UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3583153480

CO-ORDINATED SCIENCES **0654/21**

Paper 2 (Core) **October/November 2013**

2 hours

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 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 32.

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 **31** printed pages and **1** blank page.

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For Examiner's Use

1 Sodium chloride is obtained from underground deposits in the Earth's crust or from solutions such as sea water.

(a) (i) Explain why the Earth's crust contains the compound sodium chloride and not the uncombined elements sodium and chlorine.

.....

..... [1]

(ii) State **one** difference between a compound and an element.

.....

.....

..... [1]

(iii) Describe how crystals of sodium chloride could be obtained from a salt solution.

.....

.....

.....

..... [2]

(b) (i) Explain the following statements in terms of protons and electrons.

Atoms do **not** have an overall electrical charge.

.....

.....

A potassium ion, K^+, has a single positive electrical charge.

.....

.....

[2]

(ii) The chemical formula of the compound calcium nitride is Ca_3N_2.

Explain the meaning of the numbers in this formula.

.....

..... [1]

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(c) Fig. 1.1 shows apparatus used to separate the element lead from the compound lead bromide.

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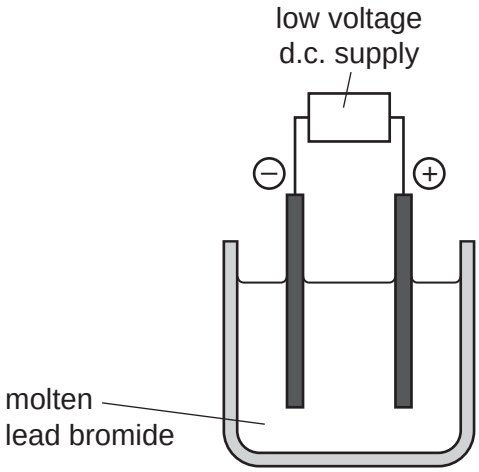

Fig. 1.1

(i) Name the process shown in Fig. 1.1.

.....[1]

(ii) Explain why an orange-coloured gas is observed rising from the molten lead bromide during the process.

.....

.....

.....[2]

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2 Fig. 2.1 shows the inside of a refrigerator.

The temperature inside the freezing compartment is -20 °C and the temperature in the rest of the refrigerator is +5 °C.

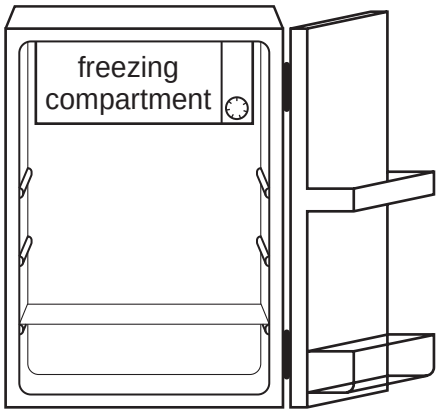

Fig. 2.1

(a) The air in the refrigerator is cooled by convection.

Draw **one** arrow on Fig. 2.1 to show the movement of the air cooled by the freezing compartment. [1]

(b) The volume of air in the refrigerator is 0.15 m^3.

The density of air is 1.26 kg/m^3.

Calculate the mass of air in the refrigerator.

State the formula that you use and show your working.

formula

working

..... kg [2]

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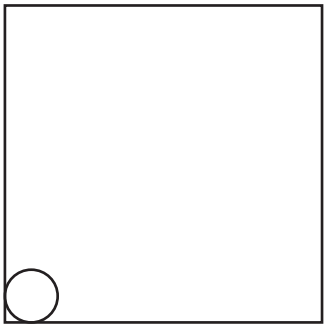
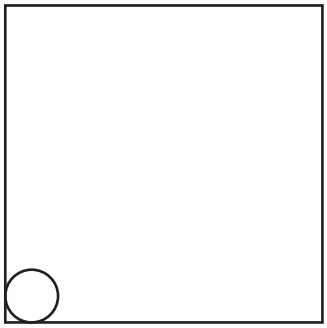
(c) (i) Complete the diagrams to show the arrangement of water molecules in solid ice and in liquid water.

One molecule has been drawn for you in each box. Each diagram should contain at least twelve water molecules.



solid ice



liquid water

[2]

(ii) Each sentence describes either a solid, a liquid or a gas.

In the right hand column write the letter **S** for solid, **L** for liquid or **G** for gas to match the description.

description	**S, L** or **G**
It cannot flow.	
It cannot transfer heat by convection.	
It contains particles which are widely separated.	
It expands the most when heated.	
It fills a closed container.	
It has a fixed volume but not a fixed shape.	

[3]

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[Turn over

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3 The concentration of glucose in the blood does not normally vary much. The hormone adrenaline causes blood glucose concentration to increase.

(a) (i) Define the term *hormone*.

.....

.....

..... [2]

(ii) State **one** effect of adrenaline on the body, other than increasing the concentration of glucose in the blood.

..... [1]

(b) Researchers investigated how adding fibre to foods affected the concentration of glucose in the blood after eating.

Fig. 3.1 shows the results that they obtained for two different types of cornflakes. Cornflakes contain a lot of starch.

