Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

4133271582

COMBINED SCIENCE **0653/42**

Paper 4 (Extended) **February/March 2018**

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 20.

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

1 Fig. 1.1 shows a diagram of the female reproductive system and some events that take place before and during early pregnancy. The fetus is the name for the developing baby.

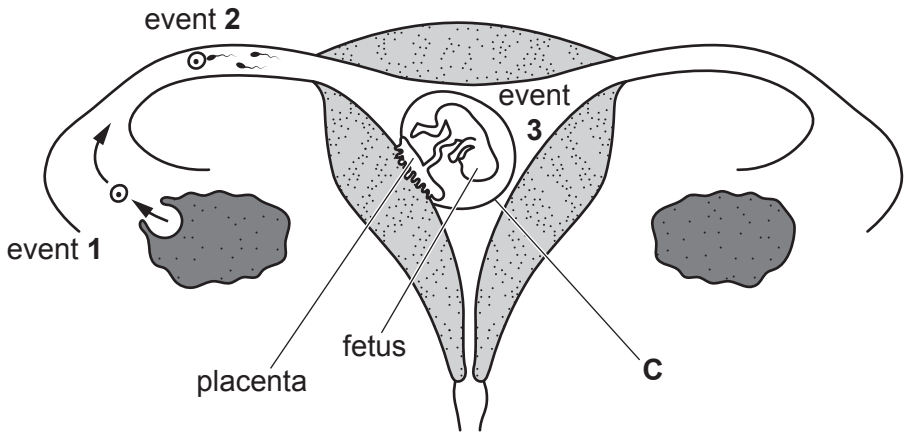

Fig. 1.1

(a) (i) State what happens during events **1** and **2**.

event **1** .....

event **2** .....

[2]

(ii) Name structure **C** in Fig. 1.1 and state its function.

name of **C** .....

function of **C** .....

.....

[2]

(b) Exchange of substances between blood in the fetus and the mother's blood takes place at the placenta. Some materials that are transferred across the placenta are shown.

amino acids **carbon dioxide** **fatty acids** **glucose** **oxygen**

(i) Name **one** substance from the list that shows net movement **from** the fetus into the mother's blood.

.....[1]

(ii) State the source of this substance in the fetus.

.....

.....[1]

(iii) Describe how the blood in the fetus reaches the placenta.

.....[1]

(c) Nicotine and carbon monoxide are taken into the blood when a person smokes.

Carbon monoxide combines with haemoglobin. This prevents oxygen from being carried in the red blood cells.

Suggest why carbon monoxide in the mother's blood is harmful to the fetus.

.....

.....

.....[2]

2 **(a)** Copper is extracted from molten copper chloride using electrolysis.

The apparatus is shown in Fig. 2.1.

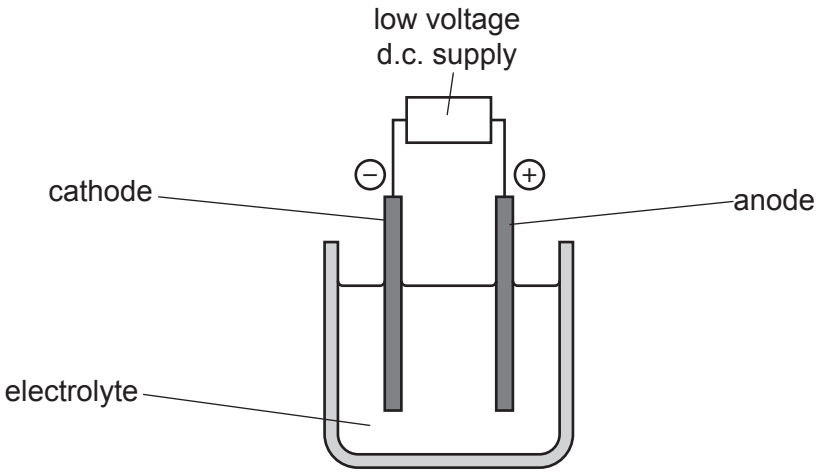

Fig. 2.1

(i) State whether this process for the extraction of copper involves a *chemical change* or a *physical change*.

