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5062750648

COMBINED SCIENCE **0653/43**

Paper 4 Theory (Extended) **May/June 2025**

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.
- Take the weight of 1.0 kg to be 9.8 N (acceleration of free fall = 9.8 m / s^2).

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 **(a)** Fig. 1.1 is a photomicrograph of human blood.

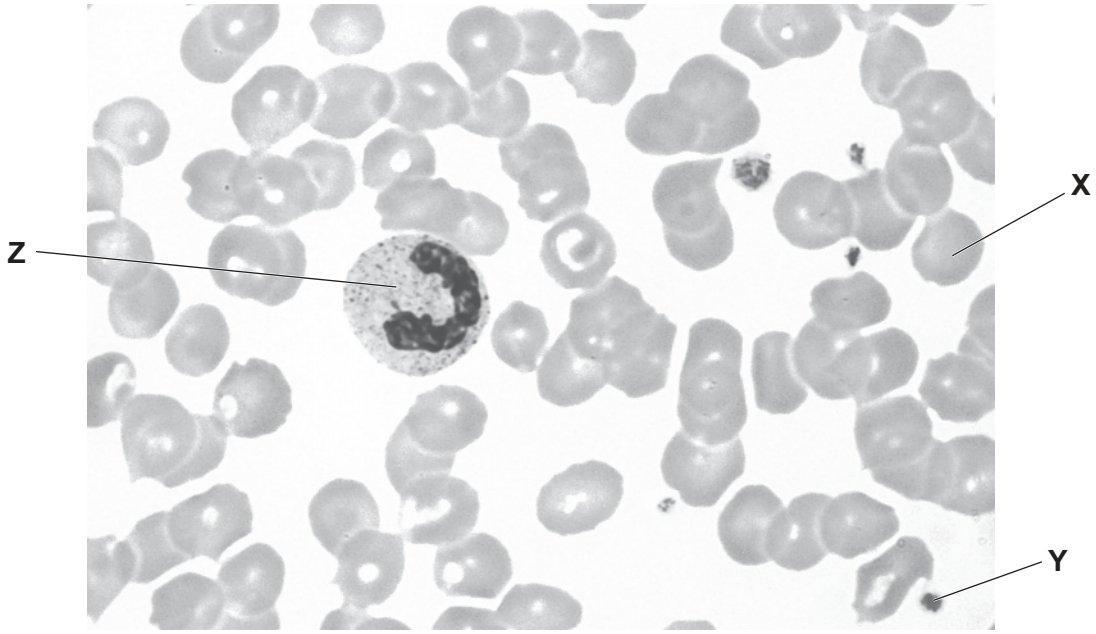

Fig. 1.1

(i) Name the blood component labelled **X** on Fig. 1.1.

..... [1]

(ii) State **one** function of the blood component labelled **Z** on Fig. 1.1.

..... [1]

(iii) The blood component labelled **Y** on Fig. 1.1 helps blood clot.

State **two** reasons why blood clots when skin is damaged.

1 .....

.....

2 .....

.....

[2]

(b) Blood is transported in blood vessels.

Fig. 1.2 is a photomicrograph of an artery and a vein.

