Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/41**

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.

DC (WW/CB) 338054/2

[Turn over

1 **(a)** Fig. 1.1 shows the female human reproductive system.

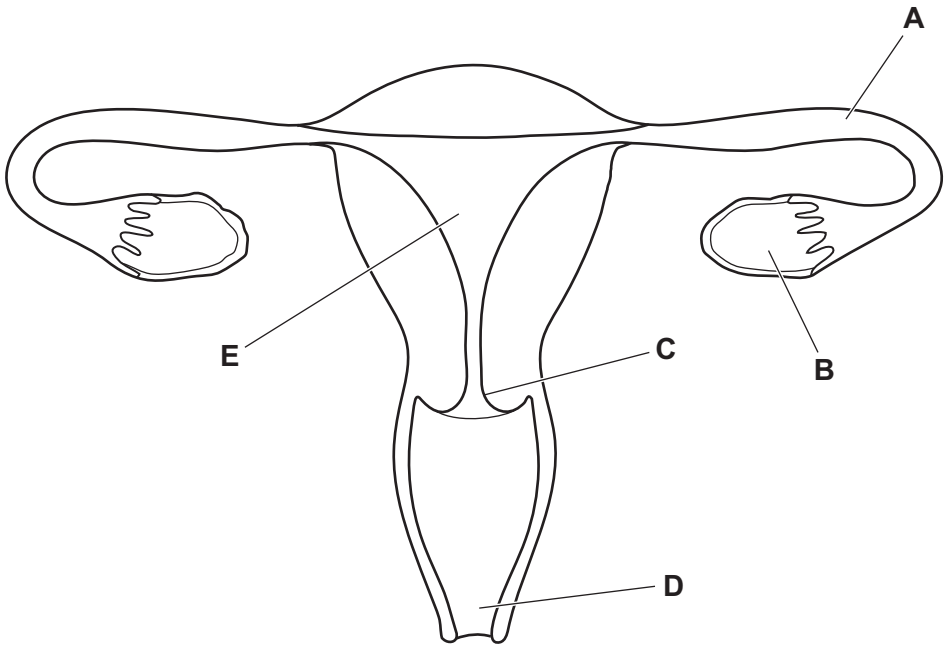

Fig. 1.1

(i) State the letter in Fig. 1.1 that identifies the part of the female reproductive system:

where female gametes are made .....

that receives the penis during sexual intercourse. .....

[2]

(ii) During pregnancy, a placenta forms inside the female reproductive system.

Describe **two** functions of the placenta.

1 .....

2 .....

[2]

(b) In the **male** human reproductive system, the penis releases male gametes.

State **two** adaptive features of male human gametes.

1 .....

2 .....

[2]

(c) Describe **two** differences between fertilisation in humans and fertilisation in plants.

1 .....

.....

2 .....

.....

[2]

(d) Fig. 1.2 shows pollen grains from one plant species.

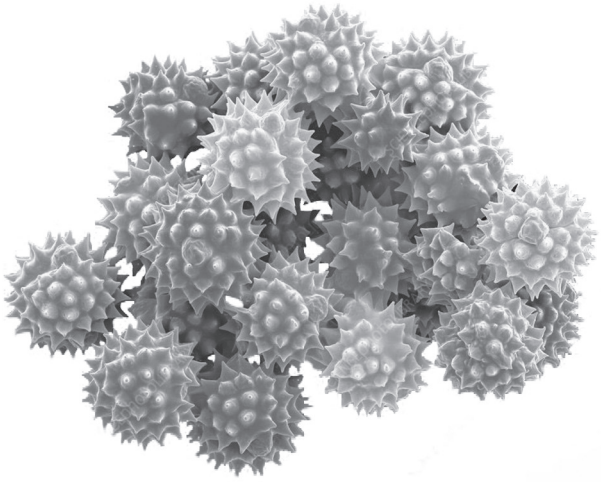

Fig. 1.2

The pollen grains have structural adaptations for pollination by one type of agent.

Identify the type of pollination agent.

Explain your answer using evidence from Fig. 1.2.

pollination agent .....

explanation .....

.....

[2]

[Total:10]

2 The position of an element in the Periodic Table is related to its atomic structure.

(a) (i) Explain the positions of sodium, Na, and potassium, K, in the Periodic Table.

