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.

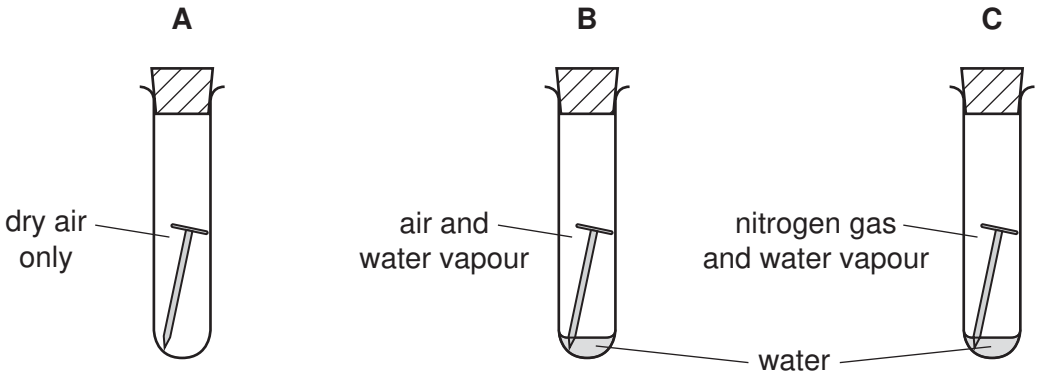


Fig. 1.1

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.

.....

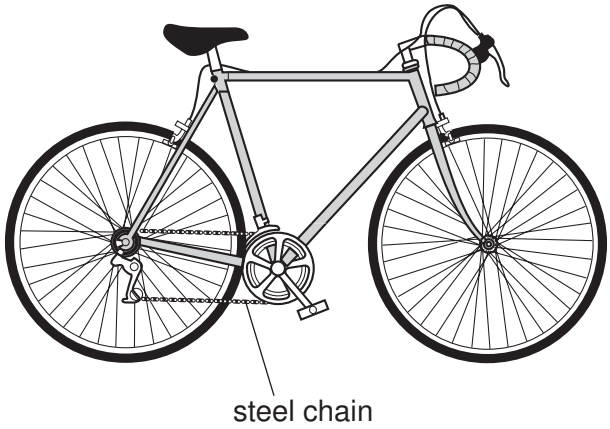
.....

.....

.....

..... [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.

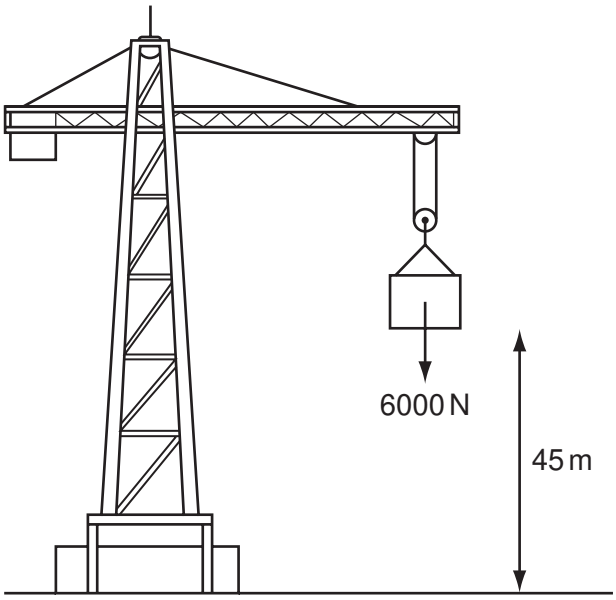


Fig. 2.1

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]

For Examiner's Use

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

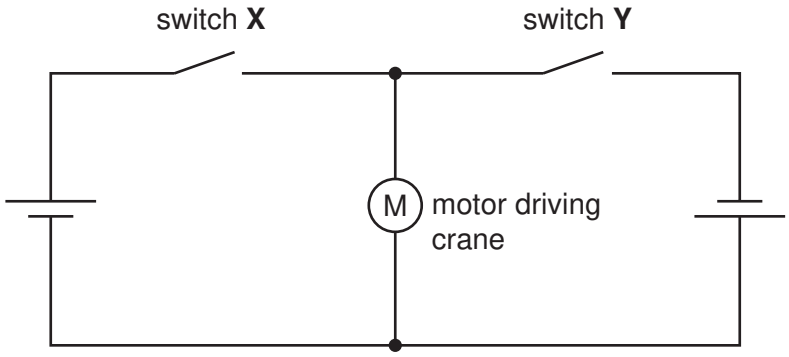


Fig. 2.2

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]

