



--

--	--	--	--	--

--	--	--	--

0653/33

May/June 2013

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 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 28.

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 **26** printed pages and **2** blank pages.

- 1 (a) Table 1.1 shows the numbers of protons, neutrons and electrons in four atoms, **A**, **B**, **C** and **D**.

For
Examiner's
Use

Table 1.1

atom	protons	neutrons	electrons
A	2	2	2
B	3	4	3
C	1	0	1
D	4	5	4

- (i) Explain which one of the atoms, **A**, **B**, **C** or **D**, has a nucleon number (mass number) of four.

atom

explanation

..... [1]

- (ii) Explain why all atoms do **not** have an overall electrical charge.

.....

.....

..... [2]

(b) Fig. 1.1 shows containers of hydrogen and helium.

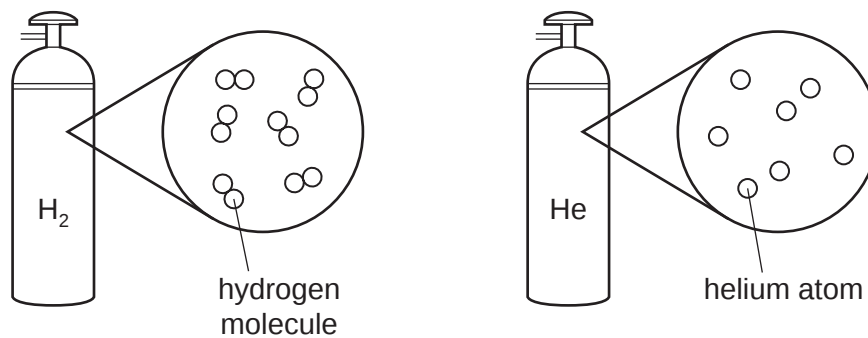


Fig. 1.1

- (i) Describe, in terms of electrons, how a chemical bond forms between two hydrogen atoms.

You may draw a diagram of a hydrogen molecule if it helps you to answer this question.

.....

 [2]

- (ii) Explain why helium exists as single atoms and **not** as molecules.

.....
 [1]

For
Examiner's
Use

(c) Hydrogen is often included in the reactivity series of metals.

Use the idea of reactivity to explain the observations shown in Fig. 1.2.

For
Examiner's
Use

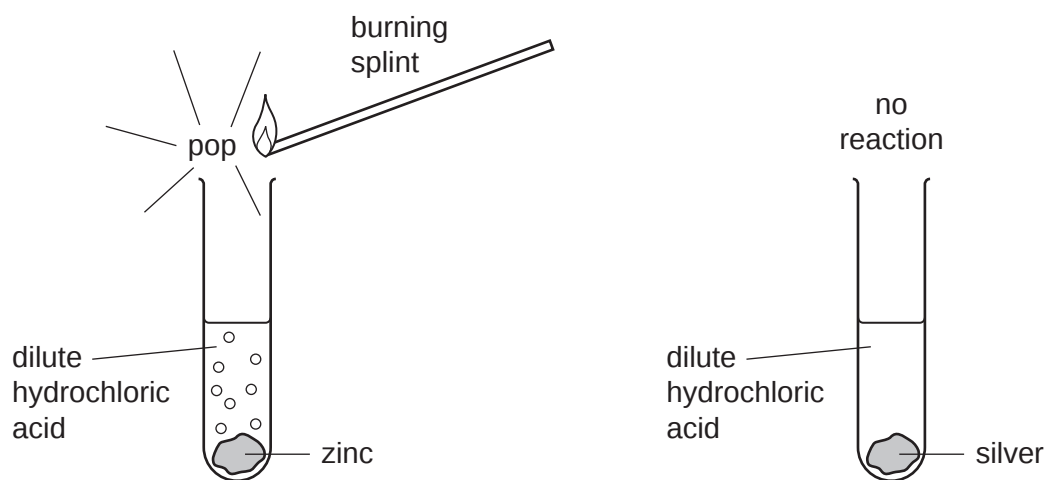


Fig. 1.2

.....

.....

.....

.....

..... [3]

- 2 (a) A fishing boat uses echo sounding to detect a shoal of fish.

This is shown in Fig. 2.1.

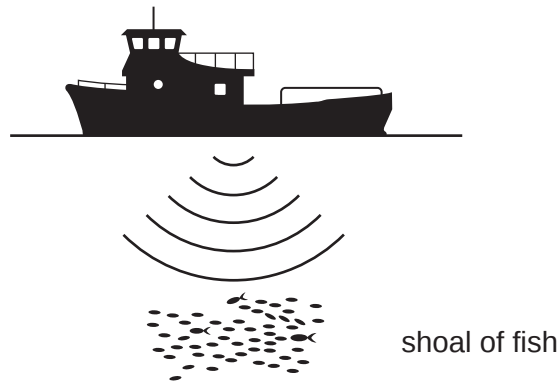


Fig. 2.1

Short pulses of sound are sent out from the boat. The echo from the shoal of fish is detected by a receiver on the boat 0.2 seconds later.

Sound waves travel through water at a speed of 1600 m/s.

- (i) Calculate the distance of the shoal of fish below the boat.

State the formula that you use and show your working.

formula

working

..... [2]

- (ii) The sound waves have a wavelength of 0.25 m.

Calculate the frequency of the waves.

State the formula that you use and show your working.

formula

working

..... [2]

For
Examiner's
Use

- (b) (i) Water waves are a renewable energy resource.

Outline **two** advantages of using renewable energy resources.

1

.....

2

..... [2]

- (ii) Fig. 2.2 shows how water waves can be used to produce electricity.

