Centre Number	Candidate Number	Name

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	

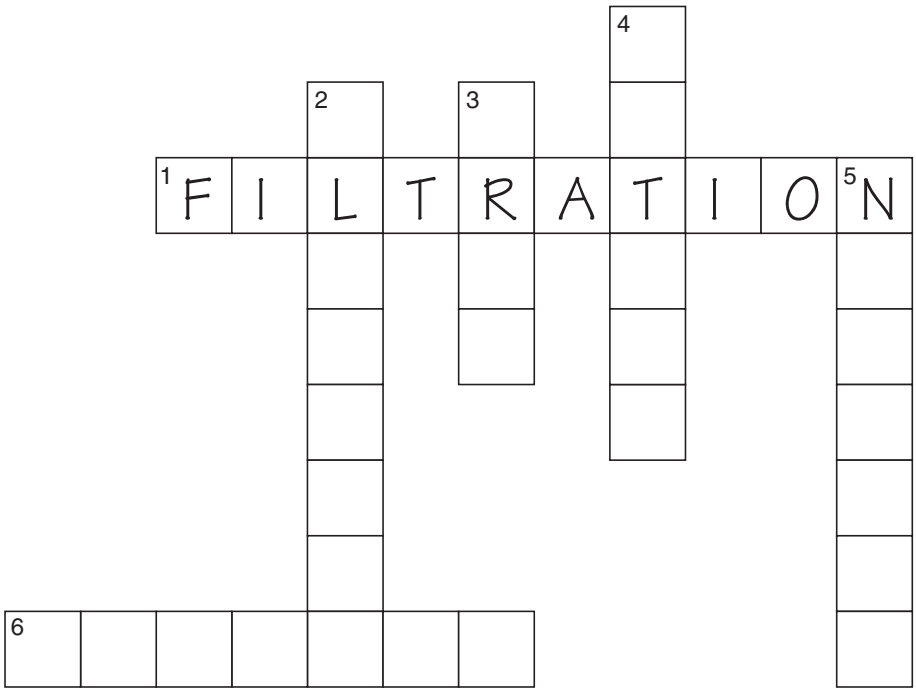
This document consists of **14** printed pages and **2** lined pages.

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate
[Turn over

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.

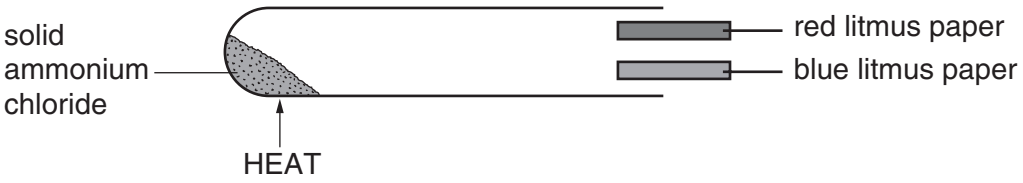
6 across Compounds that have the same molecular formula but different structural formulae.
[5]

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]

[Turn over

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_2H_5OH	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.

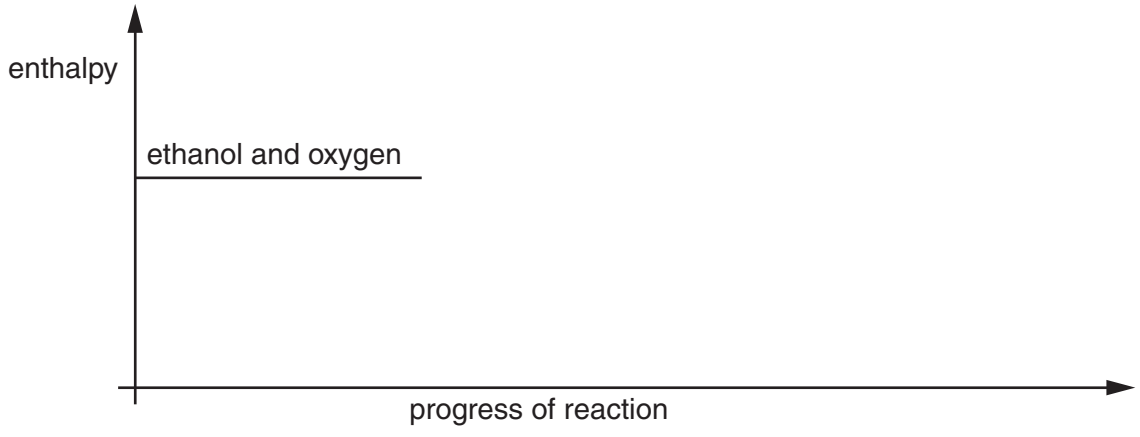
[3]

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

.....

