Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

8763870400

COMBINED SCIENCE **0653/31**

Paper 3 (Extended) **May/June 2014**

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
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.

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

1 **(a)** Fig. 1.1 shows an experiment to compare how three metals react with dilute hydrochloric acid.

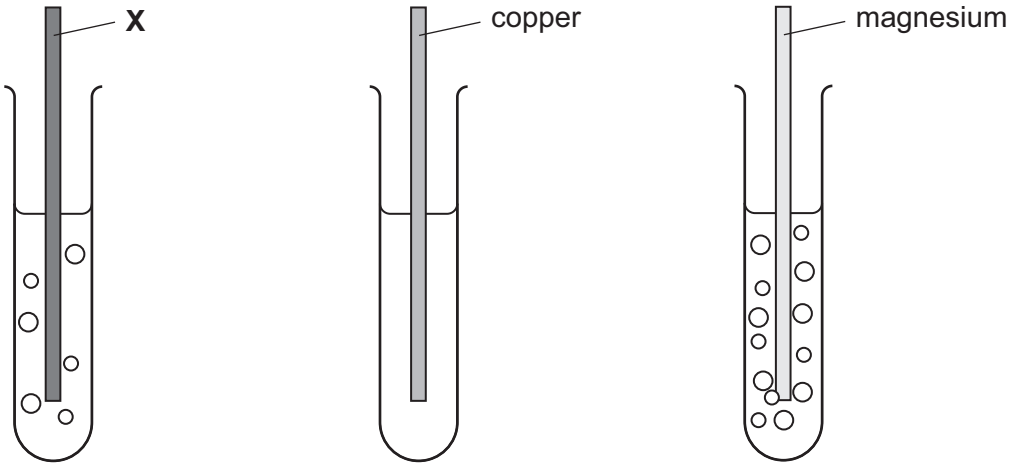

Fig. 1.1

In two of the test-tubes, bubbles of hydrogen gas are produced.

(i) Complete the balanced symbol equation for the reaction between magnesium and hydrochloric acid.

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..... + ... ⟶ $MgCl_2$ + ... [2]

1(a) **(ii)** List the three metals **X**, copper and magnesium, in order of reactivity.

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most reactive .....

.....

least reactive ..... [1]

(b) Fig. 1.2 shows an experiment in which the metal **X** is placed in solutions of copper chloride and magnesium chloride.

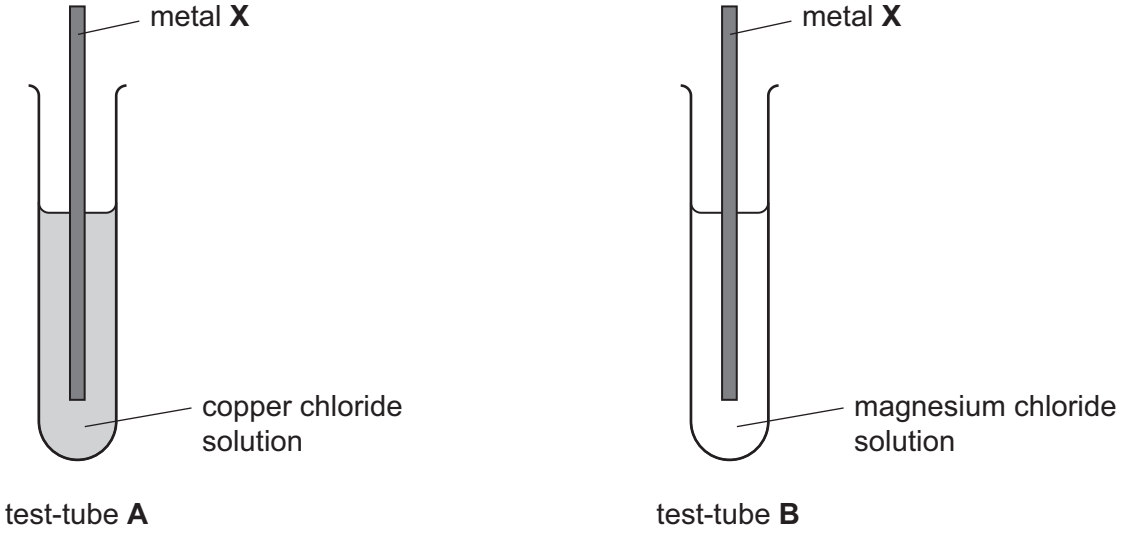

Fig. 1.2

1(b) **(i)** Describe how the appearance of the contents of test-tube **A** would change after one hour.

