Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

COMBINED SCIENCE **0653/03**

Paper 3

May/June 2005

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.

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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7	
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9	
Total	

This document consists of **20** printed pages.

1 **(a)** Fig. 1.1 shows the structure of a wind-pollinated flower.

Fig. 1.1

Explain **one** way in which the structure of this flower increases the chance of successful pollination.

.....

.....

..... [2]

(b) Fig. 1.2 shows the structure of a cell that is found inside the plant's leaves.

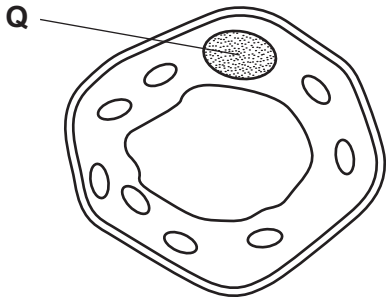


Fig. 1.2

(i) Suggest **one** way in which the structure of this cell differs from a cell in the part labelled **P** in Fig. 1.1. Explain the reason for your suggestion.

.....

.....

..... [2]

(ii) Describe the function of the part labelled **Q** in Fig. 1.2.

.....

.....

..... [2]

(c) The leaf cell shown in Fig. 1.2 requires a steady supply of water.

(i) Name the tissue in which water is transported from the roots to the leaves.

..... [1]

(ii) Describe how water is lost from leaf cells, and how this water leaves the leaf and enters the air around it.

.....

.....

.....

..... [3]

2 Fig 2.1 shows what is observed when a piece of potassium reacts in a container of chlorine.

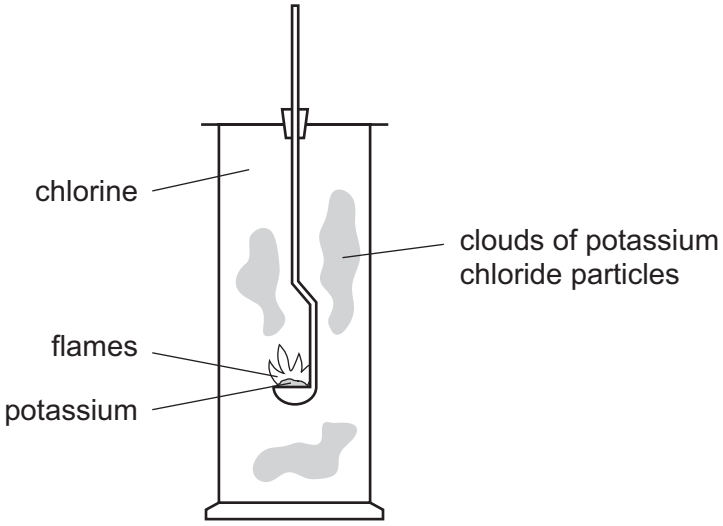


Fig. 2.1

(a) (i) Write the word equation for the reaction.

..... [1]

(ii) State which observation in Fig. 2.1 shows that the reaction is *exothermic*.

.....

..... [1]

(b) Potassium chloride can also be made by reacting potassium hydroxide solution with dilute hydrochloric acid.
Write a balanced symbolic equation for this reaction.

..... [2]

(c) The apparatus shown in Fig. 2.2 can be used to separate potassium chloride into its elements.

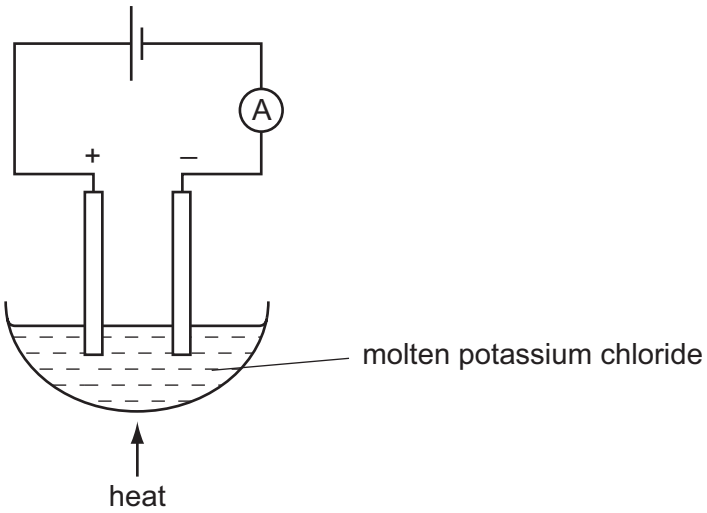


Fig. 2.2

(i) Explain why potassium ions move towards the cathode.

