Centre Number	Candidate Number	Name

CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CHEMISTRY **0620/02**

Paper 2

October/November 2003

1 hour

Candidates answer on the Question Paper.
No Additional Materials required

READ THESE INSTRUCTIONS FIRST

Write your name, centre number and candidate number in the spaces at the top of this page.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams, graphs, 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 provided on page 20.

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.

For Examiner's Use	
1	
2	
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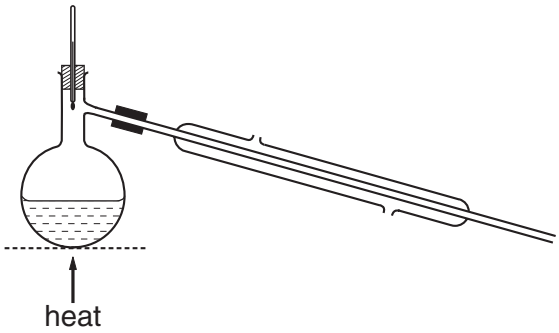
TOTAL	

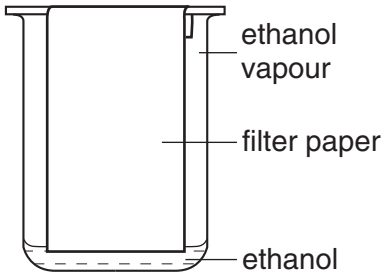
This document consists of **17** printed pages and **3** blank pages.

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate
[Turn over

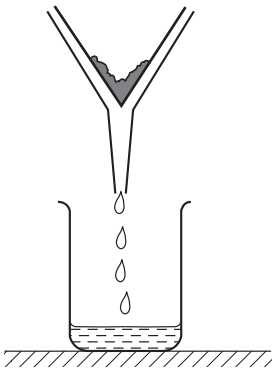
1 The diagrams show four methods of purifying substances.



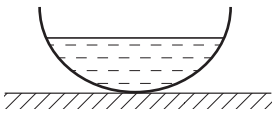
A



B



C



D

(a) Which of these methods, **A**,**B**,**C** or **D**, is best used for

(i) separating the different colours in a sample of ink? ☐

(ii) separating two liquids with different boiling points? ☐

(iii) separating mud from water? ☐

(iv) making crystals of copper sulphate from copper sulphate solution? ☐

[4]

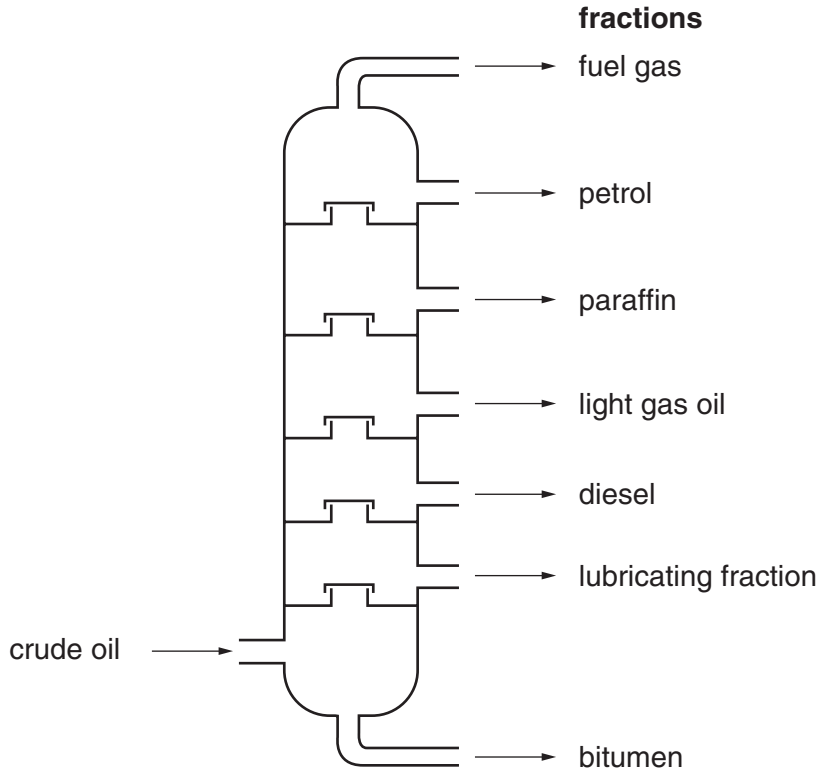
(b) State the name given to the method of separation shown in

(i) diagram **A**, ...

