Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

COMBINED SCIENCE **0653/03**

Paper 3

October/November 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.

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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Total	

This document consists of **19** printed pages and **1** blank page.

1 **(a)** Blood contains red cells, white cells and platelets.

(i) Describe how you can recognise red blood cells, apart from their colour, if you are looking at a blood sample using a microscope.

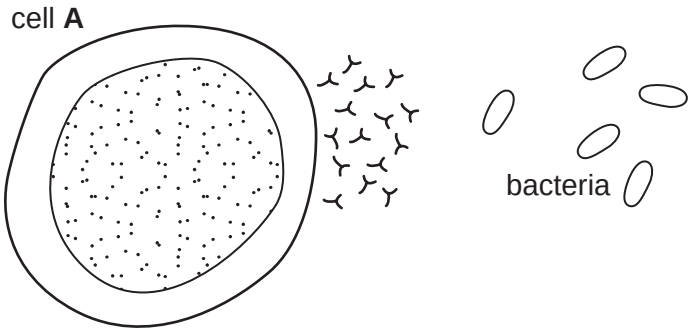
.....

.....[1]

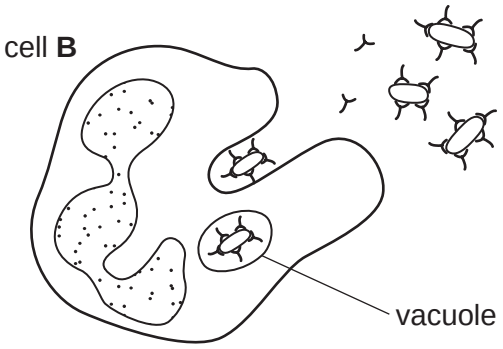
(ii) What is the function of platelets?

.....[1]

(b) White blood cells can destroy harmful micro-organisms. Fig. 1.1 shows how two different types of white blood cells work together to destroy bacteria in a person's body.



Cell **A** detects the bacteria and secretes specific molecules.



The molecules attach to the bacteria. This makes it easier for cell **B** to detect and destroy them.

Fig. 1.1

(i) Name

cell **A**, ...

cell **B**, ...

the molecules secreted by cell **A**. ..... [3]

(ii) The first time that a person is infected by a particular kind of bacterium he may become ill. However, if these bacteria get into the body a second time, the person will probably be immune to this illness.

Explain how the person becomes immune.

.....

.....

.....

.....[2]

(iii) Cell **B** secretes enzymes into the vacuole containing the bacteria. These include proteases.

Suggest how proteases can help to destroy the bacteria.

.....

.....

.....[2]

2 Fig. 2.1 shows apparatus that a student used to study the rate of reaction when hydrogen peroxide decomposes.

The equation for this reaction is shown below.

hydrogen peroxide ⟶ water + oxygen

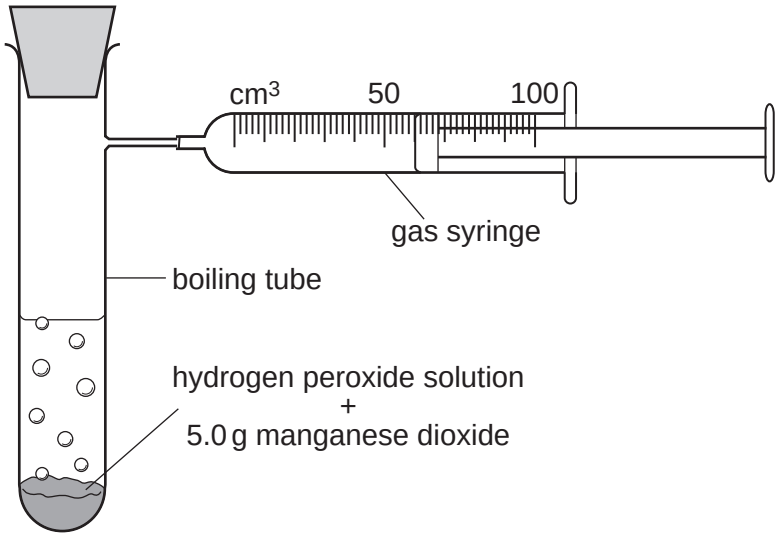


Fig. 2.1

The student added 5.0 g of the insoluble solid manganese dioxide which acted as a catalyst.

(a) Describe how the student could test the gas produced in this reaction to show that it is oxygen.