.....

.....

..... [2]

(ii) Describe how potassium ions change into potassium atoms at the cathode.

.....

.....

..... [2]

3 **(a)** An elephant can communicate with other elephants using infra-sound.
This is a very low frequency vibration, which is usually impossible for a human to hear.

(i) Suggest a possible frequency for this vibration.

..... [1]

(ii) Explain what is happening when these vibrations travel through the air. You may use a diagram to help you to answer this question.

.....

..... [2]

(b) A spider climbs vertically upwards along a thread.

(i) The spider weighs 0.02N.

Calculate the work done when it climbs 21 cm up the thread.

Show your working and state the formula that you use.

formula used

working

..... [2]

(ii) Calculate the power generated by the spider as it climbs up the thread. It climbs 21 cm in 7 seconds.

Show your working and state the formula that you use.

formula used

working

..... [2]

(iii) The mass of the spider is 2g. It begins to move up the thread with an acceleration of $2 cm/s^2$.

Calculate the resultant force causing this acceleration.

Show your working and state the formula that you use.

formula used

working

..... [3]

(c) A polar bear is a large white furry mammal that lives on the Arctic ice.

Suggest and explain **one** way in which the polar bear is adapted to reduce heat loss in this cold climate.

.....

..... [2]

4 In the 1950s, many people in London used coal to heat their houses. In early December 1952, the weather was foggy. The sulphur dioxide released from the burning of the coal stayed trapped in the fog.

(a) Fig. 4.1 shows the concentration of sulphur dioxide in the air, and also the number of people who died, from December 1st to December 15th.