Use ideas about atomic structure in your answer.

.....

.....

.....

..... [2]

(ii) State the nucleon number of sodium.

..... [1]

(b) Table 2.1 shows some information about an atom of lithium, Li, and an ion of copper, Cu^{2+}.

Complete Table 2.1.

Table 2.1

	proton number	nucleon number	number of protons	number of neutrons	number of electrons
Li atom	3	7	.....	.....	.....
Cu^{2+} ion	29	64	.....	.....	.....

[4]

(c) Copper is a transition element.

(i) Transition elements are shiny, hard metals with high melting points and high boiling points.

State **one** other physical property of transition elements.

..... [1]

(ii) State **two** chemical properties of transition elements that are different to the chemical properties of lithium.

1 .....

2 .....

[2]

[Total: 10]

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3 A block of wood has a weight of 24.1 N.

Fig. 3.1 shows the block of wood on a shelf.

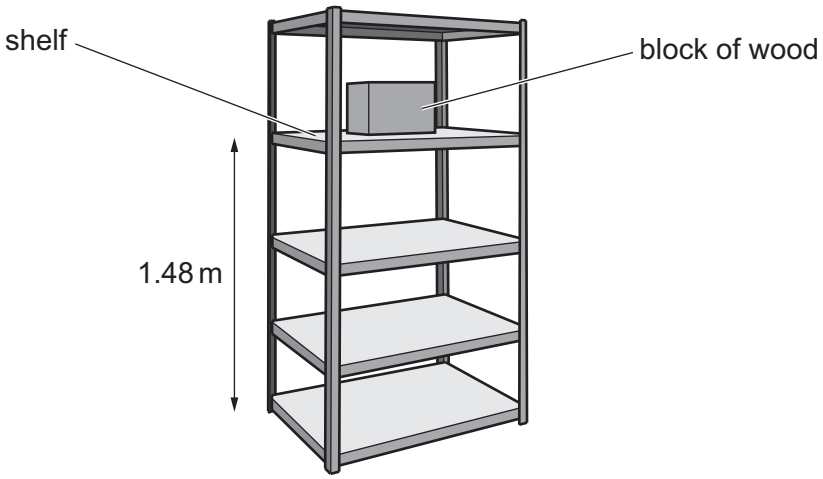


Fig. 3.1

(a) The mass of the block of wood is 2.45 kg.

Calculate the Earth's gravitational field strength.

Show your working.

Give the units of your answer.

gravitational field strength = ... units ..... [3]

(b) The block of wood is at a vertical height of 1.48 m above the ground.

Calculate the gravitational potential energy (GPE) of the block of wood.

GPE = ... J [2]

(c) The block of wood has a length of 0.64 m and a width of 0.25 m, as shown in Fig. 3.2.

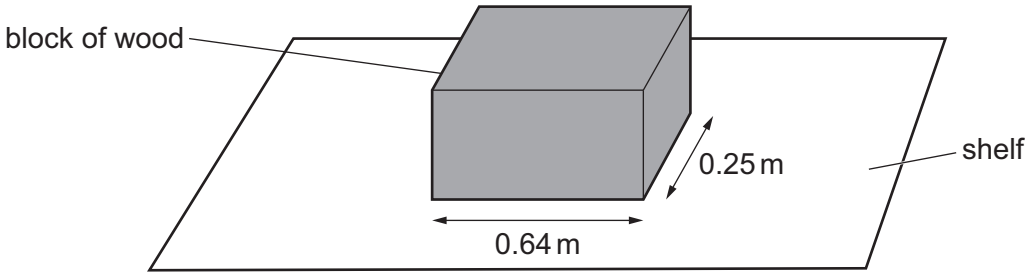


Fig. 3.2

Calculate the pressure exerted by the block of wood on the shelf.

pressure = ... Pa [3]

[Total: 8]

4 **(a)** Fig. 4.1 is a graph showing the effect of humidity on the rate of transpiration in a plant.