(ii) diagram **B**. .....

[2]

(c) Method A can be modified to separate petroleum into useful fractions.
The diagram below shows the different fractions obtained from a fractionating column.



(i) Which of these fractions has the lowest boiling point?

.....

(ii) State **one** use for each of the following fractions.

paraffin .....

bitumen .....

[3]

(d) Petroleum is a mixture of organic compounds.
Which **one** of the following best describes the compounds found in petroleum?
Put a ring around the correct answer.

acids **alcohols** **carbohydrates** **hydrocarbons**

[1]

[Turn over

(e) Before petroleum is fractionated, it is often heated to remove dissolved natural gas. Most of this natural gas is methane, CH_4.
Draw a diagram to show how the electrons are arranged in methane.

show hydrogen electrons as •
show carbon electrons as ×

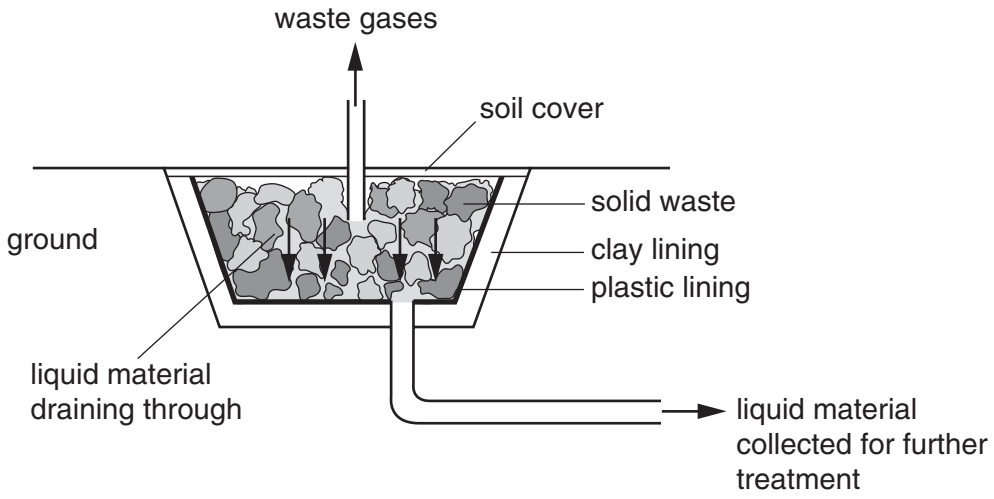
[2]

(f) Methane, ethane and propane belong to a particular homologous series of compounds. State the name of the homologous series to which these three compounds belong.

.....

[1]

2 The diagram below shows a modern landfill site for the disposal of waste materials.



The waste materials are broken down naturally in several stages.

(a) In the first stage, micro-organisms (mainly bacteria) break down some of the organic material in the waste to carbon dioxide.
What is the name given to the process by which organisms use food to produce carbon dioxide?

.....[1]

(b) In the second stage, the micro-organisms break down organic substances to produce ammonia, hydrogen and more carbon dioxide.

(i) Describe a test for hydrogen.

test .....

result .....

(ii) The large volumes of hydrogen produced may be hazardous.
Explain why hydrogen may be hazardous when mixed with air.

.....

(iii) Ammonia is a base.
Describe a test for ammonia.

test .....

result .....
[5]

(c) In the third stage, ethanoic acid is produced.
Draw the structure of ethanoic acid showing all atoms and bonds.

[1]

(d) In the fourth stage, carbon dioxide reacts with hydrogen to form methane and oxygen.

(i) Complete the equation for this reaction.

$$CO_2 + \ldots\ldots\ldots \rightarrow CH_4 + O_2$$

(ii) State one use of methane.

.....

(iii) Methane is a gas.
Which **two** of the following statements about gas molecules are true?
Tick **two** boxes.

The molecules are far apart. ☐

The molecules are not moving. ☐

The molecules are randomly arranged. ☐

The molecules are arranged in a regular manner. ☐

[4]

(e) The list below shows some of the substances which are found in the liquid which drains through the waste.

aluminium
calcium carbonate
iron
lead
magnesium
nickel
sodium sulphate
zinc

From this list choose

(i) a metal used to galvanise iron. .....