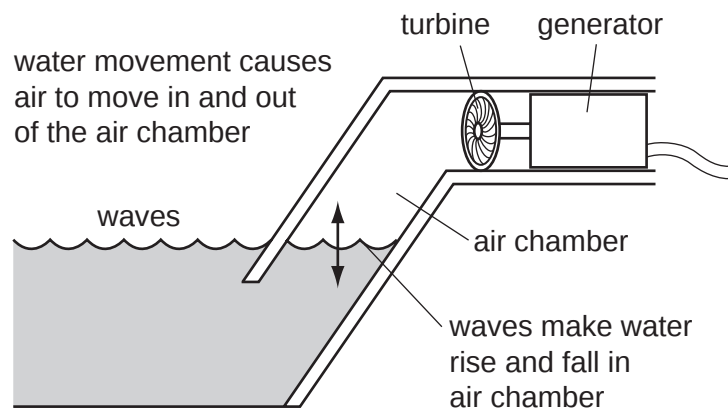


Fig. 2.2

Using the information in Fig. 2.2, describe **two** of the energy transfers that are involved in changing the kinetic energy of the waves into electrical energy.

.....

.....

.....

.....

.....

..... [2]

(c) Fig. 2.3 shows an iceberg floating in the sea.

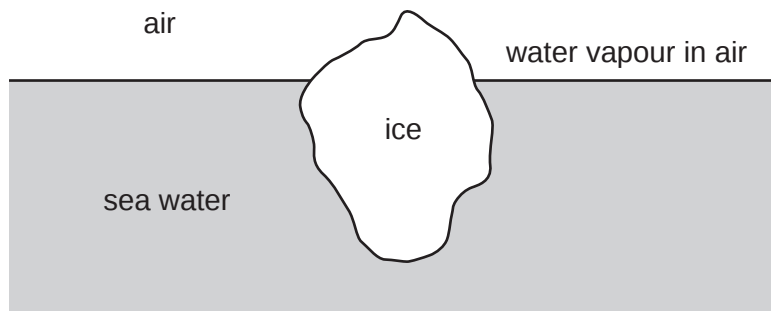


Fig. 2.3

(i) Which material named on Fig. 2.3 best fits the statement below?

“The particles are able to move, are randomly arranged and are closely packed.”

..... [1]

(ii) Name the process by which water molecules in the sea become water molecules in the air.

..... [1]

For
Examiner's
Use

3 The addition of a harmful substance to the environment is called pollution. Three examples of pollution caused by human activities are

- acid rain,
- fertilisers entering rivers and lakes,
- the release of too much carbon dioxide into the atmosphere.

(a) Describe how acid rain is caused.

.....

.....

.....

..... [2]

(b) Explain what happens in a lake after large quantities of fertilisers are washed into it.

.....

.....

.....

.....

.....

..... [3]

(c) Explain how cutting down forests can result in an increase in the carbon dioxide concentration in the atmosphere.

.....

.....

.....

..... [2]

Please turn over for Question 4.

4 Petroleum (crude oil) and rock salt occur naturally in the Earth's crust.

- (a) Petroleum is a mixture that contains thousands of different compounds. Many of these compounds are alkanes.

Draw the structure of the alkane molecule that contains eight hydrogen atoms. Use short lines to represent covalent bonds.

For
Examiner's
Use

[2]

- (b) When petroleum is refined, it is separated into simpler mixtures.

Fig. 4.1 shows a simplified diagram of apparatus that is used to refine petroleum.

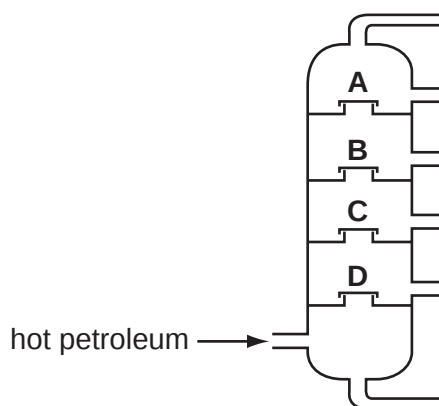


Fig. 4.1

Explain, in terms of intermolecular forces and the size of molecules, why the average boiling point of the fraction at **B** differs from the average boiling point of the fraction at **C**.

.....

.....

.....

.....

..... [3]

- (c) Rock salt contains mainly sodium chloride which is a compound of the alkali metal, sodium, and the halogen, chlorine.

For
Examiner's
Use

- (i) Explain why the uncombined elements sodium and chlorine are **not** found in the Earth's crust.

.....

..... [1]

- (ii) Describe the changes in electron configuration when sodium atoms (2,8,1) react with chlorine atoms (2,8,7) to form sodium chloride.

.....

.....

..... [2]

- 5 Milk is a liquid produced by cows, goats and other mammals, on which they feed their young.

For
Examiner's
Use

- (a) Table 5.1 shows the mass of some of the substances in 100g samples of milk from three mammals.

Table 5.1

substance	cow's milk	goat's milk	water-buffalo's milk
protein /g	3.2	3.1	4.5
fat /g	3.9	3.5	8.0
carbohydrate /g	4.8	4.4	4.9
calcium /mg	120	100	195

- (i) Which substance shown in Table 5.1 is present in the samples of milk in the smallest quantity?

..... [1]

- (ii) Suggest which substance, **not** shown in Table 5.1, is present in the samples of milk in the largest quantity.

..... [1]

- (iii) Explain **one** way in which drinking water-buffalo's milk might be better for a person's health than drinking goat's milk.

.....

 [2]

- (iv) State and explain which substance in Table 5.1 does **not** need to be digested in the human alimentary canal.

.....

 [2]

(b) Milk can be used for making yoghurt.

- Bacteria are added to the milk. The milk is kept at a temperature of 40 °C.
- The bacteria convert lactose in the milk to lactic acid.
- When the pH has reached about 4.5, the yoghurt is moved to a refrigerator at a temperature of 3 °C.

(i) Explain why the milk is kept at a temperature of 40 °C after the bacteria have been added to it.

.....

.....

..... [2]

(ii) Suggest why the yoghurt is kept in a refrigerator at a temperature of 3 °C.

.....

..... [1]

(iii) Milk has a pH of about 6.5. Explain why the pH of milk changes during the manufacture of yoghurt.

.....

..... [1]

- 6 (a) In a store, two workers are lifting 5 kg bags of flour onto the shelves. There are five shelves, 0.4 m apart. The lowest shelf is 0.4 m from the floor.