Explain your answer.

change .....

explanation .....

.....

[1]

(ii) Identify the two ions present in the electrolyte and describe, in terms of electrons, the changes to these ions at the electrodes.

first ion .....

change .....

.....

second ion .....

change .....

.....

[3]

(b) A student finds out that copper can also be extracted by heating copper(II) oxide with carbon.

(i) Name the type of chemical reaction in which copper oxide is changed to copper.

.....[1]

(ii) Construct the balanced symbol equation for this reaction.

.....[2]

(c) Copper is one element in a collection of metals which have high melting points, high densities and form coloured compounds.

Suggest one other property that is shown by these metals and that is not shown by other metals.

.....[1]

3 Fig. 3.1 shows the International Space Station orbiting the Earth.

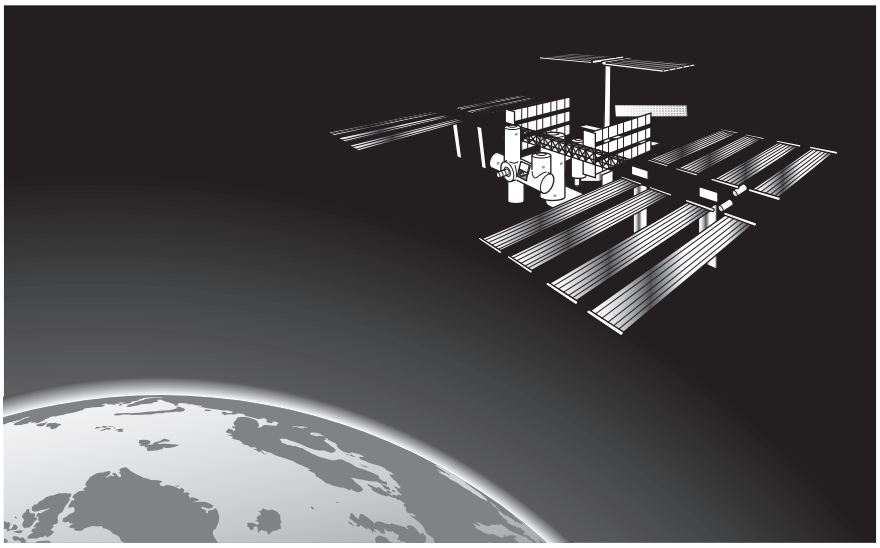

Fig. 3.1

(a) The space station is kept in orbit by the Earth's gravitational field.

Name the effect of the Earth's gravitational field on a mass.

.....[1]

(b) On one of its orbits, the space station travels at a speed of 28 000 km / h and takes 90 minutes to complete one orbit of the Earth.

Calculate the distance travelled by the space station during this orbit.

Show your working.

distance = ... km [2]

(c) The volume of the Earth is $1.08 \times 10^{21}\,m^3$.

The average density of the whole Earth is $5530\,kg/m^3$.

(i) Calculate the mass of the Earth.

State the formula you use and show your working.

formula

working

mass = ... kg [2]

(ii) The average density of the Earth's crust is $2700\,kg/m^3$.

Fig. 3.2 shows the interior structure of the Earth.

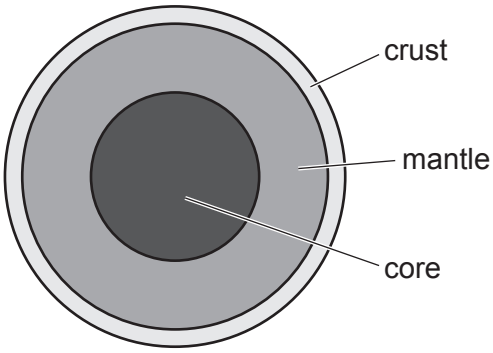

Fig. 3.2

Suggest how the average density of the mantle and core compares with the density of the crust.

Explain your answer.

.....

.....

.....[2]

(iii) The Earth's core has two layers. The outer core is liquid, while the inner core is solid. Both parts are made mostly of iron.