.....

.....[2]

(b) When the reaction was complete, the student separated the substances which were left in the boiling tube. Fig. 2.2 shows the result of the separation.

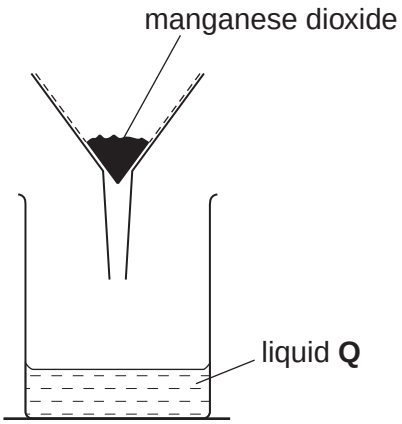


Fig. 2.2

(i) Name the method of separation shown in Fig. 2.2.

.....[1]

(ii) Name liquid **Q**.

.....[1]

(iii) Predict the mass of dry manganese dioxide which the student obtained and explain your answer.

mass .....

explanation .....

.....[2]

[Turn over

(c) Fig. 2.3 shows the results of three experiments, **A**, **B** and **C**, which the student obtained using the apparatus in Fig. 2.1. In each experiment the mass of manganese dioxide and the volume and concentration of hydrogen peroxide solution were kept constant.

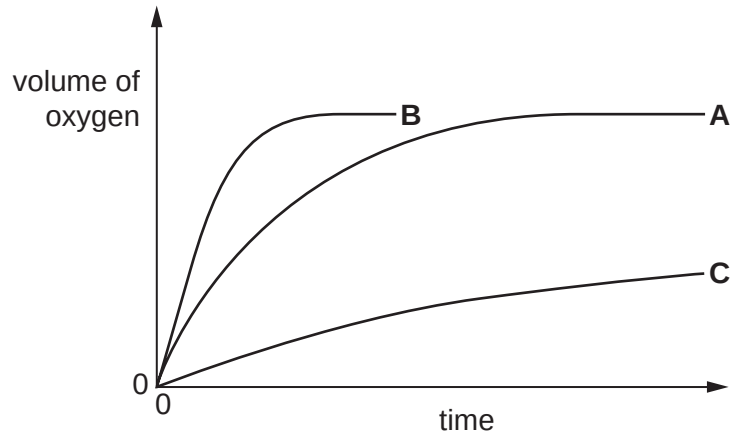


Fig. 2.3

(i) Explain how the results shown in Fig. 2.3 show that the rate of reaction was the lowest for experiment **C**.

.....

.....[1]

(ii) Explain which experiment, **A**, **B** or **C**, used manganese dioxide which had the highest surface area.

.....

.....

.....

.....

.....[2]

3 **(a)** Fig. 3.1 shows a soft iron ring. Two coils, **X** and **Y**, each of 200 turns are wound around the ring. Coil **X** is connected to a power supply and coil **Y** is connected to a 12 V lamp.

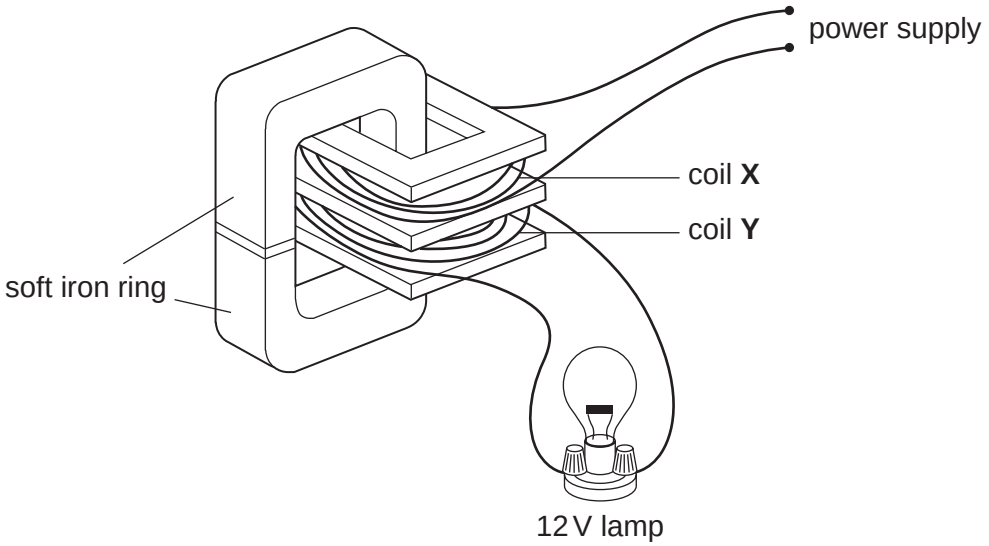


Fig. 3.1

Describe and explain what happens to the lamp when

(i) the power supply is 12 V a.c.

