Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CO-ORDINATED SCIENCES **0654/03**

Paper 3 Theory (Core) **For Examination from 2019**

SPECIMEN PAPER

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 you working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 31.

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 **30** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

1 (a) (i) A torch (flashlight) contains three cells, a lamp and a switch connected in series. Using the correct circuit symbols, draw the electrical circuit for the torch.

[2]

(ii) The resistance of the lamp is 5.0 Ω when the potential difference across the lamp is 4.5 V.

Calculate the current through the lamp.

State the formula you use, show your working and state the unit of your answer.

formula

working

current = ... unit ..... [3]

(iii) The resistance of the lamp is 5.0 Ω when lit.

Two identical lamps are connected together in series.

State the combined resistance of the two lamps when connected in series.

..... Ω [1]

(b) Fig. 1.1 shows a ray of light from the torch incident on a plane mirror.

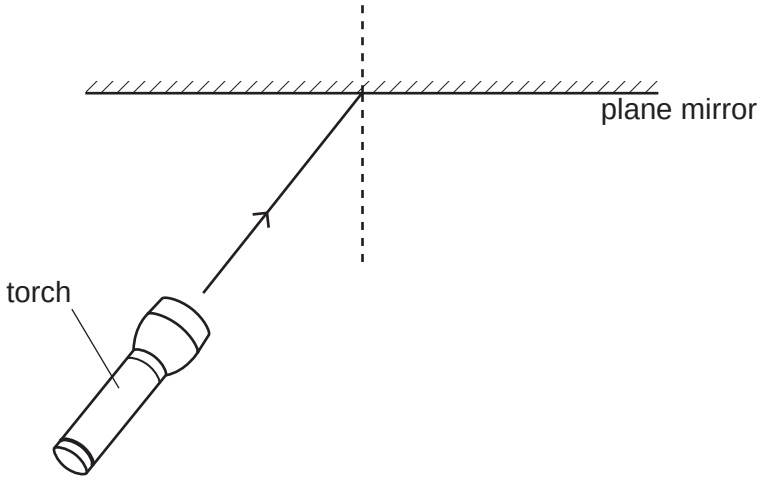

Fig. 1.1

(i) On Fig. 1.1 draw the reflected ray. [1]

(ii) On Fig. 1.1 label the angle of incidence with the letter *i*. [1]

(iii) State what happens to the value of the angle of reflection when the angle of incidence is doubled.

..... [1]

[Total: 9]

2 Petroleum (crude oil) is separated at an oil refinery.

(a) Fig. 2.1 shows the industrial apparatus used to obtain gasoline and diesel oil from petroleum.

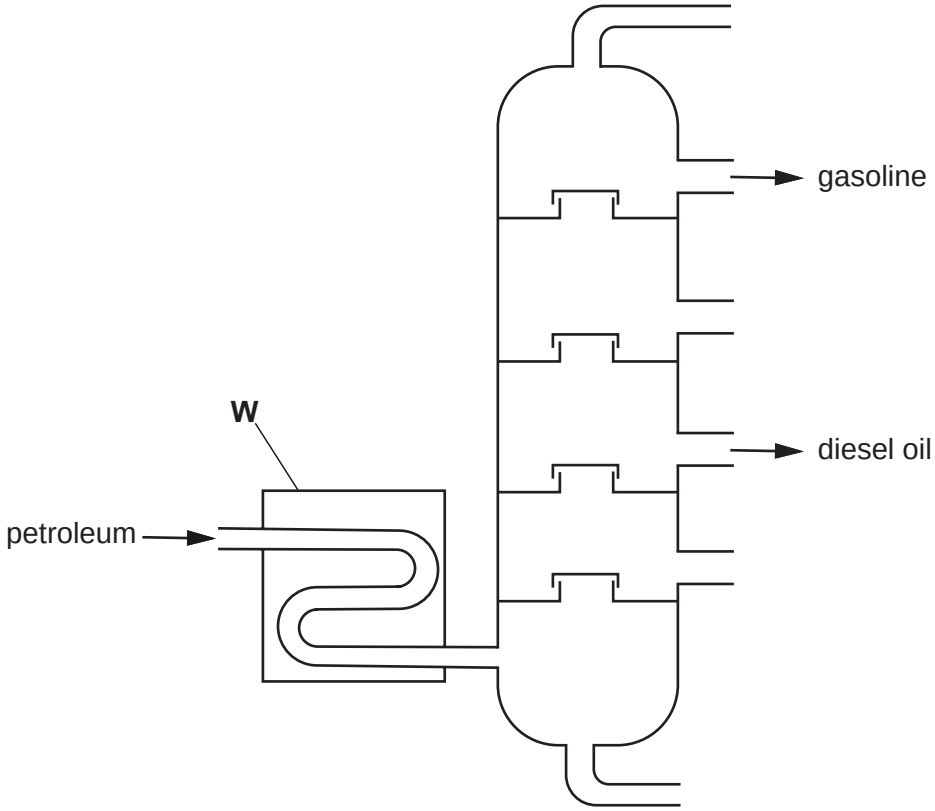

Fig. 2.1

(i) Name the process shown in Fig. 2.1.

..... [1]

(ii) State what happens to petroleum in the part of the apparatus labelled **W**.

..... [1]

(b) Fig. 2.2 shows the molecular structure of a compound found in gasoline and diesel oil.

