

Centre Number	Candidate Number	Name
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

COMBINED SCIENCE

0653/03

Paper 3

May/June 2004

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.

For Examiner's Use	
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Total	

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.

1 Gasoline is a liquid hydrocarbon fuel. Fig. 1.1 shows a gasoline fire.

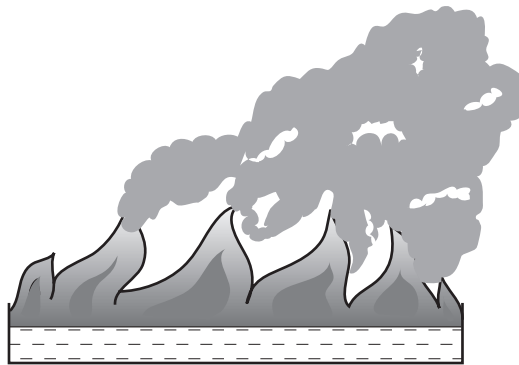


Fig. 1.1

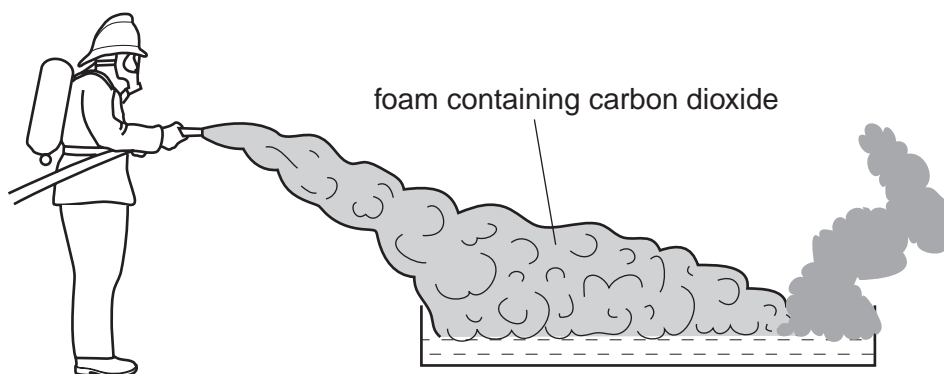
(a) (i) State the meaning of the term *hydrocarbon*.

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

(ii) In a plentiful supply of air many hydrocarbons burn with an almost invisible flame. Suggest why the fire in Fig. 1.1 produced clouds of black smoke.

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

(iii) A fire-fighter sprays foam containing carbon dioxide over the fire in order to put it out.



Explain why the fire goes out.

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

(b) The balanced equation in Fig. 1.2 shows the complete combustion of ethene. The substances involved are shown as displayed (graphical) formulae.

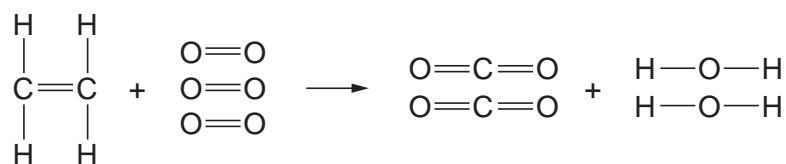


Fig. 1.2

(i) Rewrite the equation as a normal balanced equation using molecular formulae.

.....[2]

(ii) Explain why this equation is said to be *balanced*.

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

(iii) On Fig. 1.2 indicate with the letter **B** and a labelling line **one** of the chemical bonds which is broken in the reaction. [1]

(iv) On Fig. 1.2 indicate with the letter **M** and a labelling line **one** of the chemical bonds which is formed in the reaction. [1]

- 2 A student measured the pH of the water in two lakes, lake X and lake Y. The water in lake X had a pH of 5.4, while the water in lake Y had a pH of 6.8.

The student made a survey of the animals living in each lake. He took the same number and size of water samples from each lake, and identified every species of animal which he found. He then counted how many individual animals he found that belonged to each species.

Table 2.1 summarises his results.

Table 2.1

species	number of individuals in lake X	number of individuals in lake Y
A	58	12
B	0	6
C	93	15
D	0	2
E	6	22
F	1	0
G	0	3
H	0	1
I	61	6
J	0	2

- (a) Which lake had the higher species diversity? Explain your answer.

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

(b) Both lakes were in areas where acid rain of pH3 regularly fell. However, lake Y was in an area where the rocks were mostly limestone.

(i) What evidence did the student find which suggests that the acid rain had less effect on the water in lake Y than in lake X?

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

(ii) Suggest why the acid rain had less effect on the water in lake Y than in lake X.