.....

.....

(ii) the power supply is 12 V d.c.

.....

.....[3]

(b) Electricity is transmitted at a very high voltage and relatively low current. This is because it is cheaper than sending it at a lower voltage and higher current. Explain why it is cheaper.

.....

.....

.....[1]

(c) Fig. 3.2 shows a bicycle with lights and reflectors.

Fig. 3.2

Fig. 3.3 shows a circuit used to power the two lamps on the bicycle from one battery.

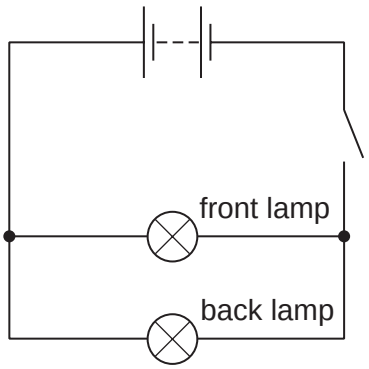


Fig. 3.3

(i) What is the name given to this method of connecting two lamps together?

.....[1]

(ii) If the filament in the back lamp breaks, current can no longer flow through the lamp. Will the front lamp stay alight or go out? Explain your answer.

.....

.....[1]

(iii) The resistance of each lamp in this circuit is 4 ohms. Calculate the combined resistance of the two lamps. Show your working and state the formula that you use.

formula used

working

.....[2]

(d) Another method of connecting the lamps is shown in Fig. 3.4.

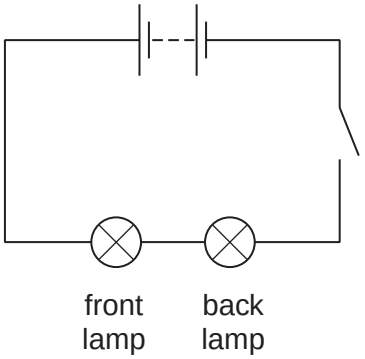


Fig. 3.4

(i) In this circuit, what happens to the front lamp if the filament in the back lamp breaks?

Explain your answer.

.....[1]

(ii) State the combined resistance of the two lamps in this circuit.

.....[1]

[Turn over

(e) The reflectors on bicycles are made of clear red plastic and use the idea of total internal reflection.

Fig. 3.5 shows light hitting part of a reflector.

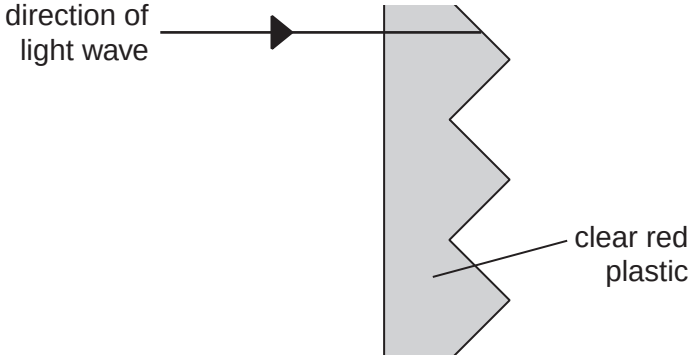


Fig. 3.5

Complete the diagram above to show how light leaves the reflector. [2]

4 Fig. 4.1 shows an insect-pollinated flower.

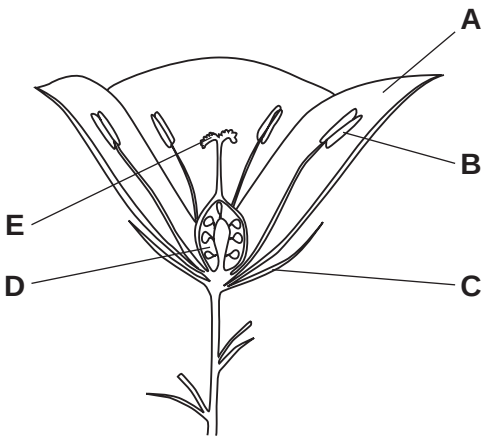


Fig. 4.1

(a) Give the **letter** of the part of the flower which

attracts insects to the flower; .....

contains the female gametes. ..... [2]

(b) Describe how this flower could be pollinated.