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.....

.....

..... [2]

1(b) **(ii)** Explain why you would not expect a chemical change in the contents of test-tube **B**.

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..... [1]

1**(c)** Copper can be extracted from copper oxide by heating it with carbon. The process involves the reduction of copper oxide.

(i) State what is meant by the term *reduction.*

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..... [1]

1(c) **(ii)** Aluminium is extracted by the process of electrolysis of molten aluminium oxide. Aluminium metal is deposited at the cathode of the electrolytic cell.

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Explain why metals are always deposited at the cathode, rather than the anode, during electrolysis.

.....

.....

..... [2]

2 Fig. 2.1 shows a food web of the organisms in a woodland containing oak trees.

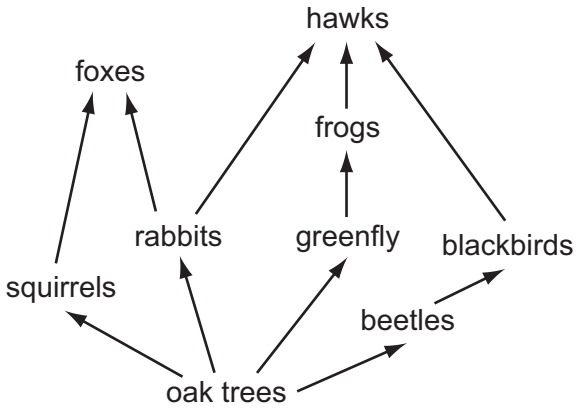

Fig. 2.1

2**(a)** State the term used to describe these organisms, the woodland, and the interactions between them.

.....

[1]

2**(b)** The animals in the food web are consumers.

Define the term *consumer*.

.....

.....

[1]

(2**c)** The food web is a network of interconnected food chains.

One food chain in Fig. 2.1, with three trophic levels, is shown.

oak tree → rabbit → hawk

Write down a food chain from Fig. 2.1 which has four trophic levels.

[2]

2**(d)** Describe **two** ways in which energy can be lost between trophic levels of a food chain.

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1 .....

.....

2 .....

..... [2]

2**(e)** The oak trees in the wood are cut down.

Describe and explain how the levels of carbon dioxide and oxygen change in the atmosphere in and around the woodland.

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.....

.....

.....

..... [3]

3 **(a)** Fig. 3.1 shows a cell (battery) and lamp taken from the same torch (flashlight).

Fig. 3.1

3(a)**(i)** Explain why two cells are needed to light this lamp. 0653/31/M/J/14

.....

.....

..... [1]

3(a)**(ii)** State what is meant by the quantity *1.2 A* written on the lamp. 0653/31/M/J/14

.....

..... [1]

3(a)**(iii)** Calculate the resistance of the lamp when it is lit and give the unit.

State the formula that you use and show your working. 0653/31/M/J/14

formula

working

resistance = ... unit ..... [3]

3**(b)** The torch is left switched on for a long time, until the batteries run down. The front of the torch becomes warm.

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Identify the energy transfers that have occurred during this time.

.....

..... [2]

3**(c)** The torch emits a narrow beam of light when switched on. Fig. 3.2 shows the torch shining at a plane mirror on the far side of a room.

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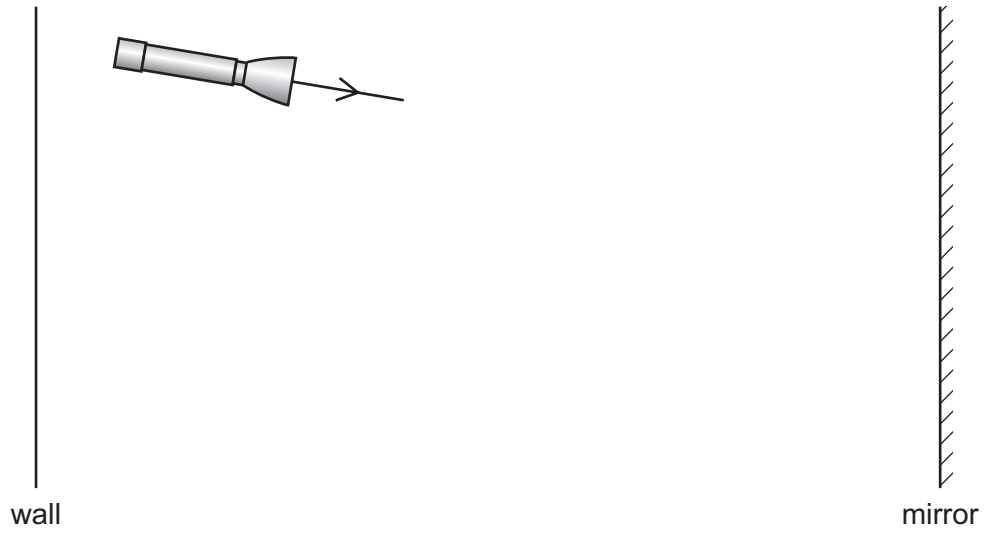

