



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CO-ORDINATED SCIENCES

0654/03

Paper 3 (Extended)

May/June 2007

2 hours

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.

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.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 20.

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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

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



1 (a) Fig. 1.1 is a side view of the thorax during breathing out and breathing in. The lungs and heart are not shown.

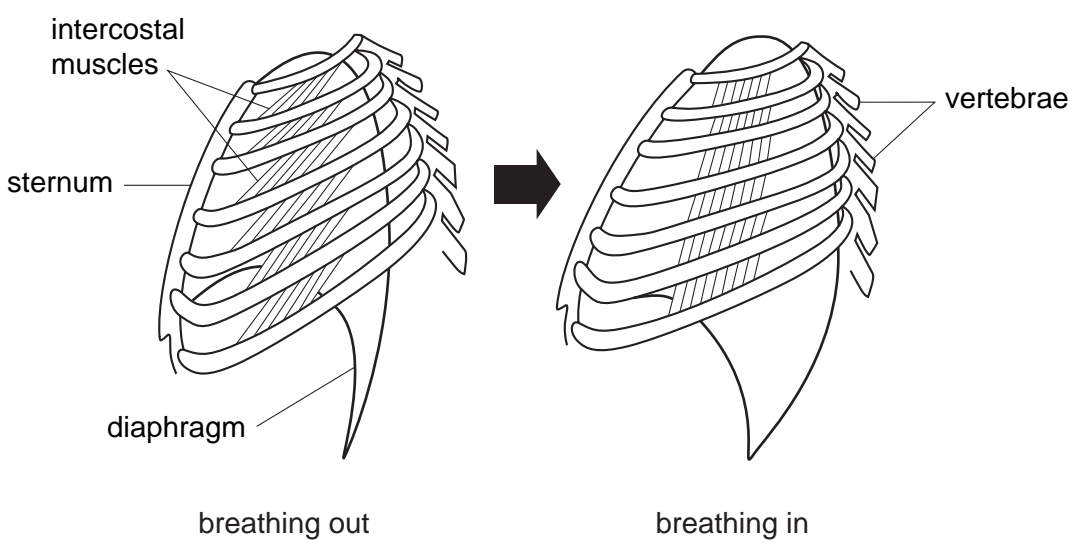


Fig. 1.1

(i) Describe how each of the following have changed between breathing out and breathing in.

the intercostal muscles

the diaphragm [2]

(ii) Explain how the changes you have described help to draw air into the lungs.

.....

.....

.....

.....

..... [3]

(b) As air is drawn into the lungs, it flows through the trachea and bronchi. These are lined with a tissue containing goblet cells and ciliated cells.

Explain how this tissue helps to prevent infections in the lungs.

.....

.....

..... [2]

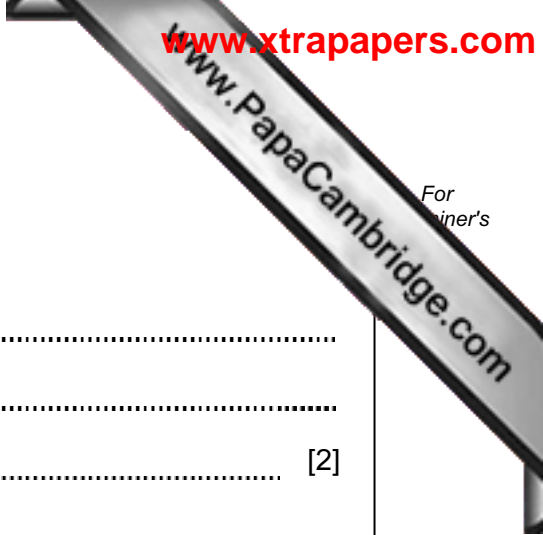
(c) Describe the effects of smoking on

(i) the goblet cells and cilia,

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

(ii) the alveoli in the lungs.

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



2 In the nineteenth century, the Russian scientist Dimitri Mendeleev, arranged the elements in order of the relative masses of their atoms. His work led to the modern Periodic Table that we use today.

(a) (i) Explain why atoms of different elements have different masses.