(ii) a transition metal. .....

(iii) a metal which is in Group IV of the periodic table. .....

(iv) a substance which will release carbon dioxide when an acid is added.

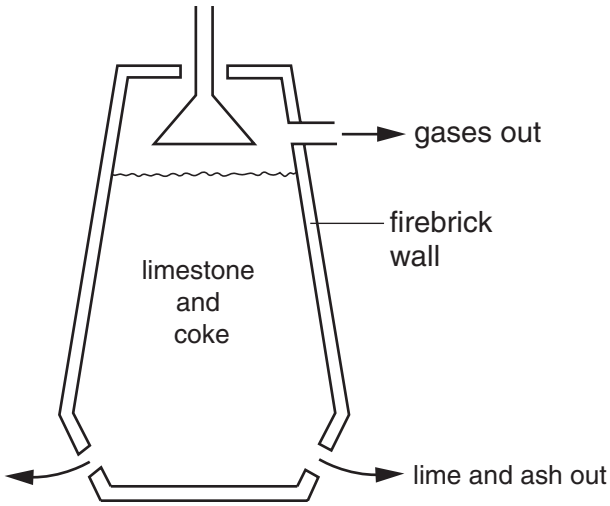
.....

(v) a metal which is used to make aircraft bodies. .....

[5]

[Turn over

3 One way of making lime from limestone (calcium carbonate) is shown in the diagram.



The limestone is mixed with coke and dropped into the limekiln. The coke is burnt and releases heat.

(a) State **one** use of limestone, other than in making lime.

.....[1]

(b) Coke is mainly carbon.
Write a symbol equation for the burning of carbon.

[2]

(c) State the name of the type of reaction which releases heat energy.

.....[1]

(d) The heat produced by the burning coke causes thermal decomposition of the limestone.
Complete the word equation for the thermal decomposition of calcium carbonate.

calcium carbonate → ....
+
....
[2]

(e) **(i)** Complete the following equation for the reaction of calcium carbonate with hydrochloric acid.

$$CaCO_3 + \ldots HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

(ii) Describe how you would test for the gas given off in this reaction.

test .....

result .....

[3]

(f) Quicklime, CaO, is a product of the thermal decomposition of calcium carbonate.

When quicklime is heated strongly with coke, calcium carbide is formed.

$$CaO + 3C \rightarrow CaC_2 + CO$$

(i) What type of reaction is the conversion of C to CO?
Explain your answer.

.....

.....

(ii) When water is added to calcium carbide, CaC_2, acetylene is formed.
State a use of acetylene.

.....

[3]

4 Bromine is an element in Group VII of the Periodic Table.

(a) State the name given to the Group VII elements.

.....[1]

(b) Bromine has two isotopes.
The nucleon (mass) number of bromine-79 is 79 and of bromine-81 is 81.

(i) What is the meaning of the term *isotopes*?

.....

.....

(ii) Complete the table to show the numbers of electrons, neutrons and protons in one atom of bromine-79 and bromine-81. A copy of the Periodic Table is printed on page 20.

number of	bromine-79	bromine-81
electrons		
neutrons		
protons		

[5]

(c) Bromine is extracted from seawater by treatment with chlorine.
When chlorine is bubbled through a solution of potassium bromide, the solution turns orange-red.

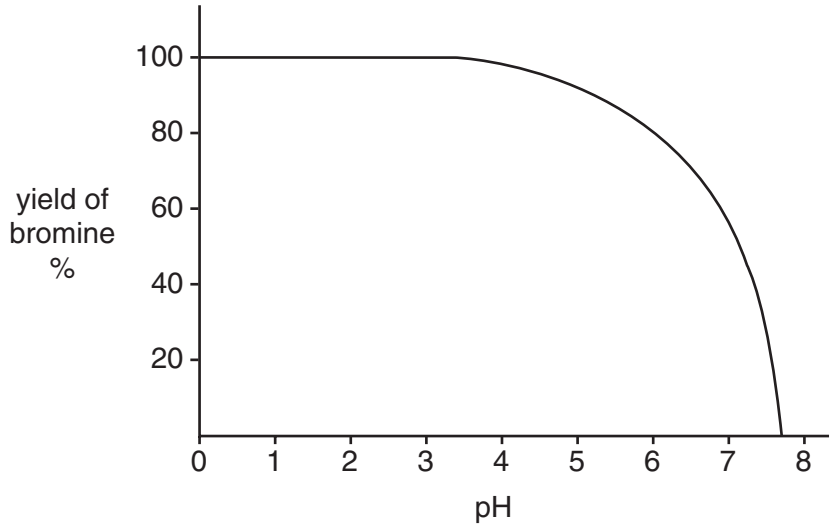
(i) What does this tell you about the reactivity of chlorine compared with bromine?

