Cambridge
O Level

CANDIDATE
NAME

CENTRE
NUMBER

CANDIDATE
NUMBER

COMBINED SCIENCE

5129/21

Paper 2

October/November 2015

2 hours 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, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
A copy of the Periodic Table is printed on page 20.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

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 **20** printed pages.

CAMBRIDGE
International Examinations

[Turn over

1 Fig. 1.1 shows a blast furnace for the extraction of iron from iron ore.
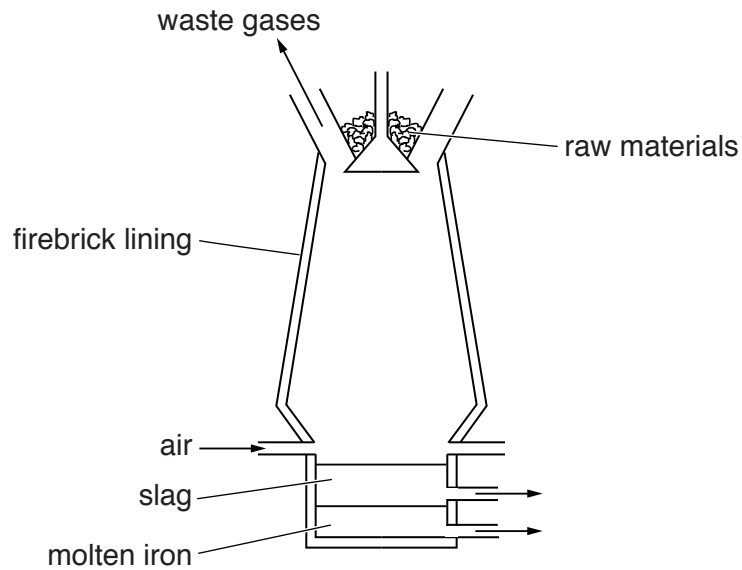
Fig. 1.1

The raw materials added to the top of the furnace are iron ore, coke and limestone.

(a) Name an ore from which iron is extracted. .... [1]

(b) Iron ore is contaminated by acidic impurities such as silicon dioxide (sand).

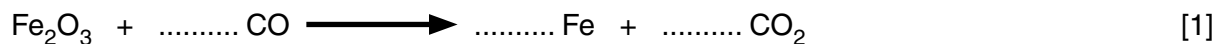Explain how the limestone added to the furnace removes the acidic impurities.

....

....

....

.... [3]

(c) In the extraction of iron, the iron ore is reduced by carbon monoxide.

Balance the equation for the reduction of iron ore.

Fe_2O_3 + ... CO $\longrightarrow$ .... Fe + ... CO_2 [1]

(d) Suggest why potassium is not extracted using the same process as iron.

.... [1]

2 Fig. 2.1 shows speed-time graphs for two cars **A** and **B**.

Car **A** starts before car **B**.
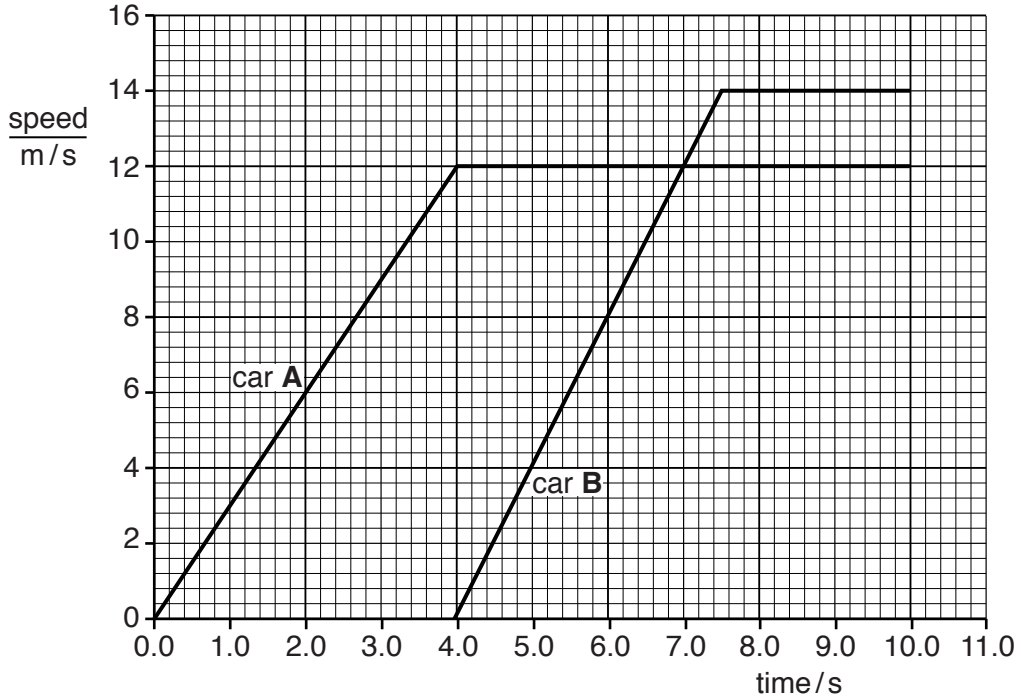
Fig. 2.1