State **two** ways in which the atoms in the outer core will be arranged differently from the atoms in the inner core.

1. .....

.....

2. .....

.....

[2]

(d) Fig. 3.3 shows large solar panels that provide energy for the space station.

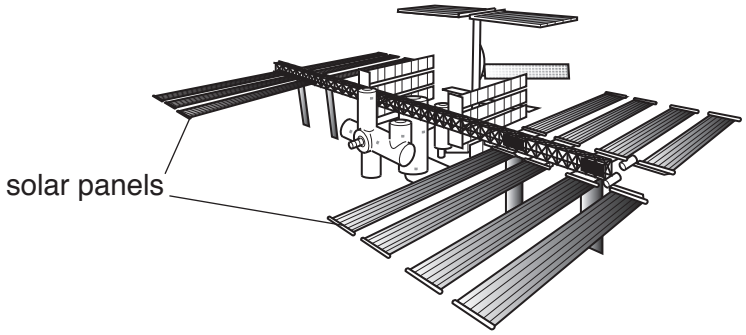

Fig. 3.3

The solar cells are in large panels that face the Sun to gather radiation energy from the Sun. This energy is stored by charging batteries on board the space station.

Complete the sequence of energy conversions that take place.

Radiation from the Sun

to ..... energy in the solar cells

to ..... energy in the batteries. [2]

4 Fig. 4.1 shows a cross-section of a leaf. Cells **P** and **Q** are examples of mesophyll cells in the leaf.

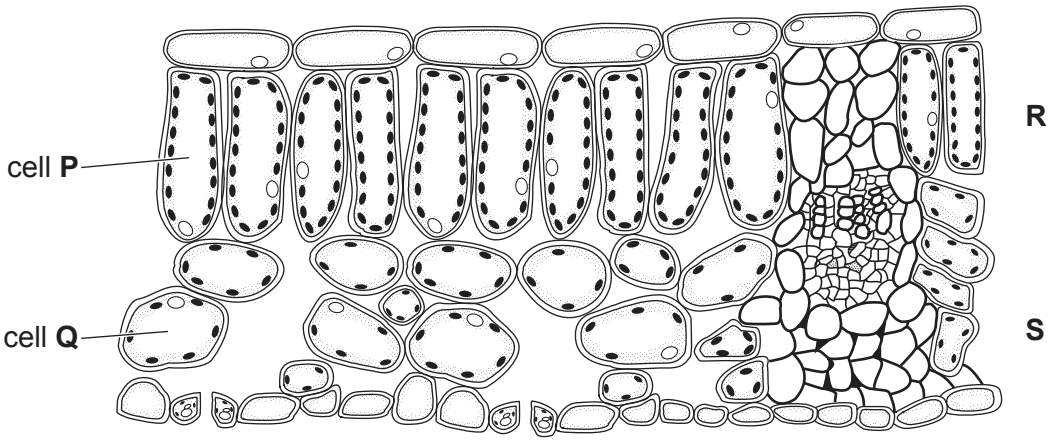

Fig. 4.1

(a) On Fig. 4.1 draw label lines from

1. **R** to the part of any cell which contains the genetic material,
2. **S** to a part of tissue that transports water.

[2]

(b) Cell **P** is able to carry out photosynthesis at a greater rate than cell **Q**.

Use evidence from Fig. 4.1 to support this statement referring to

(i) the position of cell **P** in the leaf compared with cell **Q**,

.....

.....[1]

(ii) the number of chloroplasts in cells **P** and **Q**.

.....

.....

.....[2]

(c) Describe in detail the function of chlorophyll in chloroplasts.

.....

.....

.....[2]

5 **(a)** An atom of bromine is represented by the symbol

$$^{79}_{35}\mathrm{Br}$$

(i) State the number of electrons, neutrons and protons in this atom.

electrons .....

neutrons .....

protons .....

[2]

(ii) Complete Table 5.1 to show the relative charges and approximate relative masses of electrons, neutrons and protons.

Table 5.1

particle	relative charges	approximate relative masses
electrons		
neutrons		
protons		

[2]

(b) Bromine is a non-metallic element.