.....

(ii) Write a word equation for this reaction.

[2]

(d) In order to get the maximum yield of bromine from seawater, acid is added during the extraction procedure.
The graph shows how the yield of bromine changes with pH.



(i) What is the highest pH at which the yield of bromine is 100%?

.....

(ii) The pH scale is used to measure acidity.
Some pH values are given below.

pH 3 pH 5 pH 7 pH 9 pH 11

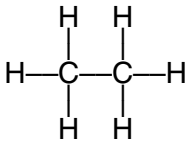
From this list of pH values choose

the pH which is most acidic. .....

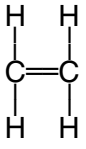
the pH of a neutral solution. .....

[3]

(e) Bromine water can be used to distinguish between ethane and ethene.



ethane



ethene

Describe what you would observe when bromine water is added to ethene.

.....

[1]

5 When fuels are burnt, carbon dioxide and water are formed.

(a) Complete the equation for the burning of propane.

$$C_3H_8 + \ldots O_2 \rightarrow 3CO_2 + 4H_2O$$

[1]

(b) Describe a chemical test for water.

test .....

result .....

[2]

(c) In which **two** of the following is carbon dioxide produced.
Tick **two** boxes.

a car driven by a petrol engine ☐

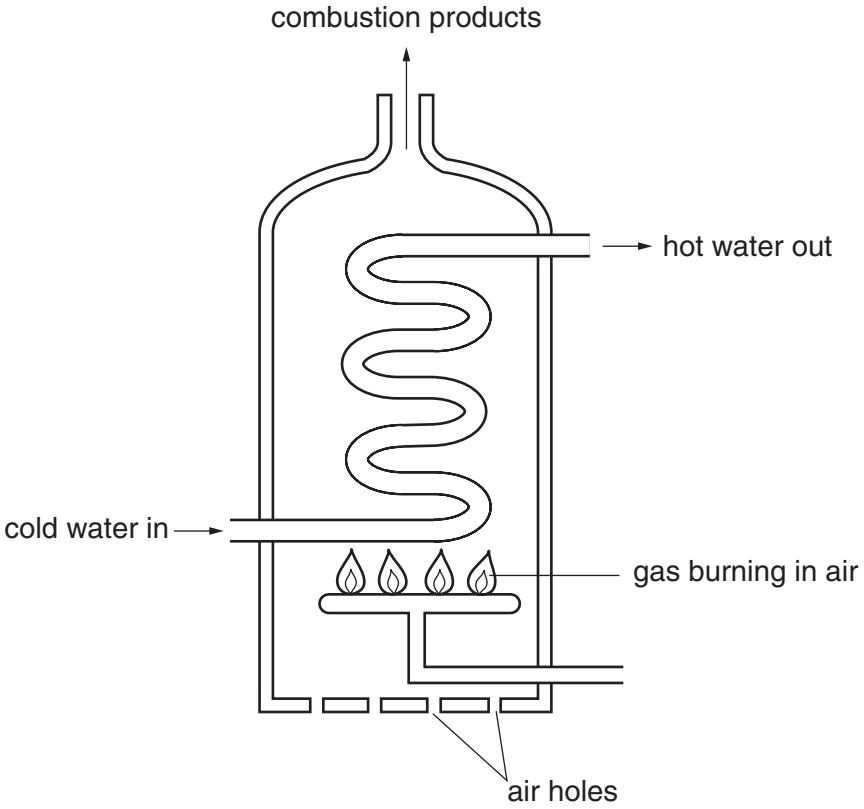
magnesium carbonate reacting with an acid ☐

sodium reacting with water ☐

zinc reacting with hydrochloric acid ☐

[2]

(d) The diagram shows a water heater.



If some of the air holes become blocked, a poisonous gas is produced.

(i) State the name of this poisonous gas.

.....

(ii) Explain how this poisonous gas has been formed.

