Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

1356912991

COMBINED SCIENCE **0653/42**

Paper 4 Theory (Extended) **October/November 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 **24** pages. Any blank pages are indicated.

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1 **(a)** Fig. 1.1 is a diagram of a fetus inside the uterus.

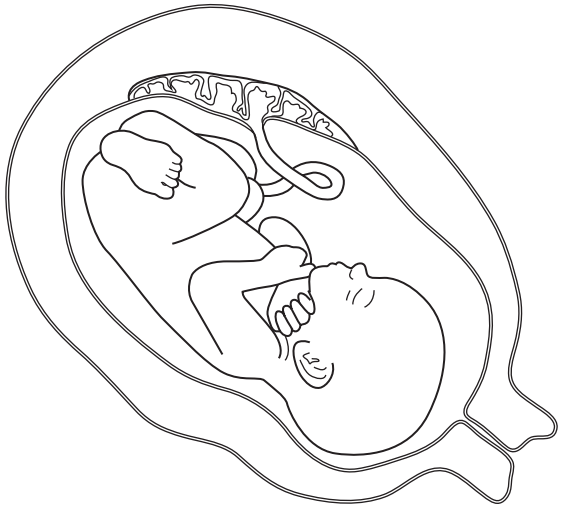

Fig. 1.1

On Fig. 1.1, draw a label line and the letter **C** to identify the cervix. [1]

(b) The fetus requires energy and amino acids for growth.

(i) State the name of the process in cells that releases energy.

..... [1]

(ii) Describe how the fetus obtains amino acids.

.....

.....

..... [2]

(c) A pregnant female takes iron tablets to supplement her diet.

Explain why iron tablets may be needed **during pregnancy**.

.....

.....

..... [2]

(d) Table 1.1 shows the names and functions of some organs associated with the alimentary canal of an adult human body.

Complete Table 1.1.

Table 1.1

organ	function
.....	uses teeth to break down food into smaller pieces
large intestine	.....
.....	egestion

[3]

[Total: 9]

2 **(a)** A student uses inert electrodes for the electrolysis of **dilute** aqueous sodium chloride and **concentrated** aqueous sodium chloride solutions.

(i) State what is meant by *inert*.

.....

..... [1]

(ii) For each solution, the products formed at the positive and negative electrodes are gases.

The student tests the gases.

Table 2.1 shows the observations.

Table 2.1

solution	gas formed at positive electrode	gas formed at negative electrode
dilute aqueous sodium chloride	relights glowing splint	'pops' with a lighted splint
concentrated aqueous sodium chloride	bleaches damp litmus paper	'pops' with a lighted splint

Use the observations in Table 2.1 to identify the gases formed at the positive and negative electrodes for each solution.

Complete Table 2.2 with the names of these gases.

Table 2.2

solution	name of gas formed at positive electrode	name of gas formed at negative electrode
dilute aqueous sodium chloride		
concentrated aqueous sodium chloride		

[3]

(iii) State the names of the positive and negative electrodes.

positive electrode .....

negative electrode .....

[1]

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(b) **Molten** sodium chloride is electrolysed using inert electrodes.

Describe how sodium is formed from sodium ions during this electrolysis.

.....

.....

.....

..... [3]

(c) During the electrolysis of **molten** sodium chloride, sodium **is** formed.

During the electrolysis of **aqueous** sodium chloride, sodium is **not** formed.

Explain this difference.

.....

.....

..... [2]

[Total: 10]

3 Two beach balls are floating in the sea.

Fig. 3.1 shows waves moving across the sea underneath the beach balls.