State the types of bond that form when bromine reacts with sodium and with hydrogen.

Explain your answers in terms of electrons.

sodium and bromine .....

explanation .....

.....

hydrogen and bromine .....

explanation .....

.....

[3]

(c) The Periodic Table on page 20 shows the positions of bromine and the other elements in Group VII.

Predict **one** Group VII element that is displaced from its salts by bromine.

.....[1]

(d) Argon is a noble gas. The noble gases are in Group VIII of the Periodic Table.

(i) State the electronic structure of an atom of argon.

.....[1]

(ii) State one use of argon.

.....[1]

6 Fig. 6.1 shows two people talking to each other using cordless telephones over a link to a communications satellite.

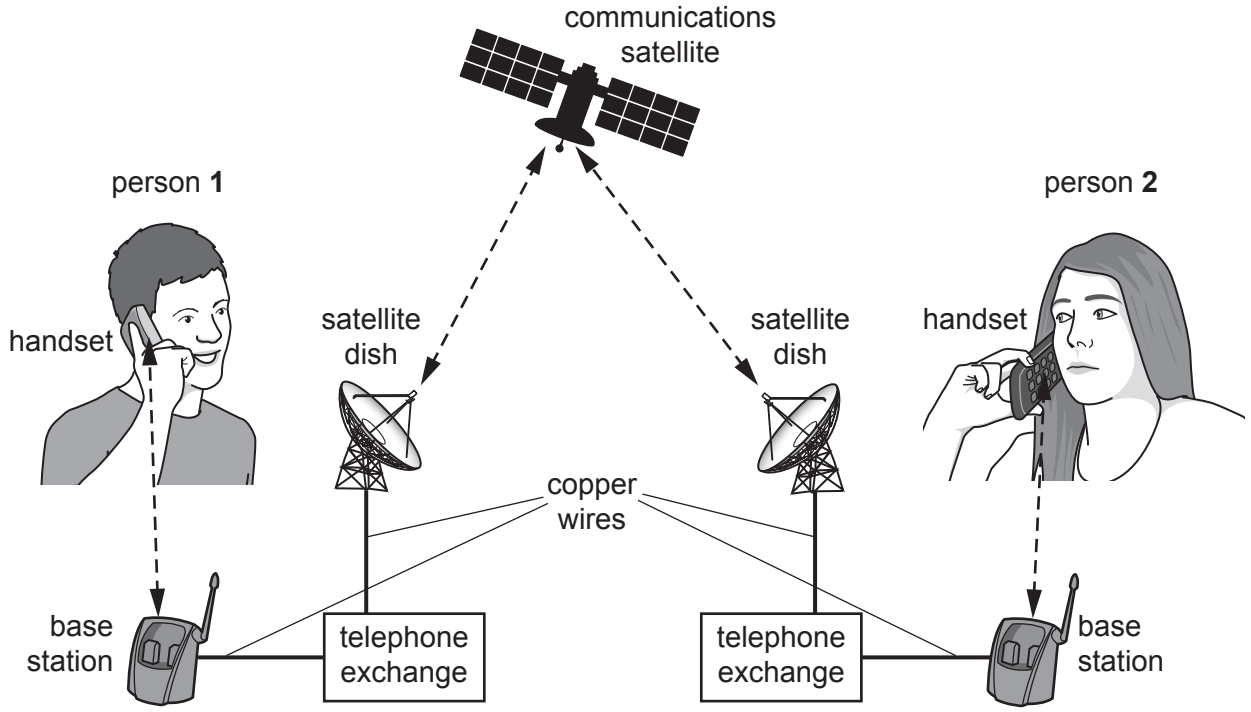

Fig. 6.1

(a) The conversation between the base stations and the satellite dishes is transmitted by electric currents in copper wires. These electric currents change rapidly when each person speaks.

Define *current* and suggest what is happening in terms of particles in a copper wire when a changing current passes through it.

.....

.....

.....[2]

(b) One person is speaking. Information is transmitted at frequencies of 300 Hz and 2.8×10^9 Hz at different stages in the communications system.