For
Examiner's
Use

Fig. 6.1 shows the two workers.

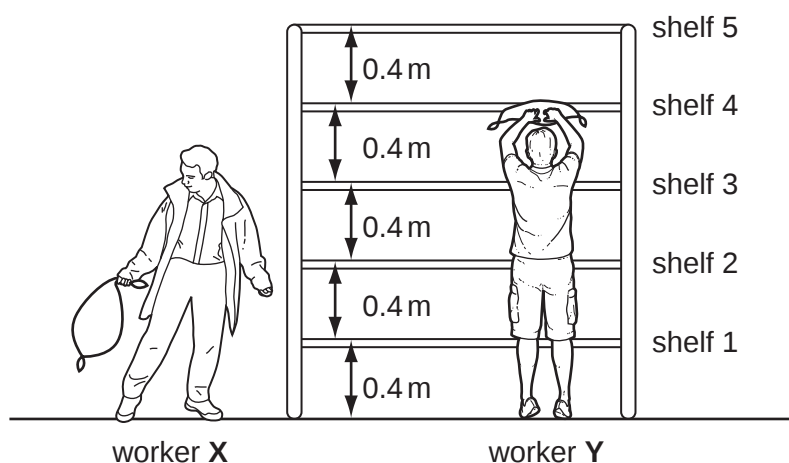


Fig. 6.1

- (i) Worker X lifts three bags from the floor to shelf 2. Worker Y lifts one bag from the floor to shelf 5.

Worker X says that he has done more work than worker Y.

Use calculations of the work done to explain whether or not he is correct.

State the formula that you use.

formula

..... [2]

- (ii) Each worker lifts one bag from the floor to shelf 2. Worker X does this more quickly than worker Y.

Which worker exerted the higher power during their lift?

Explain your answer.

..... [1]

- (iii) Each 5 kg bag of flour has a volume of 5500 cm^3 .

Calculate the average density of the bag of flour.

State your answer in g/cm^3 .

State the formula that you use and show your working.

formula

working

For
Examiner's
Use

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

- (b) Three boys, **A**, **B** and **C**, walk together from their school to a store. They stay at the store for a few minutes and then return to school.

For
Examiner's
Use

When they leave the store,

- one boy walks back to school at a steady pace,
- one boy walks back to school at a slower steady pace,
- one boy slows down gradually as he walks back to school.

The graph in Fig. 6.2 shows how their speeds vary with time during the whole journey to the store and back again.

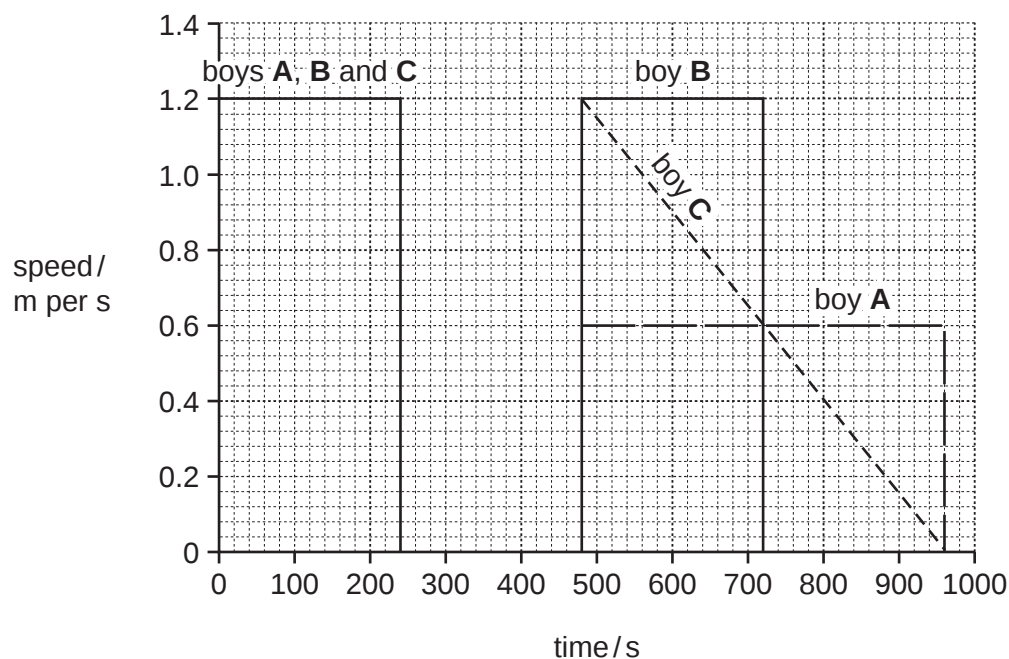


Fig. 6.2

- (i) Calculate the distance of the store from the school.

Show your working.

..... [2]

- (ii) For how many seconds do the boys stay in the store?

..... s [1]

- (iii) Which boy slowed down on his way back to school?

State a reason for your answer.

boy because

..... [1]

- 7 (a) Fig. 7.1 shows apparatus a student used to investigate the reaction between a white powder and dilute hydrochloric acid.

For
Examiner's
Use

The student predicted that a gas would be given off in her experiment and chose to test the gas using limewater.

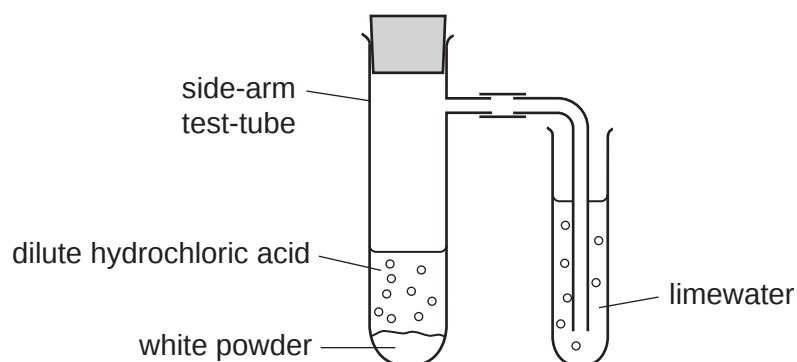


Fig. 7.1

State the gas that the student predicted would be given off.