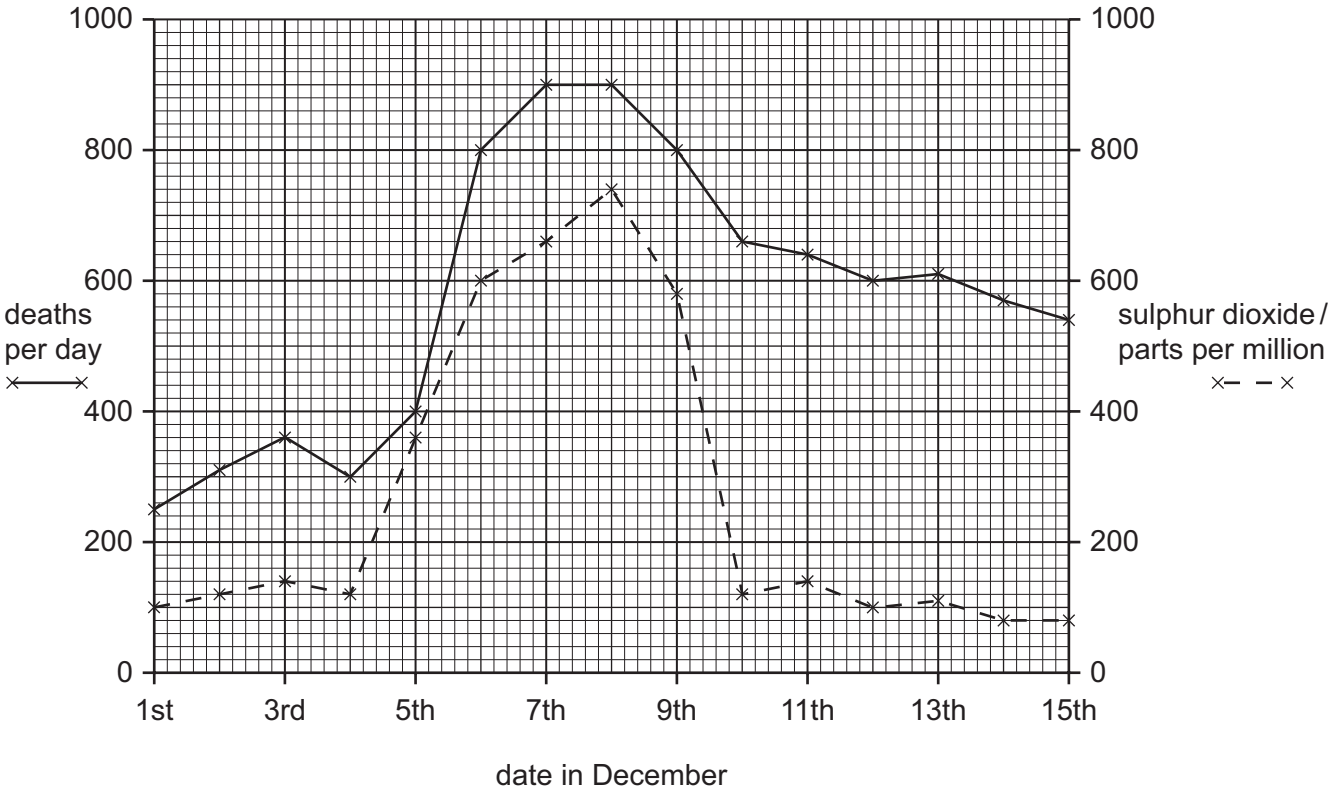


Fig. 4.1

(i) How many more people died on December 8th than on December 1st?

..... [1]

(ii) Explain how the information in the graph in Fig. 4.1 supports the idea that sulphur dioxide is harmful to health.

.....

.....

..... [1]

(iii) Suggest why the numbers of deaths were still high on December 15th, even though the concentration of sulphur dioxide had returned to a low level.

.....

..... [1]

(b) Explain how the emission of sulphur dioxide into the atmosphere can lead to the formation of acid rain.

.....

.....

..... [2]

(c) The combustion of coal also releases soot particles into the atmosphere. Some of these may fall onto plant leaves, forming a coating over them and blocking their stomata.

Explain how this could reduce the rate of growth of the plants.

.....

.....

..... [2]

5 **(a)** The full chemical symbols of four elements are shown below.

$^{1}_{1}H$ $^{16}_{8}O$ $^{24}_{12}Mg$ $^{40}_{18}Ar$

Use this information to answer **(i)** to **(iii)** below.

(i) Name the element which does not react with any of the others, and explain your answer.

name .....

explanation .....

..... [1]

(ii) Name a pair of elements which combine together to form an *ionic* compound.

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

(iii) Name two elements whose atoms have electrons in three energy levels (shells)

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

(b) Magnesium reacts with oxygen to form magnesium oxide.

$$2Mg + O_2 \longrightarrow 2MgO$$

A student found that when 4.8g of magnesium were completely oxidised, 8.0g of magnesium oxide were formed.

(i) Calculate the mass of oxygen which combined with 4.8g of magnesium.

..... [1]

(ii) The student then burned 2.4g of magnesium in a vessel containing 5.0g of oxygen. Calculate the mass of oxygen left over after all the magnesium had reacted.

Show your working.

..... [2]

(c) A student investigated factors affecting the rate of reaction between magnesium and dilute hydrochloric acid. She wanted to investigate the effects of changing

- the surface area of the magnesium,
- the temperature of the hydrochloric acid.

The apparatus she used is shown in Fig. 5.1.