(a) State the time at which the two cars have the same speed.

.... s [1]

(b) Calculate the distance travelled by car **A** between 4.0 s and 8.0 s.

distance = ... m [2]

(c) Explain how the graph shows that, initially, car **A** has a constant acceleration.

....

.... [1]

(d) A car engine converts chemical energy into heat energy and sound energy.

State two **other** forms of energy into which the chemical energy is converted when the car accelerates up a hill.

.... energy and .... energy   [2]

[Turn over

3 (a) Define *excretion*.

....

....

....

.... [2]

(b) Table 3.1 contains the names of three compounds that are excreted.

Table 3.1

name of compound	where compound is produced	organ of excretion
carbon dioxide		
water		
urea		

Complete Table 3.1 by stating where in the body each compound is produced and the organ responsible for its excretion. [6]

4 Ammonium chloride reacts with sodium hydroxide, producing sodium chloride, ammonia and water.

The equation for the reaction is

$$NH_4Cl + NaOH \longrightarrow NaCl + NH_3 + H_2O$$
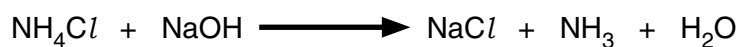
(a) (i) Calculate the relative molecular mass of

ammonium chloride, ...

sodium hydroxide. .... [2]

[A_r: N, 14; H, 1; O, 16; Na, 23; Cl, 35.5]

(ii) The relative molecular mass of ammonia is 17.

Complete the following sentences.

34 g of ammonia is produced by .... g of sodium hydroxide.

0.85 g of ammonia is produced by .... g of sodium hydroxide. [2]

(b) State an industrial use of ammonia.

.... [1]

(c) Complete the 'dot and cross' diagram in Fig. 4.1 to show the outer electrons in a molecule of ammonia. [2]
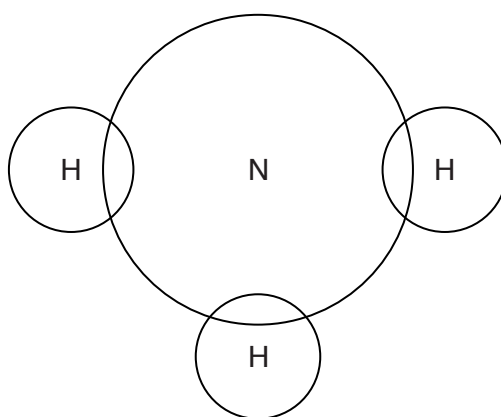

Fig. 4.1

5 Fig. 5.1 shows a mass of 1.5 kg pulled across a surface by a spring.

Fig. 5.1

The mass has an acceleration of 1.8 m/s^2.

Calculate the accelerating force exerted on the mass.

force = ... N [2]

6 Ethene is an unsaturated hydrocarbon which undergoes polymerisation to form poly(ethene).

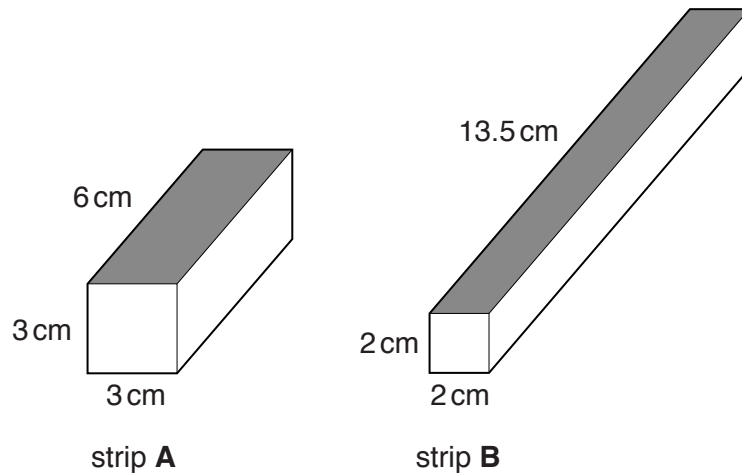**(a)** Explain the meaning of the words *unsaturated* and *polymerisation*.

