Cambridge IGCSE

Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

0053939865

CO-ORDINATED SCIENCES **0654/31**

Paper 3 (Core) **October/November 2019**

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 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 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.

Cambridge Assessment International Education

1 **(a)** Fig. 1.1 is a diagram of a cross-section through a vein.

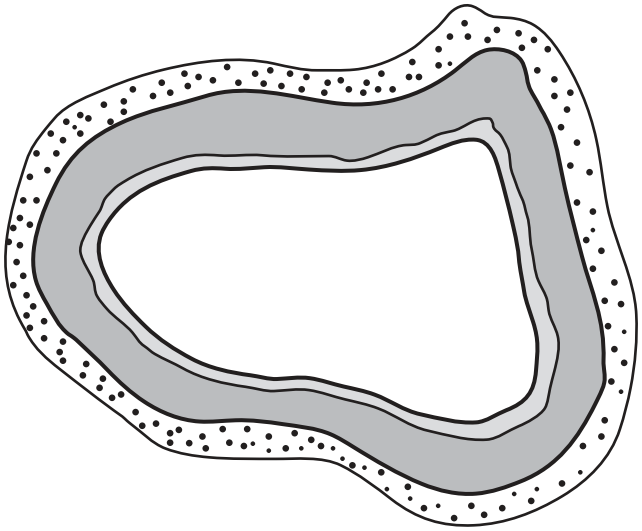


Fig. 1.1

(i) Use a label and a label line on Fig. 1.1 to identify the:

- layer of muscle and elastic fibres
- lumen.

[2]

(ii) Name a structure that is present in veins but is **not** visible in Fig. 1.1.

..... [1]

(b) Describe two ways in which the structure of capillaries is different from the structure of veins.

1 .....

.....

2 .....

.....

[2]

(c) Table 1.1 shows the names of three organs and some of the blood vessels connected to these organs.

Complete Table 1.1.

Table 1.1

organ	blood vessel taking blood to the organ	blood vessel taking blood away from the organ
heart	vena cava	.....
kidney	renal artery	.....
lung	.....	pulmonary vein

[3]

[Total: 8]

2 The Periodic Table shows the elements arranged in order of proton number.

A copy of the Periodic Table is shown on page 32.

(a) State the meaning of the term *proton number*.

.....

..... [1]

(b) Three metals, **X**, **Y** and **Z**, are in Group 1 of the Periodic Table.

Table 2.1 shows the observations when they are reacted separately with water.

Table 2.1

metal	observation
X	metal melts, gas released very quickly, coloured flame is seen
Y	metal melts, gas released quickly
Z	metal does not melt, gas released slowly

(i) Identify the gas that is released when Group 1 metals react with water.

..... [1]

(ii) Deduce which metal, **X**, **Y** or **Z**, has the greatest proton number.

Explain your answer.

metal .....

explanation .....

.....

.....

[2]

(iii) Use the information in Table 2.1 to place metals **X**, **Y** and **Z** in order of their melting points.

Explain your answer.

..... (highest)

.....

..... (lowest)

explanation .....

.....

.....

[2]

(c) Hydrogen peroxide is a colourless liquid.

Aqueous hydrogen peroxide decomposes very slowly, releasing oxygen gas.

A student adds solid manganese(IV) oxide to aqueous hydrogen peroxide and observes that oxygen gas is released at a much higher rate.

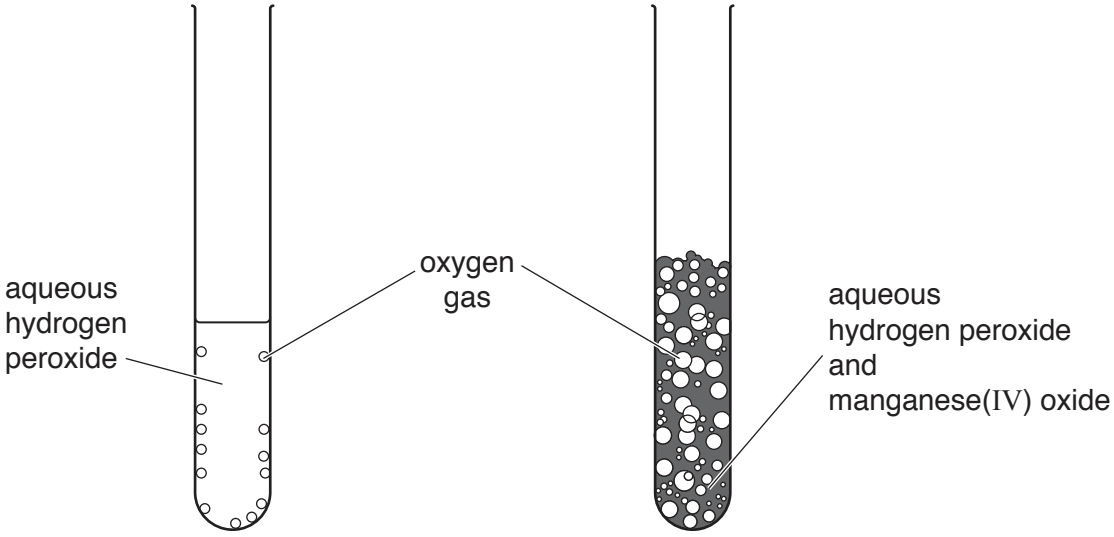


Fig. 2.1

(i) Describe the test for oxygen gas.

.....

..... [1]

(ii) Describe the role of the manganese(IV) oxide in this reaction.

.....

.....

..... [2]

(iii) Balance the symbol equation for the decomposition of hydrogen peroxide.

$$\ldots\ldots H_2O_2 \rightarrow \ldots\ldots H_2O + O_2$$

[1]

[Total: 10]

3 **(a)** Fig. 3.1 shows a worker changing a lamp on a lamp post.

