

Centre Number	Candidate Number	Name
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CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CHEMISTRY

5070/02

Paper 2

October/November 2003

1 hour 30 minutes

Candidates answer on the Question Paper.
Answer paper.

READ THESE INSTRUCTIONS FIRST

Write your name, Centre number and candidate number in the spaces provided at the top of this page and on any separate answer paper used.

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.

Section A

Answer **all** questions.

A copy of the Periodic Table is printed on page 16.

Section B

Answer any **three** questions.

Write your answers on the line pages provided and/or on separate answer paper.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

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.

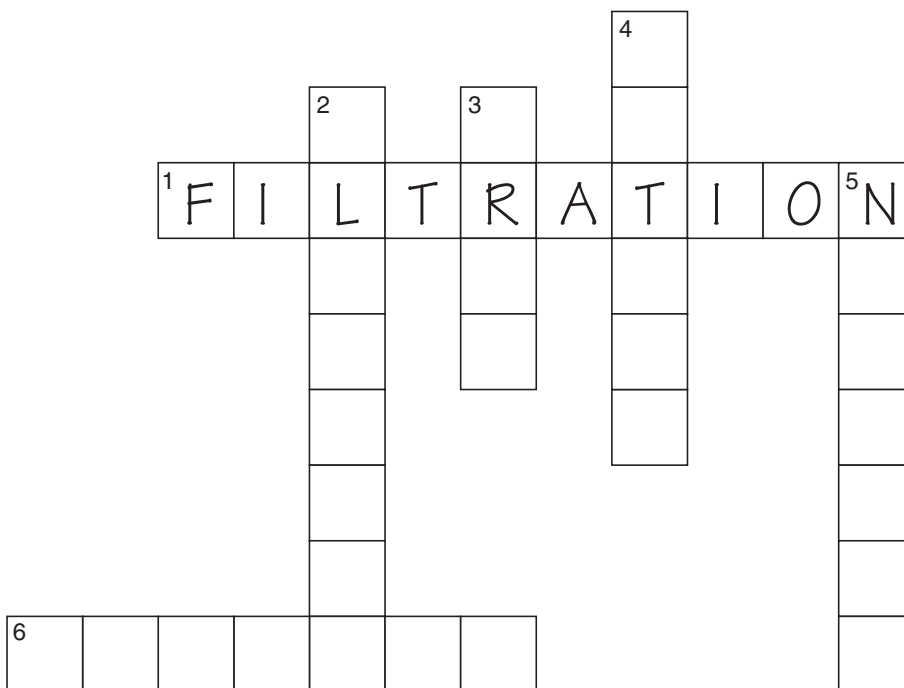
Stick your personal label here, if provided.

For Examiner's Use	
Section A	
B8	
B9	
B10	
B11	
TOTAL	

Section A

Answer **all** the questions in the spaces provided.

- A1** Use the following clues to complete the crossword.
1 across has been filled in for you.



- 1 across** A process used to remove solids during water treatment.
- 2 down** The most reactive halogen.
- 3 down** The catalyst used in the Haber Process.
- 4 down** A positively charged ion.
- 5 down** A sub atomic particle with a relative mass of one and a charge of zero.
- 6 across** Compounds that have the same molecular formula but different structural formulae.

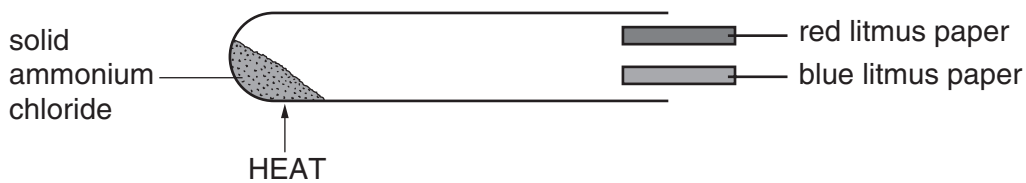
[5]

A2 The table shows some information about three gases.

name of gas	formula	relative molecular mass
chlorine	Cl_2	71
ammonia		17
	HCl	

(a) Complete the table by filling in the boxes. [3]

A student heated some solid ammonium chloride, NH_4Cl , in a test-tube. Ammonia and one other gas were formed. He tested the gases coming out of the tube with litmus paper.