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

(ii) Explain, in terms of electron configuration, why the element with proton number 36 is unreactive.

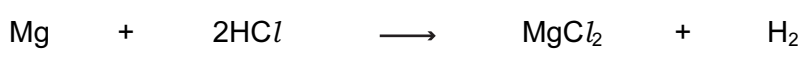
.....
..... [1]

(iii) In the modern Periodic Table the elements with proton numbers 18 and 19 are **not** in order of their relative atomic masses.

Suggest a reason for this.

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

(b) Magnesium reacts with dilute hydrochloric acid according to the equation below.



A student was asked to add 0.96 g of magnesium ribbon to 100 cm³ of dilute hydrochloric acid which had a concentration of 0.5 mol/dm³.

(i) Calculate the number of moles of magnesium in 0.96 g.

Show your working.

..... [1]

(ii) Calculate the number of moles of hydrochloric acid in 100 cm³ of a solution which has a concentration of 0.5 mol/dm³.

Show your working.

..... [1]

(iii) Use the balanced equation for this reaction and your results from (i) and (ii) to predict whether there is enough acid to react with all of the magnesium.

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

(c) Fluorine is a halogen produced by electrolysis of an electrolyte containing fluoride ions, F⁻.

There were many attempts to produce fluorine during the nineteenth century and several scientists were seriously harmed when they succeeded in making fluorine. They attempted to collect fluorine in containers made of gold or platinum and they kept the containers at a very low temperature.

(i) State and explain at which electrode, cathode or anode, fluorine is produced during electrolysis.

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

(ii) Use your knowledge of the halogen group to suggest why fluorine caused harm to scientists who first produced it.

..... [1]

(iii) Suggest why the scientists attempting to produce fluorine used gold or platinum containers at a very low temperature.

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

- 3 (a) A car of mass 1200 kg is travelling forward at a constant speed of 20 m/s. Fig. 3.1 shows the driving force and the frictional force acting on the car.

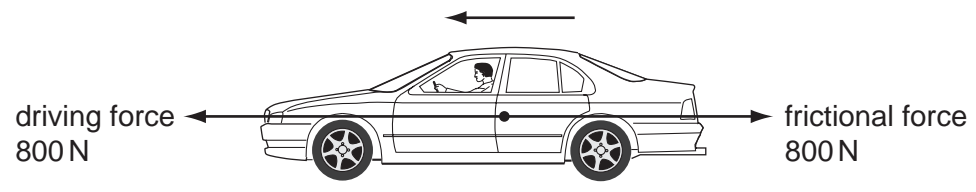


Fig. 3.1

- (i) Calculate the work done by the driving force in 30 seconds.

State the formula that you use and show your working.

formula used

working

..... [3]

- (ii) Calculate the kinetic energy of the car travelling at 20 m/s.

State the formula that you use and show your working.

formula used

working

..... [2]

(b) A pedestrian steps into the path of the moving car. Fig. 3.2 shows a graph of the speed of the car changes from the moment when the driver sees the pedestrian until the car stops.

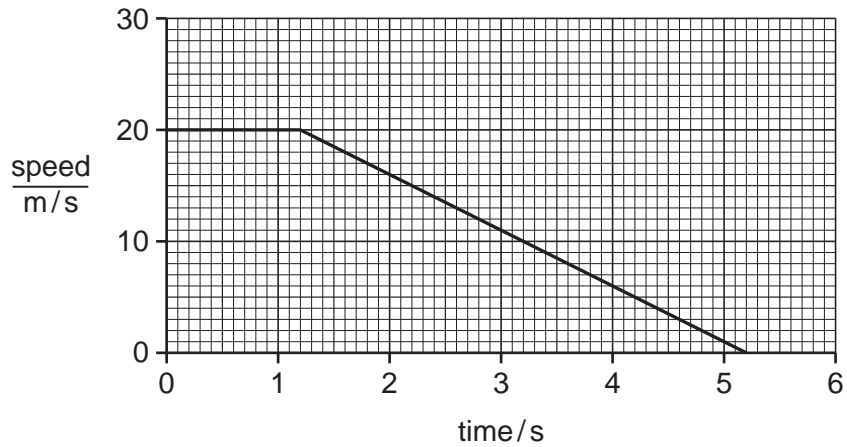


Fig. 3.2

(i) After 1.2 s the car slows down.