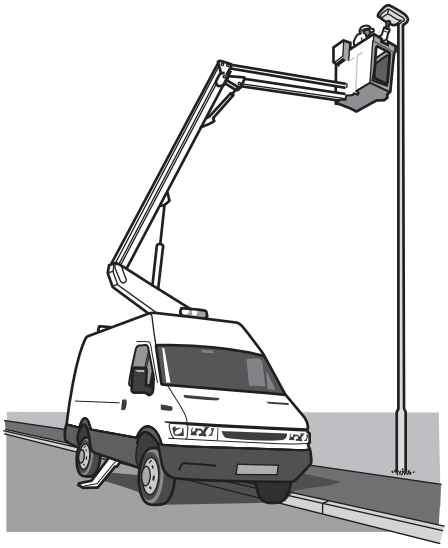


Fig. 3.1

(i) The worker is lifted up to the top of the lamp post.

State the type of energy that has been gained by the worker when he has reached the top of the lamp post.

..... [1]

(ii) As the worker changes the lamp, he drops his screwdriver.

State the type of energy that is gained by the screwdriver as it is falling to the ground.

..... [1]

(iii) The worker applies a horizontal force of 10 N to the top of the lamp post.

The total height of the post is 10 m.

Calculate the moment of the force at the base of the post and state its units.

moment = ... units .....
[3]

(b) The worker switches on the lamp. The lamp emits visible light.

(i) Fig. 3.2 shows an incomplete electromagnetic spectrum.

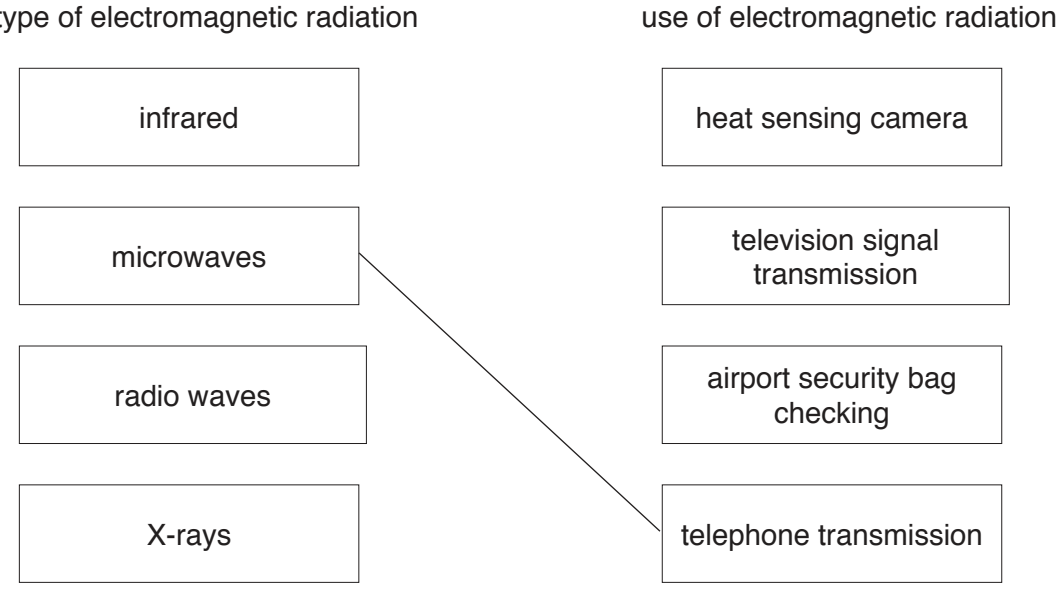
On Fig. 3.2 write **visible light** in its correct position.

gamma rays		ultraviolet				radio waves

Fig. 3.2

[1]

(ii) Draw a line from each type of electromagnetic radiation to its use. One of the lines has been drawn for you.



[2]

(iii) Four types of electromagnetic radiation are listed in **(b)(ii)**.

State which of these has the lowest frequency.

..... [1]

(c) The worker drives a van for 15 minutes and travels 8 km.

Calculate the average speed of the van in m/s.

average speed = ... m/s [3]

[Total: 12]

4 **(a)** Fig. 4.1 shows a food web.

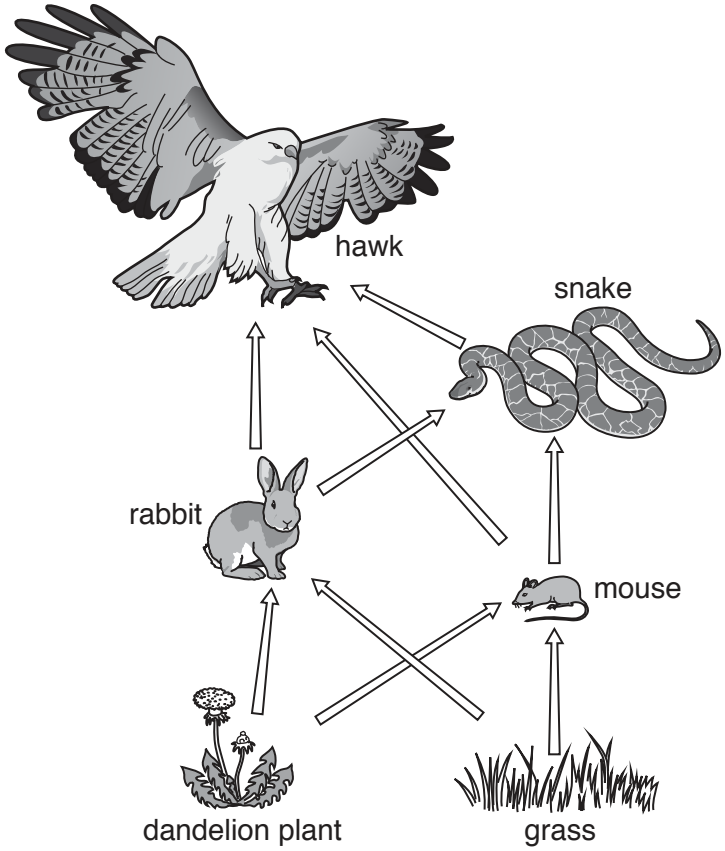


Fig. 4.1

(i) Identify **one** producer shown in Fig. 4.1.

