UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

6738300848

COMBINED SCIENCE **0653/21**

Paper 2 (Core) **May/June 2011**

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.
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 24.

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	
10	
Total	

This document consists of **21** printed pages and **3** blank pages.

UNIVERSITY of CAMBRIDGE International Examinations

For Examiner's Use

1 **(a)** A student carried out an experiment to find which substances in the environment caused nails made of mild steel to become rusty.

She selected three identical nails and placed them in sealed test-tubes, **A**, **B** and **C**, as shown in Fig. 1.1.

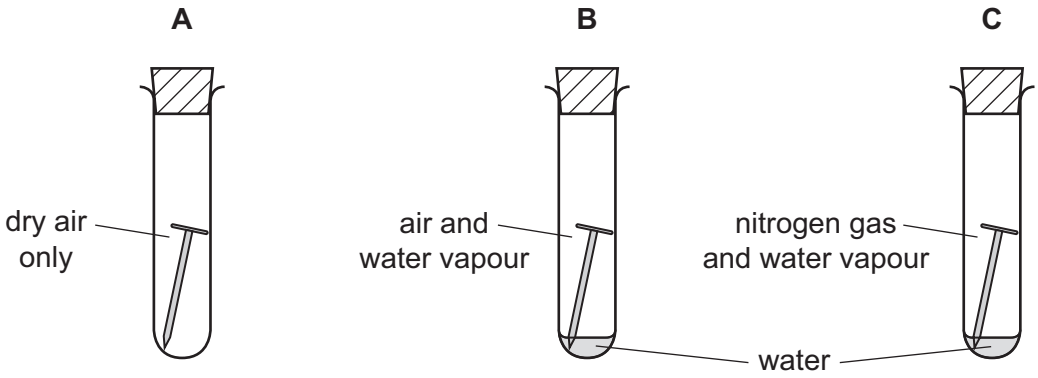


Fig. 1.1

The student observed that the nail in test-tube **B** was the only one to become rusty.

Explain why the nail in test-tube **B** in Fig. 1.1 rusted but the nails in the other two tubes did not.

.....

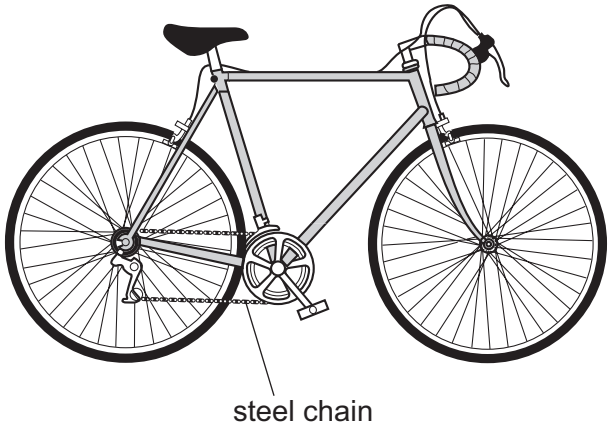
.....

.....

.....

..... [3]

(b) Bicycle chains that are made of steel are usually covered in oil made of hydrocarbon molecules. This helps to prevent rusting.



(i) State which of the chemical formulae, **V** to **Z**, represent hydrocarbons. Explain your answer.

V H_2OC

W C_2H_2

X $C_6H_{12}O_6$

Y $C_{10}H_{22}$

Z HCN

chemical formulae .....

explanation .....

..... [2]

(ii) Suggest **one** property of a hydrocarbon oil which makes it suitable for use as a barrier to prevent rusting.

..... [1]

(iii) Hydrocarbons have many uses.

State **one** important use of hydrocarbons, other than preventing rusting.

..... [1]

[Turn over

2 **(a)** Fig. 2.1 shows a crane powered by an electric motor.

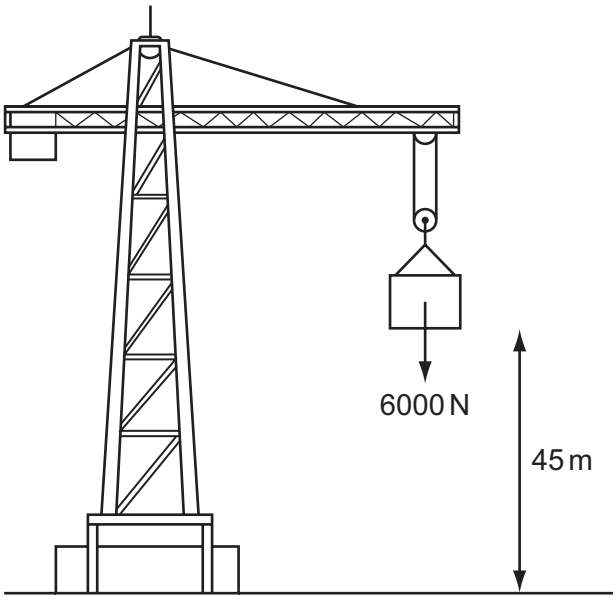


Fig. 2.1

Calculate the work done raising a load of 6000 N by a distance of 45 m.