Calculate the deceleration of the car.

State the formula that you use and show your working.

formula used

working

..... [2]

(ii) Calculate the total distance travelled by the car between the driver seeing the pedestrian and the car stopping.

Show your working.

..... [3]

- 4 An experiment was carried out into the effect of different doses of X-rays on the sperm produced by male fruit flies. Fig. 4.1 shows the results.

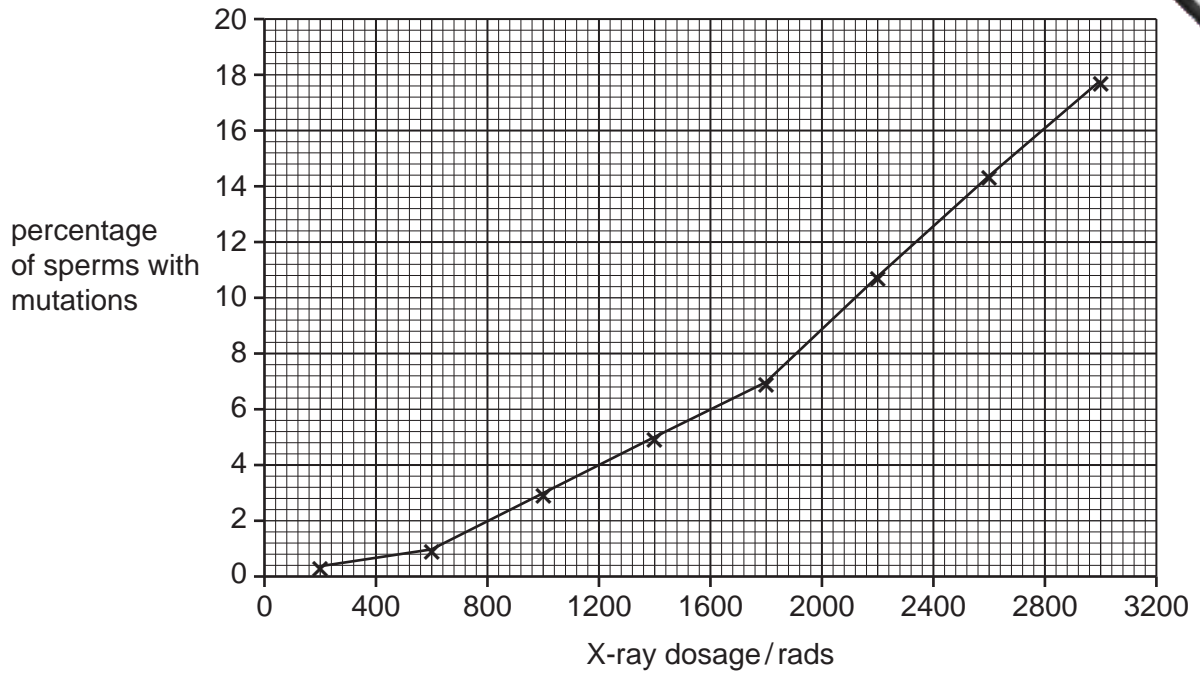


Fig. 4.1

- (a) State what is meant by a *mutation*.

.....
 [1]

- (b) (i) Using Fig. 4.1, describe the effect of increasing the X-ray dosage on the percentage of mutated sperm.

.....

 [2]

- (ii) Explain this effect.

.....

 [2]

(c) Fruit flies have four pairs of chromosomes in their cells.

Some of the mutations in the experiment above involved the loss of one chromosome.

If a fruit fly sperm that had lost one chromosome fertilised a normal egg, how many chromosomes would there be in the zygote?

..... [1]

(d) Explain why a mutation that occurs in a gamete-forming cell is more likely to be harmful than one that occurs elsewhere in a fruit fly's body.