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

(c) Explain why removing sulphur from fossil fuels can help to reduce the problems caused by acid rain.

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

(d) Soil erosion is another problem which can harm communities of organisms living in lakes. Soil washed off the land into a lake can form a suspension in the water, preventing light from passing through.

Explain how this would disrupt the food web in the lake.

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

3 Fig. 3.1 shows a weightlifter.

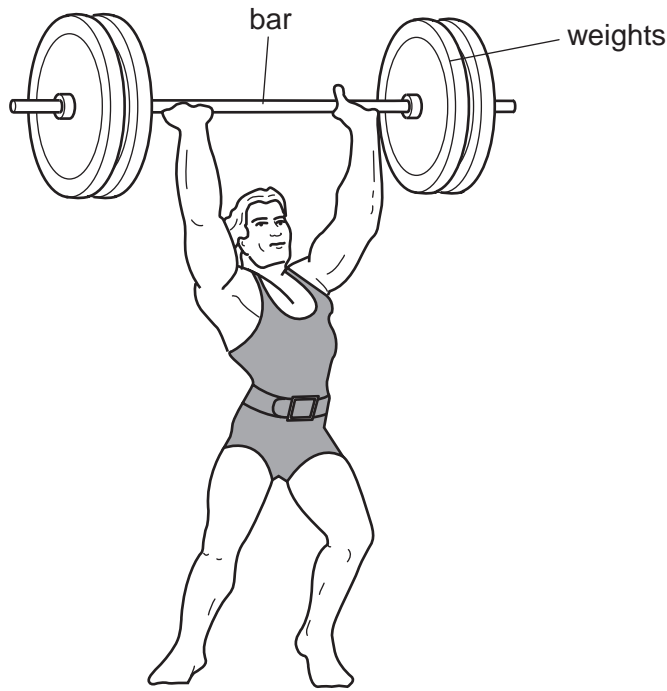


Fig. 3.1

(a) The total weight lifted by the weightlifter is 1600 newtons, which he lifts through 2 metres in 0.5 seconds.

(i) Calculate the work done on the bar and weights.
Show your working and state the formula that you use.

formula

working

.....[2]



- (ii) Calculate the power developed by the weightlifter while lifting the bar and weights. Show your working and state the formula that you use.

formula

working

.....[2]

- (b) (i) What form of energy has been gained by the bar and weights as a result of lifting them?

.....[1]

- (ii) The weightlifter suddenly drops the bar and weights, and the energy gained in (i) is now transferred to another form. Name this form of energy.

.....[1]

4 The element chlorine is an important substance used in the manufacture of many products including bleaches and sterilising agents.

(a) Explain why experiments involving chlorine must always be carried out in a fume cupboard.

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

(b) Two bleaches, STAINAWAY and SUPERWHITE contain chlorine that is easily released from solution. They are tested in a laboratory to find out which contains the greater amount of chlorine.

A chemist carries out the test shown in Fig. 4.1. She adds 1.0 cm³ of bleach to 10.0 cm³ of excess sodium iodide solution.

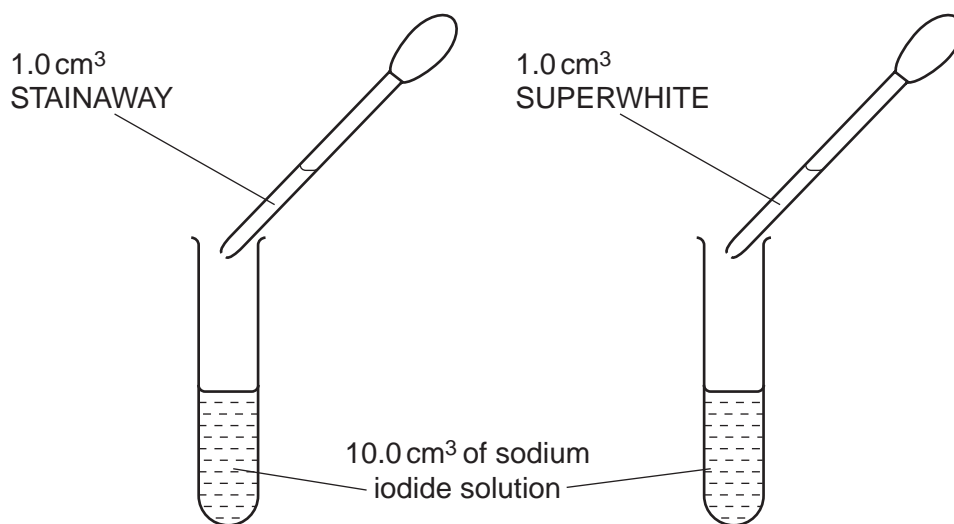


Fig. 4.1

The observations made by the chemist are shown in Table 4.1.