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

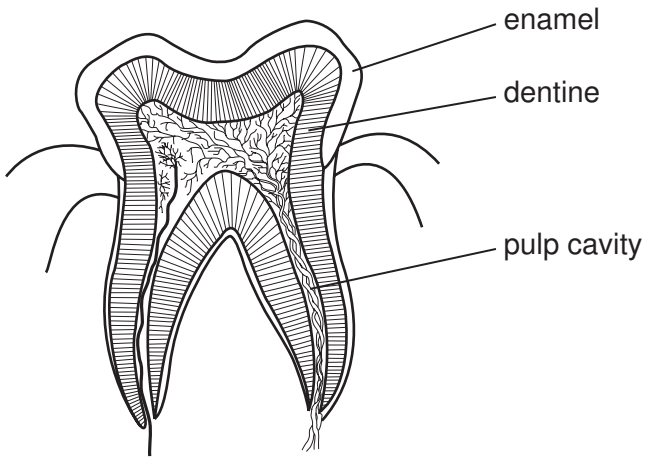


Fig. 3.1

(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.

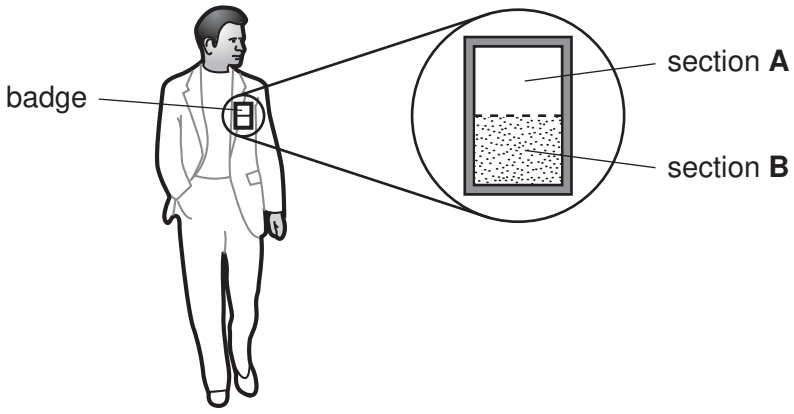


Fig. 4.1

For Examiner's Use

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.

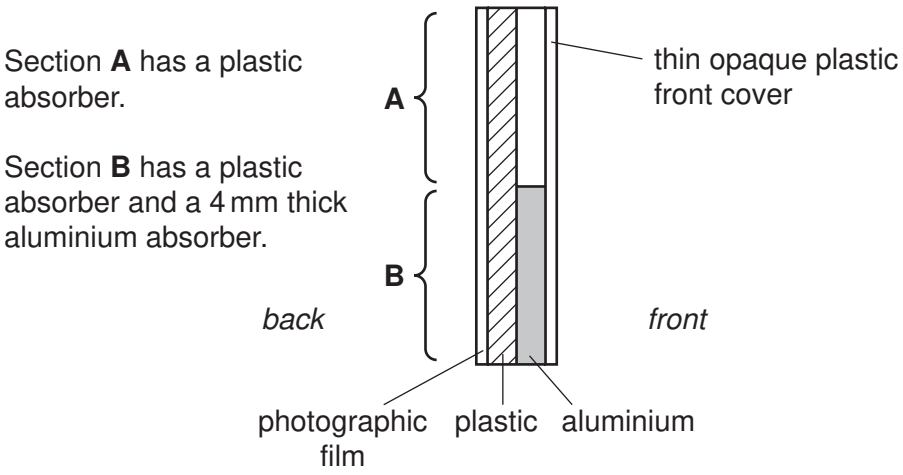


Fig. 4.2

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.