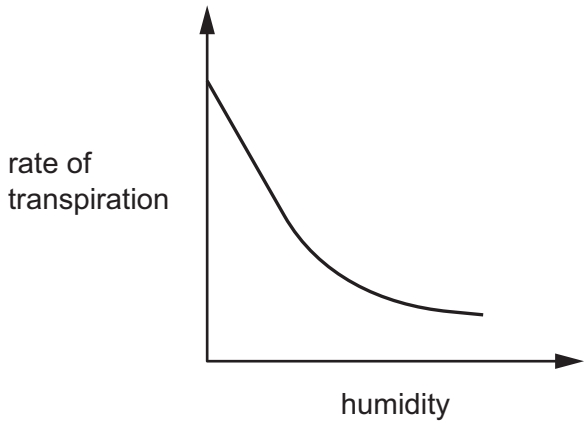


Fig. 4.1

Explain the shape of the graph shown in Fig. 4.1.

.....

.....

.....

.....

..... [3]

(b) Plants require light for photosynthesis.

Complete the balanced symbol equation for photosynthesis.

.....CO_2 + ...H_2O → ..... + ...O_2

[2]

(c) A scientist investigates phototropism in two plant shoots, **A** and **B**.

The scientist covers the tip of shoot **A** with material that allows light to pass through.
The scientist covers the tip of shoot **B** with material that blocks light.

The shoots are left to grow in light coming from one direction only.

Fig. 4.2 shows the results.

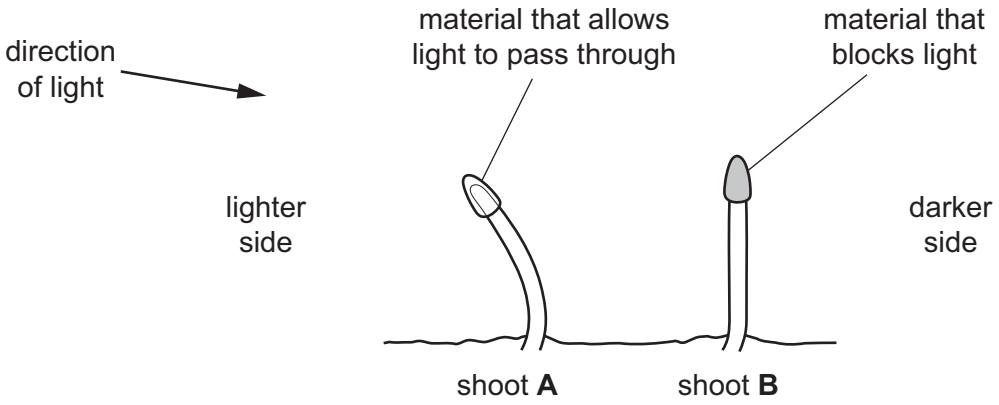


Fig. 4.2

Complete these sentences to explain the results.

More light passes through the material on shoot **A** on the lighter side than on the darker side.

This causes an ..... distribution of auxin in shoot **A**.

Auxin stimulates more growth by cell ..... on the darker side of shoot **A**.

Shoot **B** does not respond to the light because auxin is only made in the

..... of the shoot.

[3]

[Total: 8]

5 Silver chloride, magnesium chloride and sodium chloride are salts.

(a) The equation shows a reaction used to prepare silver chloride, AgCl.

$$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(.....) + NaNO_3(aq)$$

Complete the equation by adding the missing state symbol. [1]

(b) The equation shows a reaction used to prepare magnesium chloride, MgCl_2.

$$MgO(s) + ...HCl(aq) \rightarrow MgCl_2(aq) + ...(l)$$

(i) Complete and balance the equation. [2]

(ii) Suggest the change in the pH of the reaction mixture during this reaction.

Explain your answer.

pH changes from ..... to .....

explanation .....

.....

[2]

(c) Aqueous chlorine reacts with aqueous sodium bromide to form sodium chloride.

(i) State the name of the other product of this reaction.

..... [1]

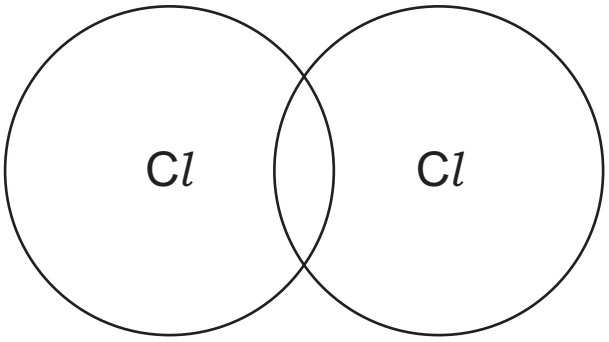
(ii) Explain why aqueous bromine does **not** react with aqueous sodium chloride.