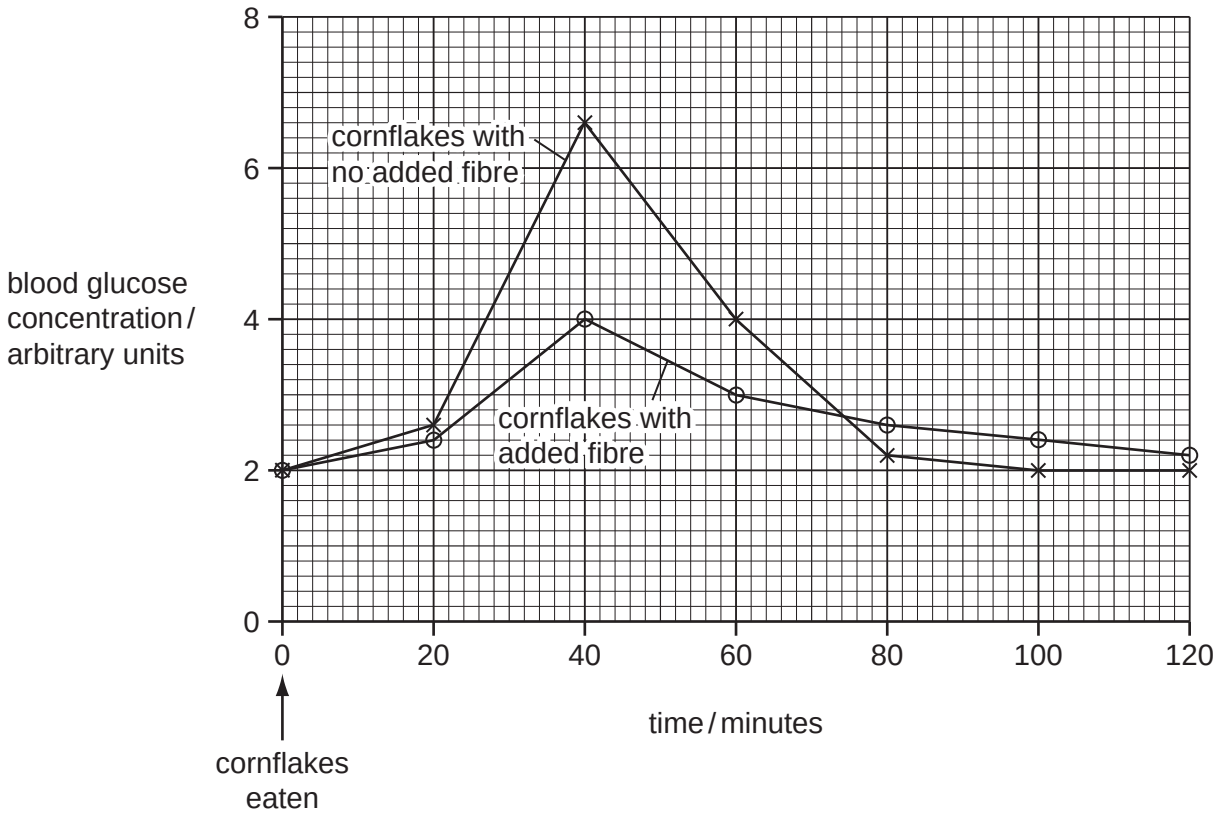

Fig. 3.1

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Use the information in Fig. 3.1 to help you to answer the following questions.

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(i) Describe how the blood glucose concentration changed after eating cornflakes with no added fibre.

.....

.....

.....

.....

..... [3]

(ii) Suggest explanations for the changes in blood glucose concentration.

.....

.....

.....

.....

..... [3]

(iii) Describe how adding fibre to the cornflakes affected the changes in blood glucose concentration after eating.

.....

.....

.....

.....

..... [3]

(c) Outline **one** other way in which fibre in the diet affects health.

.....

..... [1]

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4 Fig. 4.1 shows a period in the Periodic Table. Four elements are represented by letters which are not their usual chemical symbols.

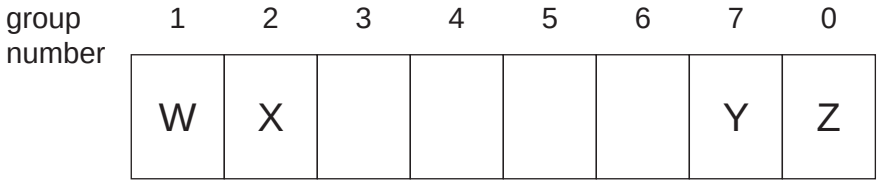

Fig. 4.1

(a) (i) State and explain which of the elements **W**, **X**, **Y** and **Z** are poor conductors of electricity.

element(s) .....

explanation .....

..... [2]

(ii) One of the elements shown in Fig. 4.1 is **not** expected to form a compound with any of the others.

State and explain which **one** of the elements this is.

element .....

explanation .....

..... [2]

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(b) Fig. 4.2 shows the melting points of four metallic elements from the same group of the Periodic Table.

