Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME

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9446530479

COMBINED SCIENCE **5129/21**

Paper 2 **May/June 2020**

2 hours 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **24** pages. Blank pages are indicated.

1 A wave is shown in Fig. 1.1.

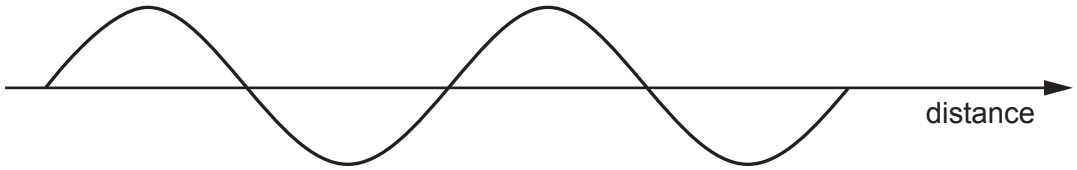

Fig. 1.1

(a) On Fig. 1.1, draw two vertical lines **one** wavelength apart.

Draw an arrow (⟷) between these two lines. [1]

(b) The wave has a speed of 2.0 m / s and a wavelength of 100 m.

Calculate the frequency of the wave.

frequency = ... Hz [2]

(c) **(i)** An electromagnetic wave enters a transparent material.

Its angle of incidence $i = 35°$. Its angle of refraction $r = 18°$.

Calculate the refractive index of the medium.

Use the equation $n = \frac{\sin i}{\sin r}$

n = ... [1]

(ii) Explain why the direction of the wave changes as it enters the transparent material.

.....

..... [1]

[Total: 5]

2 Fig. 2.1 shows the atomic structure of an atom of nitrogen, $^{15}_{7}N$.

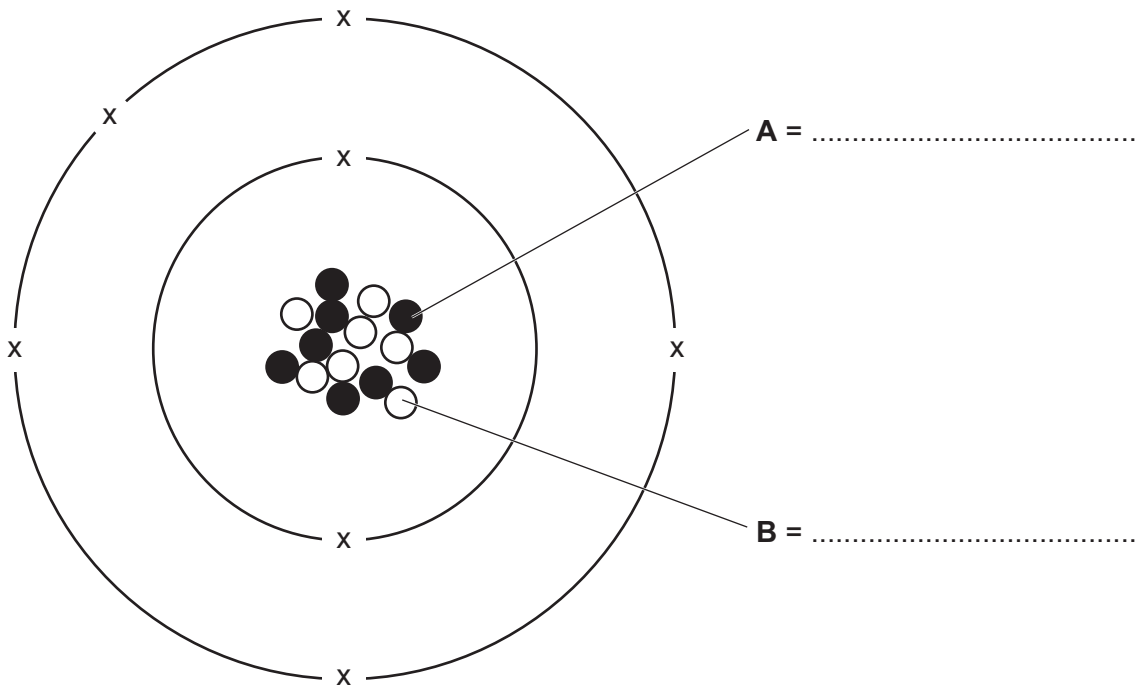

Fig. 2.1

(a) On Fig. 2.1, name the particles **A** and **B**. [1]

(b) The atom forms an ion with the formula N^{3-}.