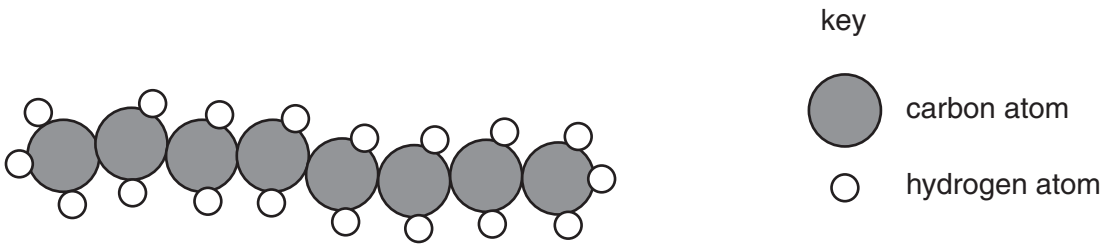

Fig. 2.2

(i) State the type of compound shown in Fig. 2.2.

..... [1]

(ii) Give the formula of the molecule shown in Fig. 2.2.

..... [1]

(c) Gasoline is used as a fuel in car engines. Gasoline contains sulfur compounds.

(i) The sulfur compounds in the gasoline burn in the car engine.

Name the pollutant gas that forms when sulfur burns.

..... [1]

(ii) State an adverse effect of the pollutant gas in **(i)**.

..... [1]

[Total: 6]

3 Fig. 3.1 shows part of a leaf in section, as it appears under a microscope.

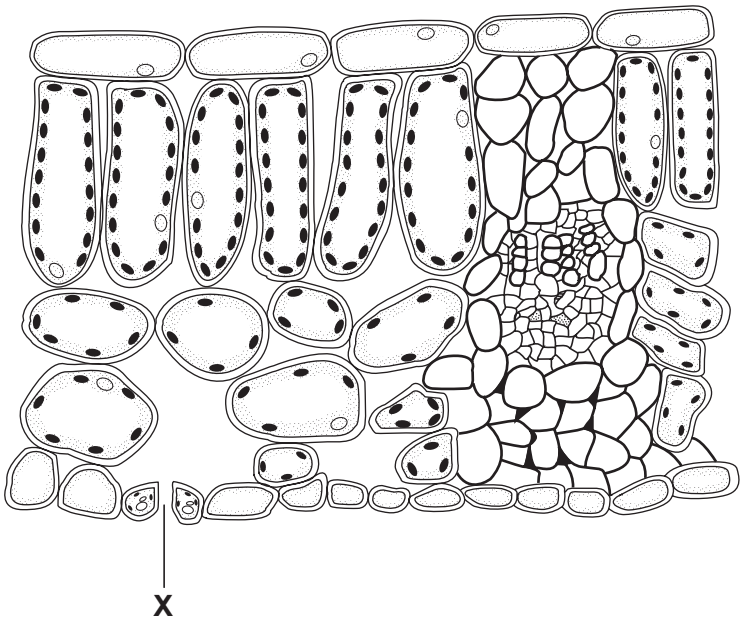

Fig. 3.1

(a) Plants lose water from their leaves in the form of water vapour.

(i) State the name for the loss of water from leaves.

..... [1]

(ii) Water inside the leaf evaporates and the water vapour then diffuses through pores in the leaf.

On Fig. 3.1, use a label line with the letter **E** to show a place inside the leaf where water evaporates. [1]

(iii) Name the pore in the leaf labelled **X**.

..... [1]

(iv) State two environmental conditions that would increase the rate of water loss from a leaf.

1. .....

2. .....
[2]

(b) Water is transported through the plant from the root to the leaf.

Complete the sequence to show the pathway of water through the plant.

root hair → ..... → xylem → cells in the leaf [1]

(c) State the products of photosynthesis.

1. .....

2. .....
[2]

(d) The leaf is the area where most photosynthesis occurs in a plant. The flower is the part of the plant involved in reproduction.

Fig. 3.2 shows a section through a flower.

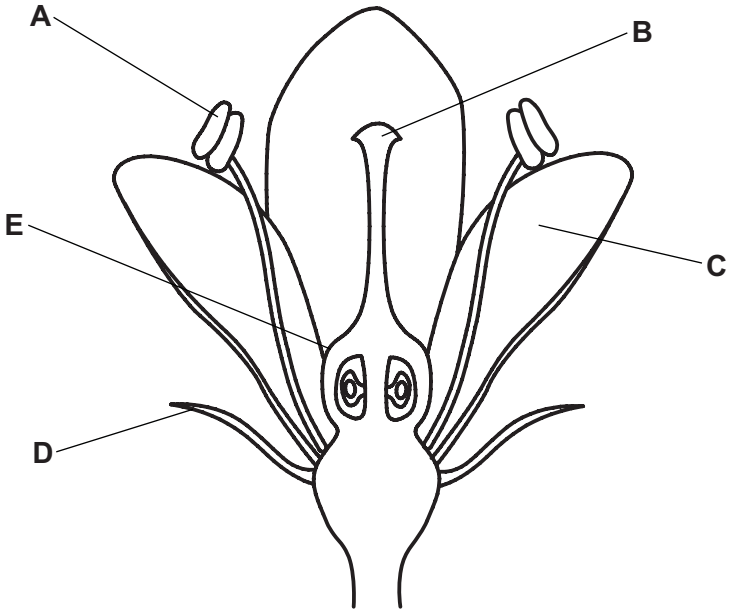

Fig. 3.2

Write **one** letter from Fig. 3.2 to identify **each** of the following.

petal .....

anther .....

stigma .....

sepal .....

[4]

[Total: 12]

4 **(a)** Fig. 4.1 shows a speed-time graph for a police car.