The red litmus quickly turned blue.
A few seconds later, both pieces of litmus paper turned red

(b) Name the process which causes the gases to move along the tube.

.....[1]

(c) Which gas turned the red litmus paper blue?

.....[1]

(d) Which gas turned the litmus paper red?

.....[1]

(e) Explain why the two gases travelled along the test-tube at different speeds. Use information from the table.

.....

[2]

A3 Liquid Petroleum Gas (LPG) and ethanol can be used as fuels for cars instead of petrol. LPG contains mainly propane. This table shows some information about propane and ethanol.

name	formula	boiling point / °C	physical state at r.t.p.	enthalpy change of combustion / kJ per mole	method of manufacture
ethanol	C ₂ H ₅ OH	78	- 1367	fermentation of sugar cane
propane	- 42	- 2220 of crude oil

(a) Complete the table by filling in the boxes. [4]

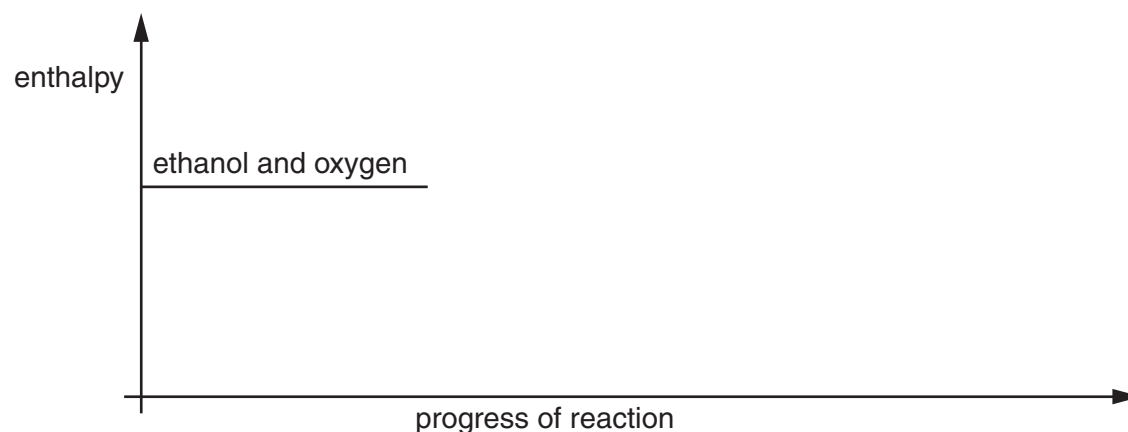
(b) When 1 kg propane burns, 50 450 kJ of energy are given out.
Show by calculation, using data from the table, that ethanol gives out less energy per kg than propane.

[3]

(c) Give **two advantages** of using ethanol rather than propane as a fuel for cars.

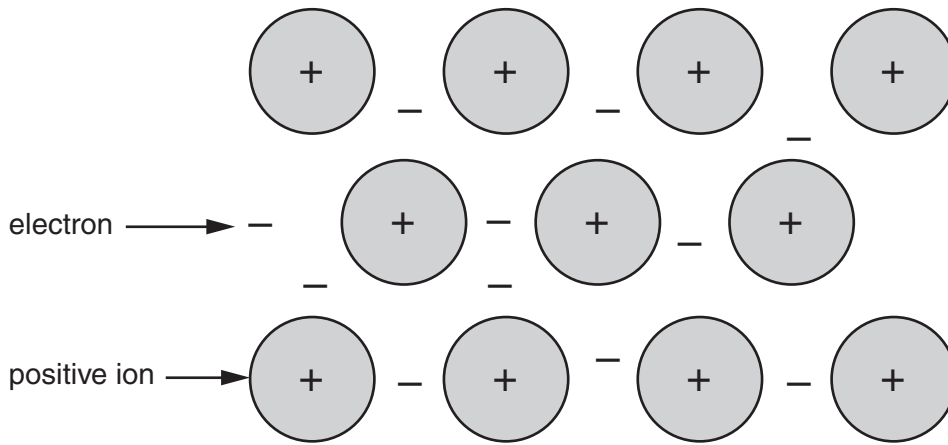
.....
.....[2]