..... [1]

(ii) Identify **one** herbivore shown in Fig. 4.1.

..... [1]

(iii) Use information from Fig. 4.1 to complete a food chain that includes the mouse and three **other** organisms.

	mouse		

[2]

(b) Complete the sentences to describe why the hawk can be classed as a secondary **or** a tertiary consumer.

The hawk is a **secondary** consumer when it eats:

.....

.....

The hawk is a **tertiary** consumer when it eats:

.....

.....

[2]

(c) A disease causes a large decrease in the rabbit population.

This causes a decrease in the snake population.

Give two reasons why the snake population decreases.

1 .....

.....

2 .....

.....

[2]

(d) State the principal source of energy for all food webs.

..... [1]

[Total: 9]

5 **(a)** Name the type of chemical bond between:

a metallic element and a non-metallic element

.....

two non-metallic elements.

.....

[2]

(b) Fig. 5.1 shows four particle diagrams, **A**, **B**, **C** and **D**.

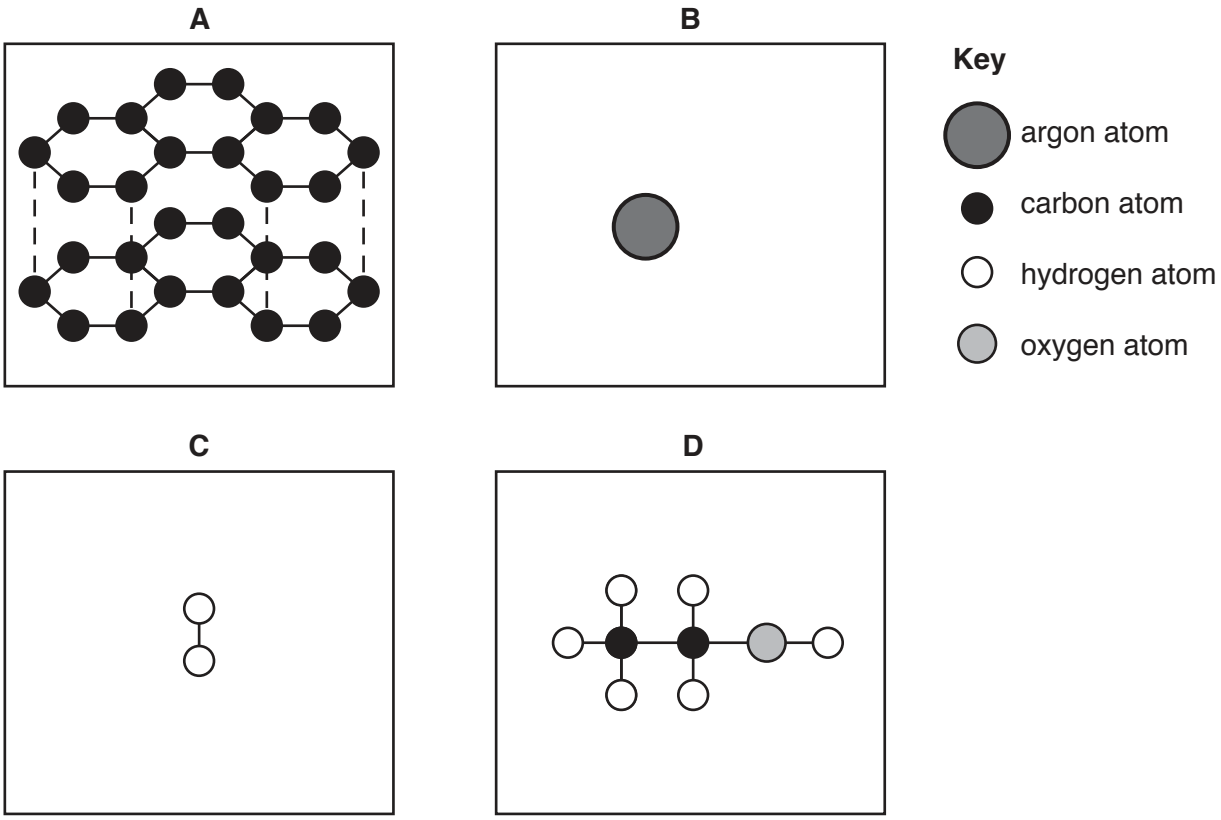


Fig. 5.1

(i) Carbon exists in different forms.

Name the form of carbon shown in diagram **A**.

..... [1]

(ii) Complete the sentences to explain why diagrams **A**, **B** and **C** show elements and why diagram **D** shows a compound.

Diagrams **A**, **B** and **C** show elements because .....

.....

.....

Diagram **D** shows a compound because .....

.....

.....
[2]

(iii) State the formula of the compound in diagram **D**.

..... [2]

(c) The element lead is separated from the compound lead(II) bromide using electrolysis as shown in Fig. 5.2.

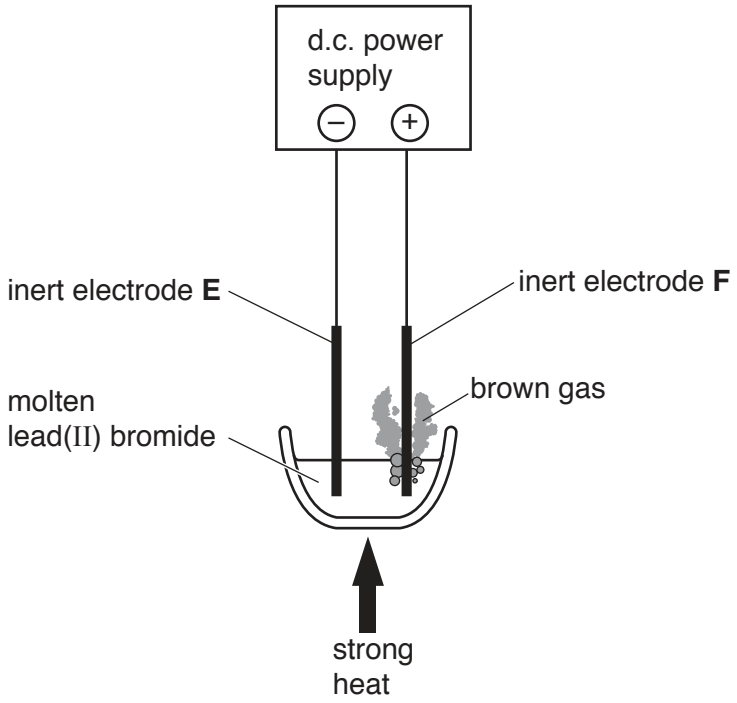


Fig. 5.2

(i) Name the inert electrodes **E** and **F** in Fig. 5.2.