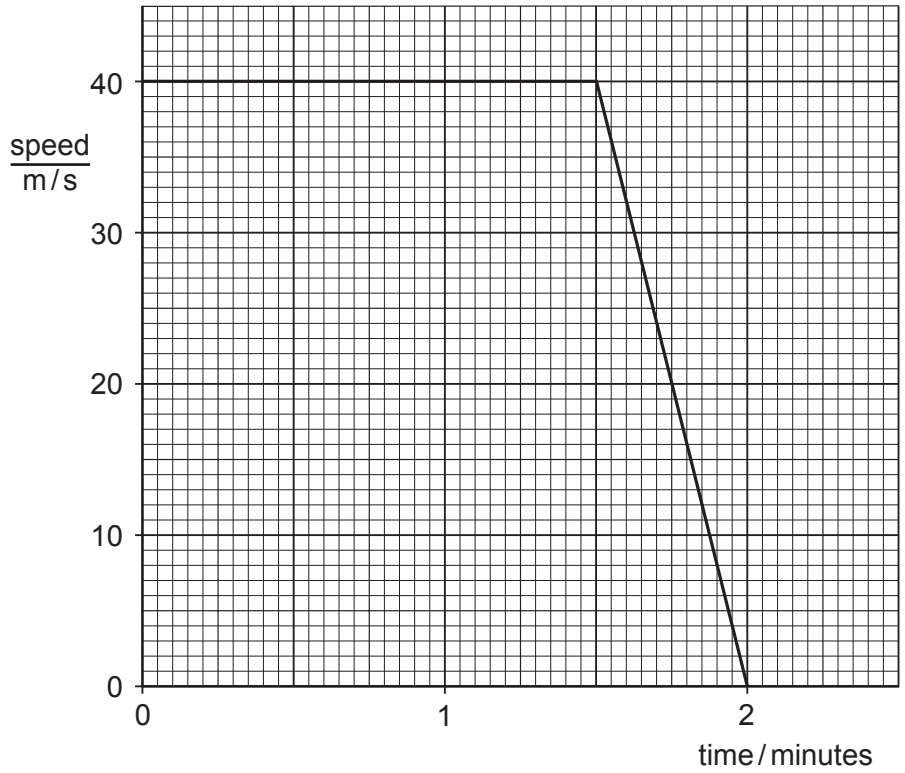

Fig. 4.1

(i) Label with the letter **X** a point on the graph when the police car is not moving. [1]

(ii) Label with the letter **D** a point on the graph where the car is decelerating. [1]

(iii) Label with the letter **K** a point on the graph where the car has the most kinetic energy. [1]

(b) The police car communicates with the police station using radio waves. The police car uses a flashing light to alert people.

(i) Radio waves and visible light are both parts of the electromagnetic spectrum.

Place radio waves and visible light in the correct boxes of the incomplete electromagnetic spectrum below.

	microwaves	infra-red			X-rays	

[2]

(ii) Microwaves are used for heating and cooking food.

State **one** other use for microwaves.

..... [1]

(iii) State **one** difference between the wave properties of radio waves and visible light.

.....

..... [1]

(iv) Fig. 4.2 represents a wave.

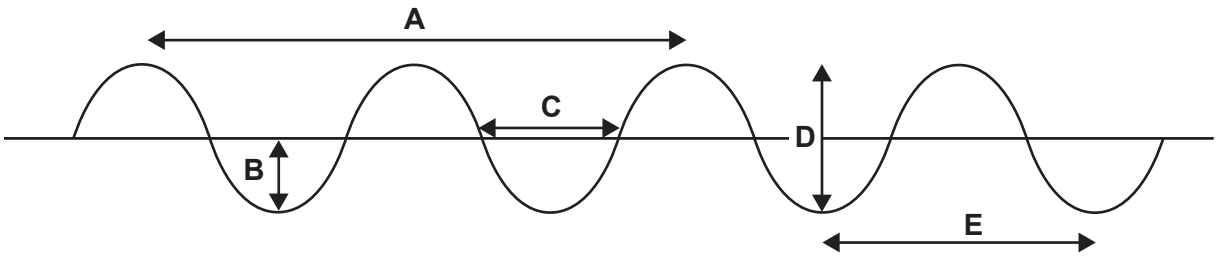

Fig. 4.2

State which measurement, **A**, **B**, **C**, **D** or **E**, is

the amplitude of the wave .....

the wavelength of the wave .....
[2]

(c) The bodywork of the police car is made from steel.

The bodywork of some vehicles is made from aluminium.

Suggest a simple way of deciding whether the bodywork of a vehicle is made from steel or aluminium.

.....

..... [1]

[Total: 10]

5 Sea water contains dissolved salt (sodium chloride).

(a) Describe how sodium chloride crystals can be obtained from sea water.

.....

.....

..... [2]

(b) Sodium chloride is formed when sodium metal reacts with chlorine gas.

In this reaction, sodium atoms are changed into sodium ions.

(i) Complete the sentences to explain the difference between a sodium atom, Na, and a sodium ion, Na^+.

A sodium **atom** has no overall charge because .....

.....

.....

A sodium **ion** has one positive charge because .....

.....

.....

[2]

(ii) Name the type of bonding in sodium chloride.

..... [1]

(c) Fig. 5.1 shows laboratory apparatus that is used to obtain chlorine from sodium chloride solution.

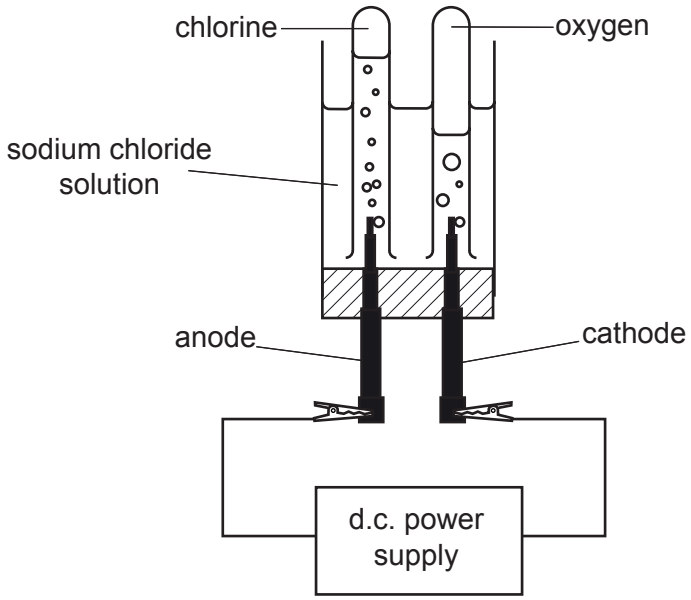

Fig. 5.1

(i) Name the process shown in Fig. 5.1.