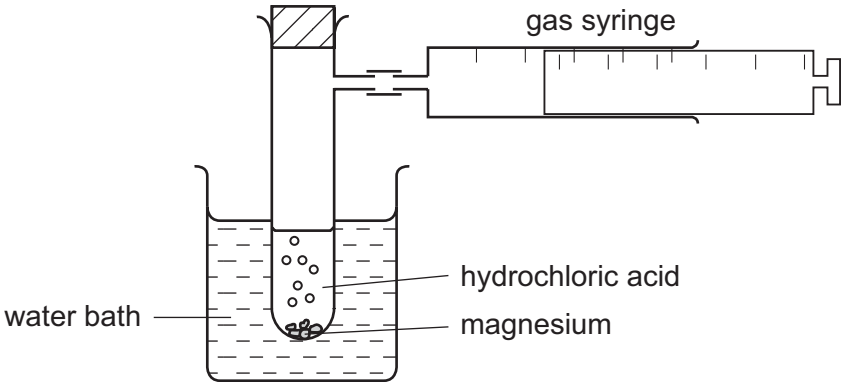


Fig. 5.1

Results of four of her experiments are shown in Table 5.1. In each experiment she used 2.0g of magnesium and 20.0 cm^3 of hydrochloric acid.

Table 5.1

experiment	temperature of acid / °C	volume of gas collected / cm^3	time taken to collect gas /minutes	rate of reaction / cm^3 per minute
1	18	50	2	25
2	18	65	2	32.5
3	28	100	2	
4	41	105	1	

(i) Name the gas given off in this reaction.

.....[1]

(ii) State **one** other important factor (variable) which the student must keep the same in each experiment.

.....[1]

(iii) Complete the two remaining boxes in Table 5.1. [1]

(iv) Suggest which pair of experiments the student carried out in order to observe the effect on reaction rate of changing the surface area of the magnesium.

Explain your answer briefly.

.....

.....

.....

.....[2]

6 **(a)** Fig. 6.1 shows a fish tank containing one fish.

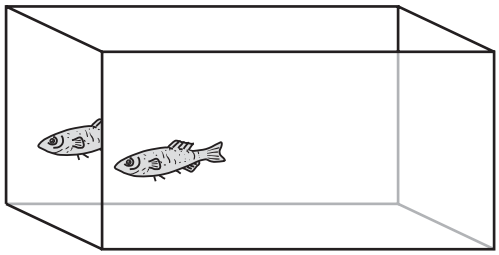


Fig. 6.1

If observed from the corner, there appear to be two fish in the tank.

Fig. 6.2 shows the tank from above.

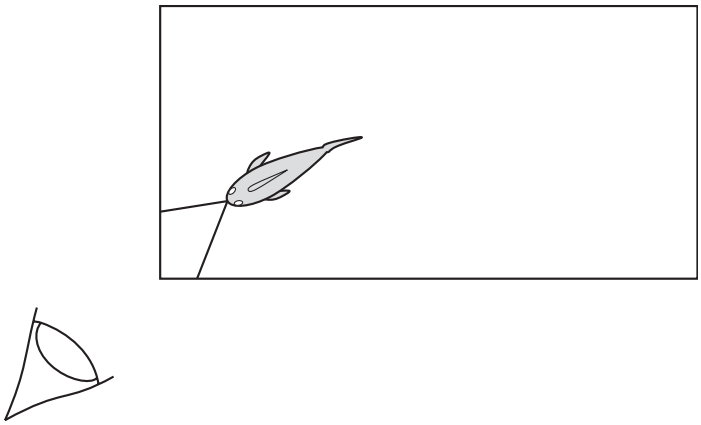


Fig. 6.2

(i) Two rays of light have been drawn from the fish.
Continue the rays of light in Fig. 6.2 to show how the light waves reach the eye. [1]

(ii) Use the diagram to explain why the observer can see two fish.
You may wish to add to Fig. 6.2 to help you answer this question.

[2]

(b) An electric heater is designed to heat the fish tank. The circuit containing this heater is shown in Fig. 6.3.

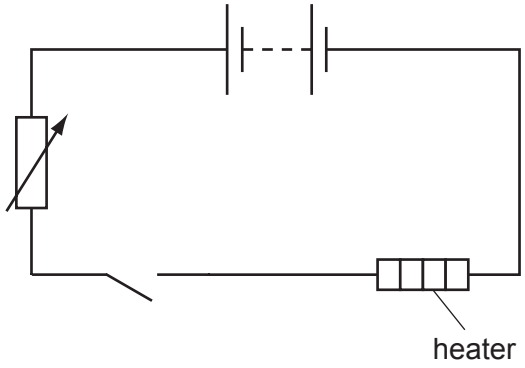


Fig. 6.3

The current flowing through the heater is 0.5 A and the voltage across it is 5.0 V.
Calculate the resistance of the heater.
Show your working and state the formula that you use.

formula used

working

..... [2]

(c) The electric heater is placed at the bottom of the fish tank rather than at the top.
Explain why this is more effective for heating the water in the tank.