.....

.....

.....

.....[3]

(c) **(i)** Describe how the stamens of a wind-pollinated flower would differ from the stamens of the flower in Fig. 4.1.

.....

.....[1]

(ii) Wind-pollinated flowers tend to produce much larger quantities of pollen than insect-pollinated flowers.

Suggest a reason for this difference.

.....

.....

.....[2]

(d) The type of reproduction which involves flowers is sexual reproduction.

Explain **one** advantage to a plant of sexual reproduction, as compared to asexual reproduction.

.....

.....

.....[2]

5 Malachite is a compound of copper found in the Earth's crust. The chemical formula of malachite is $Cu_2CO_3(OH)_2$.

(a) (i) State the number of different elements shown in the formula of malachite.

.....[1]

(ii) State the total number of atoms shown in the formula of malachite.

.....[1]

(b) (i) The formulae of four substances are shown below. Underline the formula of the substance that does **not** react with dilute hydrochloric acid to form copper chloride solution.

CuO Cu $CuCO_3$ $Cu(OH)_2$ [1]

(ii) Copper chloride solution contains copper ions, Cu^{2+}, and chloride ions, Cl^-.

Explain why the formula of copper chloride is $CuCl_2$.

.....

.....[1]

(c) Table 5.1 shows the results obtained by a student who added small pieces of different metals to copper chloride solution.

Table 5.1

metal added	observations
magnesium	• magnesium dissolves • brown insoluble solid produced
silver	no reaction
zinc	• zinc dissolves • brown insoluble solid produced

Explain why magnesium and zinc reacted but silver did not.

.....

.....[1]

(d) Fig. 5.1 shows the electrolysis of copper chloride solution. In this process copper forms on one of the electrodes and chlorine is produced at the other.

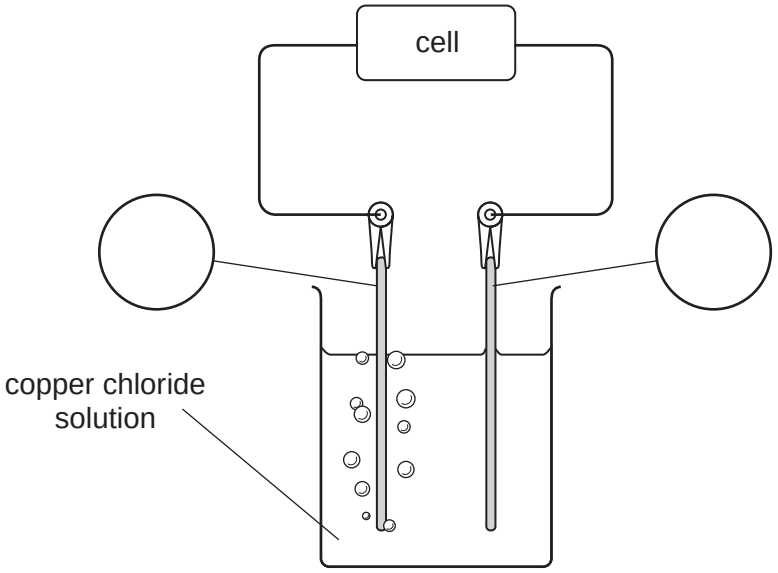


Fig. 5.1

(i) Show the electrical charges of the electrodes by writing the symbols + and − in the circles and explain your answer.

.....

.....

.....[2]

(ii) In this process copper ions, Cu^{2+}, are changed into copper atoms, Cu. Explain the difference, in terms of electrons, between a copper ion and a copper atom.

.....

.....

.....[2]

6 Penguins can swim underwater. When swimming, they can accelerate from 0 m / s to 6 m / s in 1.0 s.

Seals can accelerate from 0 m / s to their maximum speed of 2 m / s in 0.6 s.