Identify the stage at which each of these frequencies is being used, and state the type of wave involved.

(i) A frequency of 300 Hz.

.....

.....[2]

(ii) A frequency of 2.8×10^9 Hz.

.....

.....[2]

(c) When a satellite telephone is used, there is a delay of about 0.1s between one person speaking and the other person hearing.

Explain why this delay happens.

.....

.....

.....[2]

7 **(a)** Breast milk contains all the nutrients needed for a newborn baby.

One mineral contained in milk is iron.

(i) State the role of iron in the body.

.....

.....[1]

(ii) Anaemia occurs due to a shortage of iron in the body.

Describe one symptom of anaemia.

.....[1]

(b) A student uses milk to make yoghurt at home. The stages below show the method he uses.

stage **1** He heats some milk to 90 °C, then allows it to cool.

stage **2** He adds a small amount of yoghurt which he bought in a supermarket. The yoghurt contains live microorganisms.

stage **3** He stirs the mixture then leaves it in an oven set at 45 °C for several hours.

stage **4** When the mixture thickens the yoghurt is ready and the student places it in a fridge.

(i) Explain why the student carries out the following processes in stage **1**.

1. Heating the milk to 90 °C.

.....

2. Allowing the milk to cool.

.....

.....
[2]

(ii) Suggest why the student only needs to use a small amount of the yoghurt in stage **2**.

.....

.....[1]

(iii) Predict whether the student can use some of the yoghurt he has made to repeat stages **1** to **4**.

Explain your answer.

.....

.....[1]

(c) Microorganisms in the yoghurt feed on the sugar in the milk and make lactic acid. The acid affects the proteins in the milk and the yoghurt becomes thick.

Suggest and describe in detail what happens to the protein molecules in the milk.

.....

.....

.....[2]

(d) There is no fibre present in the yoghurt.

(i) Explain why fibre is needed in a balanced diet.

.....

.....[1]

(ii) Suggest a way of including fibre in the yoghurt.

.....[1]

8 Petroleum is separated into useful fractions by fractional distillation.

Process **Y** produces short alkene molecules from longer alkane molecules.

These processes are shown in Fig. 8.1.

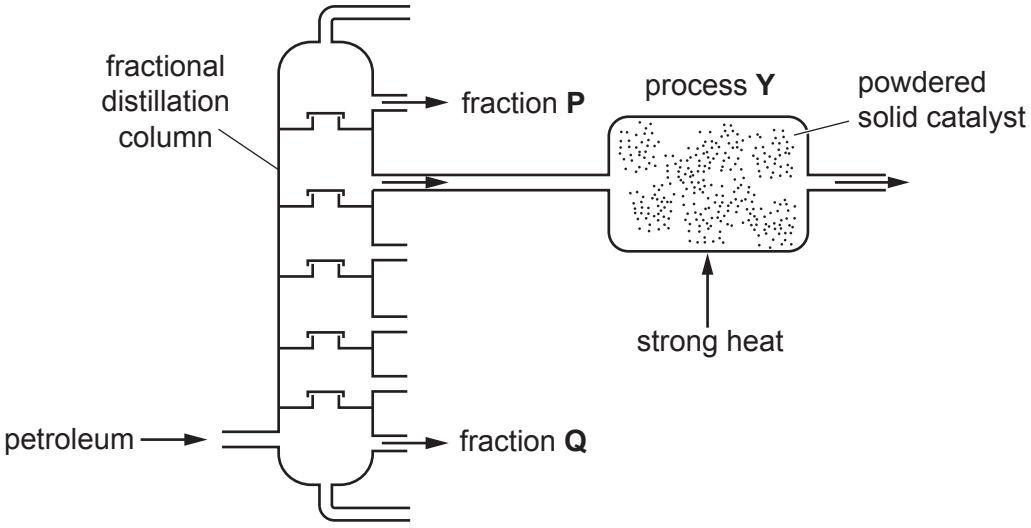

Fig. 8.1

(a) Fraction **P** and fraction **Q** contain different compounds.