..... [1]

(ii) State the charge on the anode.

..... [1]

(iii) The anode and cathodes are inert electrodes.

State the meaning of the term *inert*.

..... [1]

[Total: 8]

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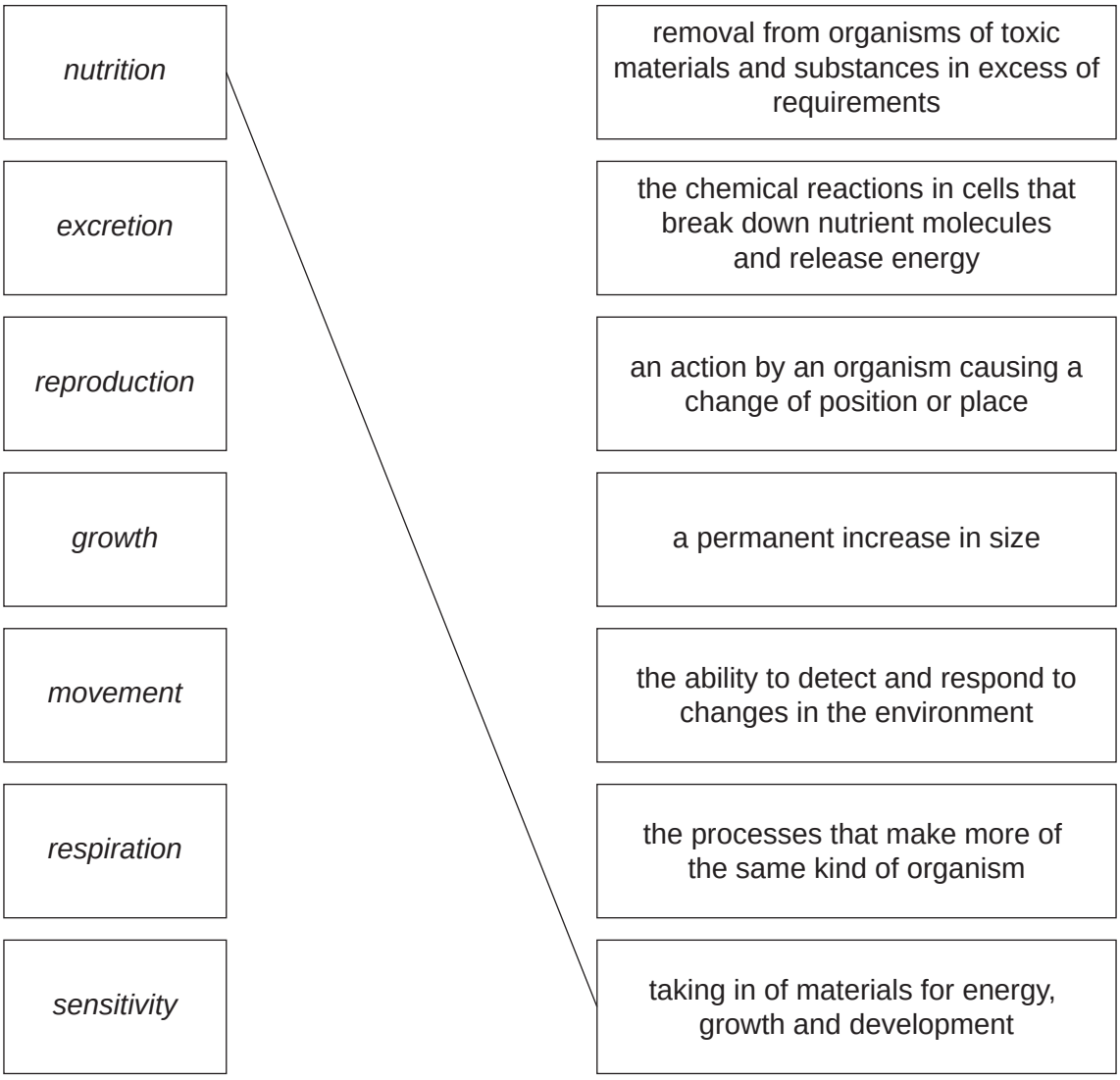
6 Nutrition is one of the seven characteristics of living organisms.

The characteristics of living organisms are listed on the left hand side.

The definitions are on the right hand side.

(a) Match the characteristics and definitions by drawing lines between them on the diagram below. One has been done for you.



[3]

(b) A scientist investigates the effect of diet on the growth of mice.

The scientist feeds two groups of mice different diets. Table 6.1 shows the diets fed to the mice.

Table 6.1

group	type of diet	contents of diet
1	basic	protein, carbohydrate, fat, mineral ions and plenty of water
2	supplemented	protein, carbohydrate, fat, mineral ions, plenty of water and some milk.

The scientist measures the average mass of the mice in each group every day for 18 days.

After 18 days he changes over the diets given to the groups of mice and continues the investigation.

The results of the investigation are shown in Fig. 6.1.