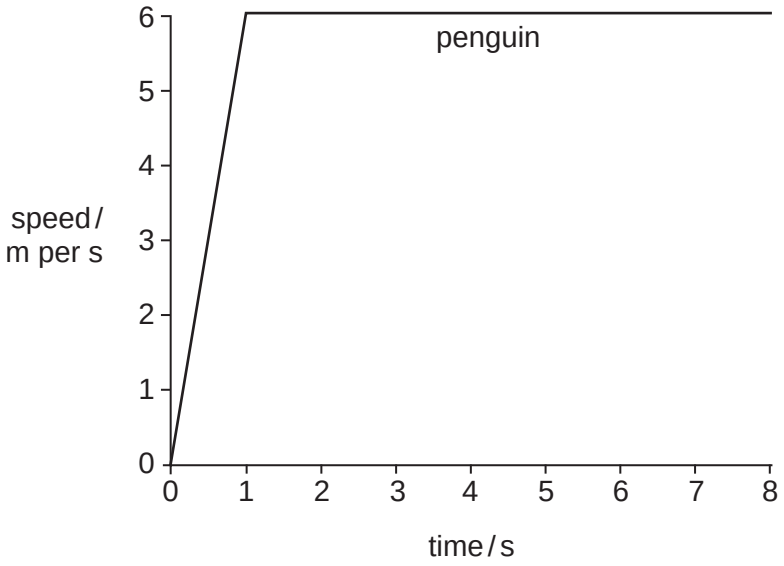
(a) The acceleration of a penguin is 6 m / s^2. Calculate the acceleration of a seal. Show your working and state the formula that you use.

formula used

working

.....[2]

(b) Fig. 6.1 shows the speed-time graph for a penguin starting from rest. On the same axes draw a speed-time graph for a seal starting from rest.



[2]

Fig. 6.1

(c) A seal starts to chase a penguin. The penguin immediately swims away.

The seal and the penguin are both at rest before the chase starts.

Use your graph to determine how much further the penguin will travel than the seal in the first four seconds of the chase. Show your working.

.....[3]

7 Fig trees grow in tropical rainforests. Fig trees provide food for monkeys and birds such as toucans. These animals may be eaten by eagles.

(a) Construct a food web showing the feeding relationships between these four organisms.

[2]

(b) Fig trees are the producers in this food web.

Describe how plants such as fig trees transfer energy from sunlight into chemical energy.

.....

.....

.....

.....[3]

(c) Food chains rarely have more than four or five links in them.

Explain why this is so.

.....

.....

.....[2]

(d) Tropical rainforests in many parts of the world are being destroyed by logging. Give **two** reasons why the conservation of tropical rainforests is important.

.....

.....

.....

.....[2]

8 The metallic element potassium and the non-metallic element chlorine react together to form the compound potassium chloride.

(a) Complete Table 8.1 by writing names of substances in the left-hand column, chosen from the list below.

potassium **chlorine** **potassium chloride**

Table 8.1

substance	description
	used to kill harmful micro-organisms in water
	reacts with water to form an alkali
	dissolves in water to form an electrolyte

[2]

(b) Fig. 8.1 shows a diagram of a chlorine atom.

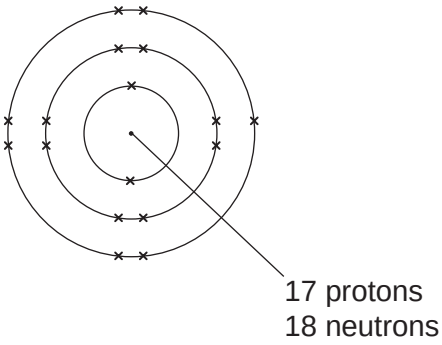


Fig. 8.1

(i) State the number of **complete** electron energy levels shown in the atom in Fig. 8.1.

.....[1]

(ii) Explain why this atom is electrically neutral.

.....

.....[1]

(c) Chlorine joins with hydrogen to make the covalent compound, hydrogen chloride.

(i) Write the balanced symbolic equation for the reaction.

.....[2]

(ii) Draw a diagram of a hydrogen chloride molecule showing how the outer electrons are arranged.

[2]

Question 9 is found on page 18

[Turn over

9 Explain each of the following.

(a) Alpha and beta radiations are affected by electric fields but gamma radiation is not.

.....

.....

.....[1]

(b) Used aerosol cans may explode if they are thrown into a fire.

.....

.....

.....[1]

(c) The heater element in a kettle is placed at the bottom of the kettle but all the water reaches boiling point.

.....

.....

.....

.....

.....[2]

(d) A satellite is able to orbit the Earth without falling to its surface.

.....

.....

.....

.....

.....[3]

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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.).