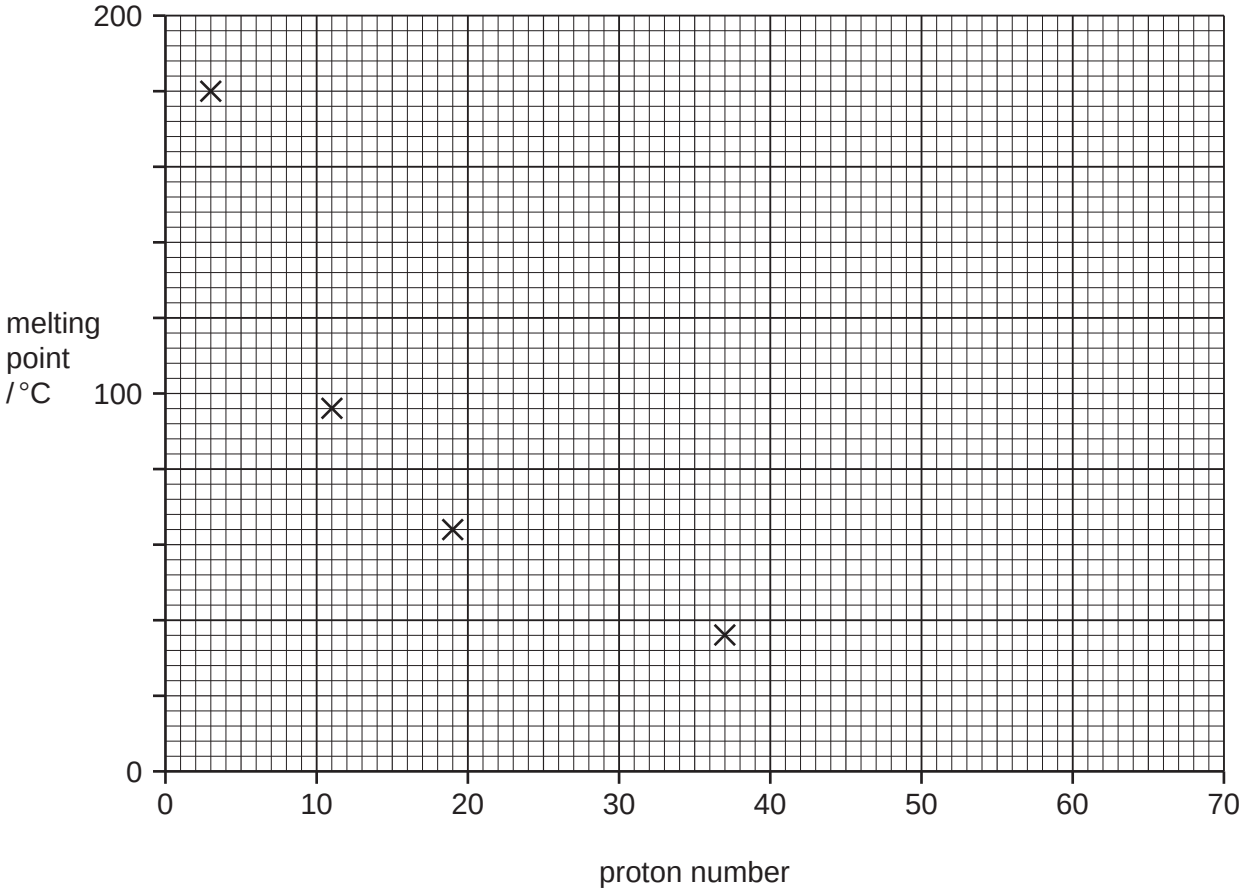

Fig. 4.2

(i) State the number of the group that contains the elements whose melting points are shown in Fig. 4.2.

Explain your answer briefly.

group number .....

explanation .....

..... [2]

(ii) Use the Periodic Table on page 32 to name the element in Fig. 4.2 that has the lowest melting point.

..... [1]

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(c) Many elements combine with oxygen to form oxides.

(i) A student is given a soluble white solid which she knows is either an oxide of a metal or an oxide of a non-metal.

Describe how the student can use the apparatus and materials shown in Fig. 4.3 to find out whether the solid is a metal oxide or a non-metal oxide.

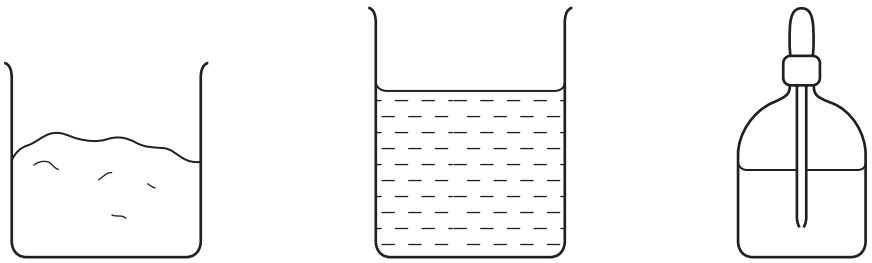

Fig. 4.3

.....

.....

..... [2]

(ii) Copper oxide is a black solid which is insoluble in water.

The student added excess dilute sulfuric acid to some copper oxide, and warmed the mixture.

The copper oxide disappeared and a clear blue solution remained.

State **one** observation which shows that a chemical change has occurred.

.....

..... [1]

(iii) Complete the **word** chemical equation for the reaction between copper oxide and dilute sulfuric acid.

copper oxide	+	sulfuric acid	→		+	

[2]

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Please turn over for Question 5.

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5 Fig. 5.1 shows a solar-powered vehicle which travelled 3000 km in 30 hours.

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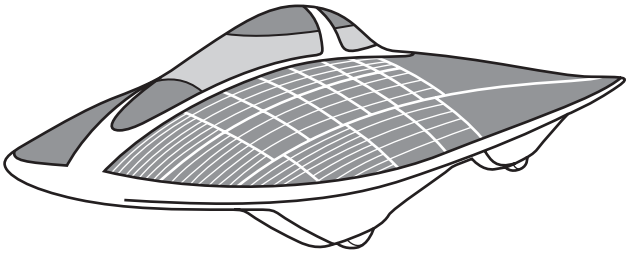

Fig. 5.1

(a) Calculate the average speed of the vehicle in km / hr.

State any formula that you use and show your working.

formula

working

..... km / hr [2]

(b) Fig. 5.2 shows a speed / time graph for part of the journey.