   (i) *unsaturated* ....

   .... [1]

   (ii) *polymerisation* ....

   ....

   .... [2]

(b) In the space below, draw the structure of poly(ethene).

[2]

7 Fig. 7.1 shows two strips **A** and **B** that are cut from the tissue of the same yam. The length, width and height of each strip are labelled.

6 cm

3 cm

3 cm

strip **A**

13.5 cm

2 cm

2 cm

strip **B**

Fig. 7.1

The strips are dried and weighed.

The mass of each strip is 70 g.

(a) Calculate the surface area of the shaded side of each strip.

Write your answers in Table 7.1.

Table 7.1

strip	surface area/cm^2
A	
B	

[1]

(b) Both strips are placed in distilled water.

After fifteen minutes they are taken out of the water, dried and re-weighed.

The results are shown in Table 7.2.

Table 7.2

strip	original mass / g	mass after fifteen minutes in distilled water / g
A	70	80
B	70	92

(i) Explain why the mass of each strip increases.

....

....

.... [2]

(ii) Explain why strip **B** gains more mass than strip **A**.

....

....

.... [2]
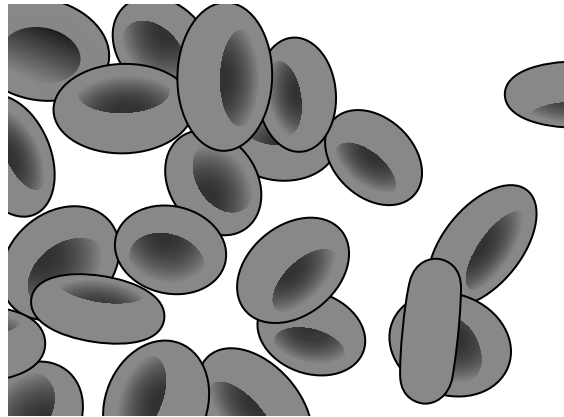
(c) Fig. 7.2 is a drawing of some red blood cells in plasma, as seen using a microscope.

Fig. 7.2

(i) Name the substance that gives these cells their red colour.

.... [1]

(ii) Some red blood cells are placed in distilled water on a microscope slide.

After four minutes, the slide is viewed using the microscope. No cells are visible, but the liquid on the slide is coloured pink.

Describe and explain what happens to the cells during the four-minute period.

....

....

....

....

.... [2]

8 Complete the following sentences about the separation of mixtures.

Water can be obtained from sea-water by ....

A mixture of hydrocarbons is separated by ....

A mixture of sand and sea-water is separated by filtration and the solution that passes through the

filter paper is called the .... The salt in the sea-water is obtained from

this solution by the process of ....

A mixture of two solids dissolved in water can be separated by ....

[5]

9 Complete the following sentences about electrical circuits.

In an electrical circuit, an .... is used to measure current.

The unit of electric current is ....

Electric current is a rate of flow of ....

[3]

10 Fig. 10.1 shows a mains plug with its cover removed.
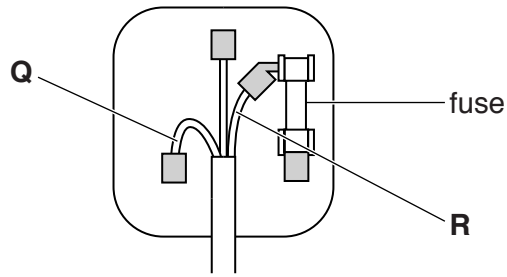

Fig. 10.1

Three wires are shown. Wires **Q** and **R** are labelled.

(a) Complete Table 10.1 to show the name and colour of wires **Q** and **R**.

Table 10.1

wire	name	colour
Q		
R		

[2]

(b) An electrical appliance is double-insulated.

Name the wire that is not required in the mains plug of this appliance.

.... [1]

(c) A kettle transforms 180 000 J of electrical energy in 2 minutes.