State the formula that you use and show your working.

formula used

working

..... J [2]

(b) Fig. 2.2 shows the circuit used by a student to operate the electric motor of a model crane.

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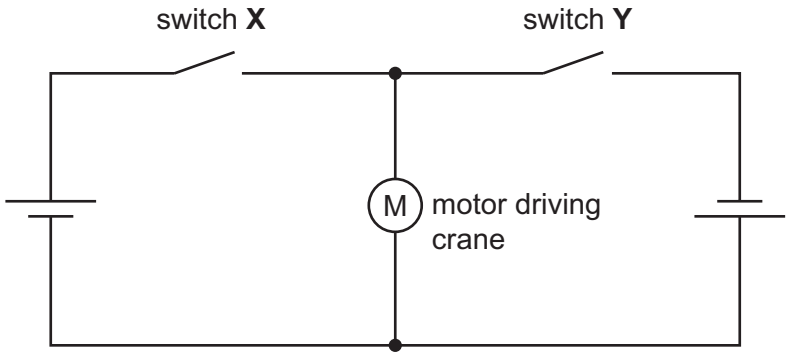


Fig. 2.2

When the student closes switch **X**, the motor runs and the crane is able to lift a load.

(i) The student then opens switch **X** and closes switch **Y**.

Describe what happens to the motor.

.....

.....

..... [2]

(ii) The student closes both switches. Describe what happens to the motor.

.....

..... [1]

3

The smell of food cooking is detected by special cells in a person's nose. The salivary glands may respond to this stimulus by secreting saliva.

(a) Name the receptor and the effector in this response.

receptor .....

effector ..... [2]

(b) When food has been taken into a person's mouth, it is mixed with saliva.

Saliva contains the enzyme amylase. Amylase digests large starch molecules to smaller sugar molecules.

(i) What is an *enzyme*?

.....

.....

..... [2]

(ii) Explain why digestion is necessary.

.....

.....

..... [2]

For Examiner's Use

(c) Fig. 3.1 shows a section through a molar tooth.

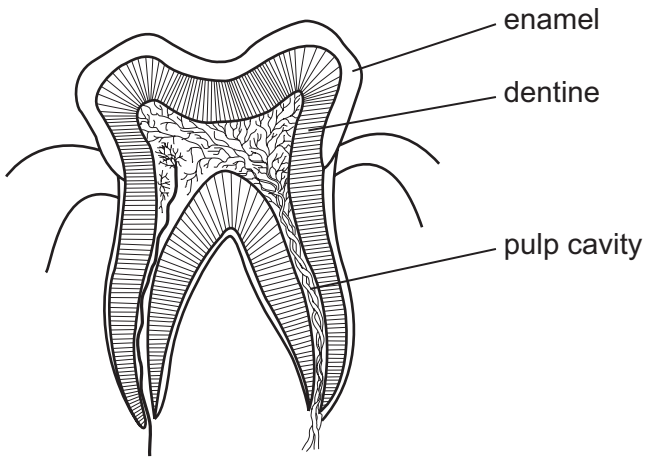


Fig. 3.1

(i) Describe how the molar teeth help in the digestion of food.

.....

.....

.....

..... [2]

(ii) Explain why a diet containing milk and other dairy foods can help to form strong teeth.

.....

.....

.....

..... [2]

For Examiner's Use

4 **(a)** **(i)** Use words from the list to complete the sentences below.

compounds **energy** **fission** **force** **fusion** **nuclei**

In nuclear power stations, the generation of electricity begins with the process of nuclear ..... . In this process, ... of atoms like uranium are split. Small amounts of uranium can release large amounts of ..... . [3]

(ii) Energy from nuclear fission can be converted into electrical energy. The first stage of this is the conversion of nuclear energy into heat energy.

Describe how heat energy is used to generate electrical energy in a power station.

.....

.....

.....

..... [3]

(b) Workers in nuclear power stations may be exposed to radiation from radioactive materials.

(i) Explain why exposure to such radiation may be hazardous to their health.

.....

.....

..... [2]

(ii) A badge made from photographic film can be used to check the exposure of the workers to radiation. Fig. 4.1 shows a worker wearing his badge.

