

Centre Number	Candidate Number	Name
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

COMBINED SCIENCE **0653/03**

Paper 3 May/June 2004

1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
The number of marks is given in brackets [] at the end of each question or part question.
A copy of the Periodic Table is printed on page 20.

For Examiner's Use	
1	
2	
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Total	

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

- 1 Gasoline is a liquid hydrocarbon fuel. Fig. 1.1 shows a gasoline fire.

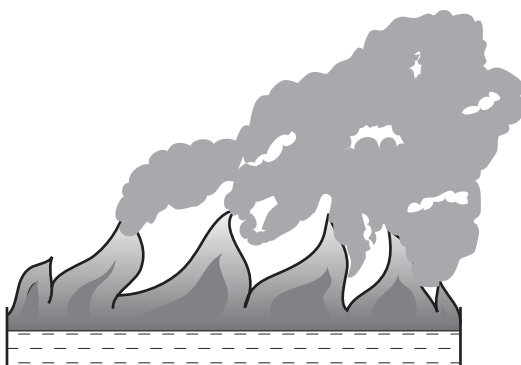


Fig. 1.1

- (a) (i) State the meaning of the term *hydrocarbon*.

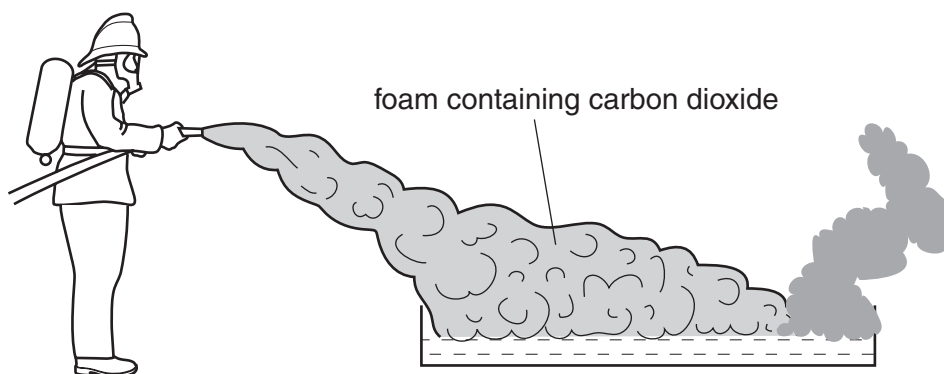
.....
[2]

- (ii) In a plentiful supply of air many hydrocarbons burn with an almost invisible flame.
 Suggest why the fire in Fig. 1.1 produced clouds of black smoke.

.....

[2]

- (iii) A fire-fighter sprays foam containing carbon dioxide over the fire in order to put it out.



Explain why the fire goes out.

.....

[2]

- (b) The balanced equation in Fig. 1.2 shows the complete combustion of ethene. The substances involved are shown as displayed (graphical) formulae.

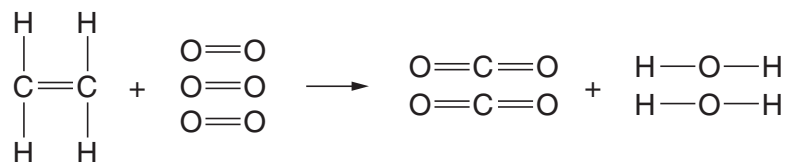


Fig. 1.2

- (i) Rewrite the equation as a normal balanced equation using molecular formulae.

.....[2]

- (ii) Explain why this equation is said to be *balanced*.

.....

.....[1]

- (iii) On Fig. 1.2 indicate with the letter **B** and a labelling line **one** of the chemical bonds which is broken in the reaction. [1]

- (iv) On Fig. 1.2 indicate with the letter **M** and a labelling line **one** of the chemical bonds which is formed in the reaction. [1]

- 2 A student measured the pH of the water in two lakes, lake **X** and lake **Y**. The water in lake **X** had a pH of 5.4, while the water in lake **Y** had a pH of 6.8.