Calculate the power of the kettle.

power = ... unit .... [3]

11 Fig. 11.1 shows the reproductive system of a woman.
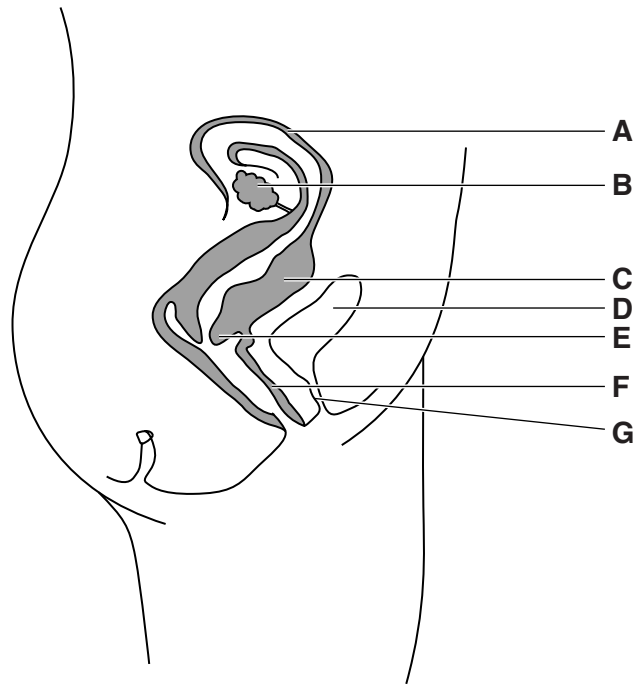
Fig. 11.1

(a) State the letter in Fig. 11.1 which identifies

 (i) the cervix, ...

 (ii) an ovary, ...

 (iii) the vagina. ....

[3]

(b) Describe a function of

 (i) the oviduct,

 ....

 ....

 (ii) the uterus.

 ....

 ....

[2]

(c) (i) The changes that occur during the menstrual cycle are controlled by hormones.

State what is meant by *hormone*.

....

....

....

.... [2]

(ii) State one factor, other than hormones, that can change the length of the menstrual cycle.

....

.... [1]

12 A student is given three bars that look identical.

One is a permanent magnet, one is made of iron and one is made of copper.

Explain how the student identifies each bar using another permanent magnet.

....

....

....

.... [3]

13 Equal volumes of sulfuric acid are placed in three test-tubes.

A piece of copper or zinc or magnesium is added to each test-tube.

The results are shown in Fig. 13.1.
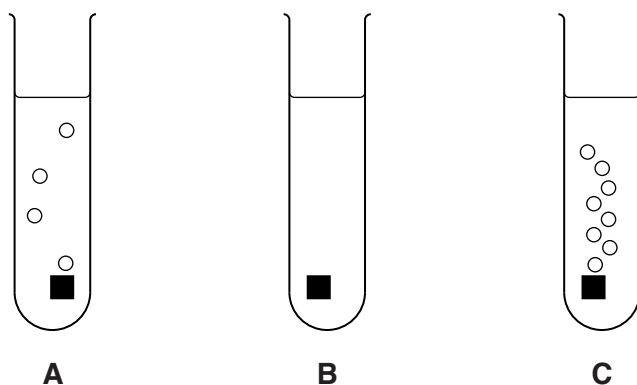
Fig. 13.1

(a) Deduce which test-tube contains

(i) copper, ...

(ii) zinc. ....

[2]

(b) Name the gas produced in the reactions. .... [1]

(c) (i) State a test and the result which shows that sulfuric acid is acidic.

test ....

result ....

[2]

(ii) The formula of sulfuric acid is H_2SO_4.

State the name of each ion in sulfuric acid.

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

14 (a) Fig. 14.1 shows a wire moving downwards between the poles of two magnets.
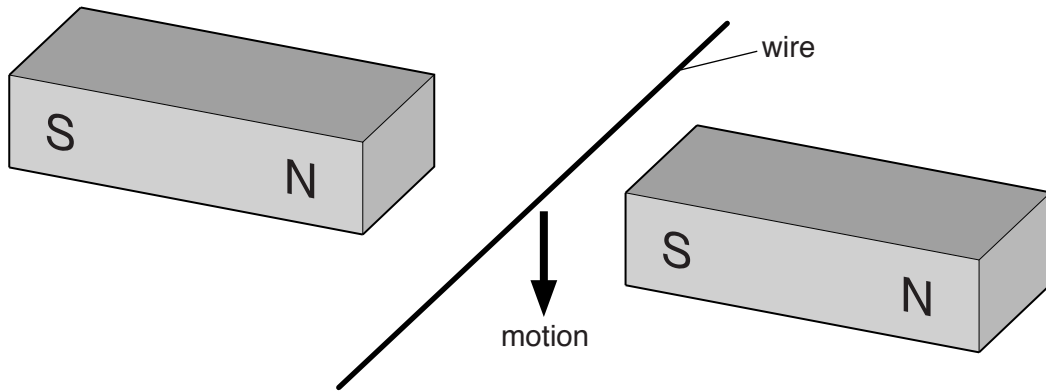
Fig. 14.1

The motion induces an electromotive force (e.m.f.) in the wire.