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

(e) Insects can be serious pests, for example by carrying disease or eating crops. Pesticides can be used to kill them, but many people are concerned about the harm that pesticides do and are trying other methods of controlling insect populations.

One new method that is being tested is to expose a large number of male insects of a harmful species to X-rays and then release them into the wild.

(i) Explain why people are concerned about the use of pesticides.

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

(ii) Suggest how the new method might reduce the population of the harmful insects.

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

5 (a) Glucose and starch are carbohydrates.

(i) The chemical formula of glucose is $C_6H_{12}O_6$.

State the total number of atoms which are combined in one molecule of glucose.

..... [1]

(ii) Explain why it is not possible to write a simple chemical formula for starch.

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

(b) Fig. 5.1 shows an experiment which was set up to investigate the action of a partially permeable membrane. A tube made from a partially permeable membrane was filled with iodine solution and placed into a beaker containing a mixture of glucose, starch and water.

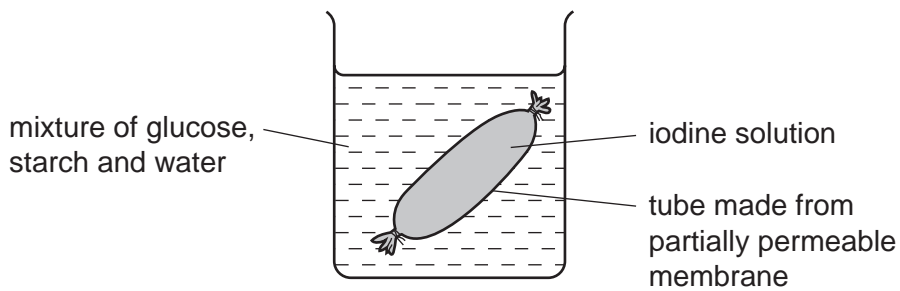


Fig. 5.1

(i) Explain the following observations which were made some time later.

The solution **inside** the tube gave a positive result with Benedict's solution.

.....
.....
.....

The solution **outside** the tube became blue-black in colour.

.....
.....
..... [4]

(ii) Predict and explain whether the solution **inside** the tube became blue-black colour.

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

(c) Plastics are materials made mainly from polymer molecules. Fig. 5.2 shows part of a polymer molecule. Molecules of this polymer are formed by addition polymerisation of an unsaturated monomer.

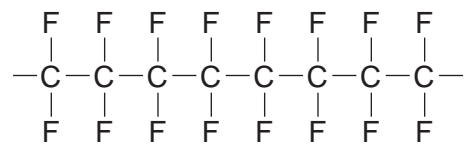


Fig. 5.2

(i) Draw the displayed formula of one of the monomer molecules which have joined to form this polymer.

[2]

(ii) Two different plastics, **A** and **B**, were heated. Plastic **A** melted easily but plastic **B** did not melt even when heated to a very high temperature.

Explain these observations. You may draw some simple diagrams to help your answer.

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

6 Fig. 6.1 shows a circuit containing four ammeters, **A₁**, **A₂**, **A₃** and **A₄**.

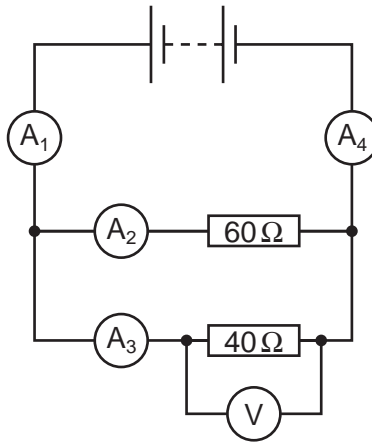


Fig. 6.1

Table 6.1 shows the readings on each ammeter.

Table 6.1

ammeter	reading on ammeter / amps
A₁	
A₂	0.2
A₃	0.3
A₄	0.5

(a) What is the reading on ammeter **A₁**?

..... [1]

(b) Calculate the combined resistance of the two resistors in the circuit in Fig. 6.1.

State the formula that you use and show your working.

formula used

working

..... [3]

(c) Fig. 6.2 shows a magnet and coil of wire connected to a sensitive ammeter.