The student made a survey of the animals living in each lake. He took the same number and size of water samples from each lake, and identified every species of animal which he found. He then counted how many individual animals he found that belonged to each species.

Table 2.1 summarises his results.

Table 2.1

species	number of individuals in lake X	number of individuals in lake Y
A	58	12
B	0	6
C	93	15
D	0	2
E	6	22
F	1	0
G	0	3
H	0	1
I	61	6
J	0	2

- (a) Which lake had the higher species diversity? Explain your answer.

.....
[1]

(b) Both lakes were in areas where acid rain of pH3 regularly fell. However, lake **Y** was in an area where the rocks were mostly limestone.

(i) What evidence did the student find which suggests that the acid rain had less effect on the water in lake **Y** than in lake **X**?

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

(ii) Suggest why the acid rain had less effect on the water in lake **Y** than in lake **X**.

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

(c) Explain why removing sulphur from fossil fuels can help to reduce the problems caused by acid rain.

.....
.....
.....[2]

(d) Soil erosion is another problem which can harm communities of organisms living in lakes. Soil washed off the land into a lake can form a suspension in the water, preventing light from passing through.

Explain how this would disrupt the food web in the lake.

.....
.....
.....
.....[3]

3 Fig. 3.1 shows a weightlifter.

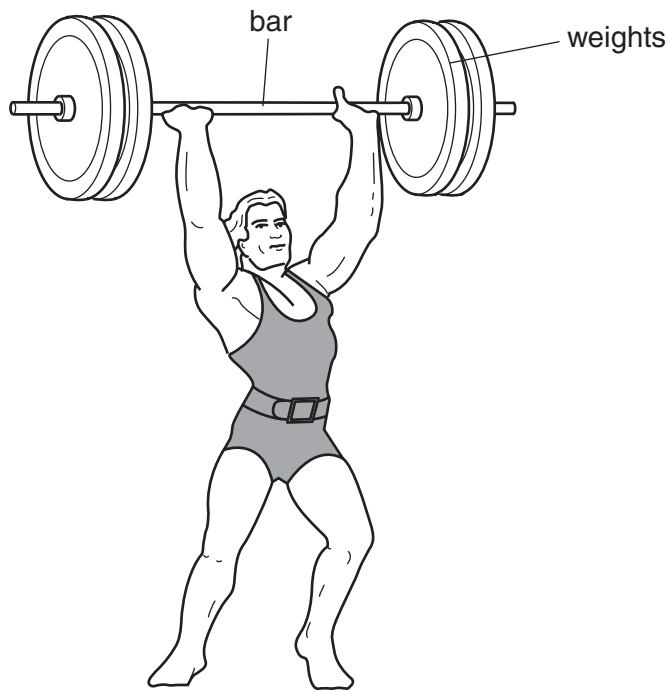


Fig. 3.1

- (a) The total weight lifted by the weightlifter is 1600 newtons, which he lifts through 2 metres in 0.5 seconds.
- (i) Calculate the work done on the bar and weights.
Show your working and state the formula that you use.

formula

working

.....[2]

- (ii) Calculate the power developed by the weightlifter while lifting the bar and weights. Show your working and state the formula that you use.

formula

working

.....[2]

- (b) (i) What form of energy has been gained by the bar and weights as a result of lifting them?

.....[1]

- (ii) The weightlifter suddenly drops the bar and weights, and the energy gained in (i) is now transferred to another form. Name this form of energy.

.....[1]

4 The element chlorine is an important substance used in the manufacture of many products, including bleaches and sterilising agents.

(a) Explain why experiments involving chlorine must always be carried out in a fume cupboard.

.....
[1]

(b) Two bleaches, STAINAWAY and SUPERWHITE contain chlorine that is easily released from solution. They are tested in a laboratory to find out which contains the greater amount of chlorine.

A chemist carries out the test shown in Fig. 4.1. She adds 1.0 cm^3 of bleach to 10.0 cm^3 of excess sodium iodide solution.