State how the motion of the wire may be changed

(i) to decrease the size of the induced e.m.f.,

.... [1]

(ii) to reverse the direction of the induced e.m.f.

.... [1]

(b) One application of electromagnetic induction is the transformer.

Explain why, for transformers, the input is an alternating voltage, rather than a direct voltage.

....

....

.... [2]

15 Use words from the list to complete the sentences below.

anther   **carpel**   **cotyledon**   **fruit**

pericarp   **plumule**   **sepal**   **stomata**

root   **testa**

Each word may be used once, more than once or not at all.

Pollen is produced by the .... of a flower.

When an insect visits a flower it transfers pollen onto the ....

After fertilisation, seeds are produced. Each seed contains a food store called the

.... and the plant embryo.

The plant embryo consists of a radical and a ....

The food store and the plant embryo are protected by an outer coating called the

....

[5]

16 The nucleus of an isotope of phosphorus contains 15 protons and 16 neutrons.

(a) Explain what is meant by *isotopes*.

....

....

.... [2]

(b) On Fig. 16.1, complete the electronic structure of this phosphorus atom.
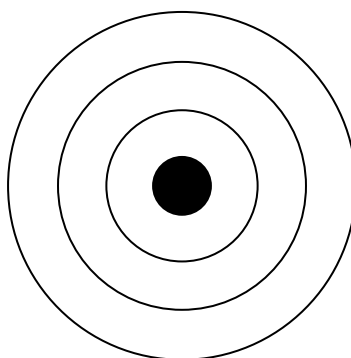
Fig. 16.1

[1]

(c) Phosphorus combines with chlorine to form the compound PCl_3.

Suggest the type of bonding in this compound and give a reason for your answer.

type of bonding ....

reason ....

.... [2]

17 All electromagnetic waves are transverse and travel at 3.0×10^8 m/s in a vacuum.

(a) An X-ray wave has a wavelength of 6.0×10^{-11} m in a vacuum.

Calculate the frequency of this wave.

frequency = ... Hz [2]

(b) (i) Name a component of the electromagnetic spectrum with higher frequencies than X-rays.

.... [1]

(ii) Name a longitudinal wave.   .... [1]

18 Table 18.1 contains descriptions of four different processes.

Table 18.1

description of process	name of process
the breakdown of large food molecules into small soluble molecules	
the release of energy from food in living cells	
the movement of molecules from a region of their higher concentration to a region of their lower concentration	
the fusion of nuclei to form a zygote and the production of genetically dissimilar offspring	

Complete Table 18.1 by naming each process.   [4]

19 A nucleus of carbon has 6 protons and 8 neutrons.

(a) Determine the nucleon number.   ....   [1]

(b) The nucleus emits a beta-particle.

   (i) State the nature of a beta-particle.

     .... [1]

   (ii) Deduce the change, if any, in the number of protons in the nucleus when a beta-particle is emitted.

     .... [1]

(c) An isotope of carbon has a half-life of 5700 years.

Initially, a sample of the isotope emits 10 000 beta-particles each second.

Calculate the time before the rate of emission is reduced to 1250 beta-particles each second.

time = ... years [2]

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	209 **Po** Polonium 84	210 **At** Astatine 85	222 **Rn** Radon 86
223 **Fr** Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †																	

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	147 **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	231 **Pa** Protactinium 91	238 **U** Uranium 92	237 **Np** Neptunium 93	244 **Pu** Plutonium 94	243 **Am** Americium 95	247 **Cm** Curium 96	247 **Bk** Berkelium 97	251 **Cf** Californium 98	252 **Es** Einsteinium 99	257 **Fm** Fermium 100	258 **Md** Mendelevium 101	259 **No** Nobelium 102	260 **Lr** Lawrencium 103	

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

Key

a
X
b

a = relative atomic mass
X = atomic symbol
b = atomic (proton) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).