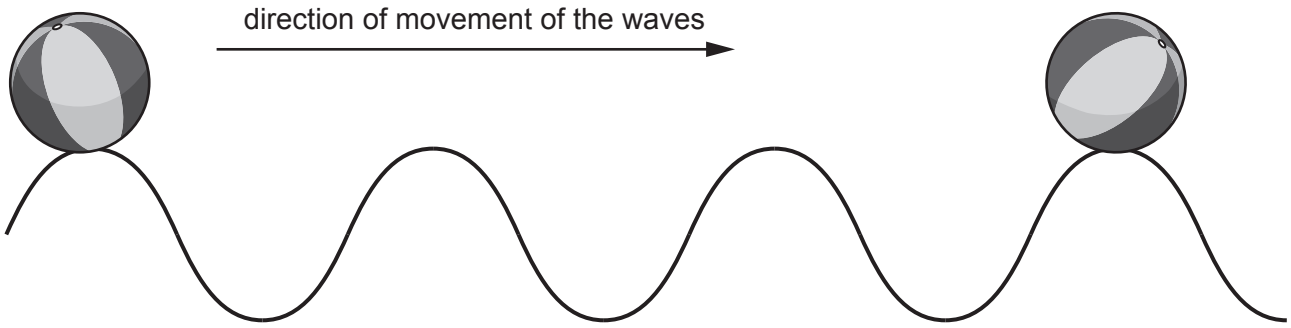

Fig. 3.1

(a) (i) State the number of wavelengths between the two beach balls.

..... [1]

(ii) On Fig. 3.1, draw a double-headed arrow (↔ or ↕) to show the amplitude of a wave. [1]

(b) Six waves pass under one beach ball in 40 seconds.

(i) Calculate the frequency of the waves.

State the unit of your answer.

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

(ii) The wavelength of the waves is 18 m.

Use your answer to **(b)(i)** to calculate the speed of the waves across the sea.

speed = ... m/s [2]

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(c) A sound wave takes 0.22 s to travel 72 m in **air**.

Circle the time taken for the same sound wave to travel 72 m in **water**.

Give a reason for your answer.

0.055 s 0.22 s 0.88 s

reason .....

.....

[1]

[Total: 8]

4 **(a)** Fig. 4.1 is a diagram of the gas exchange system in a human.

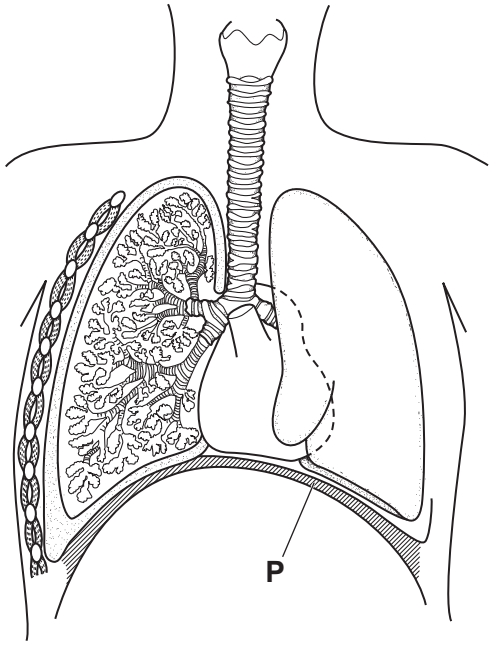

Fig. 4.1

(i) Identify the part labelled **P** in Fig. 4.1.

..... [1]

(ii) On Fig. 4.1, draw a label line and the letter **L** to identify the larynx. [1]

(b) Expired air contains a different percentage of carbon dioxide to inspired air.

State and explain this difference.

difference .....

.....

explanation .....

.....

[2]

(c) Fig. 4.2 shows cells that line the airways of a non-smoker and a smoker.