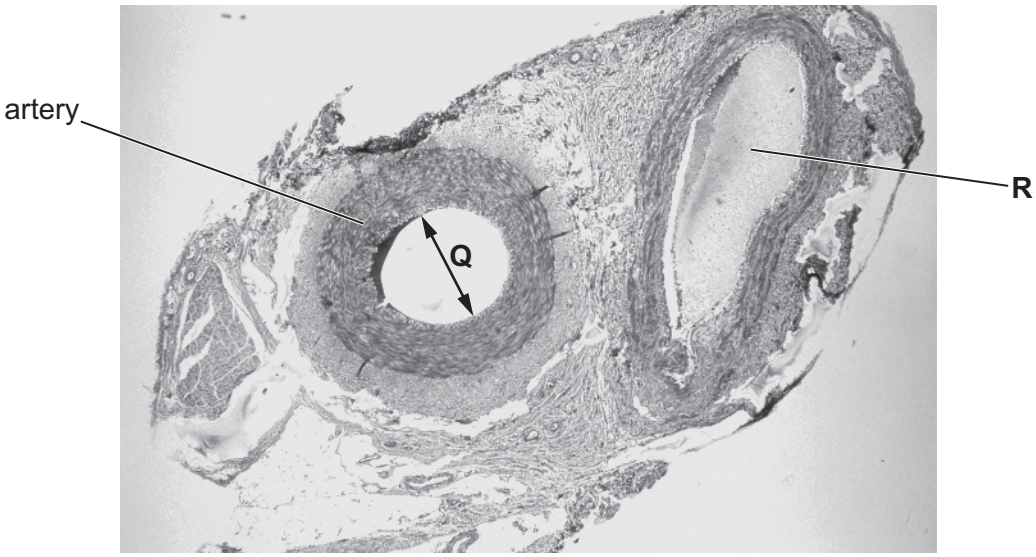

Fig. 1.2

(i) Describe evidence from Fig. 1.2 that the blood vessel labelled **R** is a vein.

.....

.....

.....

..... [2]

(ii) The diameter of the inside of the artery is indicated by line **Q** in Fig. 1.2.

Line **Q** is 15 mm in length.

The magnification of the image is ×75.

Calculate the actual diameter of the inside of the artery in micrometres (μm).

actual diameter = ... μm [3]

[Total: 9]

2 **(a)** Fig. 2.1 is a diagram of a cross-section through a leaf.

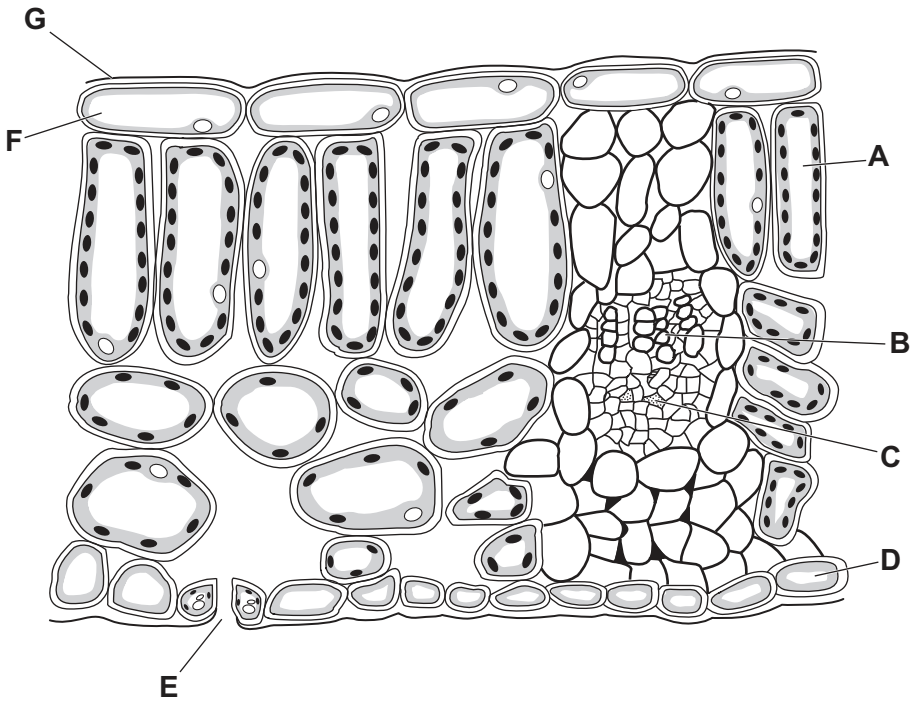

Fig. 2.1

State the letter on Fig. 2.1 that identifies:

cuticle .....

a cell specialised for photosynthesis .....

a cell that transports mineral ions to the leaf. .....

[3]

(b) A green pigment is needed for photosynthesis.

State the name of this pigment and its role in photosynthesis.

name .....

role .....

.....

.....

.....

[3]

(c) The graph in Fig. 2.2 shows the effect of temperature on the rate of photosynthesis in a plant.