Explain your answer.

name of gas

explanation

.....

..... [2]

- (b) The student investigated the temperature change when sodium hydrogencarbonate was added to excess dilute hydrochloric acid.

For
Examiner's
Use

Fig. 7.2 shows the apparatus she used.

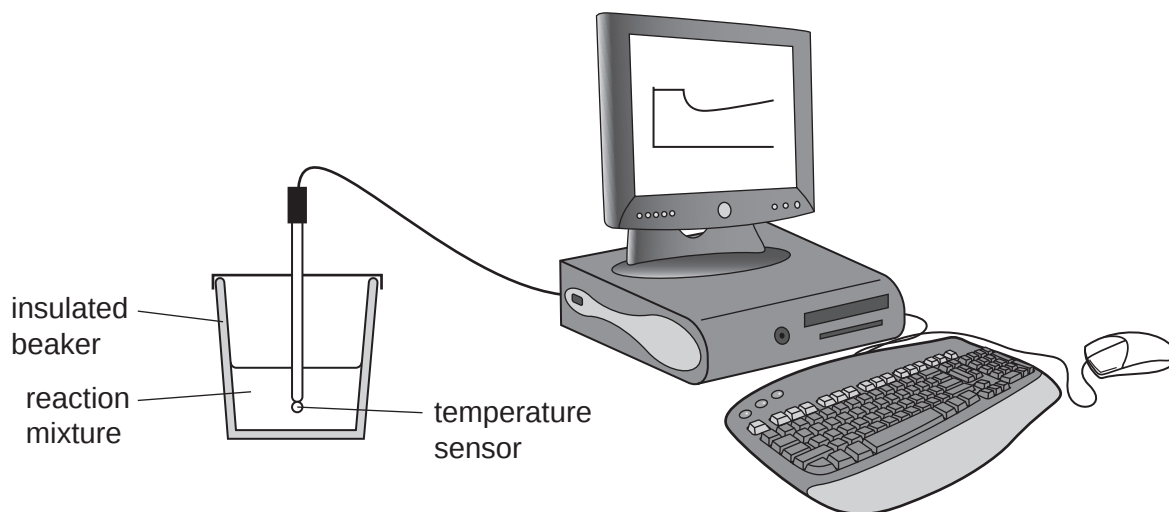


Fig. 7.2

Temperature measurements were displayed on the computer screen as a graph of temperature against time.

This graph is shown in Fig. 7.3.

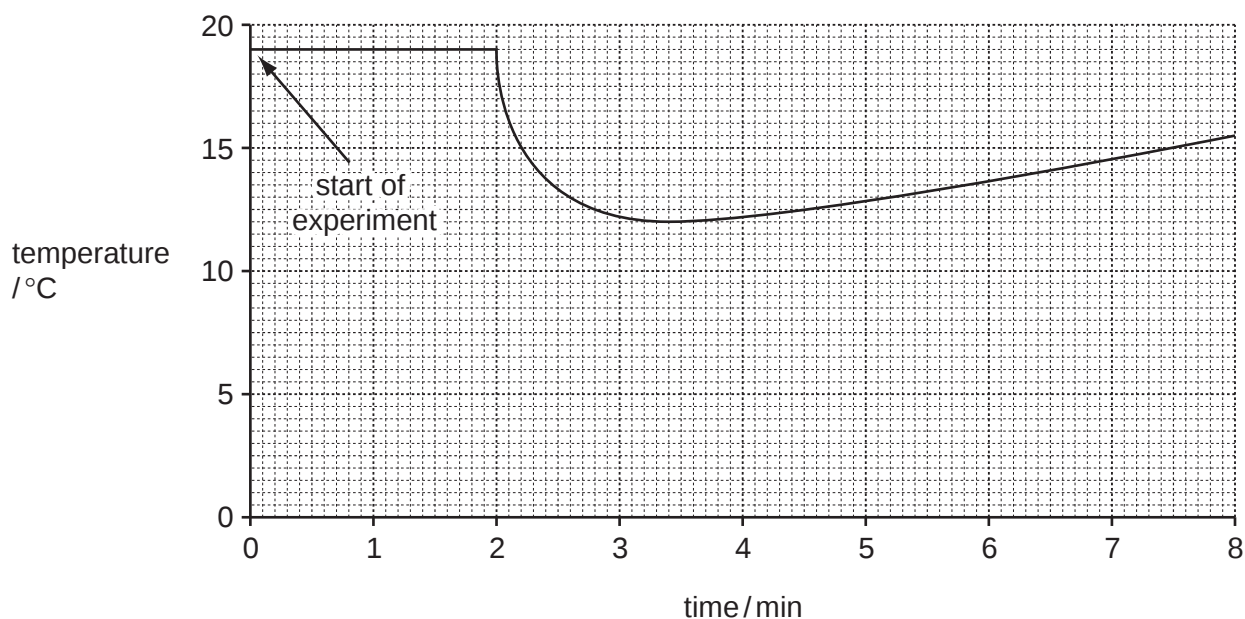


Fig. 7.3

- (i) On the graph, mark with an **X** the point where sodium hydrogencarbonate was added to the dilute hydrochloric acid. [1]

- (ii) Calculate the temperature change shown in Fig. 7.3 that occurred during the reaction.

..... [2]

- (iii) Use the results shown in Fig. 7.3 to explain, in terms of chemical energy and heat energy, the energy transformation that occurred during the reaction.

.....

.....

..... [2]

- (c) Sodium hydrogencarbonate, NaHCO_3 , is a solid compound made of sodium ions and hydrogencarbonate ions. Sodium is a metal in Group 1 of the Periodic Table.

Deduce the formula and electrical charge of a hydrogencarbonate ion.

Explain your answer.

.....

.....

..... [3]

- 8 Fig. 8.1 shows the human gas exchange system.