E .....

F .....

[2]

(ii) The process releases a brown gas.

Name the brown gas.

..... [1]

[Total: 10]

6 **(a)** Fig. 6.1 shows solar cells fitted to the roof of a house. They are connected to a washing machine.

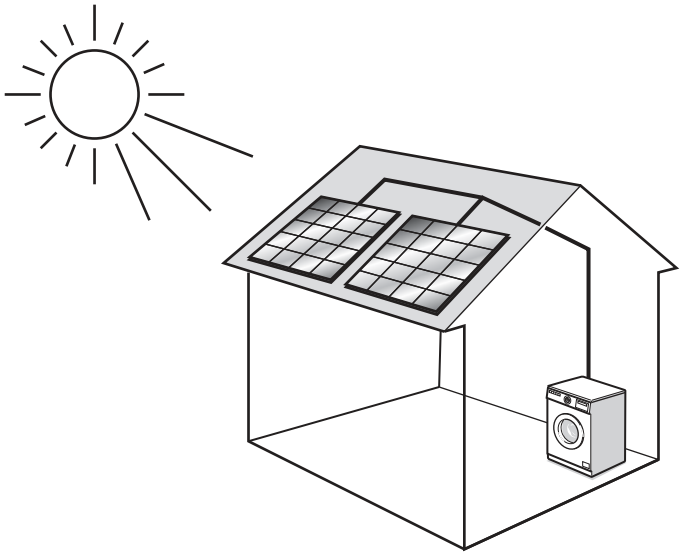


Fig. 6.1

(i) Complete the energy transfer sequence.

Light from the Sun shines on the solar cells to produce ..... energy.

Some of this energy is converted to ..... energy in the washing machine to increase the temperature of water.

[2]

(ii) The washing machine is operated during the night.

Suggest a renewable energy source that could provide energy during the night.

..... [1]

(iii) The washing machine drum is turned by an electric motor.

The turning effect of the motor can be increased by using a stronger magnet inside the motor.

State **one** other way of increasing the turning effect of the motor.

..... [1]

[Turn over

(b) The maximum current in the washing machine circuit is 10 A.

(i) State why a fuse should be fitted in the circuit of the washing machine.

.....

..... [1]

(ii) The washing machine's fuse needs to be replaced.

Four different fuse ratings are available.

3 A **10 A** **13 A** **30 A**

State the most appropriate fuse rating, and give a reason for your choice.

fuse ..... A

reason .....

.....
[2]

[Total: 7]

7 **(a)** Glucose is produced by photosynthesis and is stored in the leaves as starch.

Fig. 7.1 is a diagram of a leaf with green and white parts.

The white part of the leaf contains no chlorophyll.

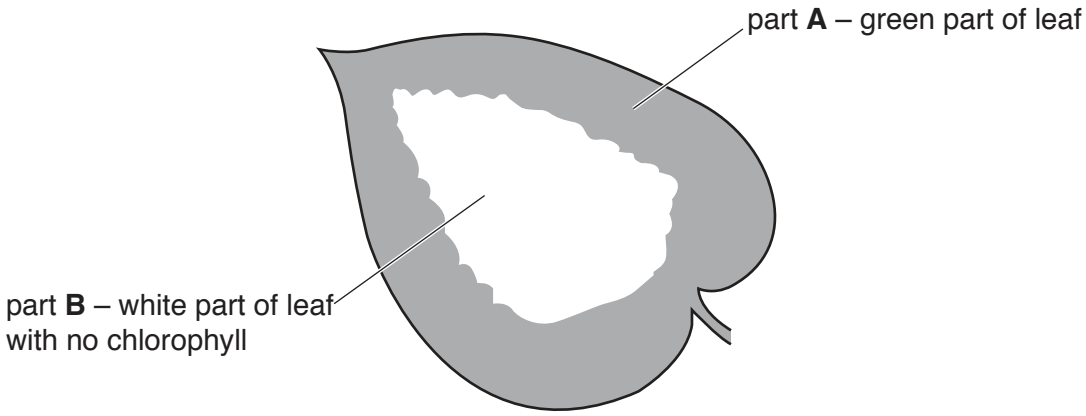


Fig. 7.1

The student tests the leaf for the presence of starch.

(i) Name the solution used to test for the presence of starch.

..... [1]

(ii) Predict the colour of the test solution after testing each part of the leaf for starch.

colour of test solution after testing part **A**

.....

colour of test solution after testing part **B**

.....
[2]

(b) Define the term *photosynthesis* using words from the list.

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

carbohydrates **fats** **heat** **light**

oxygen **proteins** **water**

Photosynthesis is the process by which plants manufacture ..... from raw materials using energy from ..... .

[2]

(c) Carbon dioxide is needed for photosynthesis.

Carbon dioxide enters the leaf by diffusion.

Define *diffusion*.

Use the word **concentration** in your answer.

.....

.....

.....

.....

..... [3]

[Total: 8]

8 **(a)** A student adds dilute sulfuric acid to four different solids in test-tubes **H**, **I**, **J** and **K**, as shown in Fig. 8.1.