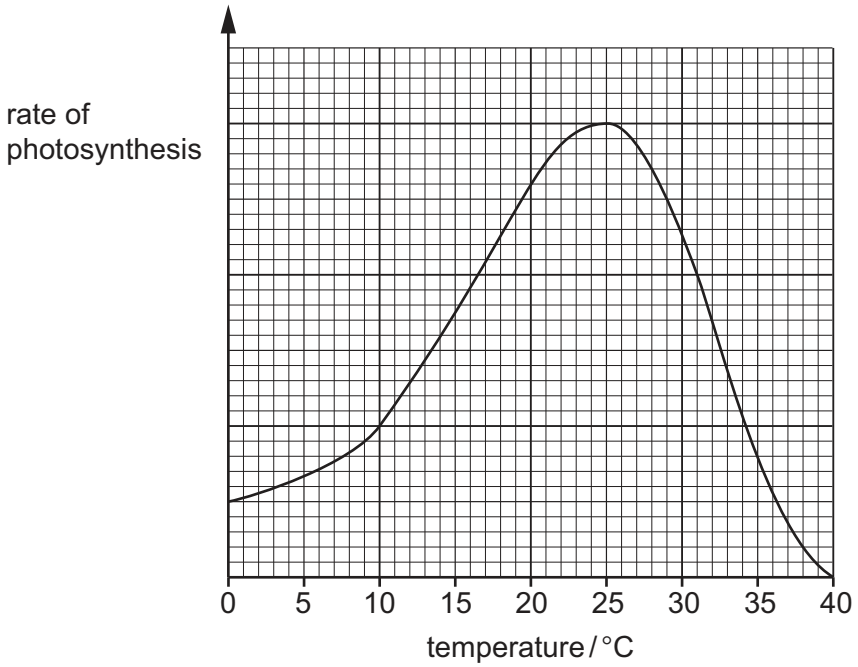

Fig. 2.2

(i) Identify the optimum temperature for photosynthesis shown in Fig. 2.2.

..... °C [1]

(ii) Enzymes are involved in photosynthesis.

Explain the result at 40 °C shown in Fig. 2.2.

.....

.....

.....

.....

..... [3]

[Total: 10]

3 **(a)** Fig. 3.1 shows part of the breathing system in humans.

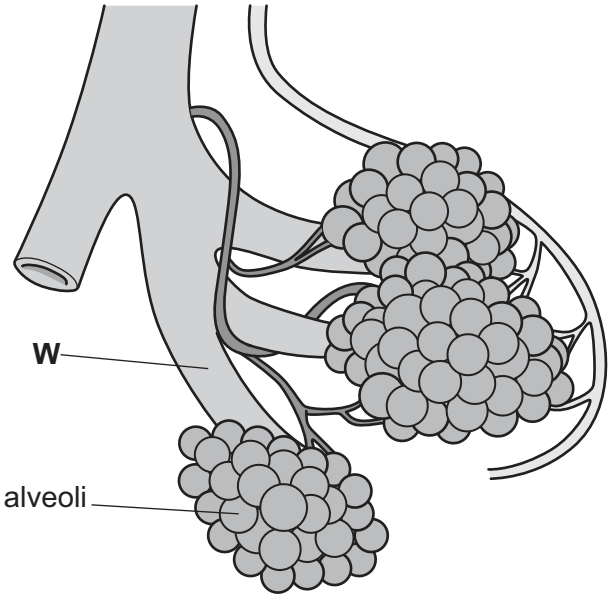

Fig. 3.1

(i) Identify the part labelled **W** in Fig. 3.1.

..... [1]

(ii) Alveoli are the gas exchange surface in humans.

Describe **two** features of the gas exchange surface in humans.

1 .....

2 .....

[2]

(b) The breathing system excretes carbon dioxide produced in aerobic respiration.

State the balanced symbol equation for aerobic respiration.

..... [2]

(c) Respiration is part of the carbon cycle. Human activities have an impact on the carbon cycle.

(i) Explain why deforestation impacts the carbon cycle.

.....

.....

.....

..... [2]

(ii) The impact on the carbon cycle is one undesirable effect of deforestation.

State **one other** undesirable effect of deforestation.

..... [1]

[Total: 8]

4 Table 4.1 shows information about three compounds, **A**, **B** and **C**.

Table 4.1

compound	melting point / °C	boiling point / °C	electrical conductivity
A	801	1465	conducts only when molten or in aqueous solution
B	1713	2950	does **not** conduct
C	–210	–196	does **not** conduct

(a) (i) Identify the compound in Table 4.1 that is a solid at 25 °C **and** has only covalent bonding.

Explain your choice.

compound .....

explanation .....

.....

.....

[2]

(ii) Identify the compound in Table 4.1 that is a simple molecular compound.