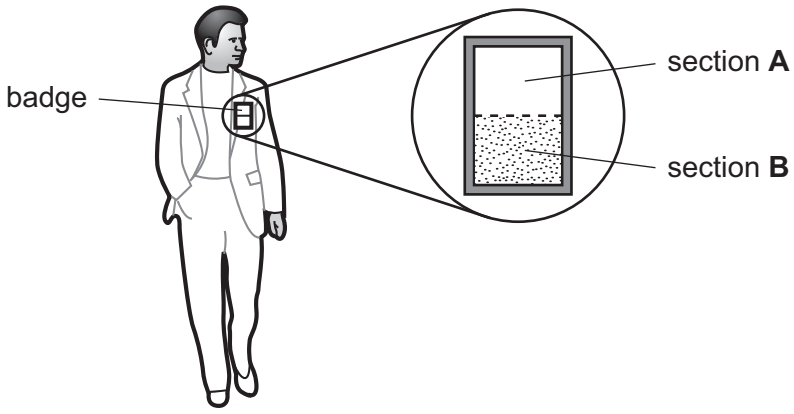


Fig. 4.1

A simple badge has two sections **A** and **B** for the detection of beta and gamma radiation. Fig. 4.2 shows the side view through the badge.

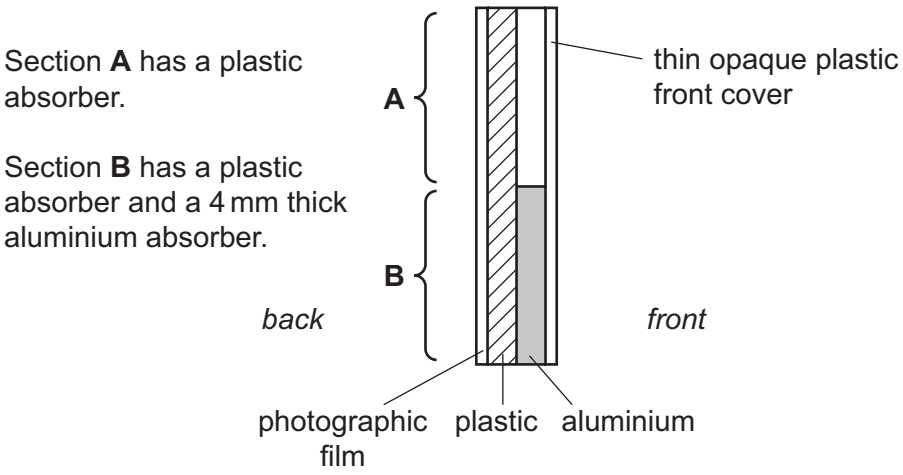


Fig. 4.2

When the photographic film from the badge is developed, it turns black where it has been exposed to radiation.

Complete Table 4.1 to show whether the photographic film will turn black when exposed to beta or gamma radiations.

Table 4.1

radiation	will section A turn black?	will section B turn black?
beta		
gamma	**yes**	

[2]

(iii) Explain why the badge can **not** be used to detect alpha radiation.

.....

..... [1]

5 Dung beetles live in places where large grass-eating animals, such as cattle, also live. The beetles collect dung produced by the cattle and make it into a ball, which they roll away and bury.

The beetles feed on the dung.

Fig. 5.1 shows a dung beetle rolling a ball of dung.

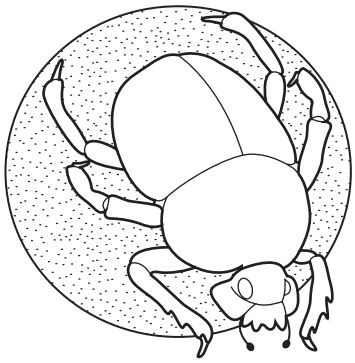


Fig. 5.1

(a) On the list below, draw lines to link each organism to its correct position in the food chain.

organism	**position in food chain**
dung beetle	producer
grass	consumer
cattle	decomposer

[2]

For Examiner's Use

(b) Dung beetles are important in the carbon cycle.

Choose some of the words in the list to complete the sentences about the carbon cycle.

carbon dioxide **digestion** **nitrogen** **oxygen**
photosynthesis **respiration** **roots** **stomata** **water**

Dung beetles digest dung, producing sugars that are absorbed into their blood. The sugars are taken into the dung beetles' cells, where they are broken down during ..... . This results in the release of ..... into the air. Plants absorb this gas through their ..... . The gas is then combined with water to make carbohydrates by ..... . [4]

(c) If a farmer keeps too many cattle in one place, the soil may be damaged.

Explain how keeping too many cattle can damage the soil.