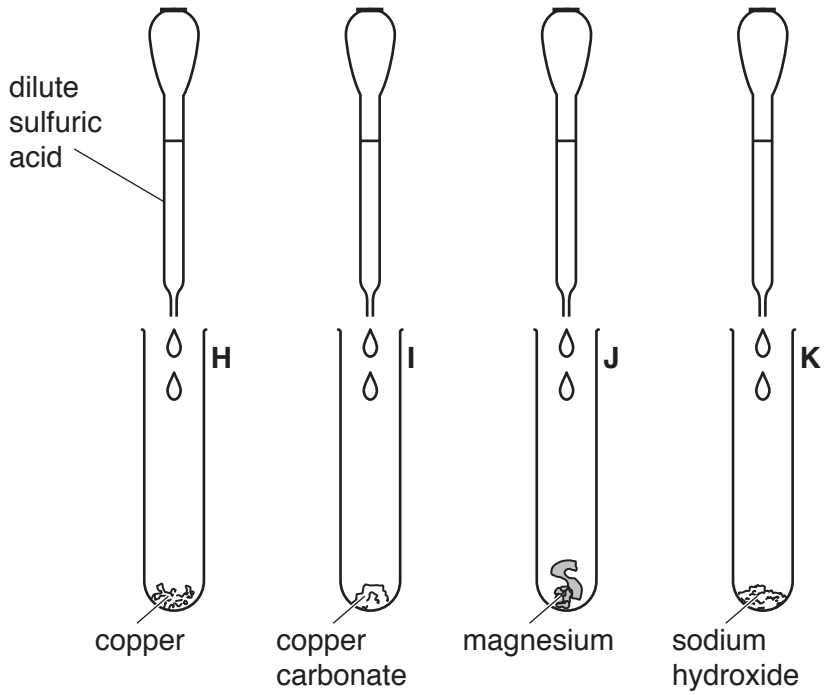


Fig. 8.1

(i) State the test-tube in which:

carbon dioxide gas is produced .....

hydrogen gas is produced .....

sodium sulfate solution is produced. .....

[2]

(ii) Suggest in which test-tube the reaction produces a blue solution.

Give a reason for your answer.

test-tube .....

reason .....

.....

.....

[1]

(b) Describe a chemical test to show that ammonium chloride contains ammonium ions.

.....

.....

..... [2]

(c) Dilute hydrochloric acid is added to aqueous sodium hydroxide.

Fig. 8.2 shows apparatus a student uses to investigate the change in pH as the acid is added.

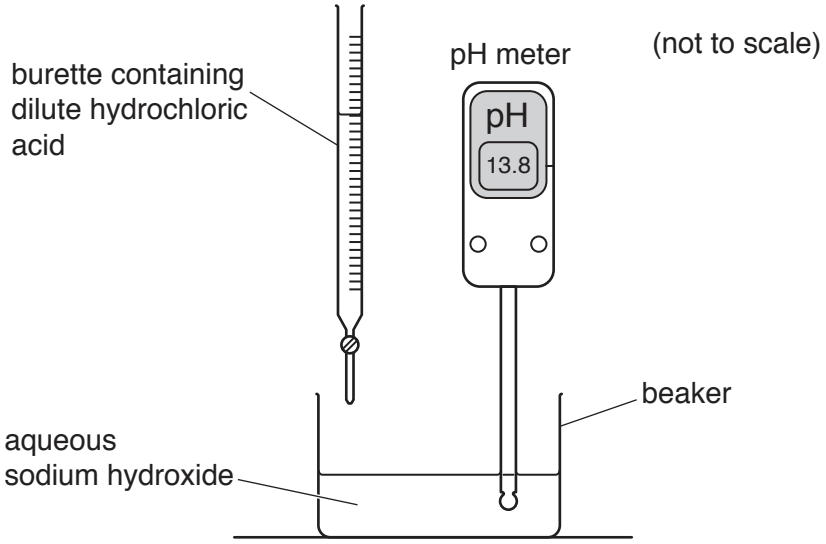


Fig. 8.2

The graph in Fig. 8.3 shows the results.

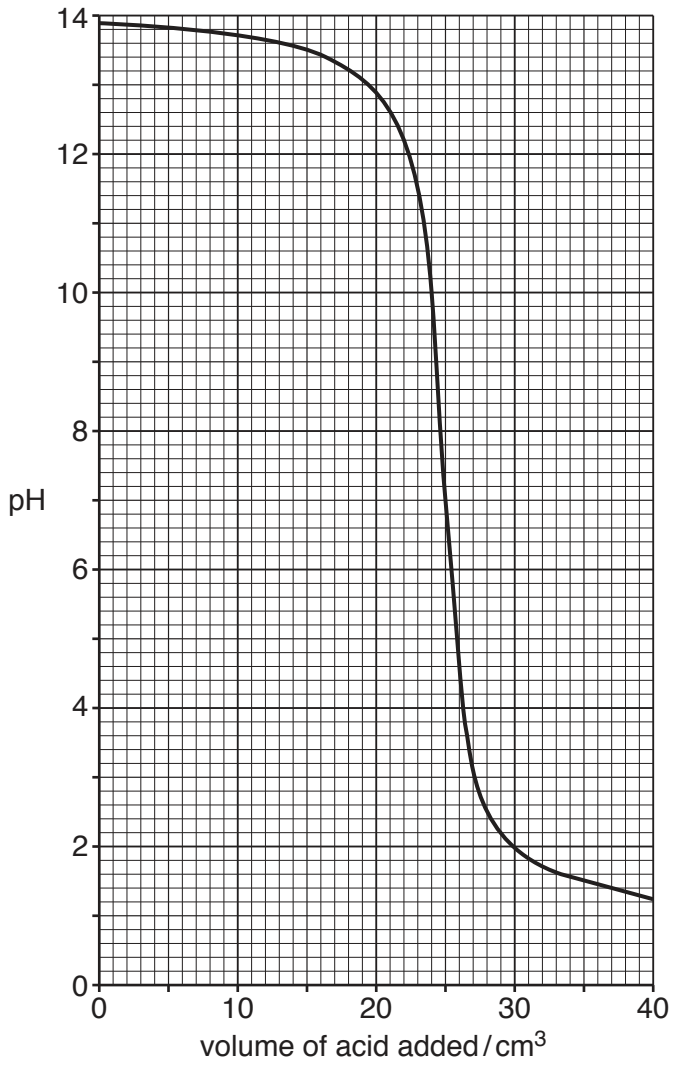


Fig. 8.3

(i) Describe how the pH of the mixture in the beaker changes as the volume of acid added increases.