(d) In a car engine, a spark plug ignites a mixture of air and ethanol. The spark is needed because the combustion of ethanol needs activation energy.
Complete the energy level diagram below for the combustion of ethanol.
Show the names of the products and label the activation energy for the reaction.



A4 The metal tungsten, symbol W, is used to make wire filaments in light bulbs. The wire glows when electricity passes through it.

This is the structure of a typical metal.



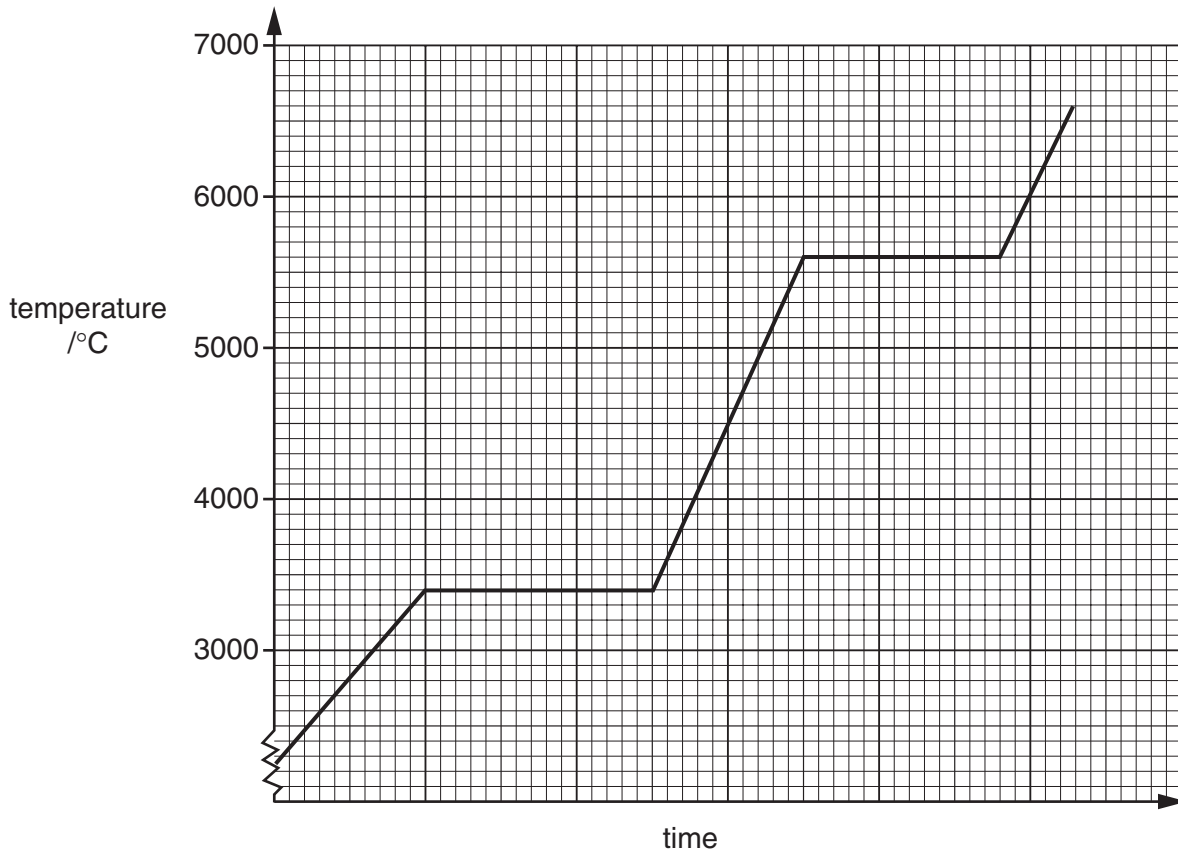
(a) Use this structure to explain how tungsten conducts electricity.