Explain your choice.

compound .....

explanation .....

.....

.....

[1]

(b) The temperature of compound **A** is increased from 800 °C to 802 °C.

Describe how the arrangement, energy and motion of the particles in compound **A** change with this increase in temperature.

arrangement .....

.....

energy .....

.....

motion .....

.....

[3]

(c) An electric current is passed through an aqueous solution of compound **A**.

A chemical change occurs.

Explain why this is a chemical change.

.....

.....

..... [2]

[Total: 8]

5 Chlorine is in Group VII of the Periodic Table.

(a) Chlorine gas is bubbled through aqueous bromide ions.

A reaction occurs and an orange-brown solution forms.

(i) Name the substance that causes the orange-brown colour.

..... [1]

(ii) Explain why this reaction happens.

.....

..... [1]

(iii) Bonds break in this reaction.

State the type of energy change that occurs when bonds break.

..... [1]

(b) Chlorine reacts with sodium to form sodium chloride.

(i) Complete the dot-and-cross diagram in Fig. 5.1 to show the outer-shell electrons in sodium ions and in chloride ions.

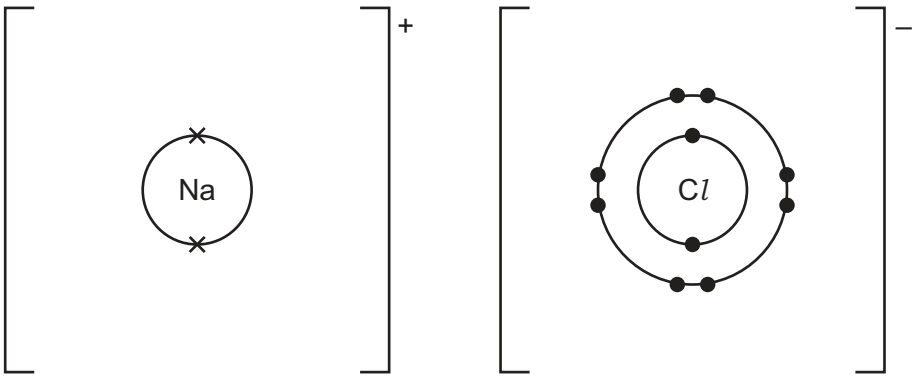

Fig. 5.1

[2]

(ii) Solid sodium chloride has a giant lattice structure of positive sodium ions and negative chloride ions.

Complete Fig. 5.2 to show the arrangement of ions in solid sodium chloride.

Show at least eight ions. Two have been drawn for you.

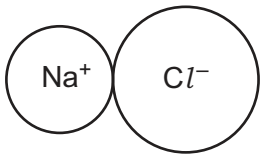

Fig. 5.2

[2]

(c) Aqueous sodium chloride reacts with aqueous lead(II) nitrate to make lead(II) chloride.

Lead(II) chloride is an insoluble salt.

(i) State the type of chemical reaction that forms an insoluble salt from two aqueous solutions.

..... [1]

(ii) Name the other salt that forms in this reaction.

..... [1]

[Total: 9]

6 **(a)** Ethene is an alkene.

The structure of ethene, C_2H_4, is shown in Fig. 6.1.

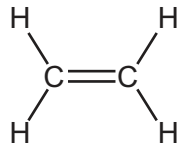

Fig. 6.1

Table 6.1 shows the formula of each product and the reaction conditions when ethene undergoes addition reactions with different molecules.

(i) Complete Table 6.1.

Table 6.1

molecule	formula of product	reaction conditions
$Br_2(aq)$		room temperature
$H_2O(g)$	C_2H_5OH	
	C_2H_6	

[4]

(ii) The symbol (g) is used in Table 6.1.

State the meaning of this symbol.

..... [1]

(b) Table 6.2 shows the formulas and boiling points of some alkenes.

Table 6.2

formula	boiling point / °C
C_3H_6	–47
C_4H_8	–7
C_5H_{10}	30

(i) Deduce the formula of the alkene that contains 7 carbon atoms.

..... [1]

(ii) The alkenes in Table 6.2 are members of the same homologous series.

State **two** ways the information in Table 6.2 supports this statement.

1 .....

.....

2 .....

.....

[2]

(iii) State how the information in Table 6.2 shows that alkenes are hydrocarbons.

.....