In both tests, the mixture changes colour from colourless to brown because iodine is formed.

Table 4.1

bleach	colour of mixture
STAINAWAY	dark brown
SUPERWHITE	light brown

(i) Explain briefly why iodine is formed in these reactions.

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

(ii) Explain how the observations allow the chemist to decide which bleach contains the greater amount of chlorine.

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

(c) (i) Draw a diagram of a chlorine molecule, showing how all of the outer shell electrons are arranged.

[2]

(ii) Name the type of chemical bond you have drawn in (i).

.....[1]

5 A farmer grows fruit that he sells to a supermarket. The supermarket wants the fruit to contain high concentrations of vitamin C.

The supermarket buyer has a simple test kit which she uses to test the vitamin C content of the fruit. She tells the farmer that fruit from trees with the genotype **AA** or **Aa** is high in vitamin C. Fruit from trees with the genotype **aa** is low in vitamin C.

The farmer decides to breed from some of his trees, to produce a large number of trees which all produce fruit high in vitamin C.

(a) (i) State the genotype of the trees which the farmer should use for breeding, in order to be sure that all of the offspring have fruit which is high in vitamin C.

.....[1]

(ii) Using genetic diagrams, explain how he can carry out a test cross to find out whether the genotype of a tree is **AA** or **Aa**.

(b) The buyer from the supermarket suggests that it would be better if the propagated the trees asexually, rather than sexually.

Is she correct? Explain your answer.

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

(c) Explain why it is good for people to eat fruit that is high in vitamin C.

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

6 (a) There are three states of matter – solid, liquid and gas.

Fig. 6.1 shows the arrangement of particles in a liquid.

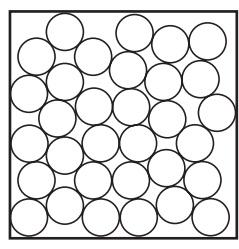
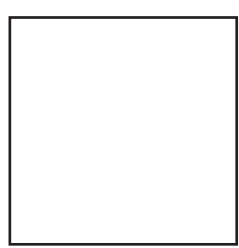
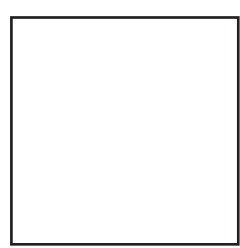


Fig. 6.1

Draw similar diagrams for a solid and a gas.



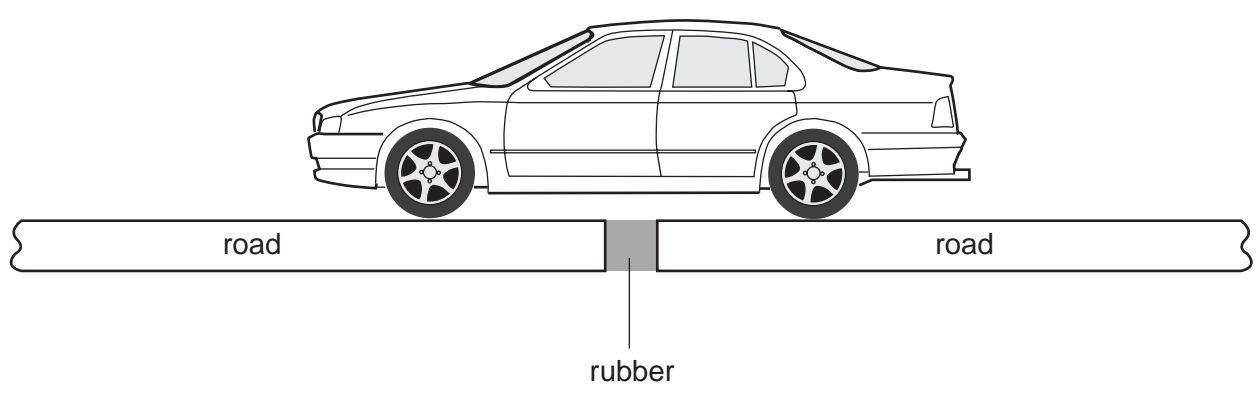
solid



gas

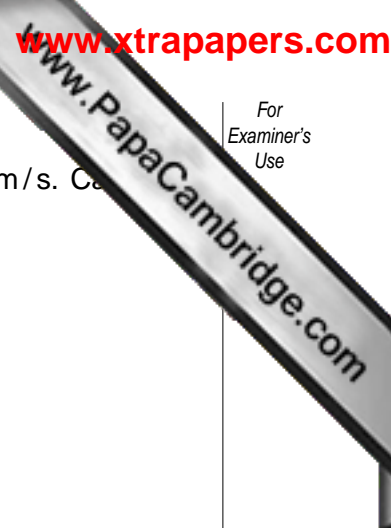
[2]

(b) A long bridge is made in sections, with gaps between each section. The gaps are filled with rubber.