.....[2]

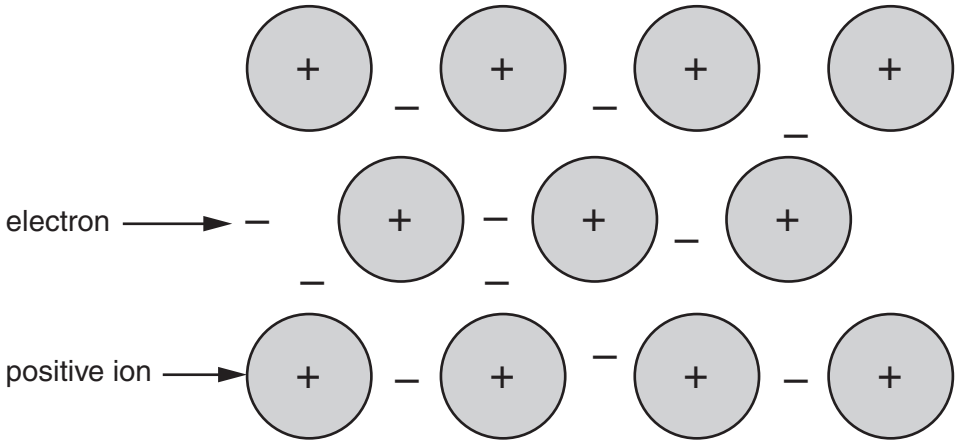
(d) In a car engine, a spark plug ignites a mixture of air and ethanol. The spark is needed because the combustion of ethanol needs activation energy.
Complete the energy level diagram below for the combustion of ethanol.
Show the names of the products and label the activation energy for the reaction.



[3]

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]

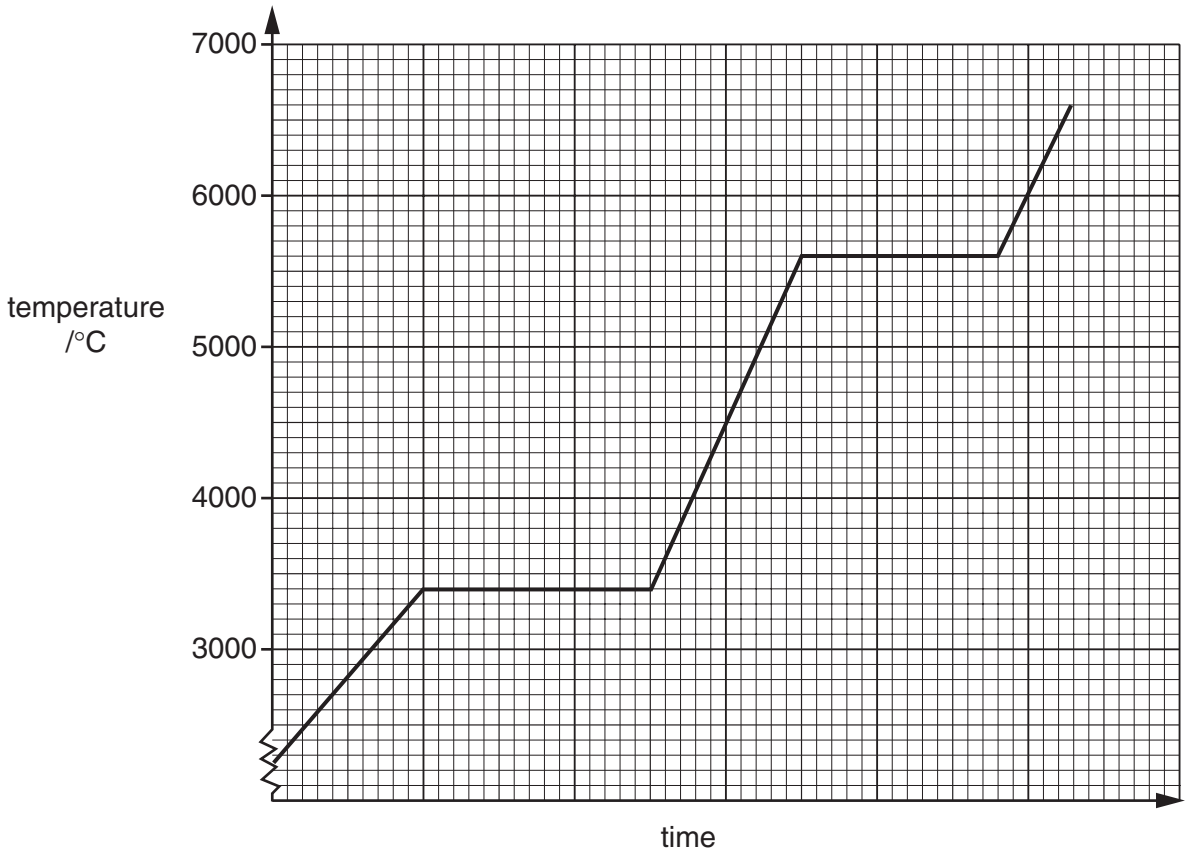
(b) Suggest **two** other physical properties of tungsten.