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

(b) Suggest **two** other physical properties of tungsten.

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

- (c) In a light bulb, the tungsten wire may get so hot that it melts and breaks. This graph shows the heating curve for tungsten.



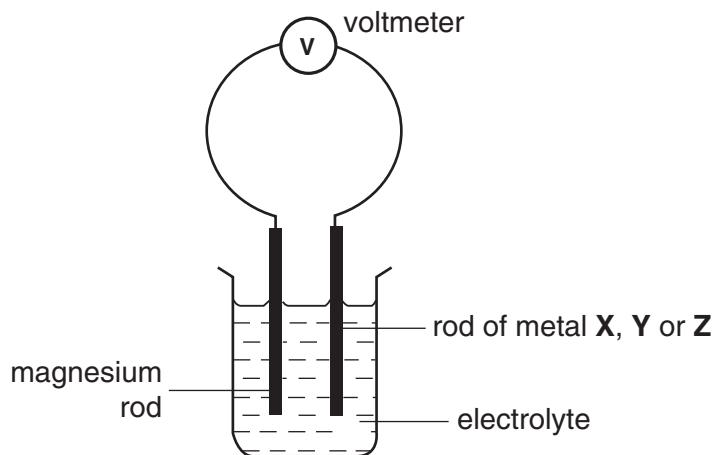
- (i) Use the graph to give the **boiling point** of tungsten.

.....

- (ii) Predict the temperature when the tungsten wire breaks.

.....[2]

A5 The diagram shows a cell that can be used to make electrical energy.



(a) Explain why distilled water is not used as the electrolyte.

.....[1]

(b) This table shows the results when rods of three metals, **X**, **Y** and **Z**, are used in separate experiments.

All the metals are less reactive than magnesium.

rod 1	rod 2	voltmeter reading / V
magnesium	X	2.72
magnesium	Y	0.78
magnesium	Z	1.10

Place the metals in order of reactivity

most reactive magnesium

.....

.....

least reactive

.....

[1]

(c) A student places a rod of magnesium in aqueous silver nitrate.

(i) Write an ionic equation, with state symbols, for the reaction which happened.

.....

(ii) What would you expect to see after the reaction had been taking place for some time?

.....

[2]

A6 Sodium is stored under oil because it rapidly oxidises to form sodium oxide, Na_2O .

- (a) Draw a 'dot and cross' diagram to show the bonding in sodium oxide, Na_2O . You need only show outer shell electrons.

[2]

Sodium oxide reacts with water to form sodium hydroxide.

- (b) Write an equation for this reaction.

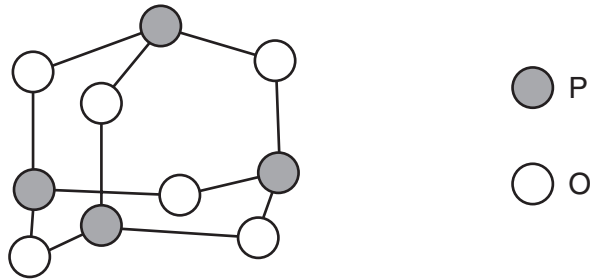
.....[1]

- (c) 62 g of sodium oxide are used to make 2 dm^3 of aqueous sodium hydroxide. What is the concentration of the sodium hydroxide solution?

Answer mol/dm^3 [2]

A7 Phosphorus is a non-metal.

This diagram shows the structure of one molecule of phosphorus(III) oxide.



(a) (i) Give the **molecular** formula of phosphorus(III) oxide.

.....