.....

..... [1]

(iii) Chlorine, Cl_2, is a covalently bonded molecule.

Complete the dot-and-cross diagram to show the outer shell electrons in Cl_2.



[2]

[Total: 9]

6 Fig. 6.1 shows a musical instrument called a glockenspiel.

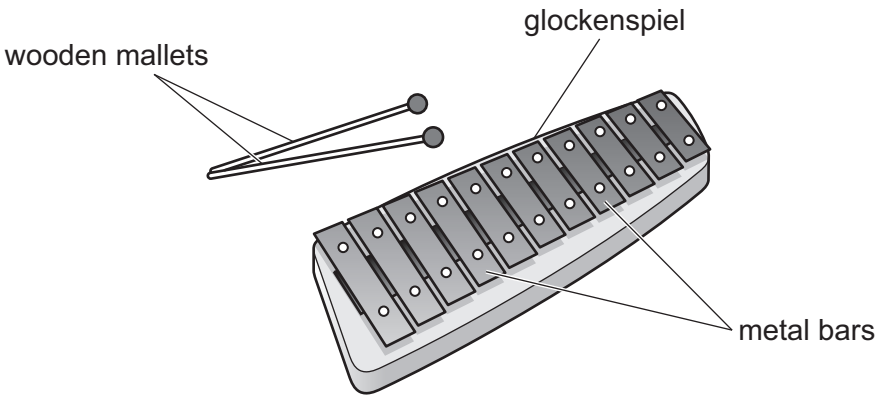


Fig. 6.1

The wooden mallets are used to hit the metal bars of the glockenspiel to produce sounds.

(a) The metal used for the bars of the glockenspiel has a melting point of 660 °C.

State what is meant by melting point.

.....

..... [1]

(b) The sounds produced by the glockenspiel have a frequency range of 784 – 4186 Hz.

(i) The speed of sound in air is 340 m / s.

Calculate the wavelength of the sound with the highest pitch produced by the glockenspiel.

wavelength = ... m [3]

(ii) Describe the longitudinal nature of sound waves.

.....

.....

..... [2]

(c) Fig. 6.2 shows a sound wave moving from air into water.

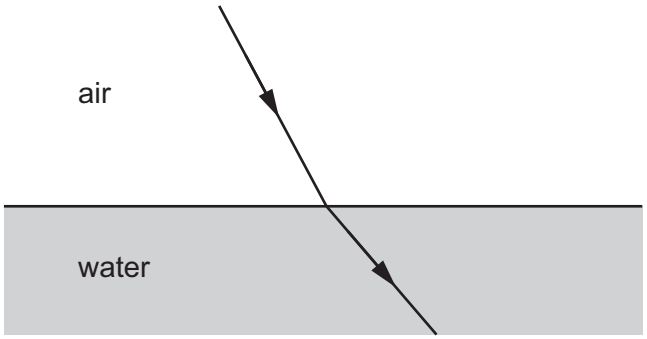


Fig. 6.2

State the name of the effect seen in Fig. 6.2 and explain why it occurs.

name of effect .....

explanation .....

.....

.....

[3]

(d) Complete Table 6.1 to show the properties of solids, liquids and gases.

Place **one** tick (✓) or cross (✗) in each box. Three have been done for you.

Table 6.1

property	solids	liquids	gases
fixed volume		✓	
fixed shape			✗
ability to flow		✓	

[2]

[Total: 11]

7 **(a)** Fig. 7.1 shows a food chain.