Fig. 3.2

3(c) **(i)** On Fig. 3.2, construct an accurate ray diagram to show how a ray of light from the torch is reflected onto the wall. [2]

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3(c)**(ii)** The torch goes out suddenly.

Explain why an observer cannot detect any delay in the spot of light disappearing from the wall.

.....

..... [1]

4 **(a)** Petroleum (crude oil) is a mixture of different hydrocarbons.

Fig. 4.1 shows the industrial apparatus used to separate petroleum into useful products.

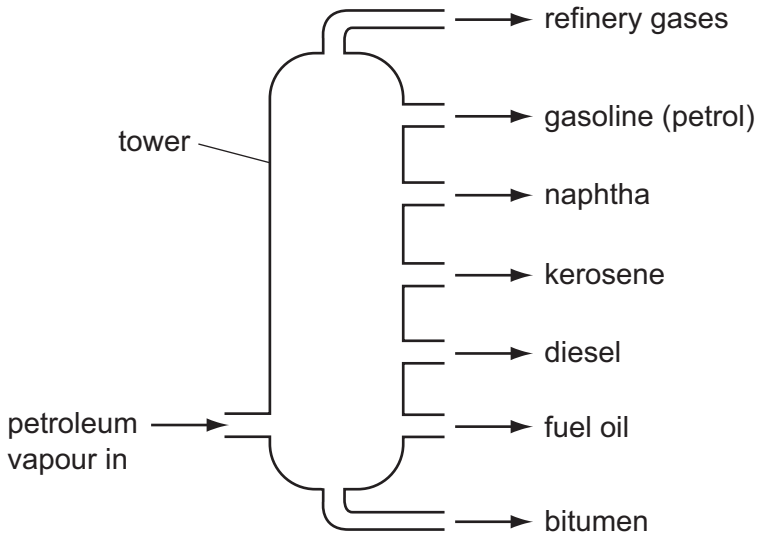

Fig. 4.1

Petroleum is vaporised and passed up a tower. Useful products from petroleum condense at different positions in the tower. 0653/31/M/J/14

4(a) **(i)** State the name of the process used to separate the petroleum mixture into useful products.

.....[1]

4(a) **(ii)** Describe how the boiling point range of a particular product affects the position in the tower where it condenses. 0653/31/M/J/14

.....

.....[1]

4(a) **(iii)** Describe and explain the relationship between the boiling point of a hydrocarbon and the size of its molecules. 0653/31/M/J/14

.....

.....

.....[2]

4**(b)** When hydrocarbons burn they produce carbon dioxide and water.

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Explain, in terms of the effect on the environment, why an increased level of carbon dioxide in the atmosphere is of concern to many people.

.....

.....

.....

..... [2]

4**(c)** Two of the hydrocarbons in refinery gas are methane and ethane.

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(i) Complete the diagram of one molecule of ethane.

[2]

4(c)**(ii)** In the process of cracking, large hydrocarbon molecules are broken down into smaller ones.

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Explain briefly why some of the smaller molecules produced by cracking are more reactive than methane and ethane.

.....

.....

..... [2]

5 (a) A boy uses headphones to listen to the radio.

(5(a)(**i)** State the useful energy transformation that occurs in the headphones when he is using them.

..... [1]

(5 (a) (**ii)** The radio emits sounds with frequencies between 100 Hz and 10 000 Hz.

Explain why the boy is able to hear all the sounds emitted through the headphones. The boy has normal hearing.

.....

..... [1]

5**(b)** A boy is swimming in a swimming pool.

His mass is 50 kg. He dives into the water from a height of 2 metres above the water surface, then swims one length of the 25 metre long pool at a constant speed of 0.5 m / s.

5(b)**(i)** Calculate the potential energy lost by the boy as he dives and hits the water surface. (gravitational field strength, g = 10 N / kg)

State the formula you use and show your working.

formula

working

..... J [2]

(5(b)**ii)** Calculate the kinetic energy of the boy as he swims one length.