.....

.....

[2]

(e) The table below compares the amounts of carbon dioxide and sulphur dioxide formed when 1 kilogram of different fuels are burnt.

fuel	mass of carbon dioxide produced / g	mass of sulphur dioxide produced / g
oil	2900	5.0
gas	2500	0.1
coal	2500	11.0

(i) Which fuel is **least** polluting?

.....

(ii) Which fuel when burnt, contributes most to the formation of acid rain?

.....

(iii) State two harmful effects of acid rain.

.....

.....

(iv) When acid rain falls on the ground, it can react with insoluble aluminium compounds in the soil. A solution of aluminium ions is formed.

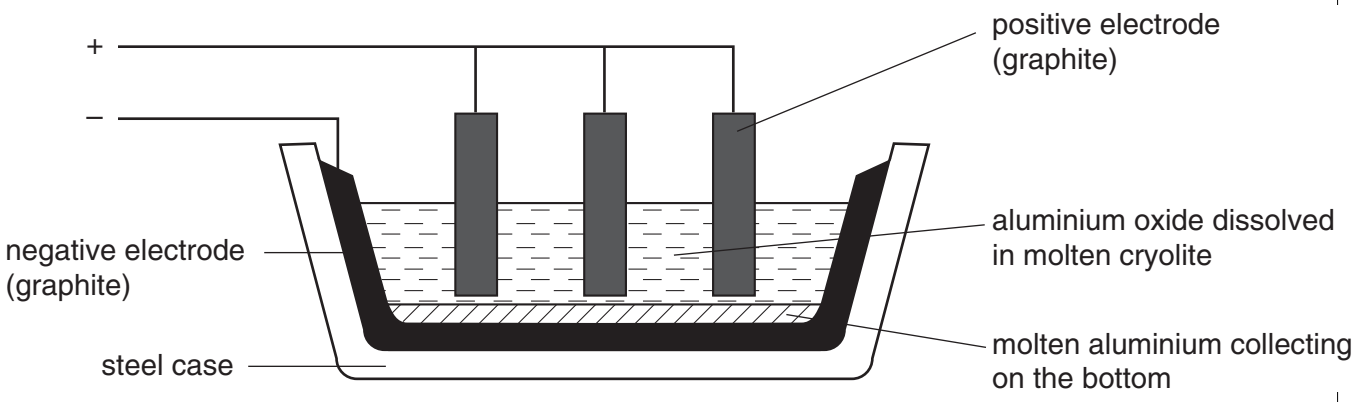
Describe what you would observe when aqueous sodium hydroxide is added to a solution containing aluminium ions.

.....

.....

[6]

6 Aluminium is extracted from its ore, bauxite.
The bauxite is purified to give aluminium oxide.
Electrolysis is then used to extract the aluminium from aluminium oxide dissolved in cryolite.



The melting point of pure aluminium oxide is 2070 °C.
The melting point of the mixture of aluminium oxide and cryolite is about 1000 °C.

(a) Suggest why electrolysis is used to extract aluminium from aluminium oxide rather than reduction using carbon.

.....

.....[1]

(b) How is the electrolyte of aluminium oxide and cryolite kept molten?

.....[1]

(c) What property of graphite makes it suitable for use as electrodes?

.....[1]

(d) State the name given to the negative electrode.

.....[1]

(e) The melting point of steel is about 1500 °C.
Suggest **two** reasons why molten aluminium oxide is not used by itself in this electrolysis.

.....

.....[2]

(f) During the electrolysis, hot oxygen is formed at the positive electrodes.
Suggest why the positive electrodes have to be replaced frequently.

.....

.....[2]

[Turn over

(g) Aluminium is formed at the negative electrode.
Complete the following equation for the reaction at the negative electrode.

$$Al^{3+} + \ldots\ldots \rightarrow Al$$

[1]

(h) Why do aluminium ions move towards the negative electrode?

.....[1]

(i) A sample of bauxite ore had the following composition:

aluminium oxide	120g
iron(III) oxide	30g
silica	40g
titanium(IV) oxide	10g

Calculate the percentage of aluminium oxide in this sample of bauxite.

[1]

(j) Aluminium is a metal in Group III of the Periodic Table.
State three physical properties which are typical of most metals.

1 .....

2 .....

3 .....

[3]

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	0
							1 H Hydrogen 1									4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

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

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).