(ii) Give the **empirical** formula of phosphorus(III) oxide.

.....[2]

(b) Explain why phosphorus(III) oxide has the properties given below.

Property 1 Phosphorus(III) oxide is acidic

explanation

.....

Property 2 Phosphorus(III) oxide has a low melting point.

explanation

.....

Property 3 Phosphorus(III) oxide will **not** conduct electricity when molten.

explanation

.....[3]

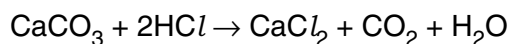
Section B

Answer **three** questions from this section.

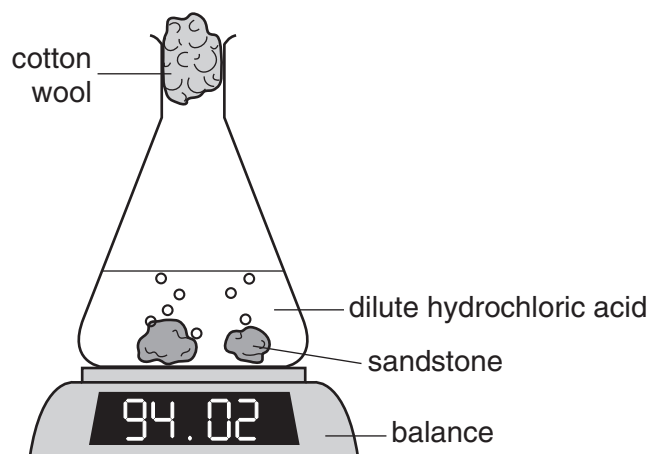
Tie any extra sheets loosely to this booklet.

B8 Sandstone contains sand (mainly silicon dioxide) and calcium carbonate.

Excess sandstone was reacted with dilute hydrochloric acid.



The rate of reaction was followed by measuring the mass lost during the reaction.

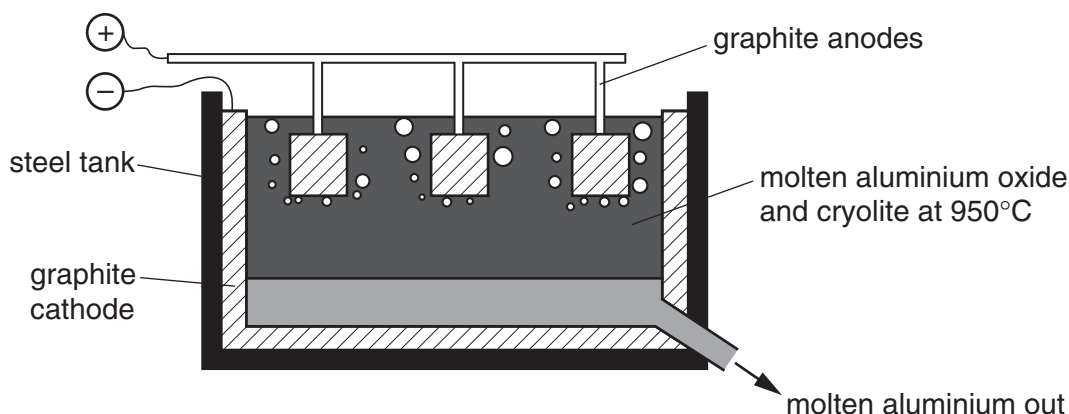


This is a table of the results.

time t / minutes	total mass lost / g
0	0.00
4	0.18
8	0.30
12	0.38
16	0.44
20	0.48
24	0.51