State the formula you use and show your working. 0653/31/M/J/14

formula

working

..... J [2]

5 **(c)** A boy switches on a television set using a remote control. 0653/31/M/J/14

Fig. 5.1 shows some of the parts of the electromagnetic spectrum.

In the correct blank box on Fig. 5.1, write the name of the part of the spectrum used by the remote control.

	X-rays		visible light		microwaves	

[2]

Fig. 5.1

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6 **(a)** Fig. 6.1 shows part of the human life cycle. The diagram is not to scale.

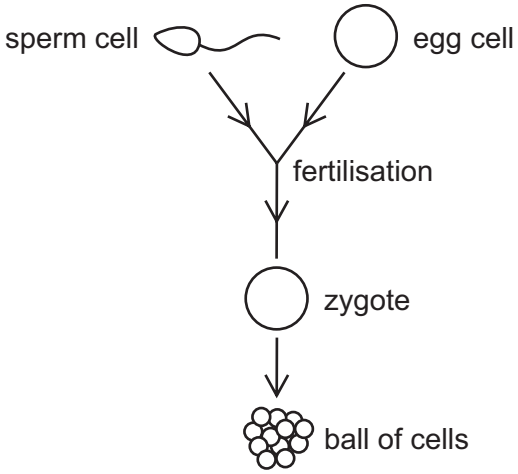

Fig. 6.1

6(a)**(i)** From Fig. 6.1, name a diploid cell. 0653/31/M/J/14

..... [1]

6(a)**(ii)** Cell division of the zygote produces a ball of cells. 0653/31/M/J/14

Describe in detail where in the female reproductive system this ball of cells is positioned for the next stage of development.

.....

..... [2]

6 **(b)** New mothers have to decide whether to breast-feed their baby or to bottle-feed their baby with formula milk. 0653/31/M/J/14

Describe

6(b)**(i)** **one** advantage of breast-feeding, 0653/31/M/J/14

.....

..... [1]

6 (b)**(ii)** **one** advantage of bottle-feeding. 0653/31/M/J/14

.....

..... [1]

6**(c)** Table 6.1 summarises some of the nutrients contained in a sample of 100 g of breast milk.

Table 6.1

nutrient	mass in 100 g sample of milk
protein	1.2 g
fat	3.8 g
carbohydrate	7.6 g
vitamin C	0.0039 g
calcium	0.033 g

6 (c)**(i)** Most of the mass of milk is water.

Use the information in Table 6.1 to calculate the approximate mass of water in the sample of milk.

You may ignore the two nutrients which have a mass much smaller than the other three nutrients in Table 6.1.

Show your working.

mass of water = ... g [2]

6 (C)**(ii)** Energy is released from milk by respiration.

1 g of fat releases 37 kJ of energy. 1 g of carbohydrate releases 16 kJ of energy.

Use the information in Table 6.1 to calculate whether more energy is released from the fat or the carbohydrate in the 100 g sample of milk.

Show your working and state your answer.

.....

.....

.....

..... [3]

7 **(a)** Fig. 7.1 shows the outer shell of a chlorine atom.

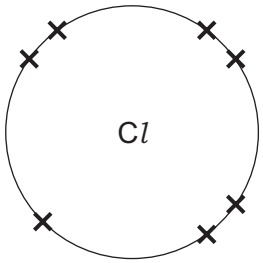

Fig. 7.1

Draw a diagram showing the arrangement of the outer electrons in the atoms of a chlorine molecule, Cl_2.

[2]

7 **(b)** Chlorine is one of the halogens that are found in Group VII of the Periodic Table.

Table 7.1 shows properties of some of the elements in Group VII.

Table 7.1

period	halogen	colour	physical state at room temperature
2	fluorine		
3	chlorine	yellow-green	gas
4	bromine	dark red-brown	liquid
5	iodine	blue-black	solid

Use the information in Table 7.1 to predict the colour and physical state of fluorine and complete Table 7. 1. [1]

7**(c)** Describe and explain what is seen when a dilute solution of chlorine is added to a colourless solution of potassium bromide.

.....

.....

..... [2]

7**(d)** Table 7.2 shows some elements in Group 0 of the Periodic Table.

Table 7.2

Group 0
helium
neon
argon
krypton
xenon

7 (d)**(i)** State a use for **one** named element in Group 0.

name .....

use .....

..... [1]

7 (d) **(ii)** Describe how the electronic structure of the atoms of the elements of Group 0 affects their chemical properties.

.....

.....

.....