.....

.....[2]

[Turn over

(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.



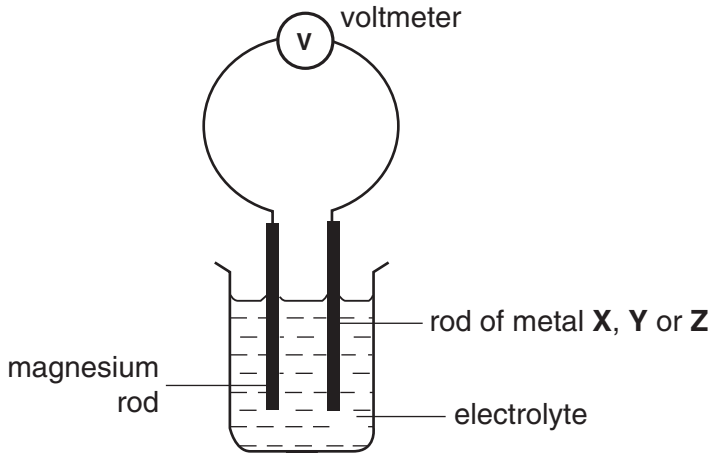
(i) Use the graph to give the **boiling point** of tungsten.

.....

(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?

.....

.....[3]

[Turn over

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.

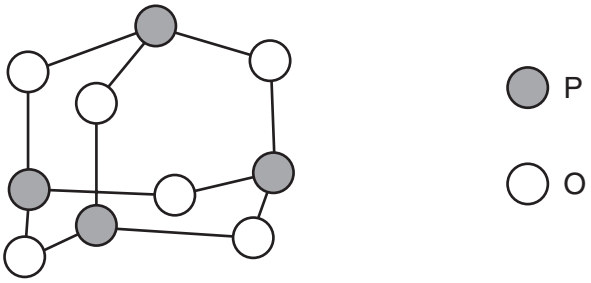
(b) Write an equation for this reaction.

.....[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.

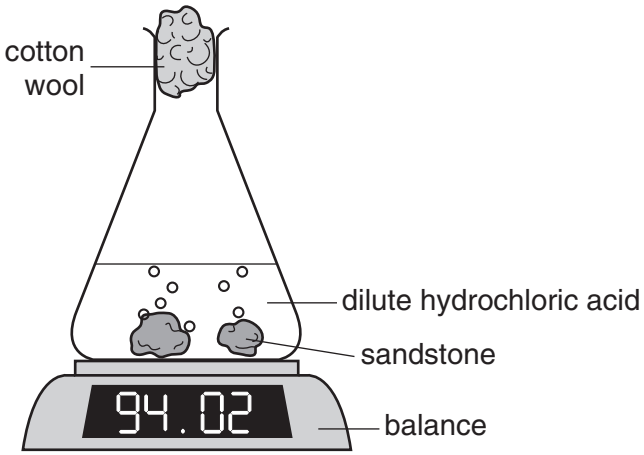
Tie any extra sheets loosely to this booklet.