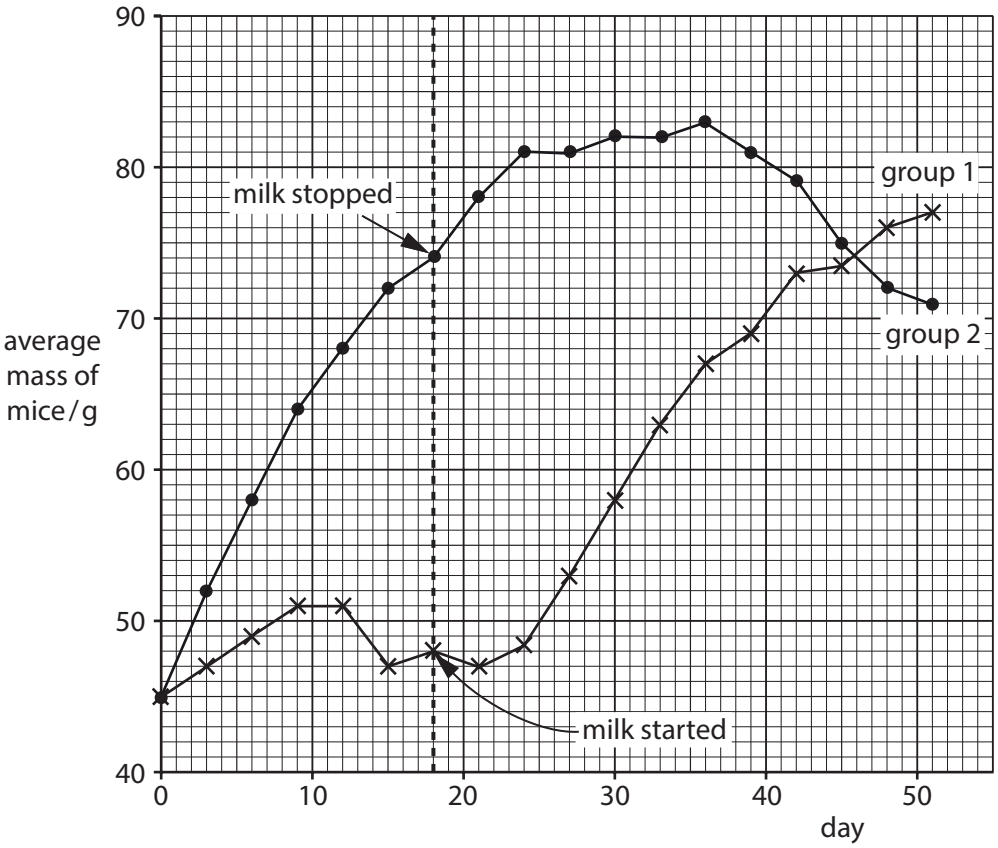


Fig. 6.1

(i) Describe one similarity and one difference in the pattern of growth of the two groups of mice between day 0 and day 9.

similarity .....

.....

difference .....

..... [2]

(ii) In the experiment, a third control group were also used, which did not have any milk in their diet for 50 days.

Suggest how the average mass of the mice would differ from the mice in group 1 and 2 at day 50.

Give a reason for your answer.

.....

.....

..... [1]

(c) State **one** function, in a diet, of

(i) protein,

..... [1]

(ii) carbohydrate.

..... [1]

(d) Name **one** mineral ion that the mice in **(b)** would need in their diet, and state its function.

mineral ion .....

function .....

..... [2]

(e) The milk in the supplemented diet in **(b)** contained vitamin D.

Suggest how a lack of vitamin D would have affected the mice on the basic diet.

.....

..... [1]

[Total: 11]

7 **(a)** A student rubs a balloon on his sweater. Charged particles move from the sweater to the balloon which becomes negatively charged.

(i) Name the charged particles.

..... [1]

(ii) The student charges a second balloon in the same way.

Fig. 7.1 shows the two charged balloons next to each other.

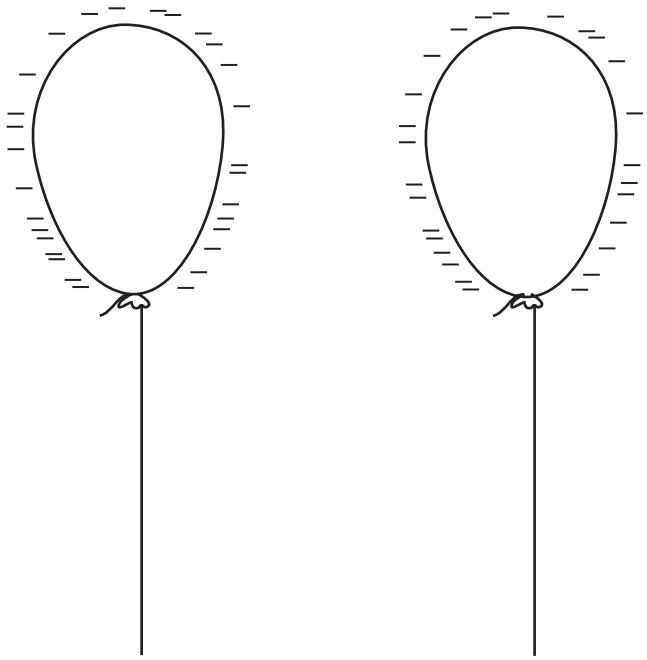


Fig. 7.1

State what happens to the balloons when the student brings the balloons very close together.

Explain your answer.

.....

.....

..... [2]

(b) The student stands 83 m from a brick wall when one of the balloons bursts.

This is shown in Fig. 7.2.