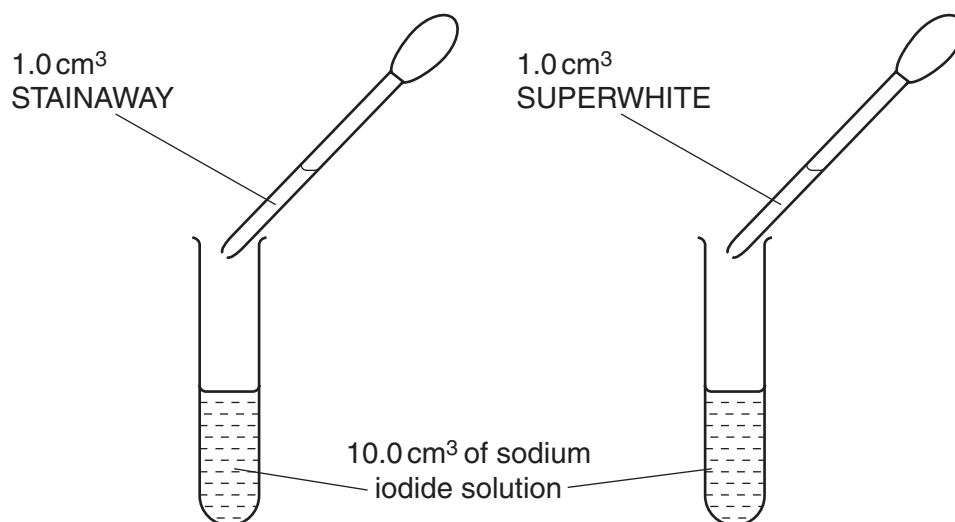


Fig. 4.1

The observations made by the chemist are shown in Table 4.1.

In both tests, the mixture changes colour from colourless to brown because iodine is formed.

Table 4.1

bleach	colour of mixture
STAINAWAY	dark brown
SUPERWHITE	light brown

(i) Explain briefly why iodine is formed in these reactions.

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

(ii) Explain how the observations allow the chemist to decide which bleach contains the greater amount of chlorine.

.....
.....
.....
.....[2]

(c) (i) Draw a diagram of a chlorine molecule, showing how all of the outer shell electrons are arranged.

[2]

(ii) Name the type of chemical bond you have drawn in (i).

.....[1]

- 5 A farmer grows fruit that he sells to a supermarket. The supermarket wants the fruit to contain high concentrations of vitamin C.

The supermarket buyer has a simple test kit which she uses to test the vitamin C content of the fruit. She tells the farmer that fruit from trees with the genotype **AA** or **Aa** is high in vitamin C. Fruit from trees with the genotype **aa** is low in vitamin C.

The farmer decides to breed from some of his trees, to produce a large number of trees which all produce fruit high in vitamin C.

- (a) (i) State the genotype of the trees which the farmer should use for breeding, in order to be sure that all of the offspring have fruit which is high in vitamin C.

.....[1]

- (ii) Using genetic diagrams, explain how he can carry out a test cross to find out whether the genotype of a tree is **AA** or **Aa**.

[4]

(b) The buyer from the supermarket suggests that it would be better if the farmer propagated the trees asexually, rather than sexually.

Is she correct? Explain your answer.

.....
.....
.....
.....[2]

(c) Explain why it is good for people to eat fruit that is high in vitamin C.

.....
.....
.....[2]

- 6 (a) There are three states of matter – solid, liquid and gas.

Fig. 6.1 shows the arrangement of particles in a liquid.

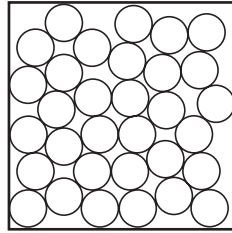
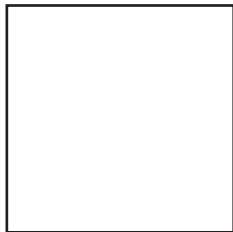
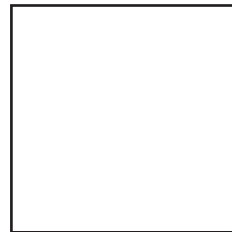


Fig. 6.1

Draw similar diagrams for a solid and a gas.