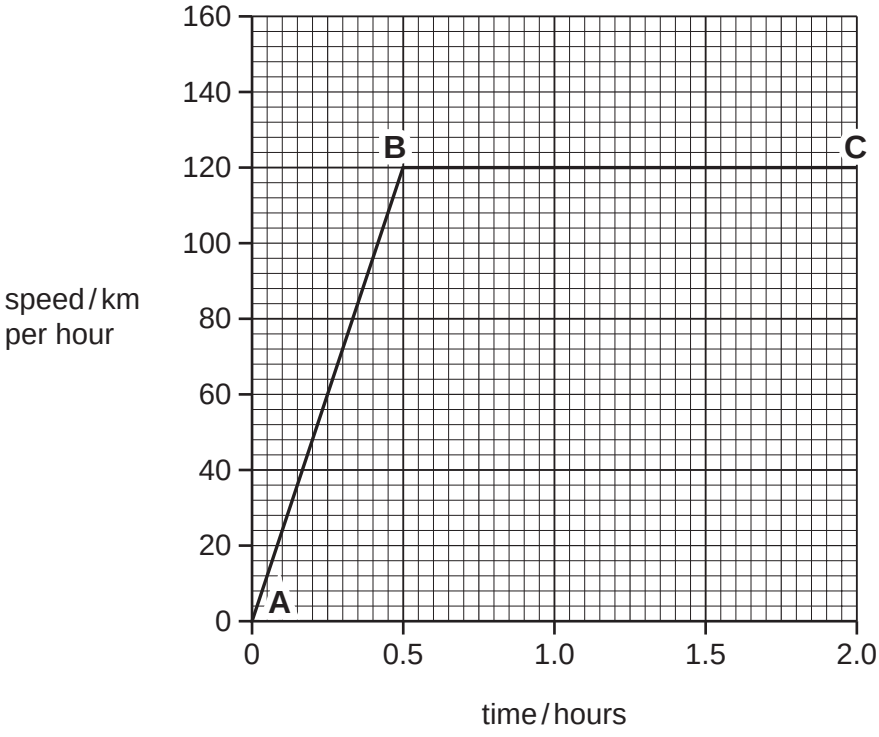

Fig. 5.2

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(i) Describe the movement of the vehicle between **A** and **B**.

..... [1]

(ii) Calculate the distance travelled between **B** and **C**.

State the formula that you use and show your working.

formula

working

..... km [2]

(c) Fig. 5.3 shows the energy flow diagram for the solar-powered vehicle.

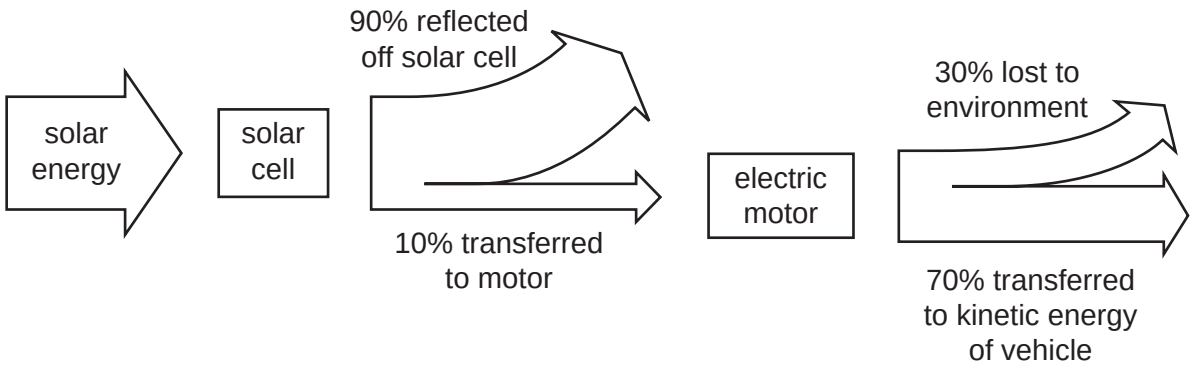

Fig. 5.3

(i) During part of the journey, the **solar cell** receives 1 000 000 joules of solar energy.

Calculate the number of joules transferred as kinetic energy to the **vehicle**.

Show your working.

..... J [2]

(ii) Write down the useful energy change which occurs in an electric motor.

..... energy to ..... energy [1]

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(d) Solar energy is a renewable energy source.

(i) Name **one** other renewable energy source.

.....[1]

(ii) Describe **one** advantage to the environment of using solar energy as a renewable energy source.

.....

.....[1]

(e) The vehicle has mirrors to help the driver see behind him. The driver sees a car in his mirror as shown on Fig. 5.4.

Use Fig. 5.4 to describe **two** characteristics of an image seen in this mirror that are similar to the characteristics of an image seen in a plane mirror.

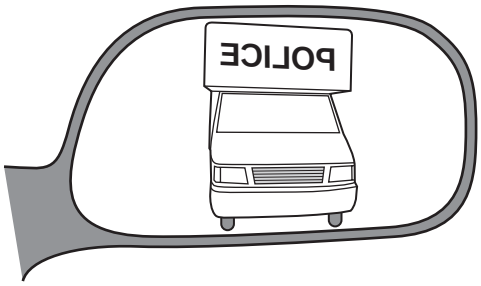

Fig. 5.4

1 .....

.....

2 .....

.....[2]

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(f) Sunlight can be focused onto smaller areas of a solar panel to improve its efficiency.

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Fig. 5.5 shows two parallel rays of sunlight being focused by a lens. The lens has a focal length of 5 cm.

Complete the diagram to show the rays of sunlight being focused by the lens.