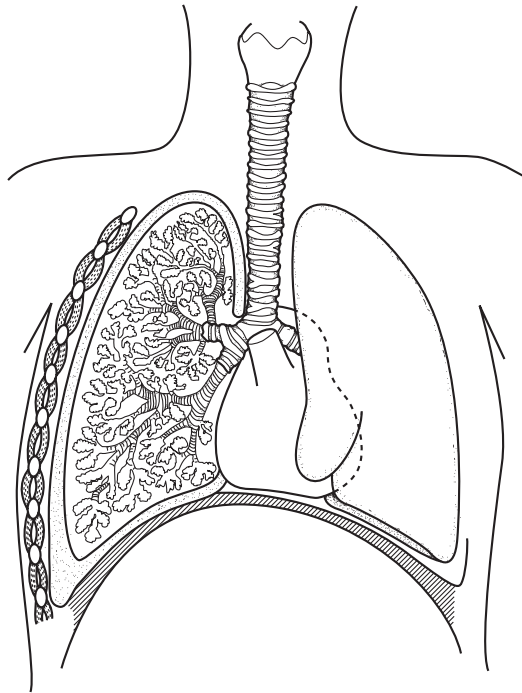


Fig. 8.1

- (a)** Use label lines to label each of these structures on Fig. 8.1.

trachea

bronchus

[2]

- (b)** Gas exchange takes place across the surface of the alveoli in the lungs.

List **two** features of alveoli that help gas exchange to take place quickly.

1

2 [2]

- (c) The gas exchange system is protected from pathogens and harmful substances by a tissue, containing goblet cells and ciliated cells, that lines the nose, trachea and bronchi.

For
Examiner's
Use

Fig. 8.2 shows part of this tissue inside the nose.

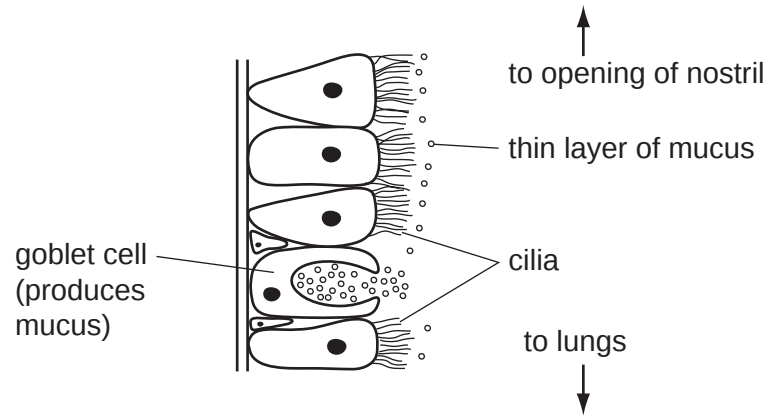


Fig. 8.2

Describe how the tissue shown in Fig. 8.2 helps to stop harmful substances getting into the lungs.

.....

.....

.....

..... [2]

- (d) An experiment was carried out to find out how passive smoking affects the activity of the goblet cells and cilia.

Six people sat in a closed room. On day 1, they breathed normal, clean air. On day 2, they breathed air containing cigarette smoke.

After one hour, a substance was sprayed into each person's nose. After 40 minutes, the researchers measured the percentage of the substance that remained in each person's nose. This was done on both days.

The faster the cilia and goblet cells were working, the faster the substance was removed from the nose.

Table 8.1 shows the results.

Table 8.1

person	percentage of substance remaining after 40 minutes	
	day 1 after breathing clean air	day 2 after breathing air containing cigarette smoke
1	65	26
2	84	49
3	67	96
4	23	51
5	40	91
6	78	24

- (ii) Which three persons' results showed that breathing air containing cigarette smoke slowed down the rate at which their cilia and goblet cells worked?

..... [1]

- (ii) Suggest how exposure to cigarette smoke could affect the health of these three people.

.....

.....

.....

.....

.....

..... [3]

Please turn over for Question 9.

- 9 (a) A student investigated how a change in potential difference across a lamp affected the current flowing through the lamp.

For
Examiner's
Use

She used wires to connect the components shown in Fig. 9.1 to make a circuit.

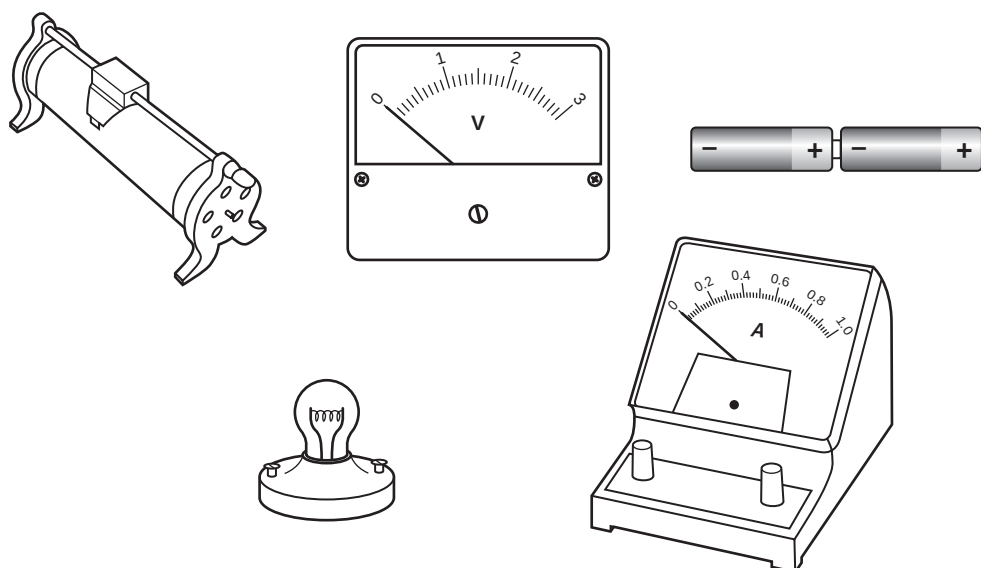


Fig. 9.1

- (i) Using the correct circuit symbols, draw a diagram to show the circuit she used.