..... [1]

[Total: 9]

7 Fig. 7.1 shows a toy car, powered by a battery.

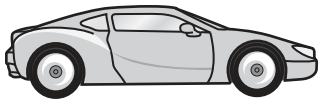

Fig. 7.1

The mass of the car is 0.64 kg.

(a) (i) Complete the sentences about mass and weight.

Mass is a measure of the quantity of ..... in an object.

Weight is the ..... force on an object that has mass.

[2]

(ii) Calculate the weight of the car.

weight = ... N [2]

(b) The car accelerates from rest with a constant acceleration of 0.25 m/s^2 for a time of 5.2 s.

(i) Calculate the resultant force acting on the car.

force = ... N [2]

(ii) Calculate the speed of the car at 5.2 s.

speed = ... m/s [2]

(c) The total power input to the car is 3.00 W.

The useful power output of the car is 0.75 W.

(i) Calculate the efficiency of the car.

efficiency = …….. % [2]

(ii) Explain why the efficiency of the car is **not** 100%.

.....

..... [1]

[Total: 11]

8 Fig. 8.1 shows a pan of water being heated on an electric hotplate.

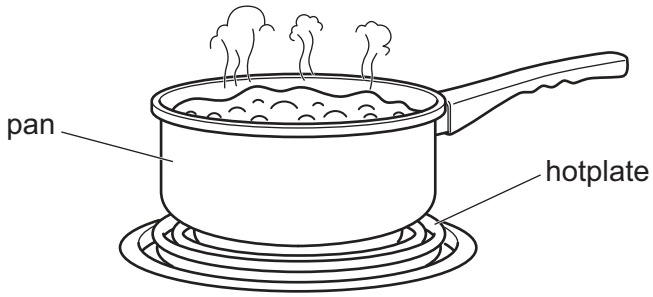

Fig. 8.1

(a) Convection occurs in the water in the pan.

Explain convection in the water in terms of density changes.

.....

.....

.....

..... [2]

(b) Some of the liquid water changes to steam.

(i) State the term that describes the change in state from liquid water to steam.

..... [1]

(ii) Describe how the forces between particles change when liquid water becomes steam.

.....

..... [1]

(c) Fig. 8.2 shows a circuit diagram for the electric hotplate.

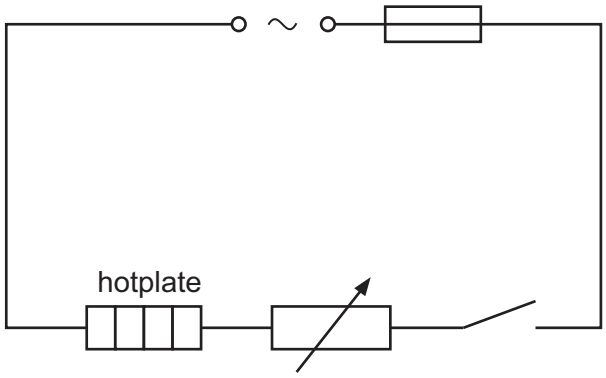

Fig. 8.2

(i) State the type of power supply used in this circuit.

..... [1]

(ii) The supply voltage is 240 V.

The hotplate has a maximum power of 2000 W.

Use a calculation to determine whether a fuse rated at 30 A is appropriate for this circuit.

Explain your answer.

explanation .....

..... [3]

[Total: 8]

9 **(a)** State the approximate age of the Universe.

..... [1]

(b) Describe how a stable star is formed.

.....

.....

.....

.....

..... [3]

(c) A telescope is used to observe a stable star in space.

The telescope can detect electromagnetic waves with wavelengths in the range 300 nm to 3000 nm.

(i) State the speed of electromagnetic waves in a vacuum.

..... [1]

(ii) Fig. 9.1 shows wavelengths for the different regions of the electromagnetic spectrum.

0.001 nm	1.0 nm	400 nm	700 nm	1.0 mm	1.0 m	
gamma radiation	X-rays	ultraviolet	visible light	infrared	microwaves	radio waves

Fig. 9.1

Use Fig. 9.1 to identify **all** the regions of the electromagnetic spectrum that the telescope can detect.

.....

..... [2]

(iii) The speed of sound waves in air is much slower than the speed of electromagnetic waves in air.

State **one** other difference between sound waves and electromagnetic waves.

.....

..... [1]

[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.).