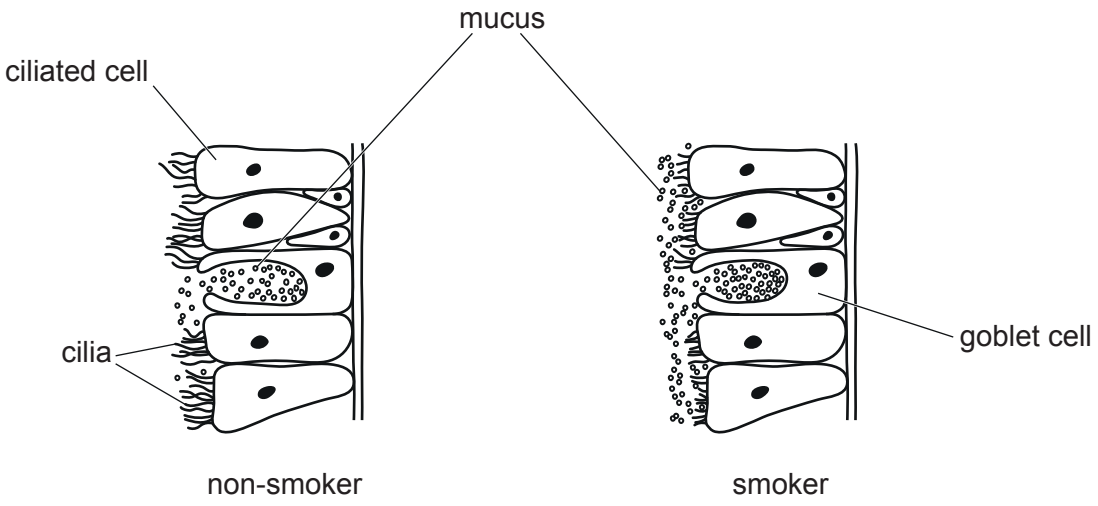

Fig. 4.2

Explain how smoking tobacco affects the function of the cells shown in Fig. 4.2.

Use the information in Fig. 4.2 in your answer.

.....

.....

.....

.....

.....

..... [3]

[Total: 7]

5 The pH values of four aqueous salt solutions are listed in Table 5.1.

Table 5.1

aqueous salt solution	pH
copper sulfate	4
iron chloride	2
magnesium sulfate	6
sodium chloride	7

(a) Describe how an aqueous salt solution can be tested to find its pH value.

.....

.....

..... [2]

(b) **(i)** Identify the most acidic aqueous salt solution listed in Table 5.1.

Explain your choice.

solution .....

explanation .....

.....
[1]

(ii) State the names of the **two** aqueous salt solutions listed in Table 5.1 that react with zinc.

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

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(c) A student reacts solid copper carbonate with dilute sulfuric acid in four different experiments.

The same mass of copper carbonate is used in each experiment.

Table 5.2 shows the conditions used.

Table 5.2

experiment	size of pieces of copper carbonate	temperature of acid / °C
1	large	20
2	large	40
3	small	20
4	small	40

State which experiment has the highest rate of reaction.

Explain your answer using ideas about colliding particles and activation energy.

experiment .....

explanation .....

.....

.....

.....

[4]

[Total: 8]

6 A meteorite is an object from space that travels through the Earth's atmosphere and hits the surface of the Earth.

(a) A meteorite in space is moving towards the Earth.

(i) Before it enters the Earth's atmosphere, the speed of the meteorite is increasing.

Explain why the speed of the meteorite increases as it moves closer to the Earth.

.....

..... [1]

(ii) The meteorite has a mass of 45 000 kg.

Calculate the kinetic energy of the meteorite when it has a speed of 1.7×10^4 m/s.

kinetic energy = ... J [2]

(b) The meteorite decelerates as it travels through the Earth's atmosphere. The deceleration increases as the meteorite gets closer to the surface of the Earth.

(i) Explain why the meteorite decelerates.

.....

..... [1]

(ii) Suggest why the deceleration increases.

.....

..... [1]

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(c) A scientist wants to identify the type of meteorite.

Fig. 6.1 shows a piece of the meteorite.

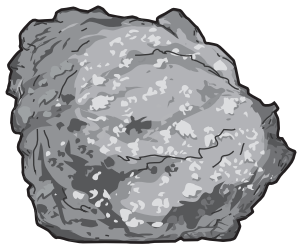

Fig. 6.1

(i) The scientist puts the piece of meteorite in a large measuring cylinder containing 2500 cm^3 of water.

The water level on the measuring cylinder increases to 3480 cm^3.

Calculate the volume of this piece of meteorite.

volume = ...cm^3 [1]

(ii) Table 6.1 shows the density ranges for three types of meteorite.

Table 6.1

type of meteorite	density range kg/m^3
stony	2110 to 3550
stony-iron	4250 to 4760
iron	7000 to 8000

The piece of meteorite has a mass of 4.52 kg.