[3]

- (ii) The student measured the current passing through a wire when a potential difference was applied across it.

Calculate the resistance of the wire when a potential difference of 0.3 V is applied and the current measured is 0.5 A.

State the formula that you use and show your working.

formula

working

..... [2]

- (b) Electricity is often transmitted through overhead power cables hung from pylons. If these cables are put up on a hot summer day, they are hung loosely from the pylons as shown in Fig. 9.2.

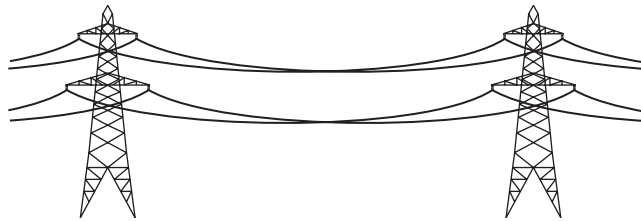


Fig. 9.2

Suggest why the cables are hung loosely.

.....

 [2]

DATA SHEET
The Periodic Table of the Elements

Group																							
I	II											III	IV	V	VI	VII	0						
												1 H Hydrogen 1											
7 Li Lithium 3	9 Be Beryllium 4																						
23 Na Sodium 11	24 Mg Magnesium 12																						
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	101 Ru Ruthenium 44	101 Rh Rhodium 45	103 Pd Palladium 46	106 Ag Silver 47	108 Cd Cadmium 48	112 In Indium 49	115 Sn Tin 50	119 Sb Antimony 51	122 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54							
133 Cs Cesium 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																					
58-71 Lanthanoid series																							
90-103 Actinoid series																							
158-171 Lanthanoid series																							
90-103 Actinoid series																							
175-188 Lanthanoid series																							
90-103 Actinoid series																							
189-202 Lanthanoid series																							
90-103 Actinoid series																							
203-216 Lanthanoid series																							
90-103 Actinoid series																							
217-232 Lanthanoid series																							
90-103 Actinoid series																							
233-246 Lanthanoid series																							
90-103 Actinoid series																							
247-262 Lanthanoid series																							
90-103 Actinoid series																							
263-288 Lanthanoid series																							
90-103 Actinoid series																							
289-310 Lanthanoid series																							
90-103 Actinoid series																							
311-326 Lanthanoid series																							
90-103 Actinoid series																							
327-342 Lanthanoid series																							
90-103 Actinoid series																							
343-368 Lanthanoid series																							
90-103 Actinoid series																							
369-394 Lanthanoid series																							
90-103 Actinoid series																							
395-420 Lanthanoid series																							
90-103 Actinoid series																							
421-446 Lanthanoid series																							
90-103 Actinoid series																							
447-472 Lanthanoid series																							
90-103 Actinoid series																							
473-498 Lanthanoid series																							
90-103 Actinoid series																							
499-524 Lanthanoid series																							
90-103 Actinoid series																							
525-550 Lanthanoid series																							
90-103 Actinoid series																							
551-576 Lanthanoid series																							
90-103 Actinoid series																							
577-602 Lanthanoid series																							
90-103 Actinoid series																							
603-628 Lanthanoid series																							
90-103 Actinoid series																							
629-654 Lanthanoid series																							
90-103 Actinoid series																							
655-680 Lanthanoid series																							
90-103 Actinoid series																							
681-706 Lanthanoid series																							
90-103 Actinoid series																							
707-732 Lanthanoid series																							
90-103 Actinoid series																							
733-758 Lanthanoid series																							
90-103 Actinoid series																							
759-784 Lanthanoid series																							
90-103 Actinoid series																							
785-810 Lanthanoid series																							
90-103 Actinoid series																							
811-836 Lanthanoid series																							
90-103 Actinoid series																							
837-862 Lanthanoid series																							
90-103 Actinoid series																							
863-888 Lanthanoid series																							
90-103 Actinoid series																							
889-914 Lanthanoid series																							
90-103 Actinoid series																							
915-940 Lanthanoid series																							
90-103 Actinoid series																							
941-966 Lanthanoid series																							
90-103 Actinoid series																							
967-992 Lanthanoid series																							
90-103 Actinoid series																							
993-1018 Lanthanoid series																							
90-103 Actinoid series																							
1019-1044 Lanthanoid series																							
90-103 Actinoid series																							
1045-1070 Lanthanoid series																							
90-103 Actinoid series																							
1071-1096 Lanthanoid series																							
90-103 Actinoid series																							
1097-1122 Lanthanoid series																							
90-103 Actinoid series																							
1123-1148 Lanthanoid series																							
90-103 Actinoid series																							
1149-1174 Lanthanoid series																							
90-103 Actinoid series																							
1175-1200 Lanthanoid series																							
90-103 Actinoid series																							
1201-1226 Lanthanoid series																							
90-103 Actinoid series																							
1227-1252 Lanthanoid series																							
90-103 Actinoid series																							
1253-1278 Lanthanoid series																							
90-103 Actinoid series																							
1279-1304 Lanthanoid series																							
90-103 Actinoid series																							
1305-1330 Lanthanoid series																							
90-103 Actinoid series																							
1331-1356 Lanthanoid series																							
90-103 Actinoid series																							
1357-1382 Lanthanoid series																							
90-103 Actinoid series																							
1383-1408 Lanthanoid series																							
90-103 Actinoid series																							
1409-1434 Lanthanoid series																							
90-103 Actinoid series																							
1435-1460 Lanthanoid series																							
90-103 Actinoid series																							
1461-1486 Lanthanoid series																							
90-103 Actinoid series																							
1487-1512 Lanthanoid series																							
90-103 Actinoid series																							
1513-1538 Lanthanoid series																							
90-103 Actinoid series																							
1539-1564 Lanthanoid series																							
90-103 Actinoid series																							
1565-1590 Lanthanoid series																							
90-103 Actinoid series																							
1591-1616 Lanthanoid series																							
90-103 Actinoid series																							
1617-1642 Lanthanoid series																							
90-103 Actinoid series																							
1643-1668 Lanthanoid series																							
90-103 Actinoid series																							
1669-1694 Lanthanoid series																							
90-103 Actinoid series																							
1695-1720 Lanthanoid series																							
90-103 Actinoid series																							
1721-1746 Lanthanoid series																							
90-103 Actinoid series																							
1747-1772 Lanthanoid series																							
90-103 Actinoid series																							