(i) Suggest why these gaps are left.

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



(ii) The gaps are left every 50 m. A car travels over the bridge at 20 m/s. Calculate how long the car will take to travel from one gap to the next.

Show your working and state the formula that you use.

formula

working

.....[2]

(c) Answer the following in terms of *conduction*, *convection* and *radiation*.

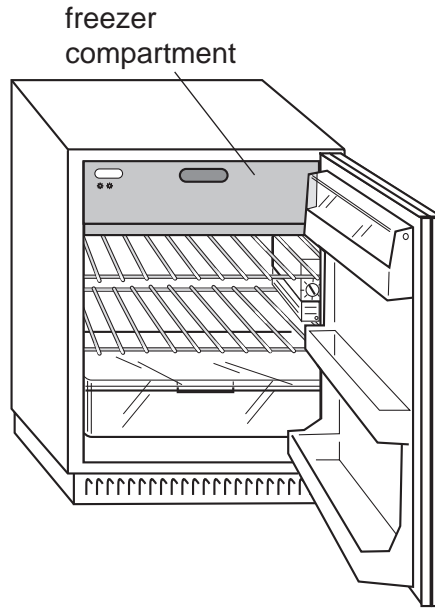
(i) Cooking pans often have handles made of plastic or wood. Why do these help to prevent you burning your hand when using the pan?

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

(ii) On a sunny day your body gets hotter when wearing a black shirt than when wearing a white shirt. Explain why this happens.

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

- (iii) In a refrigerator, the freezer compartment is usually placed at the top. Why does this help the working of the refrigerator?



.....

.....[2]

7 The air is a mixture of many substances.

(a) Complete Table 7.1 which shows information about substances in unpolluted air.

Table 7.1

substance	chemical formula of molecules	approximate % in air
nitrogen		
oxygen		

[3]

(b) Fig. 7.1 shows apparatus which can be used to measure the percentage of oxygen in 100 cm³ of air.

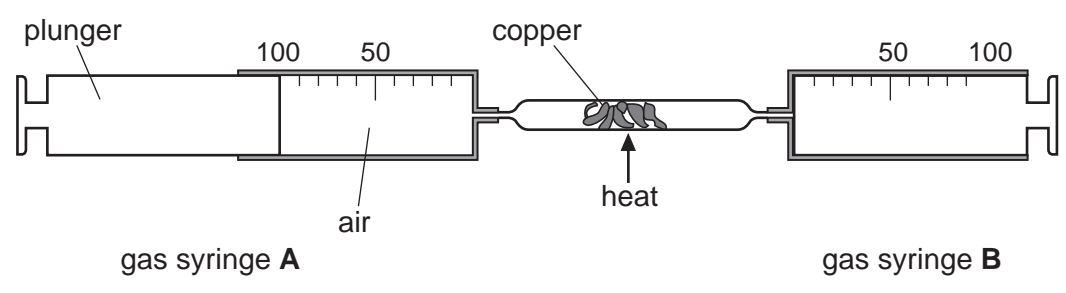


Fig. 7.1

When the plunger of gas syringe A is pushed into the syringe, the air flows through the tube containing the heated copper and fills gas syringe B. During the experiment oxygen reacts with the hot copper forming copper(II) oxide.

(i) Describe how the apparatus is used to measure the percentage of oxygen in air.

.....

.....

.....

.....

.....

.....

.....

.....

[3]

(ii) During the reaction oxygen atoms are reduced to oxide ions.
In the boxes below draw an oxygen atom and an oxide ion, showing all of its electrons in each particle.

oxygen atom	oxide ion

[2]

(iii) State the electrical charge of the oxide ion you have drawn in (ii).

.....[1]

(iv) State, in terms of electrons, why the change of an oxygen atom into an oxide ion is called *reduction*.

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



8 (a) Fig. 8.1 shows some red blood cells in a concentrated glucose (sugar) solution.