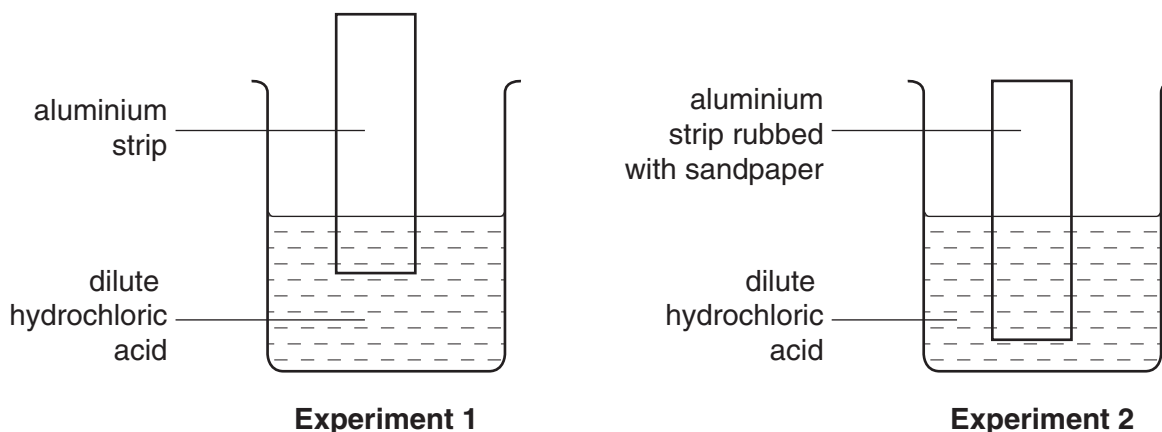
- (a) Use information from the table to show that the rate of reaction decreased. [2]
- (b) Explain, using ideas about particles colliding, why the rate of the reaction decreased. [2]
- (c) Draw a labelled diagram to show a **different** method of following the rate of reaction between sandstone and hydrochloric acid. [2]
- (d) In a second experiment, 10 g of sandstone was added to excess hydrochloric acid. The total mass lost was 0.88 g. Calculate the percentage by mass of calcium carbonate in the sandstone. [4]

- B9** This diagram shows an electrolysis tank used industrially to produce aluminium from molten aluminium oxide.



One reason that this process is expensive is that the graphite anodes need replacing regularly.

- (a) Explain, with the help of an equation, why the graphite anodes need replacing regularly. [2]
- (b) Adding molten cryolite reduces the cost of the process by lowering energy demand. Explain how adding molten cryolite reduces the energy demand of the process. [2]
- (c) State two uses of aluminium. State the property of aluminium which makes it suitable for each use. [2]
- (d) Aluminium is above hydrogen in the reactivity series. The following experiments were set up.



A reaction occurred in Experiment 2, but not in Experiment 1.

- (i) Explain what observations you would see in each experiment. Explain why the two strips behave differently.
- (ii) State the change in oxidation state of aluminium during the reaction in Experiment 2. [4]

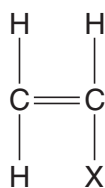
B10 A toilet cleaner contains the acid salt, sodium dihydrogen phosphate, NaH_2PO_4 .

- (a) Explain why sodium dihydrogen phosphate is both an 'acid' and a 'salt'.
- (b) Sodium dihydrogen phosphate can be made by reacting sodium hydroxide with phosphoric acid, H_3PO_4 .
- (i) Write an equation for the formation of sodium dihydrogen phosphate.
- (ii) Suggest the formula of **two** other salts formed from sodium hydroxide and phosphoric acid. [3]
- (c) The table shows information about other acidic compounds.

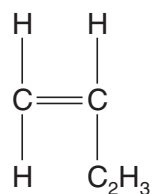
name	pH of a 0.5 mol/dm^3 solution	
sodium dihydrogen phosphate	4.5	increasing acid strength ↓
ethanoic acid	3.8	
sulphuric acid	1.0	

- (i) Explain why sulphuric acid behaves as a *strong acid* but ethanoic acid behaves as a *weak acid*.
- (ii) Describe an experiment, other than measuring pH, that you could carry out to show that sulphuric acid is a strong acid but ethanoic acid is a weak acid.
State what measurements you would make and what results you would expect. [5]

B11 Styrene-butadiene rubber is a synthetic rubber. It is made by polymerising a mixture of monomers butadiene and styrene.