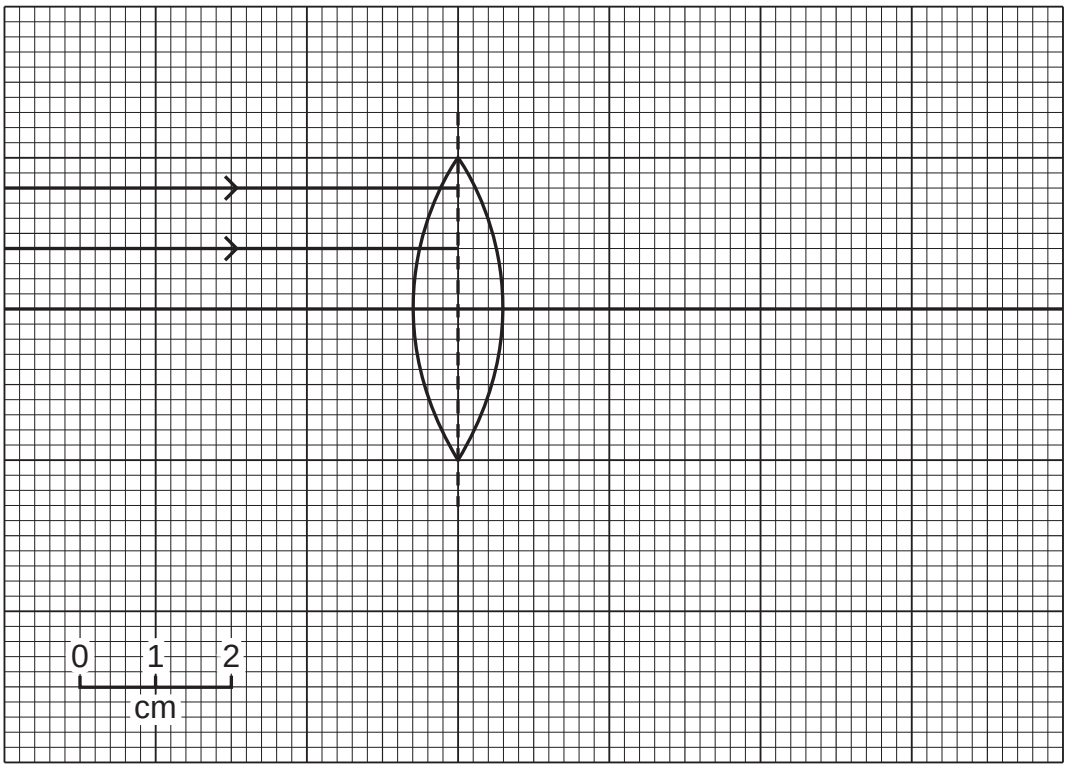

Fig. 5.5

[2]

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6 Fig. 6.1 shows a section through the heart.

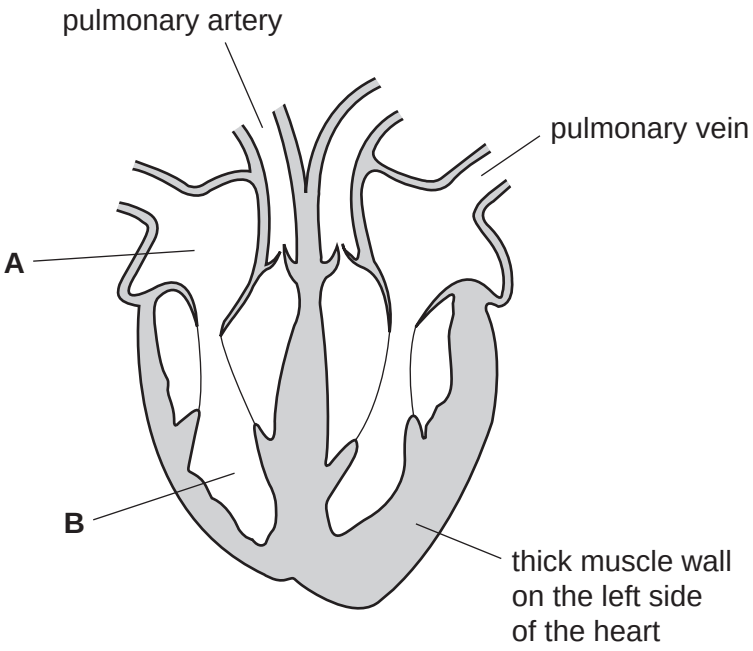

Fig. 6.1

(a) (i) Name the parts labelled **A** and **B**.

A .....

B ..... [2]

(ii) The walls of the heart are made of muscle.

Explain how this muscle pushes blood out of the heart.

.....

.....

..... [2]

(iii) Explain why the muscle wall on the left side of the heart, labelled on Fig. 6.1, is thicker than on the right side.

.....

.....

..... [2]

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(b) (i) Describe **two** differences between the contents of a pulmonary artery and a pulmonary vein.

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1 .....

.....

2 .....

..... [2]

(ii) Describe **two** differences between the structure of the wall of a pulmonary artery and the wall of a pulmonary vein.

1 .....

.....

2 .....

..... [2]

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7 Zirconium is a metallic element found in Period 5 of the Periodic Table.

(a) Zirconium metal is made into several different types of alloy.

State the meaning of the term *alloy*.

.....

..... [1]

(b) A large piece of zirconium does not burn in air but zirconium powder burns rapidly, forming zirconium oxide.

(i) Suggest the **word** chemical equation for the reaction that occurs when zirconium burns in air.

..... [1]

(ii) The mass of zirconium oxide formed is greater than the mass of zirconium burned.

Explain this in terms of atoms.

.....

.....