Use Table 6.1 and your answer to **(c)(i)** to identify the type of meteorite.

Show your working.

type of meteorite ..... [4]

[Total: 10]

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[Turn over

7 **(a)** A student investigates the effect of light intensity on the rate of photosynthesis of an aquatic plant submerged in a beaker of water.

During photosynthesis, the aquatic plant produces bubbles of gas.

The student shines a lamp on the aquatic plant from different distances and measures the volume of gas produced in 3 minutes.

Table 7.1 shows the results.

Table 7.1

distance of lamp from aquatic plant / cm	volume of gas produced in 3 minutes / cm^3	rate of gas produced / cm^3 per second
50	0.2	
40	0.8	0.004
30	1.6	0.009
20	2.2	0.012
10	2.2	0.012

(i) Calculate the rate of gas produced when the lamp is 50 cm from the aquatic plant.

..... cm^3 per second [2]

(ii) Describe the effect of light intensity on the rate of photosynthesis shown by the results in Table 7.1.

.....

.....

.....

..... [2]

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(b) The student does a different experiment to investigate the effect of **temperature** on the rate of photosynthesis.

Fig. 7.1 shows a graph of the results.

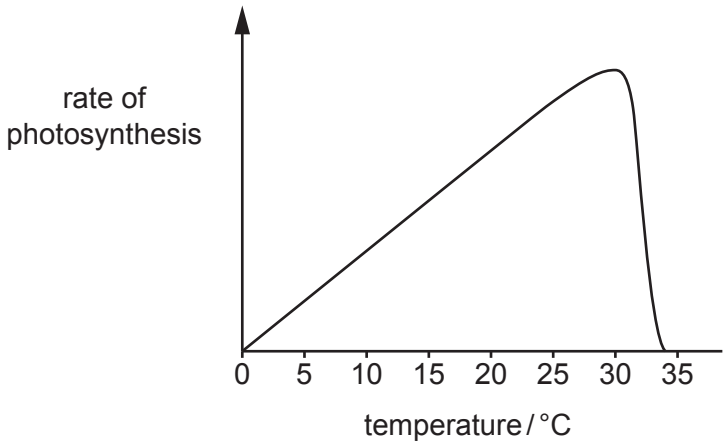

Fig. 7.1

The process of photosynthesis is controlled by enzymes.

Explain the shape of the graph seen in Fig. 7.1.

Use ideas about enzymes in your answer.

.....

.....

.....

.....

.....

..... [3]

(c) Glucose is a product of photosynthesis.

Complete these sentences about the uses of glucose in a plant.

Choose words from the list.

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

glycogen	**mesophyll**	**phloem**
protein	**starch**	**xylem**

Glucose is converted to sucrose and transported to the roots in ..... vessels.

In the roots, the sucrose is converted to ..... for storage.

[2]

(d) Plant shoots grow towards a light source.

(i) State the name of this tropic response of plants to light.

..... [1]

(ii) State the name of the chemical involved in this response.

..... [1]

[Total: 11]

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8 There has been a large increase in the concentration of carbon dioxide in the atmosphere over the last 50 years.

(a) **(i)** State the name of **one** natural process which produces carbon dioxide.

..... [1]

(ii) Suggest **one** reason for the large increase in carbon dioxide concentration over the last 50 years.

..... [1]

(b) Carbon dioxide is a greenhouse gas.

Suggest why many scientists are concerned about increased concentrations of greenhouse gases in the atmosphere.

.....

.....

..... [2]

(c) Some information about carbon dioxide and sea water is shown.

Sea water is made of water, dissolved salts and dissolved gases.
Carbon dioxide from the atmosphere dissolves in sea water.
The carbon dioxide then reacts with water to form carbonic acid.

(i) Use the information to identify a solvent, a solute and a solution.

solvent .....

solute .....

solution .....

[3]

(ii) Suggest why many scientists are concerned about increasing amounts of carbon dioxide dissolving in sea water.

.....

..... [1]

[Total: 8]

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9 Fig. 9.1 shows an electric kettle used to boil water.