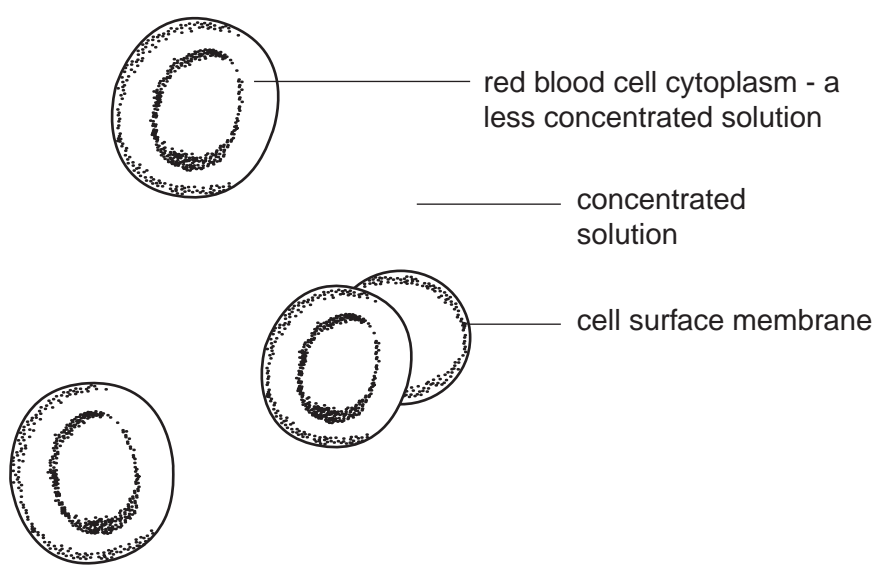


Fig. 8.1

Using your knowledge of osmosis, explain what will happen to the red blood cells.

.....

.....

.....[2]

(b) In the body, red blood cells are surrounded by blood plasma. The glucose concentration in the plasma is kept constant.

(i) Explain how the blood glucose concentration is brought down to normal if it rises too high.

.....

.....

.....

.....[3]

(ii) State the term which is used to describe the maintenance of constant internal conditions in the body.

.....[1]

(c) Blood glucose concentration usually rises a few hours after we eat food containing starch.

Explain how this happens.

.....

.....

.....

.....[3]



9 (a) Fig. 9.1 shows a circuit containing three identical resistors.

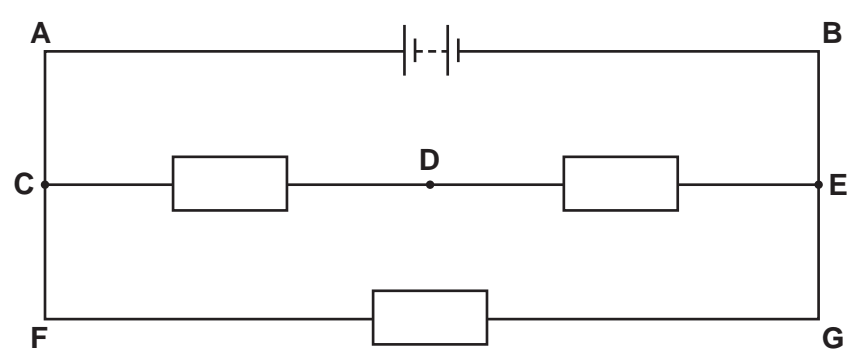


Fig. 9.1

A voltmeter connected across **AB** reads 6 V.
State the voltmeter reading when connected across

CD

FG [2]

(b) Draw a circuit diagram, using correct symbols, for a circuit with a cell, a switch, a lamp, a motor and a variable resistor that controls the speed of the motor but does not affect the brightness of the lamp.

[3]

(c) A student is given 3 resistors 2 Ω, 2 Ω and 4 Ω.

Explain how he could connect 2 or 3 of these resistors to produce a combined resistance of

(i) 6 Ω,

[2]

(ii) 1 Ω.

[2]

DATA SHEET
The Periodic Table of the Elements

		Group																																																																				
I	II	III	IV	V	VI	VII	0																																																															
7 Li Lithium 4	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 12	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 20	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 38	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	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	131 Xe Xenon 54	133 Cs Caesium 56	137 Ba Barium 56	139 La Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	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	210 Po Polonium 84	210 At Astatine 85	226 Ra Radium 88	227 Ac Actinium 89	227 Fr Francium 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	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 Pa Protactinium 91	238 U Uranium 92	238 Pu Plutonium 94	238 Np Neptunium 93	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

8-71 Lanthanoid series
90-103 Actinoid series

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.).