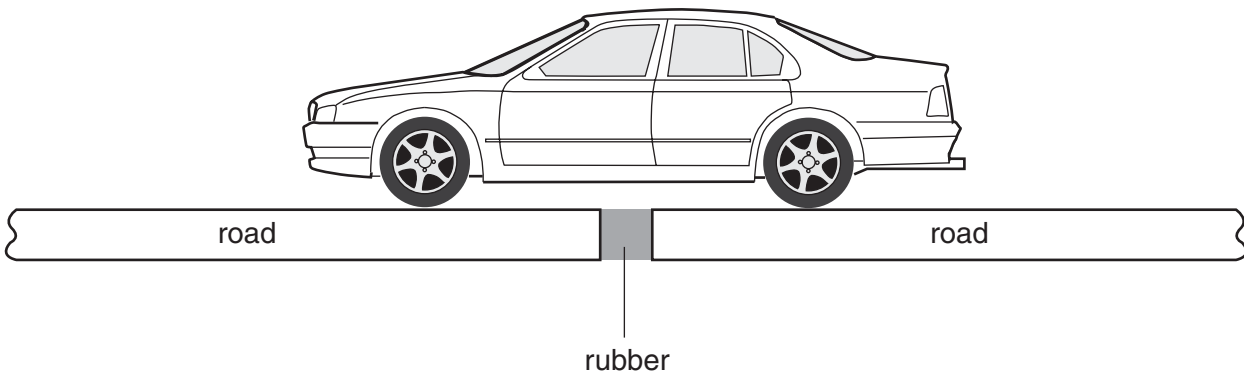
solid



gas

[2]

- (b) A long bridge is made in sections, with gaps between each section. The gaps are filled with rubber.



- (i) Suggest why these gaps are left.

.....

.....

..... [2]

- (ii) The gaps are left every 50 m. A car travels over the bridge at 20 m/s. Calculate how long the car will take to travel from one gap to the next.

Show your working and state the formula that you use.

formula

working

.....[2]

- (c) Answer the following in terms of *conduction*, *convection* and *radiation*.

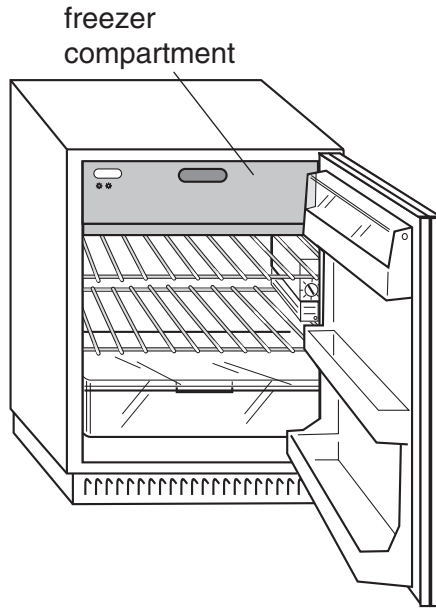
- (i) Cooking pans often have handles made of plastic or wood. Why do these help to prevent you burning your hand when using the pan?

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

- (ii) On a sunny day your body gets hotter when wearing a black shirt than when wearing a white shirt. Explain why this happens.

.....
.....
.....
.....[2]

- (iii) In a refrigerator, the freezer compartment is usually placed at the top. Why does this help the working of the refrigerator?



.....
.....[2]

- (ii) During the reaction oxygen atoms are reduced to oxide ions.
In the boxes below draw an oxygen atom and an oxide ion, showing all of the electrons in each particle.

oxygen atom	oxide ion

[2]

- (iii) State the electrical charge of the oxide ion you have drawn in (ii).