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

Excess sandstone was reacted with dilute hydrochloric acid.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

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

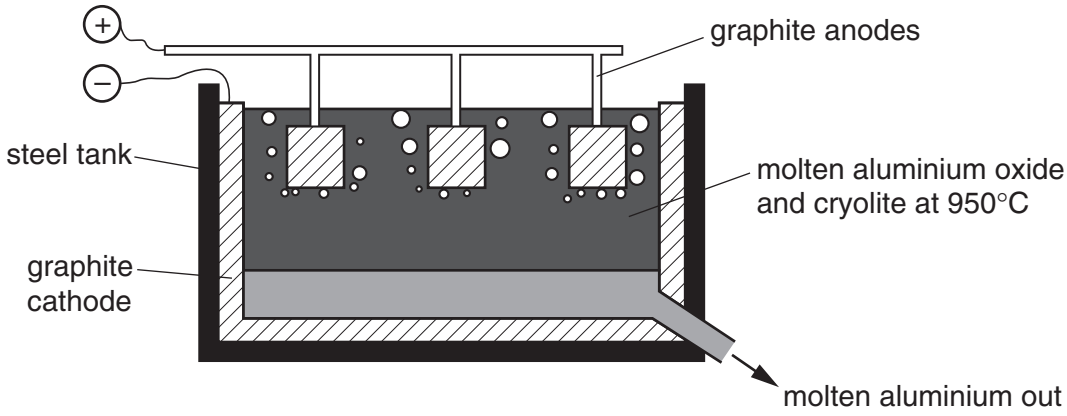
(a) Use information from the table to show that the rate of reaction decreased. [2]

(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 aluminium oxide.



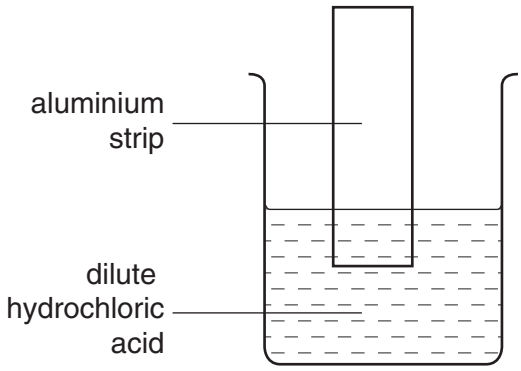
One reason that this process is expensive is that the graphite anodes need replacing regularly.

(a) Explain, with the help of an equation, why the graphite anodes need replacing regularly. [2]

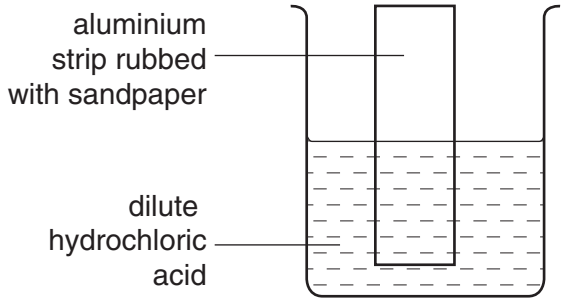
(b) Adding molten cryolite reduces the cost of the process by lowering energy demand. Explain how adding molten cryolite reduces the energy demand of the process. [2]

(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.



Experiment 1



Experiment 2

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]

[Turn over

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'. [2]

(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.

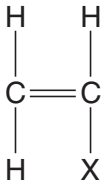
name	pH of a 0.5 mol / dm^3 solution	
sodium dihydrogen phosphate	4.5	increasing acid strength ↓
ethanoic acid	3.8	
sulphuric acid	1.0	

(i) Explain why sulphuric acid behaves as a *strong acid* but ethanoic acid behaves as a *weak acid*.

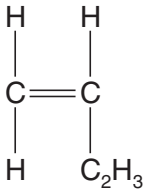
(ii) Describe an experiment, other than measuring pH, that you could carry out to show that sulphuric acid is a strong acid but ethanoic acid is a weak acid.

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 the monomers butadiene and styrene.



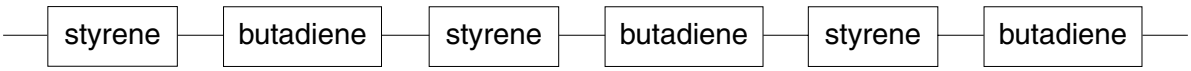
styrene



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]

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.).