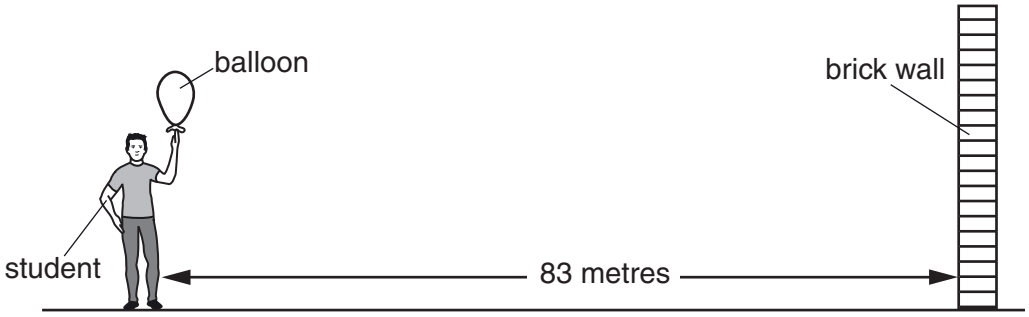


Fig. 7.2

The noise the balloon makes when it bursts travels through the air as a sound wave.

The student hears an echo.

(i) State why the student hears an echo.

.....

..... [1]

(ii) The balloon bursts and 0.50 s later the student hears the echo.

Determine the distance travelled by the sound wave in this time.

distance = ... m [1]

(iii) Use your answer to **(ii)** to calculate the speed of sound in air.

Show your working.

speed = ... m/s [2]

(c) Fig. 7.3 shows the forces acting on a hot air balloon.

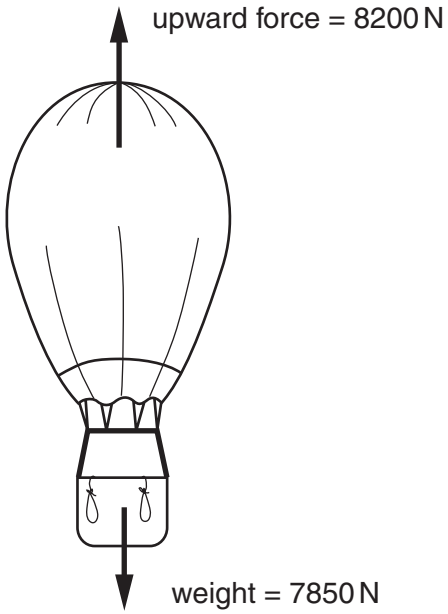


Fig. 7.3

(i) Calculate the resultant force of the weight and the upward force acting on the balloon.

resultant force = ... N [1]

(ii) Explain how the resultant force affects the movement of the balloon.

.....

..... [1]

(iii) The mass of the air in the hot air balloon is 2660 kg. The volume of the air in the hot air balloon is 2800 m^3.

Calculate the density of the air in the hot air balloon in kg / m^3.

Show your working.

density = ... kg / m^3 [2]

[Total: 11]

Question 8 starts on page 20

8 **(a)** State how the structure of the nucleus of an atom is used to place the elements in order in the Periodic Table.

..... [1]

(b) Atoms of the same element can have different nucleon numbers.

Table 8.1 shows information about two different atoms, **X** and **Y**, of the element boron.

Table 8.1

atom	proton number	nucleon number
X	5	10
Y	5	11

(i) State and explain which of the atoms, **X** or **Y**, contains the same number of neutrons as protons.

atom .....

explanation .....

.....
[1]

(ii) State the word used to describe atoms of the same element that have different nucleon numbers.

..... [1]

(c) Fig. 8.1 shows sodium reacting with water. The water contains a few drops of Universal Indicator.

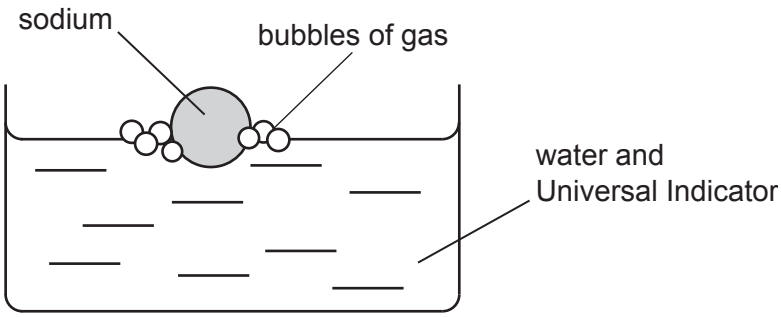


Fig. 8.1

(i) Name the gas formed when sodium reacts with water.

..... [1]

(ii) State how the pH of the solution changes during the reaction.

Explain your answer.

.....

.....

..... [2]

(iii) The experiment was repeated using lithium instead of sodium.

State **one** change in the observations made when lithium reacts with water instead of sodium.

Explain your answer.

.....

.....

..... [2]

[Total: 8]