Describe **two** of the differences between the compounds in fraction **P** and those in fraction **Q**.

1. .....

.....

2. .....

.....

[2]

(b) Name process **Y**.

.....[1]

(c) The rate of reaction in process **Y** is increased by using a powdered solid catalyst and a high temperature.

(i) State why the catalyst is used in the form of a powder.

.....

.....[1]

(ii) Explain how a high temperature increases the rate of reaction in process **Y**.

Use ideas about particles in your answer.

.....

.....[2]

(d) Bromine is added to two different samples of hydrocarbons **A** and **B**.

Hydrocarbon **A** decolourises the bromine.

Hydrocarbon **B** has no effect on the bromine.

State these two types of hydrocarbon.

A .....

B .....
[1]

(e) The combustion of hydrocarbons produces a gas that turns limewater milky.

(i) State the formula of this gas.

..... [1]

(ii) Suggest **one** concern that people have as the proportion of this gas is increasing in the air.

.....

.....[1]

9 Fig. 9.1 shows the circuit for an immersion heater using electrical energy to heat water. Two electric heating elements are immersed in water inside a large tank.

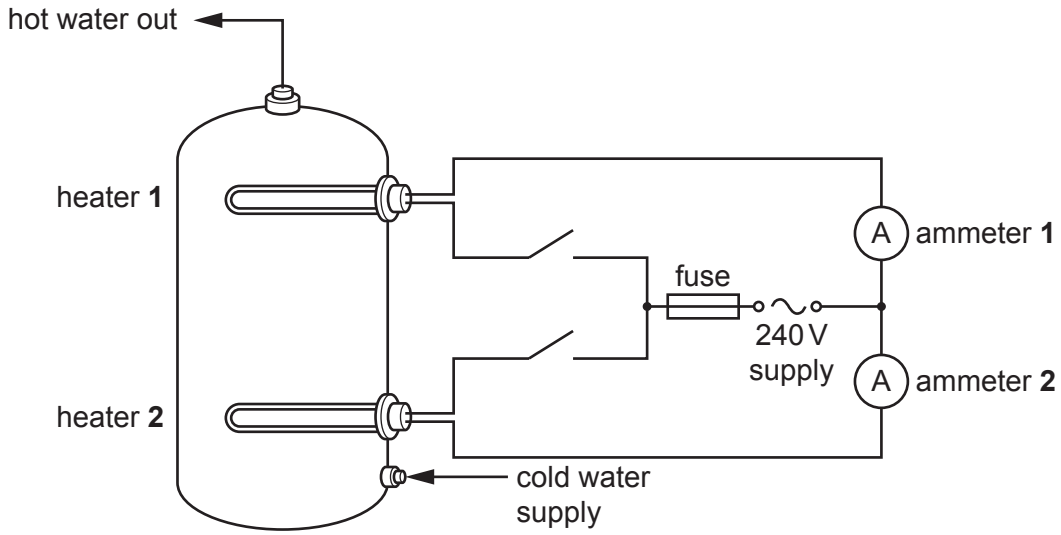

Fig. 9.1

The electrical energy is supplied at 240 V.

When both heaters are switched on, ammeter **1** reads 4 A, and ammeter **2** reads 10 A, giving a total current of 14 A through the fuse.

(a) The fuse in the supply circuit has a value of 20 A printed on it.

Explain why a 20 A fuse is used in this circuit.

.....

.....[1]

(b) Calculate the total resistance of the two heaters.

State the formula you use, and show your working.

formula

working

resistance = ... Ω [2]

(c) Calculate the electrical energy supplied by heater **2** when it is switched on for 8 hours.

State any formula you use, and show your working.

formula

working

energy = ... J [2]

(d) Heater **2** is used to provide a full tank of hot water, while heater **1** is used to provide a small amount of hot water quickly when the water in the tank is cold.

Explain why heater **1** is able to provide a small amount of hot water quickly without heating the whole tankful of water. You may wish to draw a diagram to help your answer.

.....

.....

.....

.....[3]

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9			**Key** atomic number atomic symbol name relative atomic mass								5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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