1773-1798 Lanthanoid series																							
90-103 Actinoid series																							
1799-1824 Lanthanoid series																							
90-103 Actinoid series																							
1825-1850 Lanthanoid series																							
90-103 Actinoid series																							
1851-1876 Lanthanoid series																							
90-103 Actinoid series																							
1877-1902 Lanthanoid series																							
90-103 Actinoid series																							
1903-1928 Lanthanoid series																							
90-103 Actinoid series																							
1929-1954 Lanthanoid series																							
90-103 Actinoid series																							
1955-1980 Lanthanoid series																							
90-103 Actinoid series																							
1981-2006 Lanthanoid series																							
90-103 Actinoid series																							
2007-2032 Lanthanoid series																							
90-103 Actinoid series																							
2033-2058 Lanthanoid series																							
90-103 Actinoid series																							
2059-2084 Lanthanoid series																							
90-103 Actinoid series																							
2085-2110 Lanthanoid series																							
90-103 Actinoid series																							
2111-2136 Lanthanoid series																							
90-103 Actinoid series																							
2137-2162 Lanthanoid series																							
90-103 Actinoid series																							
2163-2188 Lanthanoid series																							
90-103 Actinoid series																							
2189-2214 Lanthanoid series																							
90-103 Actinoid series																							
2215-2240 Lanthanoid series																							
90-103 Actinoid series																							
2241-2266 Lanthanoid series																							
90-103 Actinoid series																							
2267-2292 Lanthanoid series																							
90-103 Actinoid series																							
2293-2318 Lanthanoid series																							
90-103 Actinoid series																							
2319-2344 Lanthanoid series																							
90-103 Actinoid series																							
2345-2370 Lanthanoid series																							
90-103 Actinoid series																							
2371-2396 Lanthanoid series																							
90-103 Actinoid series																							
2397-2422 Lanthanoid series																							
90-103 Actinoid series																							
2423-2448 Lanthanoid series																							
90-103 Actinoid series																							
2449-2474 Lanthanoid series																							
90-103 Actinoid series																							
2475-2500 Lanthanoid series																							
90-103 Actinoid series																							
2501-2526 Lanthanoid series																							
90-103 Actinoid series																							
2527-2552 Lanthanoid series																							
90-103 Actinoid series																							
2553-2578 Lanthanoid series																							
90-103 Actinoid series																							
2579-2604 Lanthanoid series																							
90-103 Actinoid series																							
2605-2630 Lanthanoid series																							
90-103 Actinoid series																							
2631-2656 Lanthanoid series																							
90-103 Actinoid series																							
2657-2682 Lanthanoid series																							
90-103 Actinoid series																							
2683-2708 Lanthanoid series																							
90-103 Actinoid series																							
2709-2734 Lanthanoid series																							
90-103 Actinoid series																							
2735-2760 Lanthanoid series																							
90-103 Actinoid series																							
2761-2786 Lanthanoid series																							
90-103 Actinoid series																							
2787-2812 Lanthanoid series																							
90-103 Actinoid series																							
2813-2838 Lanthanoid series																							
90-103 Actinoid series																							
2839-2864 Lanthanoid series																							
90-103 Actinoid series																							
2865-2890 Lanthanoid series																							
90-103 Actinoid series																							
2891-2916 Lanthanoid series																							
90-103 Actinoid series																							
2917-2942 Lanthanoid series																							
90-103 Actinoid series																							
2943-2968 Lanthanoid series																							
90-103 Actinoid series																							
2969-2994 Lanthanoid series																							
90-103 Actinoid series																							
2995-3020 Lanthanoid series																							
90-103 Actinoid series																							
3021-3046 Lanthanoid series																							
90-103 Actinoid series																							
3047-3072 Lanthanoid series																							
90-103 Actinoid series																							
3073-3098 Lanthanoid series																							
90-103 Actinoid series																							
3099-3124 Lanthanoid series																							
90-103 Actinoid series																							
3125-3150 Lanthanoid series																							
90-103 Actinoid series																							
3151-3176 Lanthanoid series																							
90-103 Actinoid series																							
3177-3202 Lanthanoid series																							
90-103 Actinoid series																							
3203-3228 Lanthanoid series																							
90-103 Actinoid series																							
3229-3254 Lanthanoid series																							
90-103 Actinoid series																							
3255-3280 Lanthanoid series																							
90-103 Actinoid series																							
3281-3306 Lanthanoid series																							
90-103 Actinoid series																							
3307-3332 Lanthanoid series																							
90-103 Actinoid series																							
3333-3358 Lanthanoid series																							
90-103 Actinoid series																							
3359-3384 Lanthanoid series																							
90-103 Actinoid series																							
3385-3410 Lanthanoid series																							
90-103 Actinoid series																							
3411-3436 Lanthanoid series																							
90-103 Actinoid series																							
3437-3462 Lanthanoid series																							
90-103 Actinoid series																							
3463-3488 Lanthanoid series																							
90-103 Actinoid series																							
3489-3514 Lanthanoid series																							
90-103 Actinoid series																							
3515-3540 Lanthanoid series																							
90-103 Actinoid series																							
3541-3566 Lanthanoid series																							
90-103 Actinoid series																							
3567-3592 Lanthanoid series																							
90-103 Actinoid series																							
3593-3618 Lanthanoid series																							
90-103 Actinoid series																							
3619-3644 Lanthanoid series																							
90-103 Actinoid series																							
3645-3670 Lanthanoid series																							
90-103 Actinoid series																							
3671-3696 Lanthanoid series																							
90-103 Actinoid series																							
3697-3722 Lanthanoid series																							
90-103 Actinoid series																							
3723-3748 Lanthanoid series																							
90-103 Actinoid series																							
3749-3774 Lanthanoid series																							
90-103 Actinoid series																							
3775-3800 Lanthanoid series																							
90-103 Actinoid series																							
3801-3826 Lanthanoid series																							
90-103 Actinoid series																							