9 Fig. 9.1 shows, for one country, the number of people recorded as newly infected with HIV each year from 2000 to 2010.

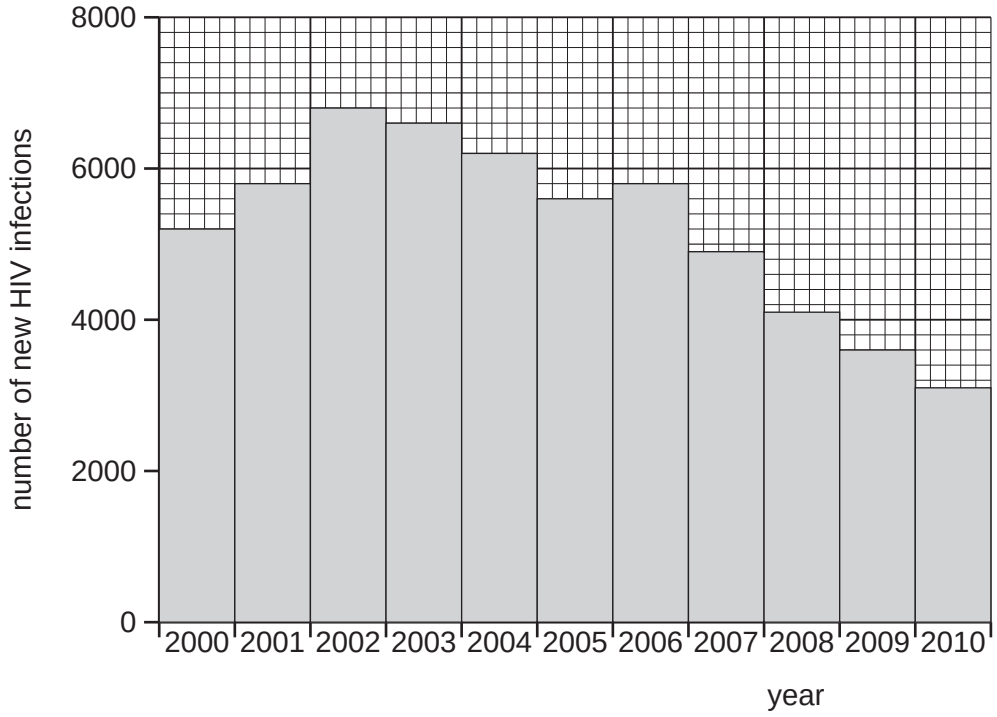


Fig 9.1

(a) (i) State the year in which the number of new HIV infections was greatest.

year ..... [1]

(ii) Suggest **one** reason why the actual number of new HIV infections may have been greater than this.

.....

..... [1]

(b) State two ways in which HIV can be transmitted.

1. .....

2. ..... [2]

(c) (i) Use data from Fig. 9.1 to describe how the number of new HIV infections changed between 2006 and 2010.

.....

.....

..... [2]

(ii) Suggest two ways in which a government can reduce the number of new HIV infections.

1. .....

2. ..... [2]

[Total: 8]

10 (a) Coal is burned in a power station to generate electricity.

Fig. 10.1 shows the energy transfers in a coal burning power station.

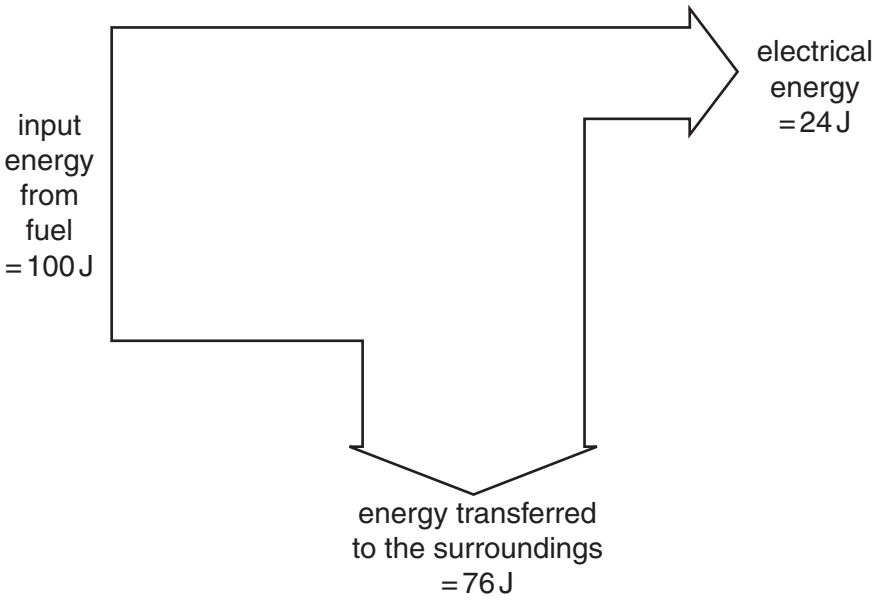


Fig. 10.1

(i) State the form of energy in a fuel such as coal.

..... [1]

(ii) State the form in which most energy is transferred to the surroundings.

..... [1]

(iii) Explain how information in Fig. 10.1 shows that the energy transfer from the fuel to electrical energy is not 100% efficient.

.....

..... [1]

(b) The workers in a nuclear power station take safety precautions to protect themselves from radioactive materials.

(i) Explain why working with radioactive materials is dangerous to humans.

.....

.....

..... [2]

(ii) Describe how enclosing the nuclear reactor in thick concrete protects the workers.

.....

..... [1]

(c) (i) The nuclide notations for magnesium-28 and aluminium-28 are

$$^{28}_{12}Mg \qquad ^{28}_{13}Al$$

Magnesium-28 is a radioactive isotope. It decays to form aluminium-28.

Complete the sentences below using words from the list below.

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

electron **neutron** **nucleon** **nucleus** **proton**

The elements magnesium and aluminium both have the same ..... number.

An atom of magnesium-28 has an unstable ..... [2]

(ii) For **each** statement below put a tick (✓) in **one** correct box.

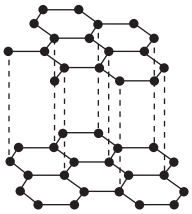
	alpha	beta	gamma
negatively charged	☐	☐	☐
positively charged	☐	☐	☐
neutral	☐	☐	☐

[2]

[Total: 10]

11 Fig. 11.1 shows the structures of diamond and graphite.

diamond



graphite

● = carbon atom

Fig. 11.1

(a) Describe the similarities and differences between these structures.

.....

.....

.....

.....

.....

..... [4]

(b) Graphite burns in air to form carbon dioxide.

Describe a test for carbon dioxide.

test .....

result .....

[2]

(c) Carbon dioxide and calcium oxide are produced from calcium carbonate in the reaction shown.

$$\text{calcium carbonate} \rightarrow \text{calcium oxide} + \text{carbon dioxide}$$

Give the name of this type of reaction.