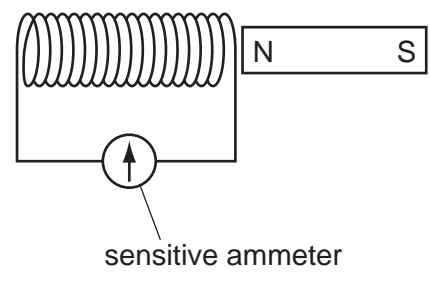


Fig. 6.2

(i) When the magnet is moved into the coil, the needle on the ammeter shows a deflection to the left.

Explain why a reading on the ammeter is produced.

.....

.....

..... [2]

(ii) Explain how this effect is used in a dynamo to produce an output voltage. You may use a diagram to help with your answer.

.....

.....

.....

.....

.....

..... [4]

For
winner's

7 Fig. 7.1 shows a pyramid of numbers for a food chain.

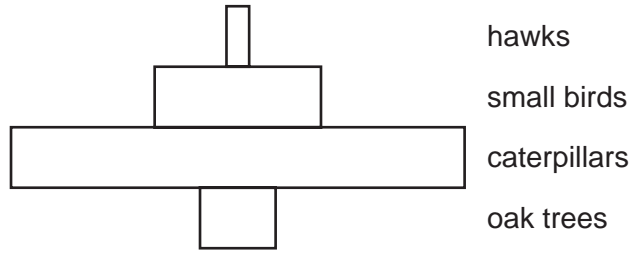


Fig. 7.1

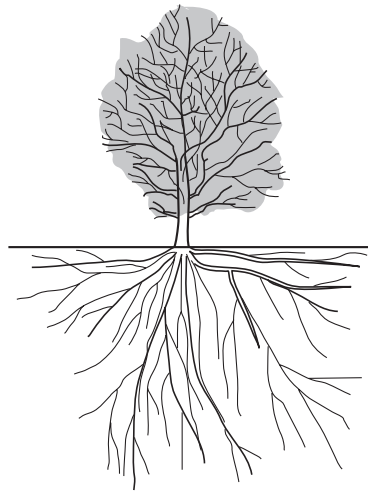
(a) Explain why the pyramid of numbers is this shape.

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

(b) Oak trees are the producers in this food chain. Describe how they transfer energy from sunlight into chemical energy that can be passed along the chain.

.....
.....
.....
.....
.....
.....
.....
..... [4]

(c) An oak tree can be many metres tall.



Describe and explain how water from the soil is transported up to the leaves at the top of the tree.

.....

.....

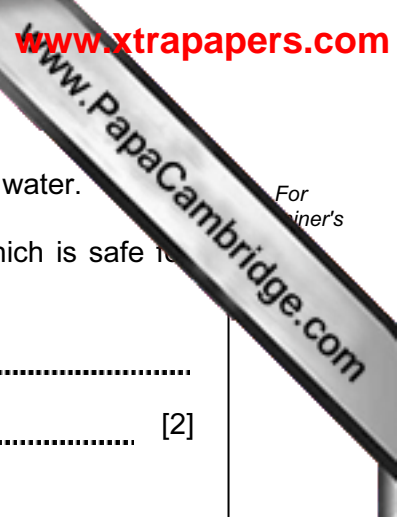
.....

.....

.....

.....

[3]



For
winner's

8 In many countries supplies of clean water for drinking are obtained from river water.

(a) State two processes that are used to convert river water into water which is safe for humans to drink.

- 1.
- 2. [2]

(b) A sample of safe drinking water still contained dissolved calcium sulphate, CaSO₄, which helped to make the water hard.

(i) State the formula of the particle present in this water which causes hardness.
..... [1]

(ii) A student carried out an experiment to find out if boiling would remove the hardness from this sample of water.

The results of his experiment are shown in Table 8.1.

Table 8.1

water sample	volume of water tested / cm ³	volume of soap solution needed for lather / cm ³
distilled water	25.0	0.2
hard water control (unboiled)	25.0	8.0
hard water boiled for 5 minutes	25.0	3.0
hard water boiled for 10 minutes	25.0	3.0

What conclusions could the student draw from these results?