.....

.....

..... [2]

(ii) Use the graph to find the volume of acid that produces a neutral solution.

Explain your answer.

volume of acid ..... cm^3

explanation .....

.....

[2]

(iii) Complete the word equation for the reaction that occurs in the beaker.

hydrochloric acid	+	sodium hydroxide	→		+	

[1]

[Total: 10]

9 **(a)** Fig. 9.1 shows a ray of light from a lamp striking the surface of an ice rink.

The ice acts like a plane mirror.

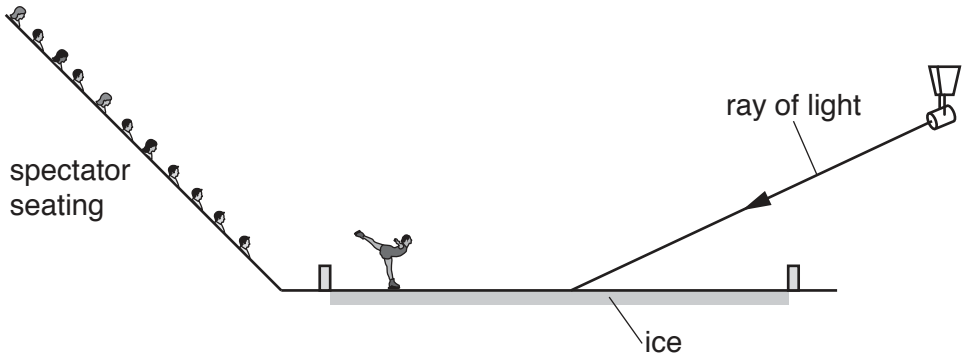


Fig. 9.1

(i) On Fig. 9.1 draw the normal at the point where the ray strikes the ice rink **and** label with the word ***normal***. [1]

(ii) On Fig. 9.1 draw the reflected ray to show where a spectator will see the ray **and** label with the words ***reflected ray***. [1]

(iii) On Fig. 9.1 mark the angle of incidence **and** label with the letter ***i***. [1]

(b) The ice rink is prepared by melting the surface and freezing it again to create a smooth surface.

(i) State the temperature at which the water on the surface freezes.

..... [1]

(ii) A piece of ice is left to melt in a container.

Complete Fig. 9.2 to show the arrangement of particles in liquid water.

The diagram for ice has been done for you.

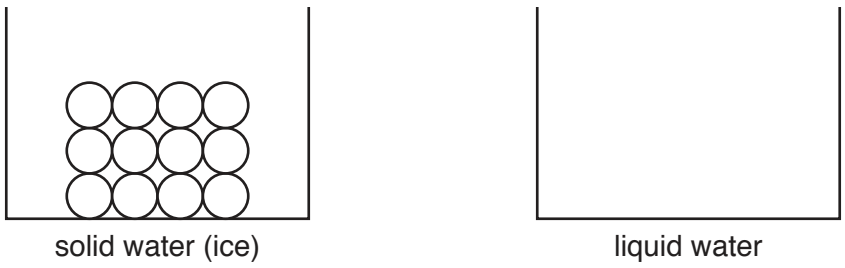


Fig. 9.2

[2]

(c) Fig. 9.3 shows how the blade of an ice skate cuts a groove into the ice.

Fig. 9.4 shows a very heavy machine used to make the ice smooth again.

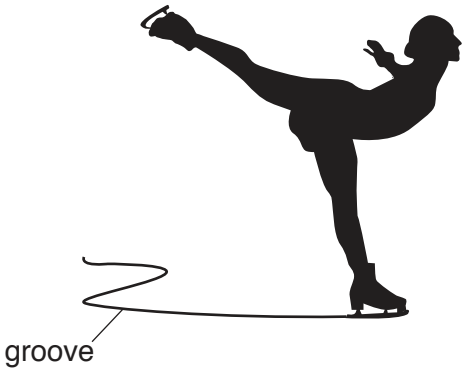


Fig. 9.3

Fig. 9.4

The machine does **not** cut grooves into the ice.

Explain this observation.

.....

.....

..... [2]

(d) A sample of the ice was taken for analysis.

The mass of the sample was 4600 g.

The volume was 5000 cm^3.

Calculate the density of the ice.

density = ... g/cm^3 [2]

(e) The floor that surrounds the rink is made from rubber.

Suggest why a floor made from rubber can prevent sliding.

..... [1]

[Total: 11]

10 (a) The skin has an important role in the maintenance of body temperature.

Fig. 10.1 is a diagram of a cross-section of the skin.

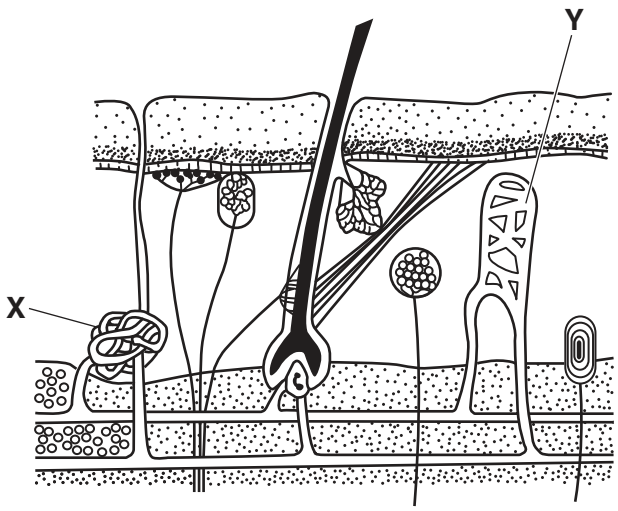


Fig. 10.1

Identify the parts labelled **X** and **Y** in Fig. 10.1.