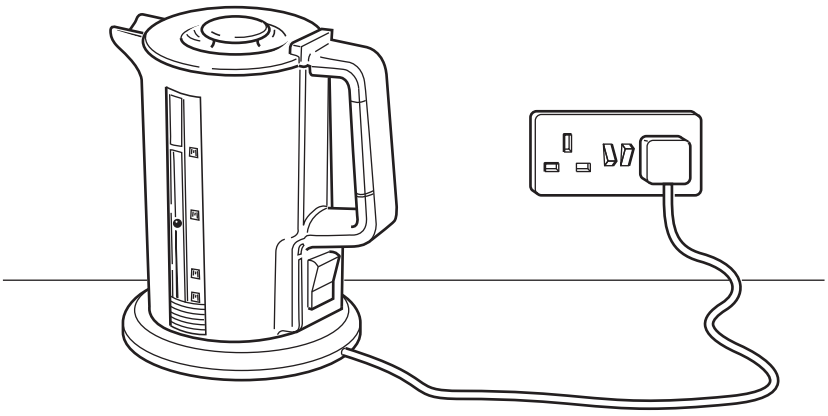

Fig. 9.1

(a) State the boiling point of water, including the correct unit.

..... [1]

(b) When the water in the kettle is boiling, a switch turns off the kettle.

The switch is made of a thin piece of steel joined to a thin piece of brass.

Fig. 9.2 shows the switch when it is cold (turned ON) and when it is hot (turned OFF).

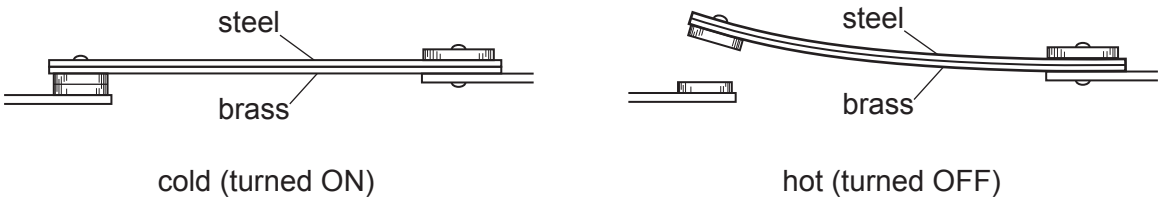

Fig. 9.2

Explain why the switch turns off when it is hot.

.....

.....

.....

..... [2]

(c) Fig. 9.3 shows a label on the kettle.

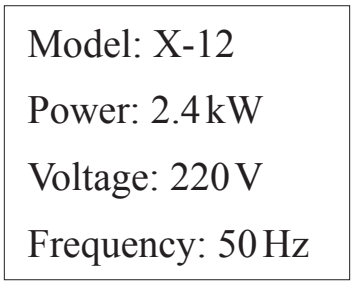

Fig. 9.3

(i) Calculate the current from the source when the kettle is turned on.

current = ... A [3]

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(ii) The electric circuit in the kettle contains a heating element, a lamp and a switch.

- The heating element has 220 V across it.
- The lamp has 220 V across it.
- The switch controls both the heating element and the lamp.

Fig. 9.4 shows an incomplete circuit diagram for the kettle.

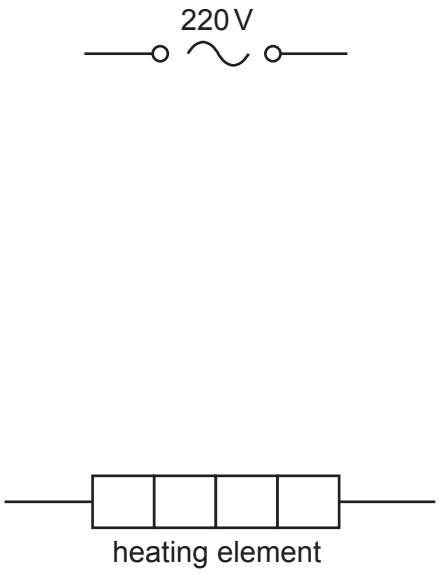

Fig. 9.4

On Fig. 9.4, complete the circuit diagram to include the switch and the lamp. [3]

[Total: 9]

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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.).