..... [2]

(iii) Suggest why zirconium powder burns rapidly but a large piece of zirconium does not.

.....

.....

..... [2]

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(c) Fig. 7.1 shows information about five different types of zirconium atoms.

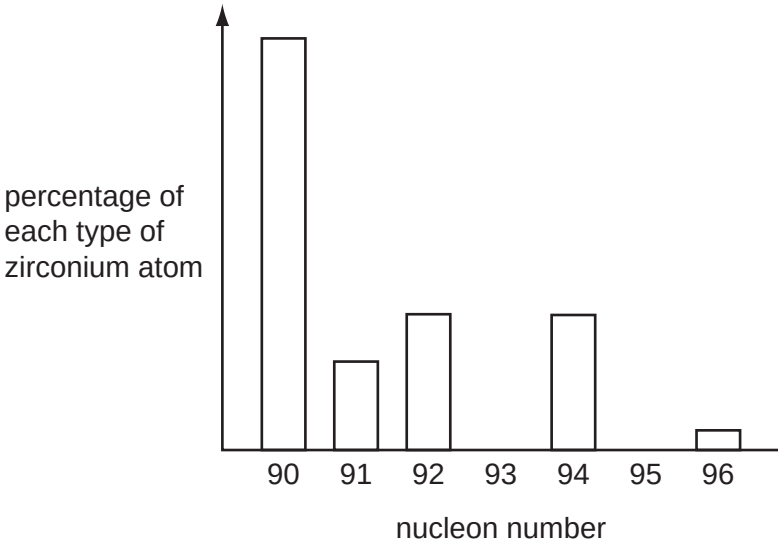

Fig. 7.1

(i) Use the Periodic Table on page 32 to find the proton number of zirconium.

proton number of zirconium = ... [1]

(ii) Complete Table 7.1 showing the numbers of protons and neutrons in two of the zirconium atoms in Fig. 7.1.

Table 7.1

atom	number of protons	number of neutrons
Zr-90		
Zr-96		

[2]

(iii) State the scientific word that is used to refer to atoms of the same element that have different numbers of neutrons.

..... [1]

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8 **(a)** Complete Table 8.1 below by drawing the circuit symbol for each electrical component.

Table 8.1

name of component	circuit symbol
open switch	
resistor	
voltmeter	
fuse	

[2]

(b) Fig. 8.1 shows an electrical hazard.

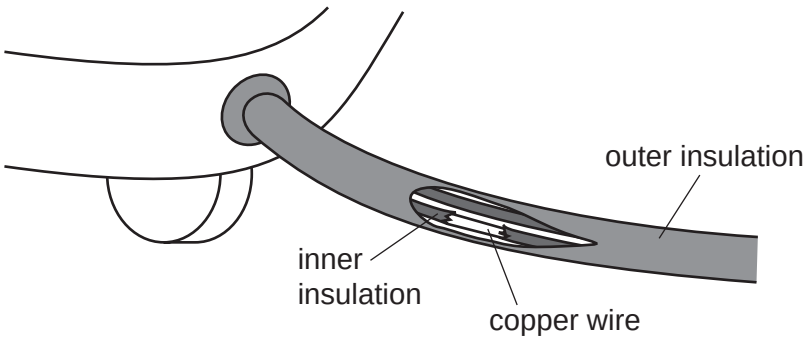

Fig. 8.1

State the hazard.

.....

.....

Explain why this situation is dangerous.

.....

.....

[2]

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(c) In the circuit shown in Fig. 8.2 the reading on ammeter $\mathbf{A_3}$ is 0.5 A.

(i) State the current readings on ammeters $\mathbf{A_1}$ and $\mathbf{A_2}$.

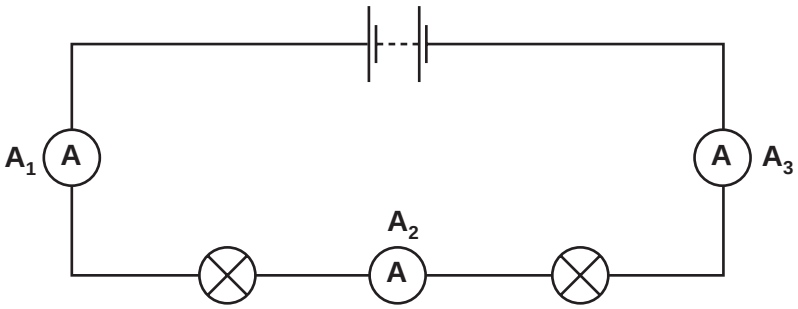

Fig. 8.2

$\mathbf{A_1}$ ..... A

$\mathbf{A_2}$ ..... A [1]

(ii) Each lamp in the circuit has a resistance of 5 Ω.

Calculate the combined resistance of the two lamps in the circuit.

State the formula that you use and show your working.

formula

working

..... Ω [2]

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(d) Fig. 8.3 shows how the resistance of an electrical component in a circuit changes with temperature.