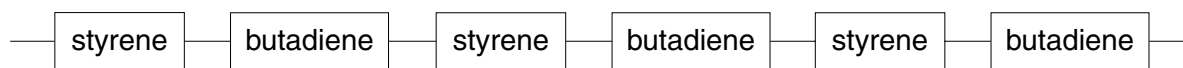
styrene



butadiene

- (a) What type of polymerisation will take place when the monomers polymerise? Explain your reasoning. [2]

One possible structure for the polymer is shown below.



- (b) Give the full structural formula for the repeating unit in this polymer structure. [2]
- (c) When the mixture of styrene and butadiene polymerises, the polymer is unlikely to contain only this regular, repeating pattern. Explain why. [1]

Butadiene can be made by cracking butane in a cracking tower.

- (d) (i) Butane cracks to form butadiene and one other product.
Write an equation to show this reaction.
- (ii) Give a use of the other product of this reaction. [2]
- (e) 2.90 kg of butane entered the cracking tower. After the reaction, 2.16 kg of butadiene had been made.
Calculate the percentage yield of butadiene. [3]

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A series of horizontal dotted lines for writing, spanning the width of the page.

DATA SHEET
The Periodic Table of the Elements

		Group																																																																																																																																
I	II	III	IV	V	VI	VII	0																																																																																																																											
7 Li Lithium	9 Be Beryllium	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>1 H Hydrogen</td> <td colspan="10"></td> </tr> <tr> <td>11 B Boron</td> <td>12 C Carbon</td> <td>13 Al Aluminium</td> <td>14 Si Silicon</td> <td>15 P Phosphorus</td> <td>16 S Sulphur</td> <td>17 Cl Chlorine</td> <td>18 Ar Argon</td> <td>19 F Fluorine</td> <td>20 Ne Neon</td> <td>21 Sc Scandium</td> <td>22 Ti Titanium</td> <td>23 V Vanadium</td> <td>24 Cr Chromium</td> <td>25 Mn Manganese</td> <td>26 Fe Iron</td> <td>27 Co Cobalt</td> <td>28 Ni Nickel</td> <td>29 Cu Copper</td> <td>30 Zn Zinc</td> <td>31 Ga Gallium</td> <td>32 Ge Germanium</td> <td>33 As Arsenic</td> <td>34 Se Selenium</td> <td>35 Br Bromine</td> <td>36 Kr Krypton</td> <td>37 Rb Rubidium</td> <td>38 Sr Strontium</td> <td>39 Y Yttrium</td> <td>40 Zr Zirconium</td> <td>41 Nb Niobium</td> <td>42 Mo Molybdenum</td> <td>43 Tc Technetium</td> <td>44 Ru Ruthenium</td> <td>45 Rh Rhodium</td> <td>46 Pd Palladium</td> <td>47 Ag Silver</td> <td>48 Cd Cadmium</td> <td>49 In Indium</td> <td>50 Sn Tin</td> <td>51 Sb Antimony</td> <td>52 Te Tellurium</td> <td>53 I Iodine</td> <td>54 Xe Xenon</td> <td>55 Cs Caesium</td> <td>56 Ba Barium</td> <td>57 La Lanthanum</td> <td>58 Ce Cerium</td> <td>59 Pr Praseodymium</td> <td>60 Nd Neodymium</td> <td>61 Pm Promethium</td> <td>62 Sm Samarium</td> <td>63 Eu Europium</td> <td>64 Gd Gadolinium</td> <td>65 Tb Terbium</td> <td>66 Dy Dysprosium</td> <td>67 Ho Holmium</td> <td>68 Er Erbium</td> <td>69 Tm Thulium</td> <td>70 Yb Ytterbium</td> <td>71 Lu Lutetium</td> <td>72 Hf Hafnium</td> <td>73 Ta Tantalum</td> <td>74 W Tungsten</td> <td>75 Re Rhenium</td> <td>76 Os Osmium</td> <td>77 