3827-3852 Lanthanoid series																							
90-103 Actinoid series																							
3853-3878 Lanthanoid series																							
90-103 Actinoid series																							
3879-3904 Lanthanoid series																							
90-103 Actinoid series																							
3905-3930 Lanthanoid series																							
90-103 Actinoid series																							
3931-3956 Lanthanoid series																							
90-103 Actinoid series																							
3957-3982 Lanthanoid series																							
90-103 Actinoid series																							
3983-4008 Lanthanoid series																							
90-103 Actinoid series																							
4009-4034 Lanthanoid series																							
90-103 Actinoid series																							
4035-4060 Lanthanoid series																							
90-103 Actinoid series																							
4061-4086 Lanthanoid series																							
90-103 Actinoid series																							
4087-4112 Lanthanoid series																							
90-103 Actinoid series																							
4113-4138 Lanthanoid series																							
90-103 Actinoid series																							
4139-4164 Lanthanoid series																							
90-103 Actinoid series																							
4165-4190 Lanthanoid series																							
90-103 Actinoid series																							
4191-4216 Lanthanoid series																							
90-103 Actinoid series																							
4217-4242 Lanthanoid series																							
90-103 Actinoid series																							
4243-4268 Lanthanoid series																							
90-103 Actinoid series																							
4269-4294 Lanthanoid series																							
90-103 Actinoid series																							
4295-4320 Lanthanoid series																							
90-103 Actinoid series																							
4321-4346 Lanthanoid series																							
90-103 Actinoid series																							
4347-4372 Lanthanoid series																							
90-103 Actinoid series																							
4373-4398 Lanthanoid series																							
90-103 Actinoid series																							
4399-4424 Lanthanoid series																							
90-103 Actinoid series																							
4425-4450 Lanthanoid series																							
90-103 Actinoid series																							
4451-4476 Lanthanoid series																							
90-103 Actinoid series																							
4477-4502 Lanthanoid series																							
90-103 Actinoid series																							
4503-4528 Lanthanoid series																							
90-103 Actinoid series																							
4529-4554 Lanthanoid series																							
90-103 Actinoid series																							
4555-4580 Lanthanoid series																							
90-103 Actinoid series																							
4581-4606 Lanthanoid series																							
90-103 Actinoid series																							
4607-4632 Lanthanoid series																							
90-103 Actinoid series																							
4633-4658 Lanthanoid series																							
90-103 Actinoid series																							
4659-4684 Lanthanoid series																							
90-103 Actinoid series																							
4685-4710 Lanthanoid series																							
90-103 Actinoid series																							
4711-4736 Lanthanoid series																							
90-103 Actinoid series																							
4737-4762 Lanthanoid series																							
90-103 Actinoid series																							
4763-4788 Lanthanoid series																							
90-103 Actinoid series																							
4789-4814 Lanthanoid series																							
90-103 Actinoid series																							
4815-4840 Lanthanoid series																							
90-103 Actinoid series																							
4841-4866 Lanthanoid series																							
90-103 Actinoid series																							
4867-4892 Lanthanoid series																							
90-103 Actinoid series																							
4893-4918 Lanthanoid series																							
90-103 Actinoid series																							
4919-4944 Lanthanoid series																							
90-103 Actinoid series																							
4945-4970 Lanthanoid series																							
90-103 Actinoid series																							
4971-4996 Lanthanoid series																							
90-103 Actinoid series																							
4997-5022 Lanthanoid series																							
90-103 Actinoid series																							
5023-5048 Lanthanoid series																							
90-103 Actinoid series																							
5049-5074 Lanthanoid series																							
90-103 Actinoid series																							
5075-5100 Lanthanoid series																							
90-103 Actinoid series																							
5101-5126 Lanthanoid series																							
90-103 Actinoid series																							
5127-5152 Lanthanoid series																							
90-103 Actinoid series																							
5153-5178 Lanthanoid series																							
90-103 Actinoid series																							
5179-5204 Lanthanoid series																							
90-103 Actinoid series																							
5205-5230 Lanthanoid series																							
90-103 Actinoid series																							
5231-5256 Lanthanoid series																							
90-103 Actinoid series																							
5257-5282 Lanthanoid series																							
90-103 Actinoid series																							
5283-5308 Lanthanoid series																							
90-103 Actinoid series																							
5309-5334 Lanthanoid series																							
90-103 Actinoid series																							
5335-5360 Lanthanoid series																							
90-103 Actinoid series																							
5361-5386 Lanthanoid series																							
90-103 Actinoid series																							
5387-5412 Lanthanoid series																							
90-103 Actinoid series																							
5413-5438 Lanthanoid series																							
90-103 Actinoid series																							
5439-5464 Lanthanoid series																							
90-103 Actinoid series																							
5465-5490 Lanthanoid series																							
90-103 Actinoid series																							
5491-5516 Lanthanoid series																							
90-103 Actinoid series																							
5517-5542 Lanthanoid series																							
90-103 Actinoid series																							
5543-5568 Lanthanoid series																							
90-103 Actinoid series																							
5569-5594 Lanthanoid series																							
90-103 Actinoid series																							
5595-5620 Lanthanoid series																							
90-103 Actinoid series																							
5621-5646 Lanthanoid series																							
90-103 Actinoid series																							
5647-5672 Lanthanoid series																							
90-103 Actinoid series																							
5673-5698 Lanthanoid series																							
90-103 Actinoid series																							
5699-5724 Lanthanoid series																							
90-103 Actinoid series																							
5725-5750 Lanthanoid series																							
90-103 Actinoid series																							
5751-5776 Lanthanoid series																							
90-103 Actinoid series																							
5777-5802 Lanthanoid series																							
90-103 Actinoid series																							
5803-5828 Lanthanoid series																							

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

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

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

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.