X .....

Y .....

[2]

(b) The graph in Fig. 10.2 shows the differences in temperature of the skin of a person during and after exercise.

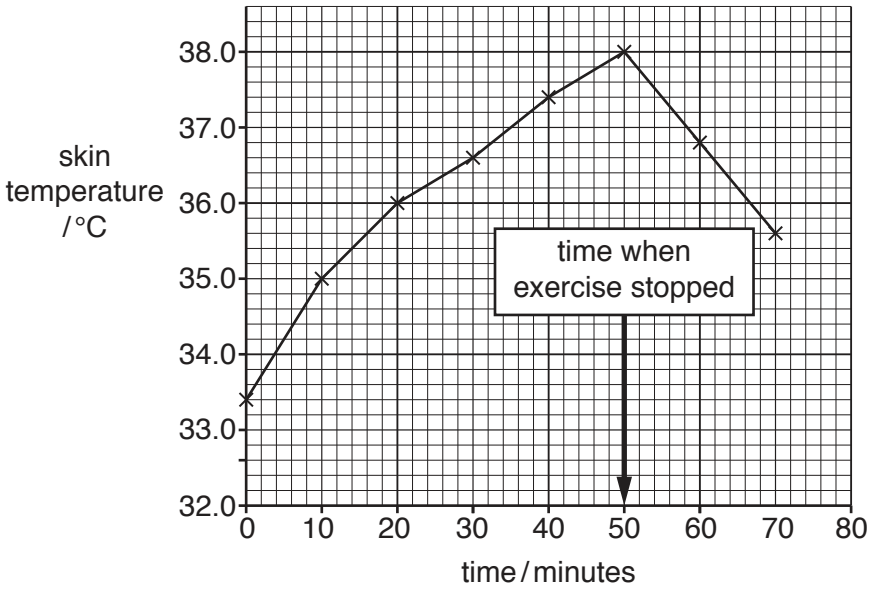


Fig. 10.2

(i) Describe the pattern in the results shown in Fig. 10.2.

Include data to support your answer.

.....

.....

.....

..... [2]

(ii) State two changes that occur in the skin of the person during exercise, other than changes in temperature.

change 1 .....

.....

change 2 .....

..... [2]

[Turn over

(c) The body tries to maintain a constant internal temperature.

(i) Name the organ in the body that coordinates the maintenance of a constant internal temperature.

..... [1]

(ii) Name the term used to describe the maintenance of a constant internal environment.

..... [1]

[Total: 8]

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11 **(a)** State the names and percentages of the two main gases in air.

gas 1 ..... percentage ..... %

gas 2 ..... percentage ..... %

[2]

(b) Fig. 11.1 shows the composition of two gas mixtures **Y** and **Z**.

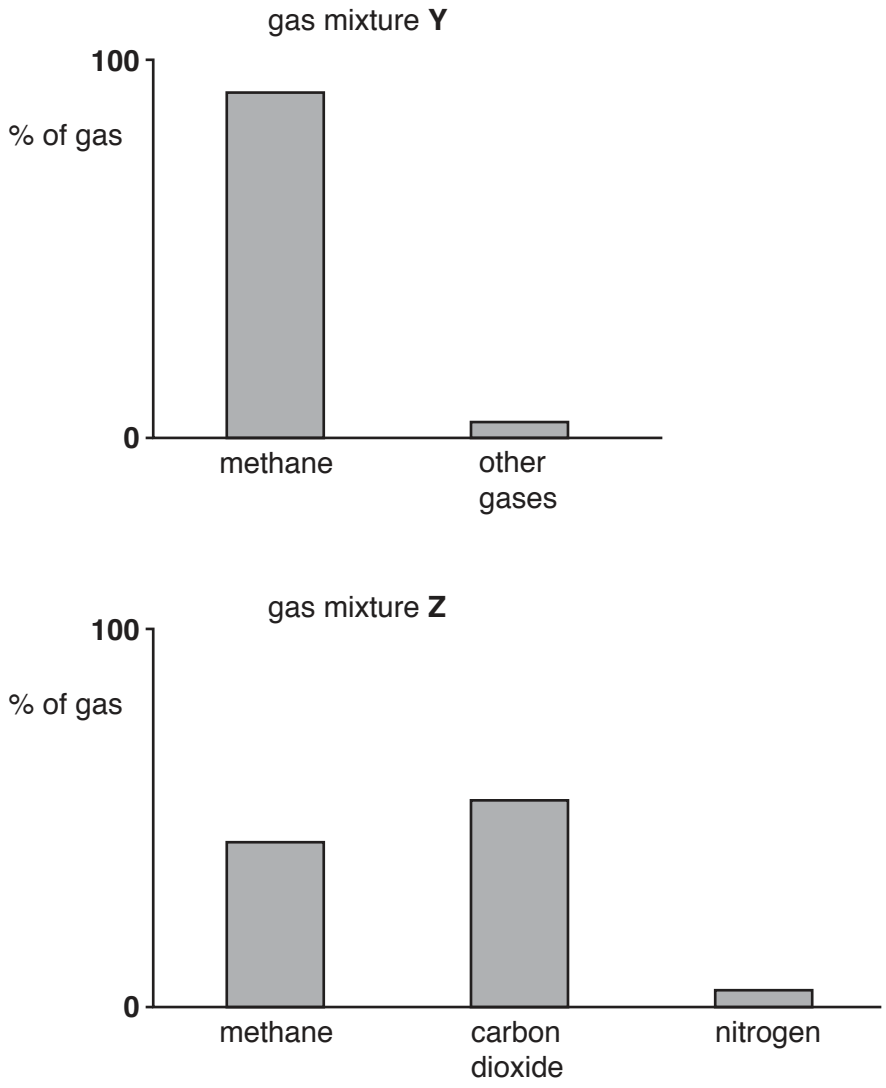

Fig. 11.1

(i) Deduce which gas mixture, **Y** or **Z**, is natural gas. Explain your answer.

mixture .....

explanation .....