-
-
-
- [2]

- (c) Some types of salt used to flavour food are mixtures of sodium chloride and potassium chloride. Sodium chloride and potassium chloride are both ionic compounds.
- (i) Potassium chloride can be formed by reacting potassium directly with chlorine. Fig. 8.1 shows the electron arrangements in a potassium atom and a chlorine atom.

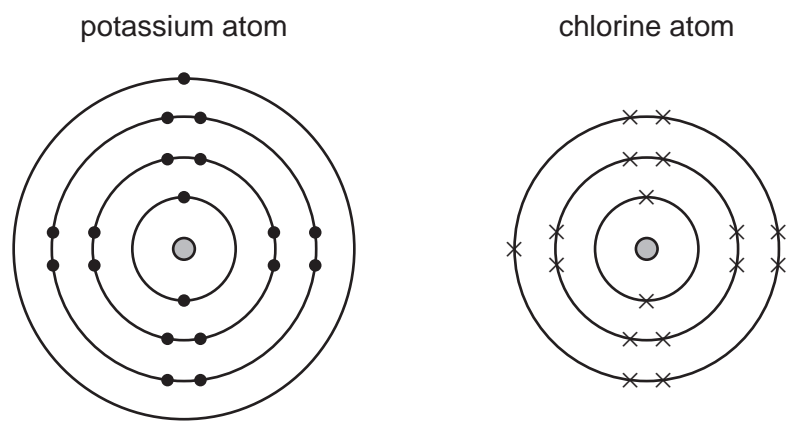


Fig. 8.1

In the space below, draw diagrams similar to those in Fig. 8.1 which show the electron arrangements of the two particles when combined in potassium chloride.

[2]

- (ii) Explain briefly why potassium chloride is a solid with a high melting point at room temperature.

.....

.....

..... [2]



9 A police car uses a siren and a blue light to alert people.

(a) (i) Explain why sound needs a medium, such as air, to travel through.

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

(ii) How will the sound of the siren change if the amplitude of the sound waves emitted is increased?

..... [1]

(iii) Suggest a suitable frequency for the sound emitted by the siren to alert people.

..... [1]

(b) The police communicate using radio waves. Both blue light and radio waves are part of the electromagnetic spectrum.

(i) State **one** property which all electromagnetic waves have in common.

..... [1]

(ii) State **one** difference between blue light waves and radio waves.

..... [1]

(iii) The radio waves used have a frequency of 10 000 000 Hz and a wavelength of 30 m.

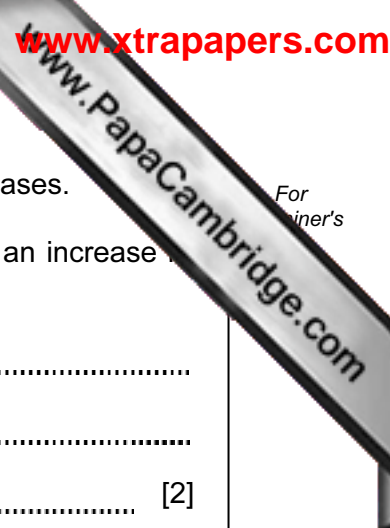
Calculate the speed of these waves.

State the formula that you use and show your working.

formula used

working

..... [2]



(c) As the police car drives along the temperature of the air in the tyres increases.

(i) Use the ideas of the kinetic theory to explain why this will result in an increase in tyre pressure.

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

(ii) The original temperature of the air in the tyres was 10°C and the final temperature was 30°C.

Calculate the final pressure of the air in the tyres if the original pressure was 200 000 N/m².

State the formula that you use and show your working.

formula used

working

..... [3]

DATA SHEET
The Periodic Table of the Elements

		Group																																																																		
I	II	III	IV	V	VI	VII	0					0																																																								
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	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	101 Ru Ruthenium 44	106 Pd Palladium 46	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	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	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	210 Rn Radon 86	226 Ra Radium 88	227 Ac Actinium 89	†
												140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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	238 U Uranium 92	238 Pa Protactinium 91	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 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.).

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