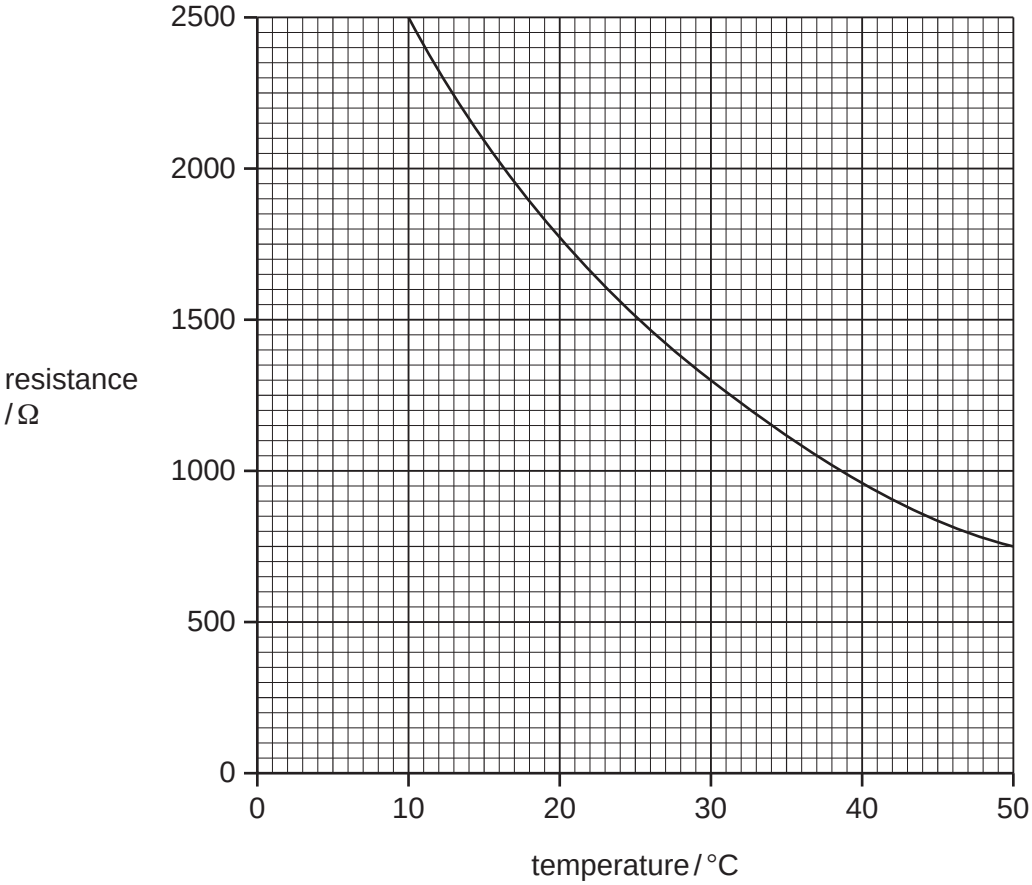

Fig. 8.3

(i) Write down the equation that shows how resistance is related to potential difference and current.

..... [1]

(ii) State the resistance of the component at 30 °C. ..... Ω [1]

(iii) Calculate the current that passes through the component at 30 °C when it is connected to a 12 V power supply.

Show your working.

..... A [2]

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Please turn over for Question 9.

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9 Chinchillas are mammals with thick grey fur. Chinchillas are often kept as pets.

People try to breed chinchillas with unusual fur.

(a) A rare allele of the gene that determines fur colour, **A**, is dominant to the normal allele, **a**. Table 9.1 shows the possible fur colours arising from these two alleles.

Table 9.1

genotype	colour
AA	zygote does not develop
Aa	white
aa	normal grey

(i) State the biological term for the observed effect produced by the genotype.

..... [1]

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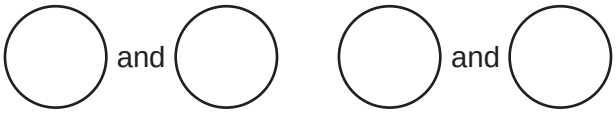
(ii) A breeder has two white chinchillas.

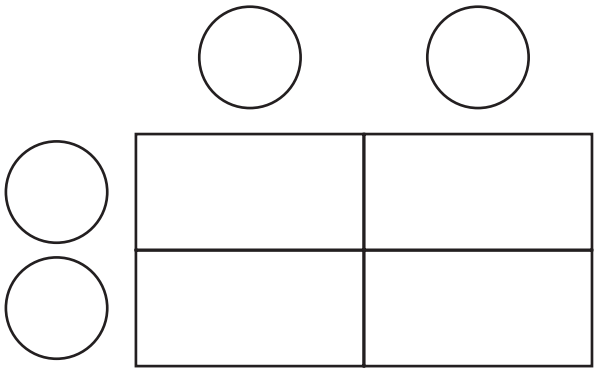
Complete the genetic diagram to show the genotypes of the offspring that would be produced when these two chinchillas are bred together.

genotype of parents ..... and .....

gametes  and and

gametes from female chinchilla

gametes from male chinchilla



[3]

(iii) State the ratio of fur colour that you would expect in the offspring resulting from this cross.

Explain your answer.

ratio of normal grey fur : white fur = ... : .....

explanation .....

..... [2]

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(b) Wild chinchillas live in rocky places in the Andes mountains, where it gets cold at night.

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(i) Suggest how the chinchilla's fur can help it to maintain a constant body temperature.

.....

.....

..... [2]

(ii) Suggest why almost all the chinchillas found in the wild have normal grey fur colour rather than white fur.

.....

.....

..... [2]

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10 Ethene, C_2H_4, is a gaseous, unsaturated hydrocarbon.

(a) Explain the meanings of both words in the term *unsaturated hydrocarbon*.

.....

.....

.....

..... [2]

(b) A sample of ethene was bubbled through bromine solution.