.....

.....

..... [2]

7 Fig. 7.1 shows the structure of the human alimentary canal.

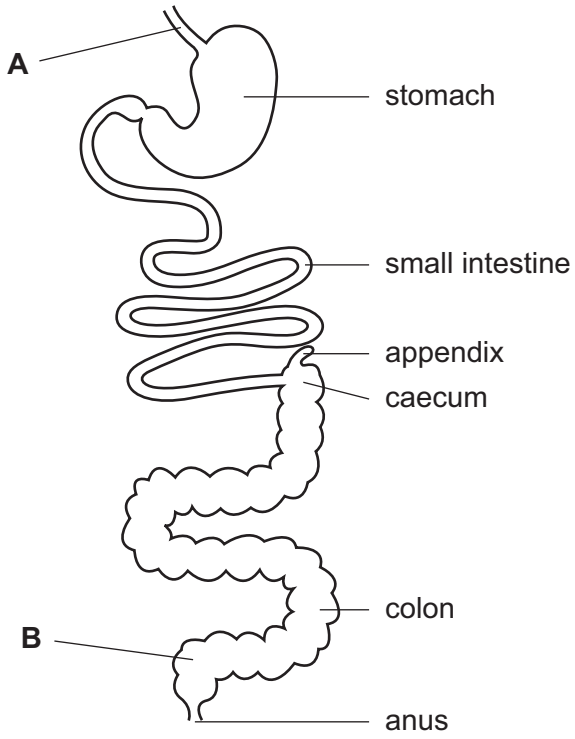


Fig. 7.1

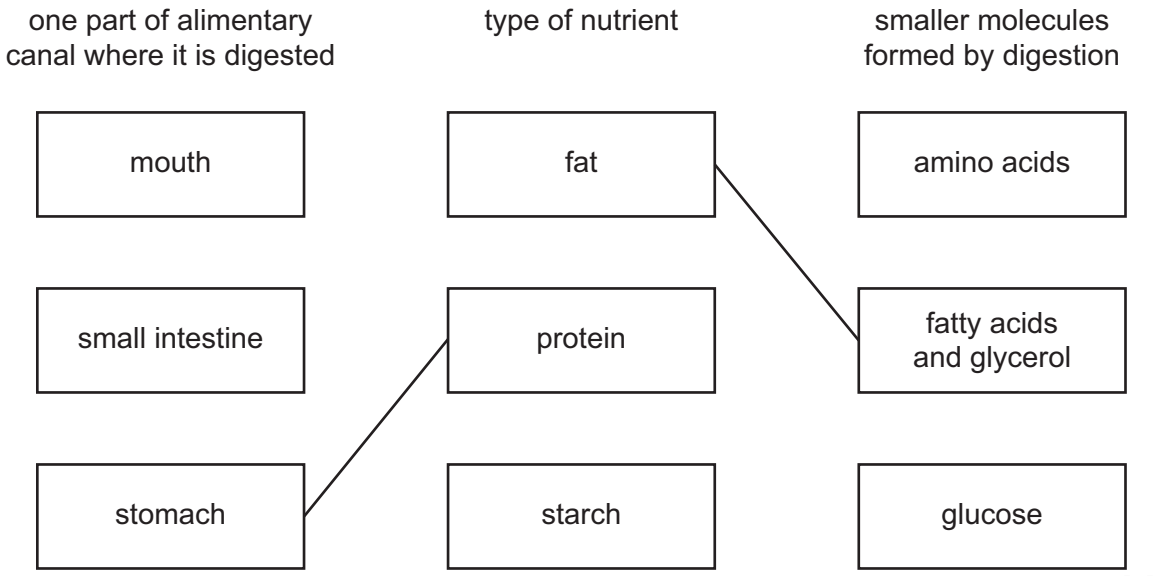
(a) Name the parts labelled **A** and **B**.