.....[1]

- (iv) State, in terms of electrons, why the change of an oxygen atom into an oxide ion is called *reduction*.

.....

.....[1]

8 (a) Fig. 8.1 shows some red blood cells in a concentrated glucose (sugar) solution.

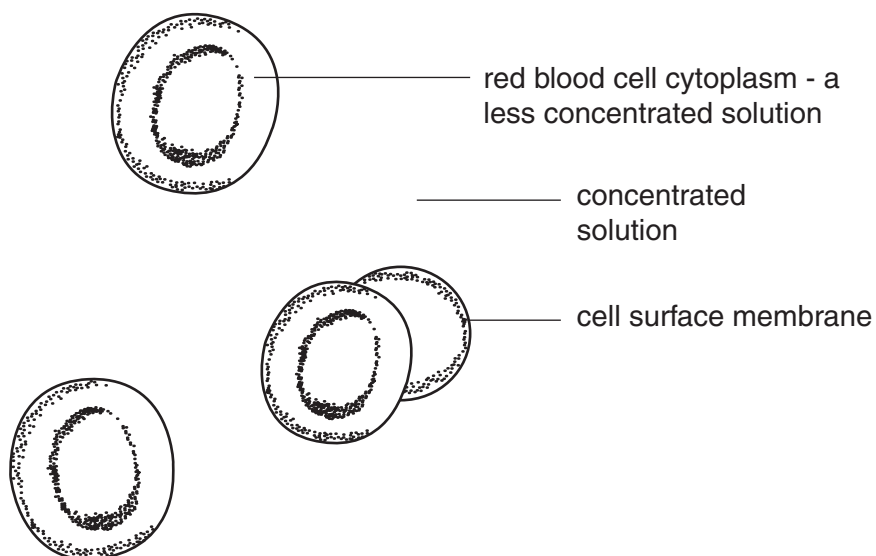


Fig. 8.1

Using your knowledge of osmosis, explain what will happen to the red blood cells.

.....
.....
.....[2]

(b) In the body, red blood cells are surrounded by blood plasma. The glucose concentration in the plasma is kept constant.

(i) Explain how the blood glucose concentration is brought down to normal if it rises too high.

.....
.....
.....[3]

(ii) State the term which is used to describe the maintenance of constant internal conditions in the body.

.....[1]

- (c) Blood glucose concentration usually rises a few hours after we eat food containing starch.

Explain how this happens.

.....

.....

.....

.....[3]

- 9 (a) Fig. 9.1 shows a circuit containing three identical resistors.

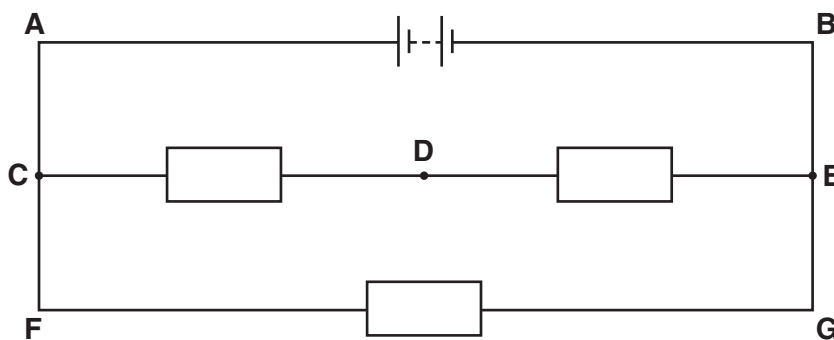


Fig. 9.1

A voltmeter connected across **AB** reads 6 V.
State the voltmeter reading when connected across

CD

FG

[2]

- (b) Draw a circuit diagram, using correct symbols, for a circuit with a cell, a switch, a lamp, a motor and a variable resistor that controls the speed of the motor but does not affect the brightness of the lamp.

[3]

- (c) A student is given 3 resistors $2\ \Omega$, $2\ \Omega$ and $4\ \Omega$.