.....

.....

.....

..... [2]

For Examiner's Use

6 The Earth provides raw materials which are processed into useful products.

(a) Choose products from the list to complete the right hand column of Table 6.1. The first one has been done as an example.

aluminium **ceramics** **chlorine** **glass** **steel**

Table 6.1

raw material	useful product
sand and metal oxides	glass
iron ore	
sodium chloride	

[2]

(b) Air is a **mixture** of elements and compounds.

Nitrogen dioxide, NO_2, is a **compound** of nitrogen and oxygen.

(i) State **two** differences between a mixture of two elements and a compound of the same elements.

1 .....

.....

2 .....

..... [2]

(ii) Air which has been cooled and pressurised turns to a liquid. The gases nitrogen and oxygen can be separated, by fractional distillation, from liquid air.

Suggest why it is possible to separate these elements from liquid air by fractional distillation.

.....

..... [1]

For Examiner's Use

(c) Nitrogen and hydrogen can be made to react together to form ammonia, NH_3.

This reaction requires a catalyst and a high temperature.

(i) Describe the advantages of using a catalyst in a chemical reaction.

.....

.....

.....

..... [2]

(ii) State the effect of a high temperature on the rate of the reaction.

..... [1]

(iii) Ammonia is used to make the salts ammonium nitrate and ammonium phosphate, which are used as fertilisers.

State the type of substance which reacts with ammonia to make salts, and name the type of chemical reaction which occurs.

type of substance .....

type of reaction ..... [2]

For Examiner's Use

7 In an experiment, weights were hung on a spring and the length of the spring measured.

Fig. 7.1 shows a graph of the results.

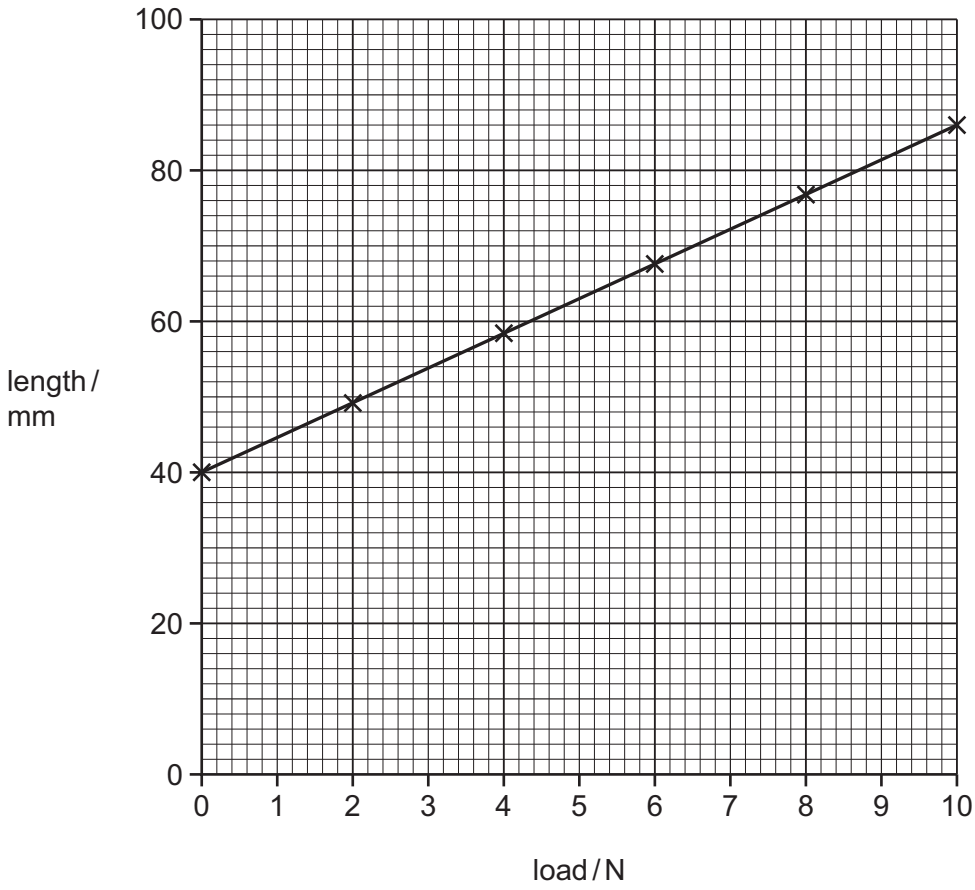


Fig. 7.1

(a) Describe the relationship between the load on the spring and the length of the spring.

.....

[1]

(b) Fig. 7.2 shows a wooden bird suspended from the spring.