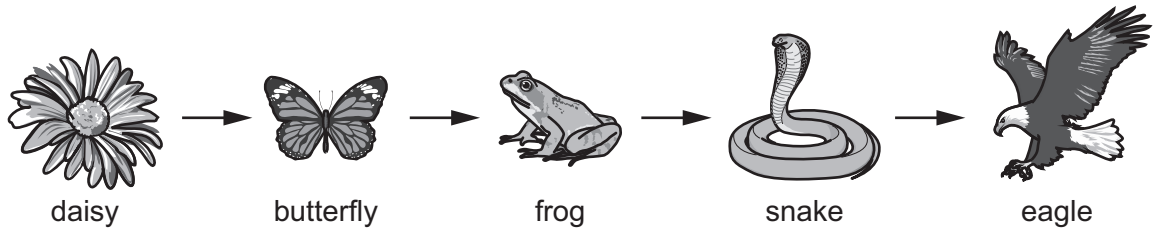


Fig. 7.1

(i) State the name of an organism in Fig. 7.1 that:

is a quaternary consumer .....

occupies trophic level 1. .....

[2]

(ii) State **two** processes that transfer energy out of a food chain.

1 .....

2 .....

[2]

(b) Humans digest food in the alimentary canal using enzymes.

(i) Table 7.1 shows the names of some enzymes and the substrates and products for these enzymes.

Complete Table 7.1.

Table 7.1

enzyme	substrate	product
amylase	.....	simpler sugars
.....	protein	amino acid
lipase	fats	..... and .....

[3]

(ii) State **two** functions of hydrochloric acid in the alimentary canal.

1 .....

2 .....

[2]

[Total: 9]

8 Carbon dioxide is a greenhouse gas.

(a) Complete the sentence about greenhouse gases in the Earth's atmosphere.

Increased concentrations of greenhouse gases cause an .....

greenhouse effect.

[1]

(b) Table 8.1 shows some reactions that make carbon dioxide.

Complete Table 8.1 by stating the formula and name of **one** compound that can be used in each type of reaction.

Choose from the formulae shown.

$CaCO_3$ CaO $Ca(OH)_2$ CH_4 CO_2

You may use each formula once, more than once or not at all.

Table 8.1

reaction that makes carbon dioxide	compound	
	formula	name
complete combustion of a gaseous compound		
reaction of a solid with a dilute acid		
thermal decomposition		

[3]

(c) Carbon dioxide is produced when gasoline (petrol) is burned in vehicle engines.

(i) Gasoline is a fraction of petroleum that contains saturated hydrocarbon molecules.

State **one** other way that the structures of molecules within the gasoline fraction are similar.

.....

..... [1]

(ii) The cracking of larger alkanes makes smaller alkanes and alkenes.

State **two** conditions required for cracking.

1 .....

2 .....

[2]

[Total: 7]

9 Fig. 9.1 shows an electrical circuit that includes three identical lamps and a fixed resistor.

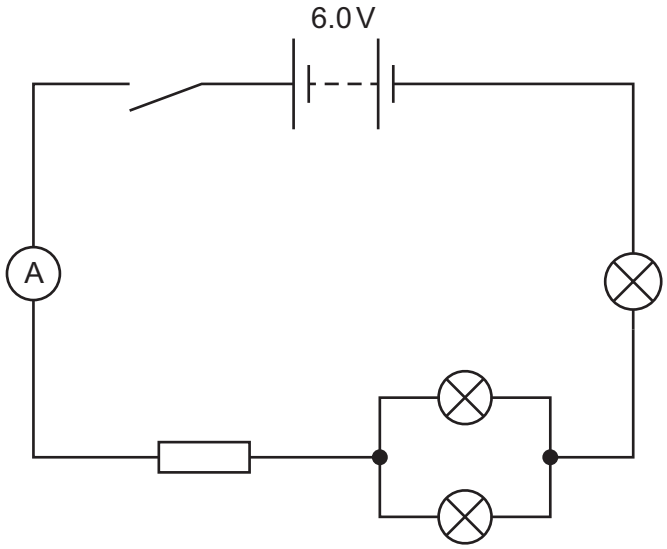


Fig. 9.1

(a) State the name of the component that is the energy source for the circuit.

..... [1]

(b) Draw on Fig. 9.1 to show how a voltmeter is connected to measure the potential difference (p.d.) across the fixed resistor. [2]

(c) The switch is closed.

The reading on the ammeter is 0.25A.

The resistance of the fixed resistor is 15Ω.

(i) Calculate the **total** resistance of the circuit.

total resistance of circuit = ... Ω [2]

(ii) Use your answer to **(c)(i)** to calculate the resistance of **one** lamp.

Show your working.

resistance of one lamp = ... Ω [3]

[Total: 8]

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.).