Ir Iridium</td> <td>78 Pt Platinum</td> <td>79 Au Gold</td> <td>80 Hg Mercury</td> <td>81 Tl Thallium</td> <td>82 Pb Lead</td> <td>83 Bi Bismuth</td> <td>84 Po Polonium</td> <td>85 At Astatine</td> <td>86 Rn Radon</td> <td>87 Fr Francium</td> <td>88 Ra Radium</td> <td>89 Ac Actinium</td> <td>90 Th Thorium</td> <td>91 Pa Protactinium</td> <td>92 U Uranium</td> <td>93 Np Neptunium</td> <td>94 Pu Plutonium</td> <td>95 Am Americium</td> <td>96 Cm Curium</td> <td>97 Bk Berkelium</td> <td>98 Cf Californium</td> <td>99 Es Einsteinium</td> <td>100 Fm Fermium</td> <td>101 Md Mendelevium</td> <td>102 No Nobelium</td> <td>103 Lr Lawrencium</td> <td>104 Rf Rutherfordium</td> <td>105 Db Dubnium</td> <td>106 Sg Seaborgium</td> <td>107 Bh Bohrium</td> <td>108 Hs Hassium</td> <td>109 Mt Meitnerium</td> <td>110 Ds Darmstadtium</td> <td>111 Rg Roentgenium</td> <td>112 Cn Copernicium</td> <td>113 Nh Nihonium</td> <td>114 Fl Flerovium</td> <td>115 Mc Moscovium</td> <td>116 Lv Livermorium</td> <td>117 Ts Tennessine</td> <td>118 Og Oganesson</td> </tr> </table>										1 H Hydrogen											11 B Boron	12 C Carbon	13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulphur	17 Cl Chlorine	18 Ar Argon	19 F Fluorine	20 Ne Neon	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton	37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon	55 Cs Caesium	56 Ba Barium	57 La Lanthanum	58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon	87 Fr Francium	88 Ra Radium	89 Ac Actinium	90 Th Thorium	91 Pa Protactinium	92 U Uranium	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	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
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| 23 **Na** Sodium | 24 **Mg** Magnesium | 39 **K** Potassium | 40 **Ca** Calcium | 45 **Sc** Scandium | 48 **Ti** Titanium | 51 **V** Vanadium | 52 **Cr** Chromium | 55 **Mn** Manganese | 56 **Fe** Iron | 59 **Co** Cobalt | 59 **Ni** Nickel | 64 **Cu** Copper | 65 **Zn** Zinc | 70 **Ga** Gallium | 73 **Ge** Germanium | 75 **As** Arsenic | 79 **Se** Selenium | 80 **Br** Bromine | 84 **Kr** Krypton | 85 **Rb** Rubidium | 88 **Sr** Strontium | 89 **Y** Yttrium | 90 **Zr** Zirconium | 91 **Nb** Niobium | 93 **Ta** Tantalum | 94 **Hf** Hafnium | 95 **La** Lanthanum | 96 **Ce** Cerium | 97 **Pr** Praseodymium | 98 **Nd** Neodymium | 99 **Pm** Promethium | 100 **Sm** Samarium | 101 **Eu** Europium | 102 **Gd** Gadolinium | 103 **Tb** Terbium | 104 **Dy** Dysprosium | 105 **Ho** Holmium | 106 **Er** Erbium | 107 **Tm** Thulium | 108 **Yb** Ytterbium | 109 **Lu** Lutetium | 110 **Hf** Hafnium | 111 **Ta** Tantalum | 112 **W** Tungsten | 113 **Re** Rhenium | 114 **Os** Osmium | 115 **Ir** Iridium | 116 **Pt** Platinum | 117 **Au** Gold | 118 **Hg** Mercury | 119 **Tl** Thallium | 120 **Pb** Lead | 121 **Bi** Bismuth | 122 **Po** Polonium | 123 **At** Astatine | 124 **Rn** Radon |

87-103 Lanthanoid series
104-118 Actinoid series

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.).