..... [2]

8 Fig. 8.1 shows a simple type of air conditioner called a 'swamp cooler' that is used in buildings in dry desert places.

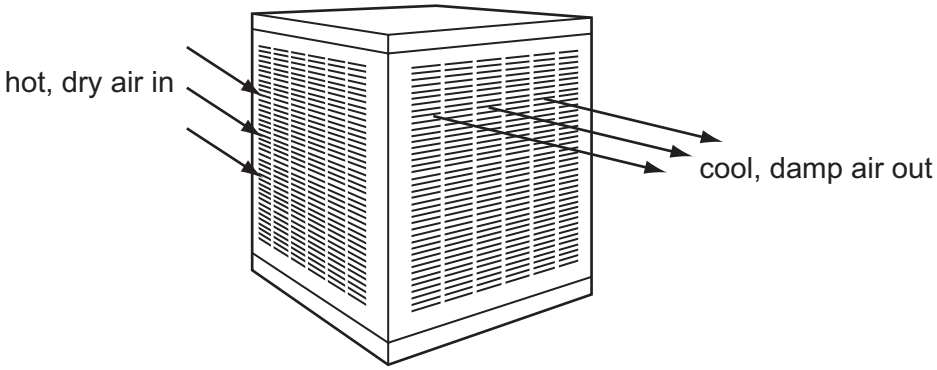

Fig. 8.1

Hot, dry air is blown by a fan over the surface of water in a metal container. The hot dry air causes some of the water to evaporate. The air coming out of the swamp cooler is cool and damp.

(a) (i) Describe the changes to the arrangement of the molecules of water during evaporation.

.....

.....

..... [2]

8 (a)**(ii)** Explain, referring to the movement of molecules in water and air, why the hot dry air is cooled.

.....

.....

.....

..... [2]

8**(b)** In hot countries, houses are often painted white.

Explain why this helps to keep a house cooler.

.....

.....

..... [2]

8**(c)** The fan in the swamp cooler is noisy. A girl standing in the same room can hear the noise. Describe how the sound

8 (c) **(i)** is produced by the fan,

.....

..... [1]

8 (c) **(ii)** travels from the fan to the girl's ear.

.....

..... [1]

9 Fig. 9.1 is a flowchart to show the circulation of blood in the body.

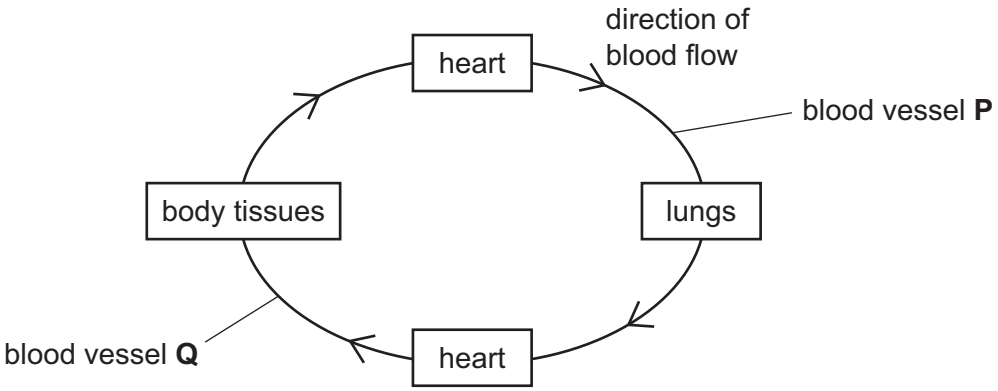

Fig. 9.1

(a) Explain why this is described as a *double circulation*.

.....

..... [1]

9 **(b) (i)** Complete the sentence using words or phrases from the list.

You may use each word or phrase once, more than once, or not at all.

aorta	**body**	**left**	**lungs**
pulmonary artery		**pulmonary vein**	**right**

Blood leaves the ..... ventricle of the heart to go through blood vessel **P**, which is the ....., taking blood to the lungs

[2]

9(b)**(ii)** Blood in vessel **P** has a different pressure from blood in vessel **Q**.
Describe this difference and explain why it is necessary.

.....

.....

.....

..... [2]

9 **(c)** The composition of blood changes as it flows through the tissues of the small intestine.

State

9(c) **(i)** **one** substance that **leaves** the blood as it flows through the tissues of the small intestine,

.....

[1]

9(c) **(ii)** **two** substances that **enter** the blood as it flows through the tissues of the small intestine.

.....

.....

[2]

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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 †															

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 above, **X** in the centre, b below

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.).