Fig. 7.2

The direction of 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 your arrow **B**. [1]

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

.....

..... [1]

For Examiner's Use

(d) The volume of the bird is 30 cm^3 and the density of the wood is 0.8 g / cm^3.

Show that the mass of the bird is 24 g.

State the formula that you use and show your working.

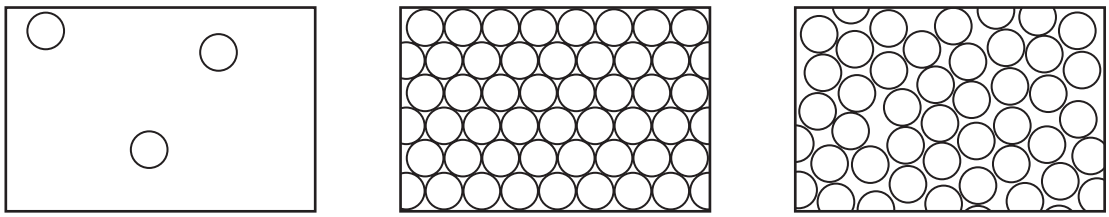
formula used

working

[2]

(e) The metal in the spring is an example of a solid.

Fig. 7.3 shows the arrangement of particles in a solid, liquid and gas.



X **Y** **Z**

Fig. 7.3

Which diagram **X**, **Y** or **Z** shows the arrangement of particles in the spring?

Explain your answer.

diagram .....

explanation .....

.....

..... [2]

For Examiner's Use

8 Fig. 8.1 shows a sperm cell.

Fig. 8.1

(a) (i) State the name and number of the structures present in the nucleus of a human sperm cell.

.....

..... [2]

(ii) On Fig. 8.1, use label lines to label and name **two** structures, other than the nucleus, that are found in **all** animal cells. [2]

(iii) Describe **two** ways in which the shape of a sperm cell helps it to swim to an egg.

1 .....

.....

2 .....

..... [2]

(b) Name the organ in which sperm are produced. ..... [1]

(c) Describe what happens immediately after a sperm meets an egg in the oviduct.

.....

.....

..... [2]

For Examiner's Use

9 The chemical formulae for each of three compounds found in rocks are shown below.

$CaMg(CO_3)_2$	dolomite
$KAlSi_3O_8$	potassium feldspar
SiO_2	quartz

(a) (i) State the total number of atoms shown in the formula of potassium feldspar.

..... [1]

(ii) When a flame test is carried out on **one** of the compounds in the list, a lilac colour is produced.

Suggest, with a reason, which one of the compounds is being tested.

compound .....

reason .....

..... [2]

(iii) **Two** of the elements shown in the chemical formulae above are in Period 4 of the Periodic Table.

State the **name** of **one** of these elements. ..... [1]

(b) When calcium carbonate, $CaCO_3$, is heated strongly for some time using a Bunsen flame, a chemical reaction occurs.

The word equation for this reaction is

calcium carbonate ⟶ calcium oxide + carbon dioxide

(i) State the type of chemical reaction which occurs.

Explain your answer.

type of reaction .....

explanation .....

.....

..... [2]

For Examiner's Use

(ii) Predict whether the mass of calcium oxide which is produced in this reaction is

- greater than,
- **or** less than,
- **or** the same as

the mass of the calcium carbonate which is used.

Circle your prediction.

Explain your answer.

.....

..... [1]

(iii) The student then added a little of the calcium oxide to some cold water that contains full range indicator solution (Universal Indicator).

The student made two observations which are shown below.

Explain these observations.

observation 1
There was a large increase in the temperature of the mixture.

explanation .....

.....

observation 2
The indicator changed colour from green to purple.

explanation .....

..... [2]

For Examiner's Use

10 The speakers of three MP3 music players are being compared.

(a) The speakers are tested to find the range of frequencies they produce.

Table 10.1 shows the results.

Table 10.1

speaker	range of frequencies / Hz
A	100 to 10 000
B	20 to 25 000
C	20 to 40 000

(i) What is meant by the term *frequency*?

.....

..... [1]

(ii) Use the information in Table 10.1 to suggest why the music played through speaker **A** might not sound as good as the other two speakers.

.....

.....

..... [1]

(iii) Music played through speakers **B** and **C** sounds the same.

Suggest a reason for this.

.....

..... [1]

(b) An MP3 player is able to receive a radio station broadcasting on 102.7 MHz / 0.28 m.

What does 0.28 m refer to?

.....

..... [1]

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II									III	IV	V	VI	VII	0
															4 He Helium 2
					1 H Hydrogen 1										
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 Sulfur 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.).