..... [1]

[Total: 7]

12 Fig. 12.1 represents the carbon cycle.

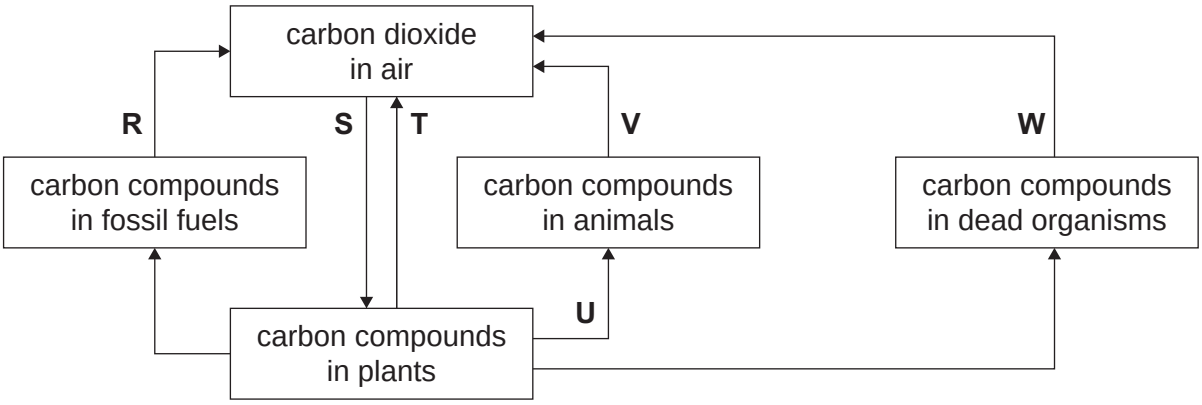


Fig. 12.1

(a) Use Fig. 12.1 to answer the following questions.

(i) Name the process labelled **R**.

..... [1]

(ii) Name a group of organisms that are responsible for the process labelled **W**.

..... [1]

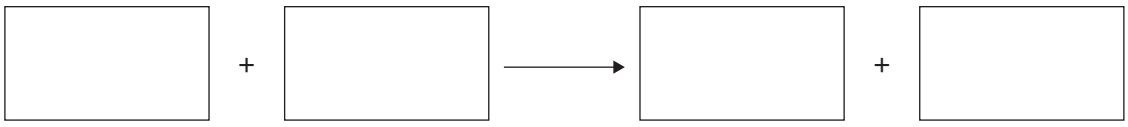
(iii) Give **two** letters that identify respiration.

..... [2]

(iv) Give **one** letter that identifies photosynthesis.

..... [1]

(b) State the **word** equation for respiration.



[2]

(c) Describe the role of the Sun in the carbon cycle.

.....

.....

..... [2]

[Total: 9]

13 **(a)** Fig. 13.1 shows an experiment to investigate the conditions needed for iron to rust.

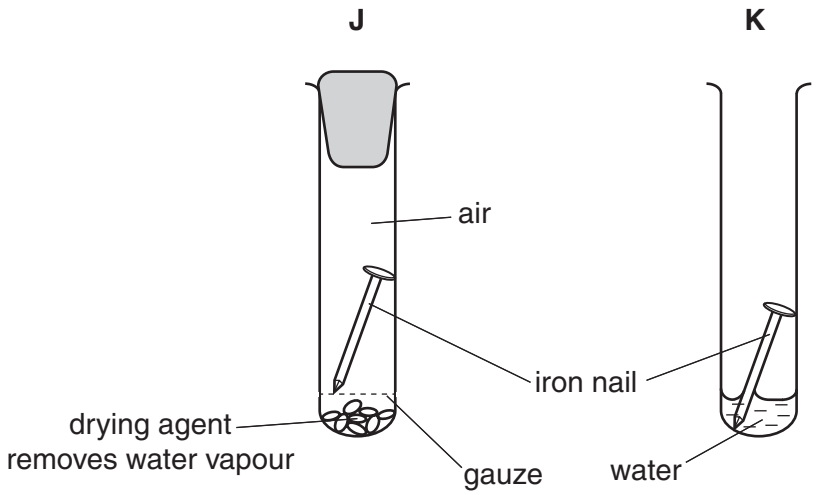


Fig. 13.1

(i) Predict and explain in which test-tube, **J** or **K**, the nail rusted.

Your explanation should include why the iron rusted in one of the test-tubes and not in the other.

test-tube in which rust forms .....

explanation .....

.....

.....

.....

[2]

(ii) Mild steel is used to make bicycle frames and car bodies.

Mild steel contains iron.

Describe how rusting is prevented on bicycle frames and car bodies.

.....

..... [1]

(iii) Explain why the method you have described in **(ii)** prevents rust forming.

.....

..... [1]

(b) Table 13.1 shows some of the physical and chemical properties of five oxides **V** to **Z**.

Table 13.1

oxide	physical state at 20 °C	colour	pH after shaking with water
V	solid	white	7
W	solid	red	7
X	solid	white	13
Y	solid	white	1
Z	gas	colourless	2

(i) State and explain which of the oxides do **not** affect the pH of water.

oxides .....

explanation .....

.....

[2]

(ii) State which of the oxides contains a transition element.

Give a reason for your answer.

oxide .....

reason .....

.....

[1]

(iii) The elements calcium and phosphorus both form solid, white oxides.

Use the information in Table 13.1 to state whether oxide **Y** is calcium oxide or phosphorus oxide.

Explain your answer.

oxide **Y** is .....

explanation .....

.....

..... [2]

(c) Magnesium burns in air to form magnesium oxide.

This is an exothermic reaction.

(i) Write the **word** equation for this reaction.

[ ] **+** [ ] → [ ]

[1]

(ii) State what happens to the temperature during an exothermic reaction.

.....

..... [1]

[Total: 11]

The Periodic Table of Elements

Group I	Group II						Group III	Group IV	Group V	Group VI	Group VII	Group VIII
						1 H hydrogen 1						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 –		114 Fl flerovium –		116 Lv livermorium –		

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.).

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