A .....

B ..... [2]

(b) The boxes below contain the name of a nutrient, a part of the alimentary canal in which it is digested, and the name of the molecules which are formed during digestion.

Draw lines to connect the nutrient to the appropriate part of the alimentary canal and to the molecules which are formed. Two lines have been drawn for you.



[2]

(c) Fig. 7.1 shows that the small intestine is the longest part of the alimentary canal. Suggest how this helps it to carry out its functions effectively.

.....

.....

..... [2]

(d) Glucose is a good energy food. Athletes often drink liquids containing glucose to provide them with energy quickly.

(i) Describe how glucose provides energy for an athlete's muscles.

.....

.....

..... [2]

(ii) Describe how you can test a drink to find out if it contains a reducing sugar, such as glucose.

.....

.....

..... [2]

8 **(a)** When it has been buried, compressed and heated underground for millions of years, wood is converted into a common type of solid fuel.
Name the solid fuel formed from wood over millions of years.

.....

[1]

(b) Fig. 8.1 shows an experiment carried out on some small pieces of wood.

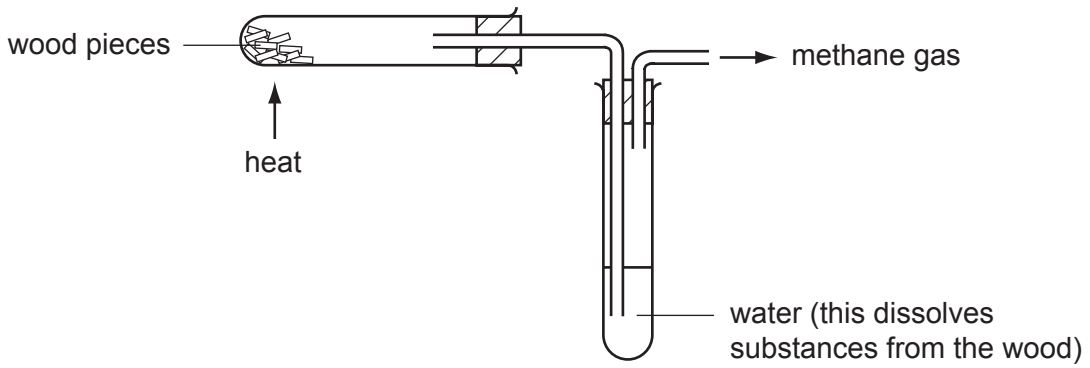


Fig. 8.1

The wood in the experiment does not catch fire. Suggest the type of chemical reaction that is occurring.

Explain your answer briefly.

type of reaction .....

explanation .....

.....

.....

[2]

(c) Propane, C_3H_8, is a gaseous hydrocarbon fuel.

(i) When propane is shaken with bromine solution, the mixture remains orange.
Explain what this observation shows about the bonding in propane molecules.

.....

.....

.....

[2]

(ii) The equation below shows the complete combustion of propane.
Complete the balancing of the equation. [1]

$$C_3H_8 + \text{.....} O_2 \longrightarrow 3CO_2 + \text{.....} H_2O$$

(iii) Calculate the formula mass of propane.
Show your working.

..... [2]

9 **(a)** Fig. 9.1 shows a toy bird suspended from a ceiling by a spring.

Fig. 9.1

(i) The upward force of the spring has been labelled **A**.
Draw another arrow on the diagram to show the direction of the other force acting on the bird.
Label it **B**. [1]

(ii) The bird is not moving. What can be stated about the sizes and directions of forces **A** and **B**?

.....

..... [1]

(b) The toy bird is made of a thin piece of aluminium.
On Fig. 9.1 write the letter **C** where the centre of mass is likely to be. [1]

(c) The mass of the toy bird is 7.5 g and its volume is 3.0 cm^3.

(i) Suggest how you could measure the volume of the bird.

.....

..... [2]

(ii) Calculate the density of the bird.

Show your working and state the formula that you use.

formula used

working

..... [2]

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.).