.....

[1]

(ii) Describe how gas mixture **Z** is tested to show it contains carbon dioxide.

test .....

result .....

[2]

(c) Methane and propane are used as fuels.

(i) Fig. 11.2 shows a molecule of propane.

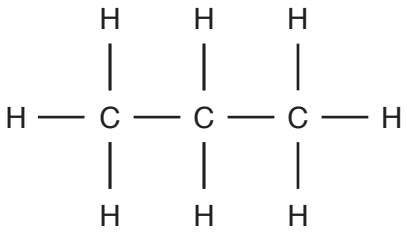

Fig. 11.2

State why propane is described as:

a hydrocarbon

.....

.....

a saturated compound.

.....

.....

[3]

(ii) Identify the compounds that are produced by the complete combustion of methane.

1 .....

2 .....

[2]

[Total: 10]

12 (a) Between the Sun and the Earth there is the vacuum of space.

(i) State the part of the electromagnetic spectrum mostly involved in the transfer of thermal energy by radiation.

..... [1]

(ii) It takes 8 minutes for visible light to travel from the Sun to the Earth.

State how long it takes for other electromagnetic waves to travel from the Sun to the Earth.

..... [1]

(iii) The magnetic field around the Earth protects living things from the Sun's harmful ionising radiation.

State **one** effect of ionising radiation on living things.

..... [1]

(iv) Explain why the sound produced by the Sun cannot be heard on Earth.

.....

..... [1]

(b) A boy uses a thin converging lens to focus the Sun's light rays onto a sheet of paper.

(i) Complete the ray diagram in Fig. 12.1 to show what happens to the rays of light after they pass through the lens.

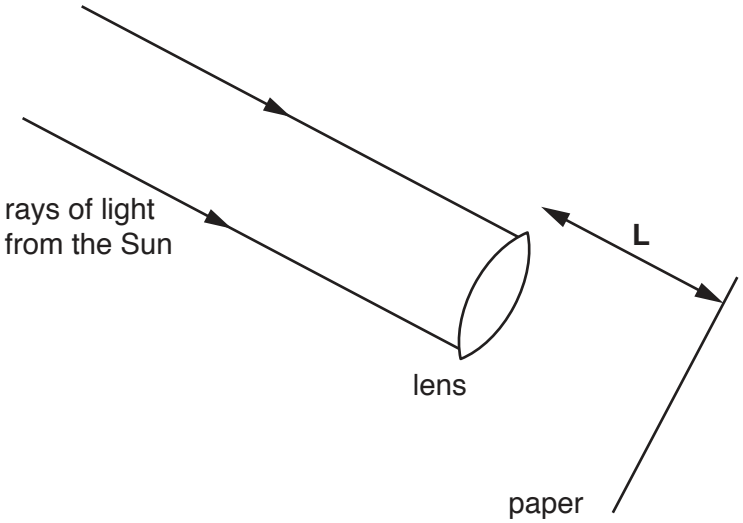

Fig. 12.1 [1]

(ii) Name the distance labelled **L** in Fig. 12.1.

..... [1]

(c) The boy builds a torch (flashlight) to shine light through the lens.

The circuit contains a cell, a switch and a lamp all connected in series.

(i) Draw a circuit diagram for the torch.

[2]

(ii) The potential difference across the lamp is 9 V.

The current flowing in the circuit is 4.5 A.

Calculate the resistance of the lamp.

resistance = ... Ω [2]

[Total: 10]

13 (a) Fig. 13.1 is a diagram of a flower.

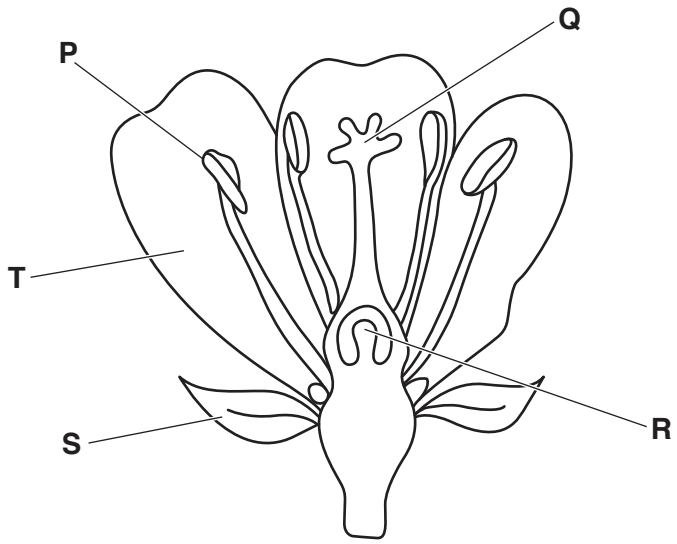

Fig. 13.1

Using the letters from Fig. 13.1, identify where these processes occur:

fertilisation .....

pollination. .....

[2]

(b) Table 13.1 shows some of the features of fertilisation and pollination.

Place ticks (✓) in the boxes to show the correct features of fertilisation and pollination.

Table 13.1

	involves transfer of pollen grains	involves ovules	involves fusion of nuclei
fertilisation			
pollination			

[2]

(c) Name **one** agent of pollination.

..... [1]

(d) A gardener plants seeds to grow flowers.

Using your knowledge of seed germination, describe two ways the gardener could improve the chances of successful germination.

1 .....

.....

2 .....

.....

[2]

[Total: 7]

The Periodic Table of Elements

Group																	
I	II										III	IV	V	VI	VII	VIII
																2 He helium 4
3 Li lithium 7	4 Be beryllium 9										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 –	113	114 Fl flerovium –	115	116 Lv livermorium –	117	118

Key

atomic number
atomic symbol
name
relative atomic mass

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.).