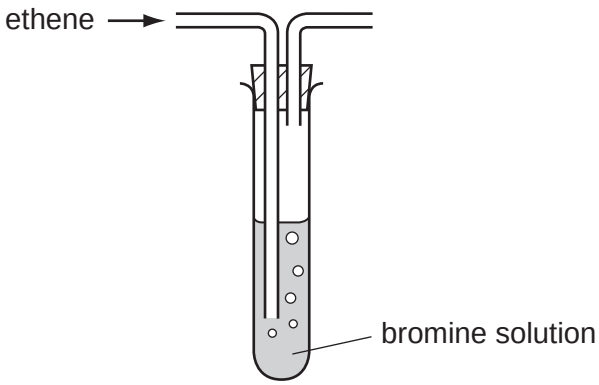

Fig. 10.1

Describe the colour change that is observed when ethene reacts with bromine.

from ..... to ..... [1]

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(c) Propane, C_3H_8, is a gaseous hydrocarbon used as a fuel.

Fig. 10.2 shows a cross-section through a small furnace (kiln) in which items of pottery are being heated by a propane burner. The temperature inside the kiln is 950 °C.

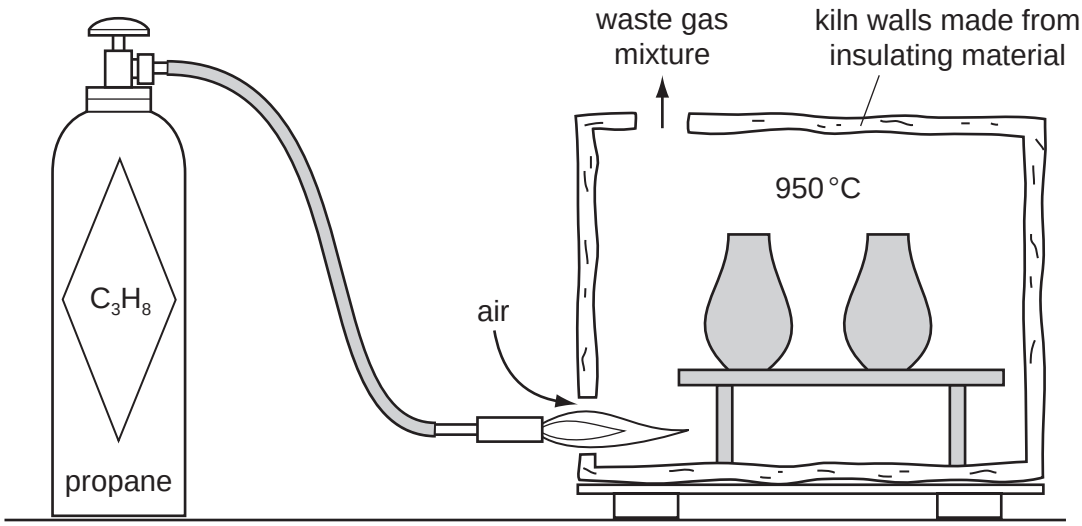

Fig. 10.2

(i) State which information from Fig. 10.2 shows that the combustion of propane is exothermic.

Explain your answer.

.....

.....

..... [2]

(ii) Explain why the waste gas mixture contains high concentrations of carbon dioxide and water vapour.

.....

..... [1]

(iii) The waste gases may also contain some carbon monoxide.

Suggest a reason for this.

.....

..... [1]

(iv) Explain why it is much safer to use a kiln like the one in Fig. 10.2 outside in the open air.

.....

..... [1]

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11 X-rays and γ(gamma)–rays are both forms of electromagnetic radiation. They are also both forms of ionising radiation and are used in the treatment of cancer.

(a) State the meaning of the term *ionising radiation*.

.....

..... [1]

(b) Name the radiation that comes between X-rays and visible light in the electromagnetic spectrum. Give **one** use for this radiation.

radiation .....

use .....

..... [2]

(c) **(i)** Electromagnetic waves are transverse waves. Water waves are also transverse.

Draw a diagram of a transverse wave on the axes below.

Label the amplitude and wavelength on your diagram.

[3]

(ii) Sound waves are **not** transverse waves.

State the type of wave motion demonstrated by sound waves.

..... [1]

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12 **(a)** Fig. 12.1 shows a plant cell.

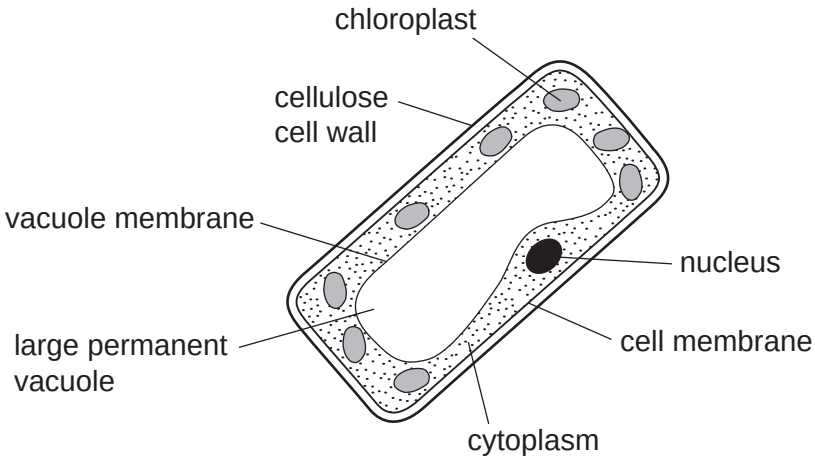

Fig. 12.1

(i) Name the tissue in the leaf in which this type of cell is found.

.....[1]

(ii) Describe how photosynthesis is carried out in this cell.

.....

.....

.....

.....

.....

.....[3]

(b) About one tenth of the Earth's surface is covered by forests in which much photosynthesis takes place.

Explain how extensive deforestation could harm the environment.

.....

.....

.....

.....

.....

.....[3]

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

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