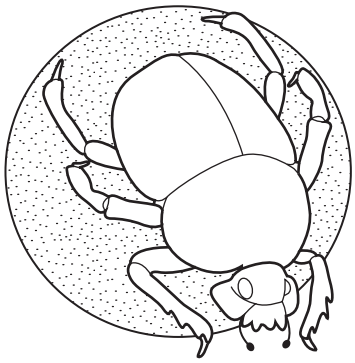


Fig. 5.1

(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]

(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.

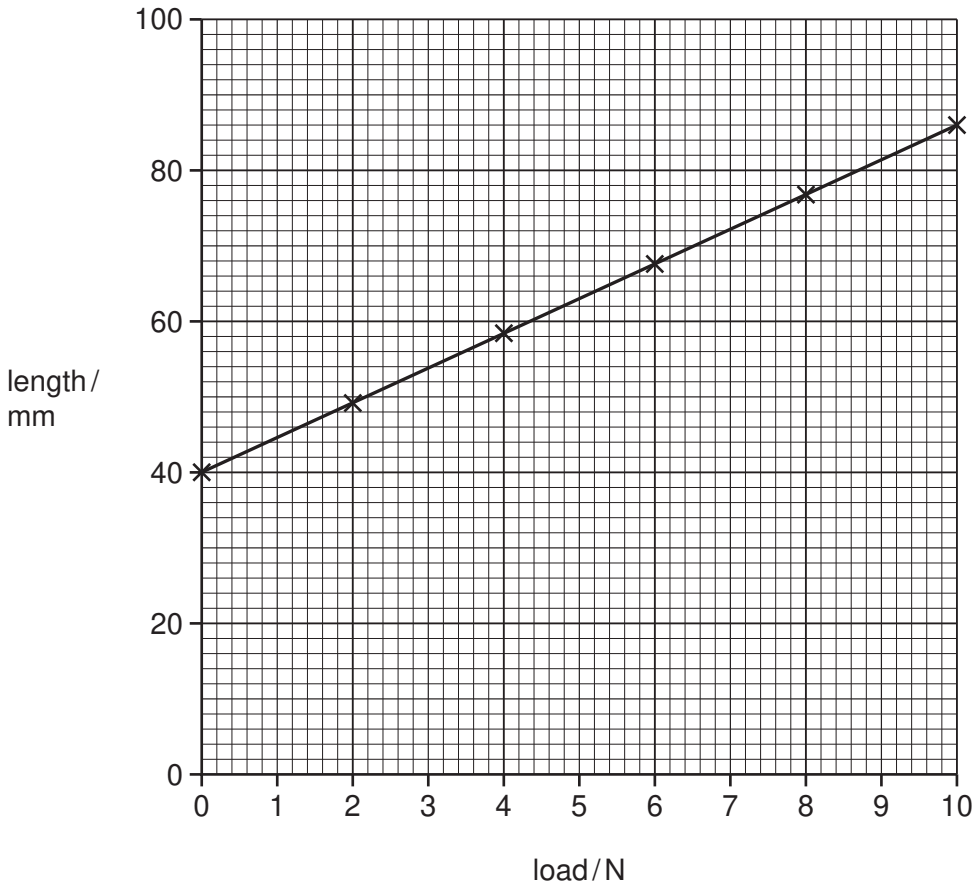


Fig. 7.1

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

.....

[1]

For Examiner's Use

(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.

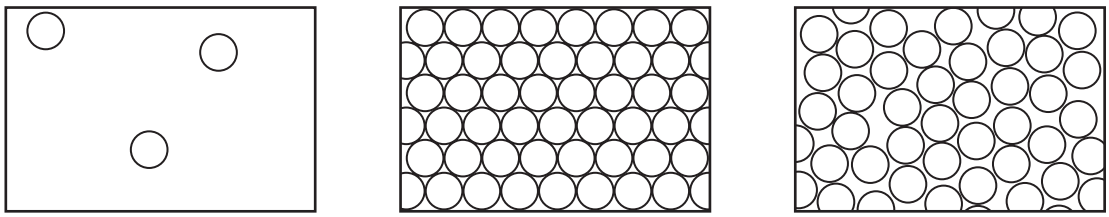
formula used

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]

(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
							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** 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 †															

*58-71 Lanthanoid series
†90-103 Actinoid series

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

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 dm^3 at room temperature and pressure (r.t.p.).