Explain how he could connect 2 or 3 of these resistors to produce a combined resistance of

(i) $6\ \Omega$,

[2]

(ii) $1\ \Omega$

[2]

DATA SHEET
The Periodic Table of the Elements

Group		I	II	III	IV	V	VI	VII	0						
7	9	1								4					
Li Lithium 3	Be Beryllium 4	H Hydrogen 1								He Helium 2					
23	24								19	20					
Na Sodium 11	Mg Magnesium 12								F Fluorine 9	Ne Neon 10					
39	40								32	35.5					
K Potassium 19	Ca Calcium 20								S Sulphur 16	Cl Chlorine 17					
85	88								79	80					
Rb Rubidium 37	Sr Strontium 38								Se Selenium 34	Br Bromine 35					
133	137								128	127					
Cs Caesium 55	Ba Barium 56								Te Tellurium 52	I Iodine 53					
226	227								207	209					
Fr Francium 87	Ra Radium 88								Pb Lead 82	Bi Bismuth 83					
		65	64	59	59	56	55	52	51	48	45	40	39	37	
		Zn Zinc 30	Cu Copper 29	Ni Nickel 28	Co Cobalt 27	Fe Iron 26	Mn Manganese 25	Cr Chromium 24	V Vanadium 23	Ti Titanium 22	Sc Scandium 21	Ca Calcium 20	K Potassium 19	Rb Rubidium 37	
		112	108	106	103	101	100	96	93	91	89	84	84	84	
		Cd Cadmium 48	Ag Silver 47	Pd Palladium 46	Rh Rhodium 45	Ru Ruthenium 44	Tc Technetium 43	Mo Molybdenum 42	Nb Niobium 41	Zr Zirconium 40	Y Yttrium 39	Kr Krypton 36	Kr Krypton 36	Kr Krypton 36	
		201	197	195	192	190	186	184	181	178	139	84	84	84	
		Hg Mercury 80	Au Gold 79	Pt Platinum 78	Ir Iridium 77	Os Osmium 76	Re Rhenium 75	W Tungsten 74	Ta Tantalum 73	Hf Hafnium 72	La Lanthanum 57	Xe Xenon 54	Xe Xenon 54	Xe Xenon 54	
		204	207	209	209	204	207	207	204	204	209	86	86	86	
		Tl Thallium 81	Pb Lead 82	Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86	Rn Radon 86	Rn Radon 86	Rn Radon 86	Rn Radon 86	Rn Radon 86	Rn Radon 86	Rn Radon 86	Rn Radon 86
		162	165	167	169	173	175	175	175	175	175	175	175	175	
		Dy Dysprosium 66	Ho Holmium 67	Er Erbium 68	Tm Thulium 69	Yb Ytterbium 70	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71
		159	157	152	150	144	141	140	232	238	238	232	232	232	
		Tb Terbium 65	Gd Gadolinium 64	Eu Europium 63	Sm Samarium 62	Pm Promethium 61	Nd Neodymium 60	Pr Praseodymium 59	Ce Cerium 58	Th Thorium 90	U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96
		159	157	152	150	144	141	140	232	238	238	232	232	232	232
		Bk Berkelium 97	Cm Curium 96	Am Americium 95	Pu Plutonium 94	Np Neptunium 93	U Uranium 92	Pa Protactinium 91	Th Thorium 90	Th Thorium 90	U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96
		167	165	167	169	173	175	175	175	175	175	175	175	175	175
		Er Erbium 68	Ho Holmium 67	Er Erbium 68	Tm Thulium 69	Yb Ytterbium 70	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71	Lu Lutetium 71
		100	99	100	101	102	103	103	103	103	103	103	103	103	103
		Fm Fermium 100	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103	Lr Lawrencium 103	Lr Lawrencium 103	Lr Lawrencium 103	Lr Lawrencium 103	Lr Lawrencium 103	Lr Lawrencium 103	Lr Lawrencium 103	Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

a	X
b	†

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).