	357
sulfur	113	445

(i) Identify the substance which is a liquid over the smallest range of temperature.

..... [1]

(ii) Identify the substance which has the slowest moving molecules when it turns from a liquid into a gas.

..... [1]

(iii) The thermal conductivity of the metal mercury is 40 times higher than the thermal conductivity of the non-metal sulfur.

Suggest why the thermal conductivity of mercury is so much greater.

.....

..... [1]

(b) Mercury vapour is used in street lamps. One colour of light emitted is green, which has a wavelength of 546×10^{-9} m.

The speed of light is 3.0×10^{8} m / s.

Calculate the frequency of the green light.

State the unit of your answer.

frequency = ... unit ..... [3]

(c) A street lamp requires a power input of 175 W from the electricity supply.

(i) Only 20% of the energy input is emitted as light.

Suggest the form of energy output for the remaining 80% of the input.

..... [1]

(ii) The street lamp is used for 8 hours.

Calculate the total energy input.

energy = ... J [3]

[Total: 10]

7 **(a)** Fig. 7.1 is a graph showing the effect of temperature on two different enzymes, **A** and **B**.

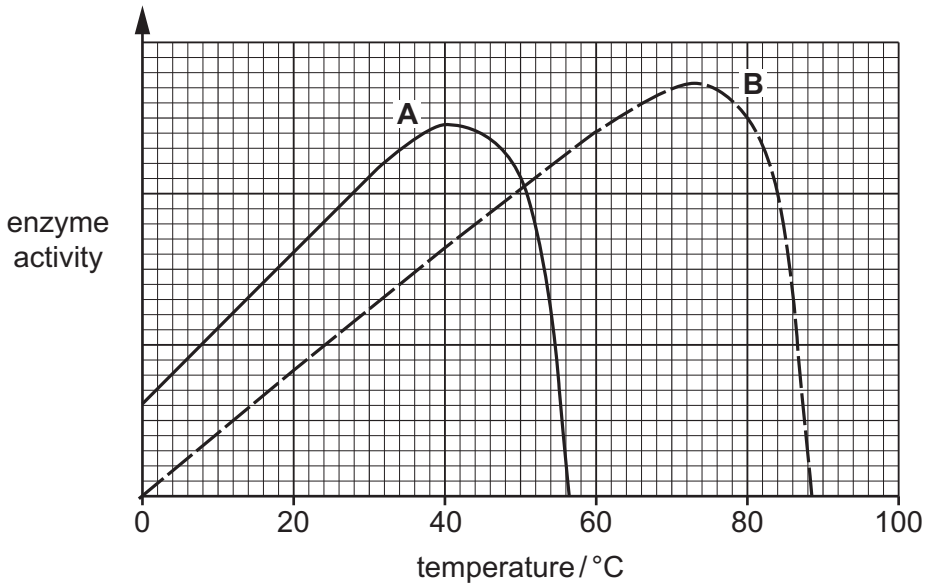


Fig. 7.1

(i) Identify the temperature at which enzyme **A** is most active.

..... °C [1]

(ii) Compare the effect of temperature on the two enzymes.

.....

.....

.....

.....

..... [3]

(iii) Explain the effect of temperature on the activity of enzyme **B** above 75 °C.

.....

.....

..... [2]

(b) Lipase enzymes are found in the small intestine of humans.

State the role of lipase enzymes in the small intestine.

.....

.....

..... [2]

(c) Enzymes are used in aerobic respiration.

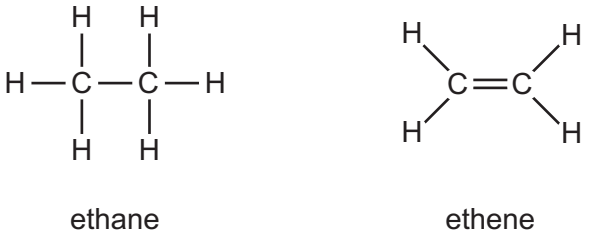
Complete the balanced chemical equation for aerobic respiration.

..... O_2 + ... $\longrightarrow$ .... + ... CO_2

[2]

[Total: 10]

8 Fig. 8.1 shows the structures of ethane and ethene.



ethane ethene

Fig. 8.1

(a) **(i)** Ethane and ethene are hydrocarbons. State what is meant by the term hydrocarbon.

.....

..... [2]

(ii) Use Fig. 8.1 to explain what is meant by the term unsaturated.

.....

..... [1]

(b) The polymerisation of ethene forms the polymer poly(ethene).

(i) Identify this type of polymerisation.

..... [1]

(ii) Describe what happens to the ethene molecules during polymerisation.

.....

..... [1]

(iii) Ethane **cannot** form a polymer.
Explain why.

.....

..... [1]

(c) Complete the balanced symbol equation for the complete combustion of ethene.

C_2H_4 + ... O_2 $\rightarrow$ ..... CO_2 + ...

[2]

[Total: 8]

9 Fig. 9.1 shows a car travelling forwards along a road.

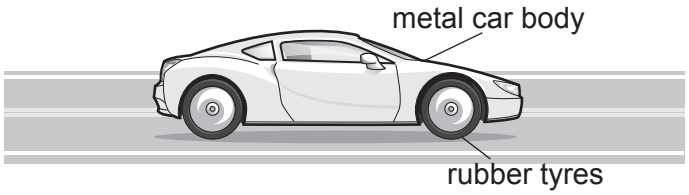


Fig. 9.1

As the car drives along, electrostatic charges build up on the car.

(a) (i) State what causes an electrostatic charge to form on the car.

..... [1]

(ii) Name the particles transferred when an electrostatic charge builds up on the car.

..... [1]

(iii) Explain why the electric charge does **not** travel to the ground while the car is being driven along the road.

.....

.....

..... [2]

(b) When the car stops, the driver gets out and touches the metal car body. The electric charge on the car travels through the driver to the ground. The electric current through the driver as the charge travels to the ground is 0.015 A and lasts for 0.3 ms.

(i) Calculate the total electric charge that travels through the driver.

charge = ... C [2]

(ii) The total resistance of the driver's body and shoes is 40 000 Ω.

Show that the potential difference between the driver and the car before she touches the door handle is 600 V.

[1]

[Total: 7]

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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.).