Describe how this ion is formed.

Explain why the ion is stable.

.....

.....

..... [2]

(c) Nitrogen obtained from air is combined with hydrogen in the manufacture of ammonia.

(i) State the approximate percentage of nitrogen in clean air.

..... [1]

(ii) State the name of the process used to obtain hydrogen from hydrocarbons.

..... [1]

[Total: 5]

3 Complete Fig. 3.1 by drawing one straight line from each biological term to its description.

biological term	description
diffusion	the movement of gas molecules down a concentration gradient
enzyme	a chemical that alters the activity of a target organ
excretion	the removal of toxic materials and the waste products of metabolism
hormone	a biological catalyst
osmosis	the tissue transporting carbohydrates in plants
xylem	the tissue transporting water and mineral ions in plants
	the movement of water molecules through a partially permeable membrane

Fig. 3.1

[6]

4 Fig. 4.1 shows an electromagnet made from a coil of wire wrapped around an iron core.

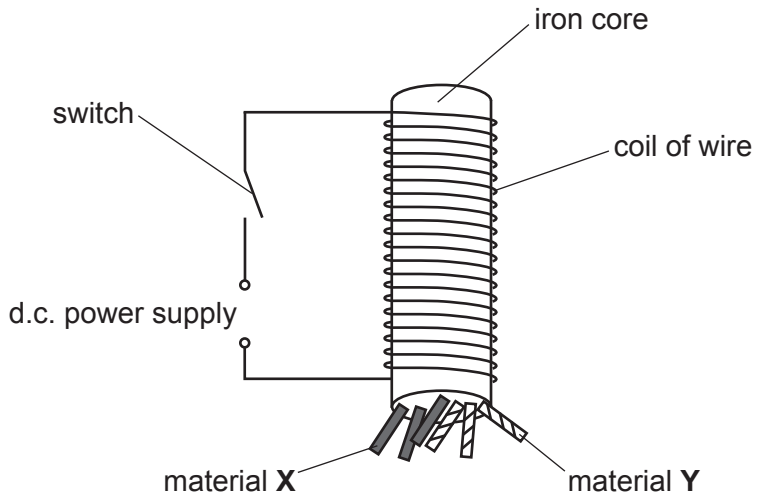

Fig. 4.1

(a) When the switch is closed, pieces of materials **X** and **Y** are attracted to the bottom of the electromagnet.

Explain why this happens.

.....

.....

..... [3]

(b) When the switch is opened, the pieces of material **X** remain on the electromagnet and the pieces of material **Y** fall off.

Name material **X** and explain your answer.

material **X** .....

explanation .....

.....

[2]

(c) State what is meant by the term *d.c.* in the phrase *d.c. power supply*.

..... [1]

[Total: 6]

5 Zinc reacts with hydrochloric acid to produce zinc chloride and hydrogen.

The equation for the reaction is:

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$$

The relative molecular mass, M_r, of zinc chloride is 136.

The volume of 2 g of hydrogen gas is 24 dm^3.

[A_r: Zn, 65; C*l*, 35.5; H, 1]

(a) Complete the following sentences.

65 g of zinc produces ..... g of zinc chloride and ..... dm^3 of hydrogen.

3.25 g of zinc produces ..... g of zinc chloride. [3]

(b) Describe a test to show that hydrogen is given off in the reaction.

State the result of the test.

test .....

result .....

.....
[2]

(c) Suggest the names of two **other** substances which react with hydrochloric acid to produce zinc chloride.

..... and ..... [2]

[Total: 7]

6 **(a)** Fig. 6.1 shows the structures of a human eye.

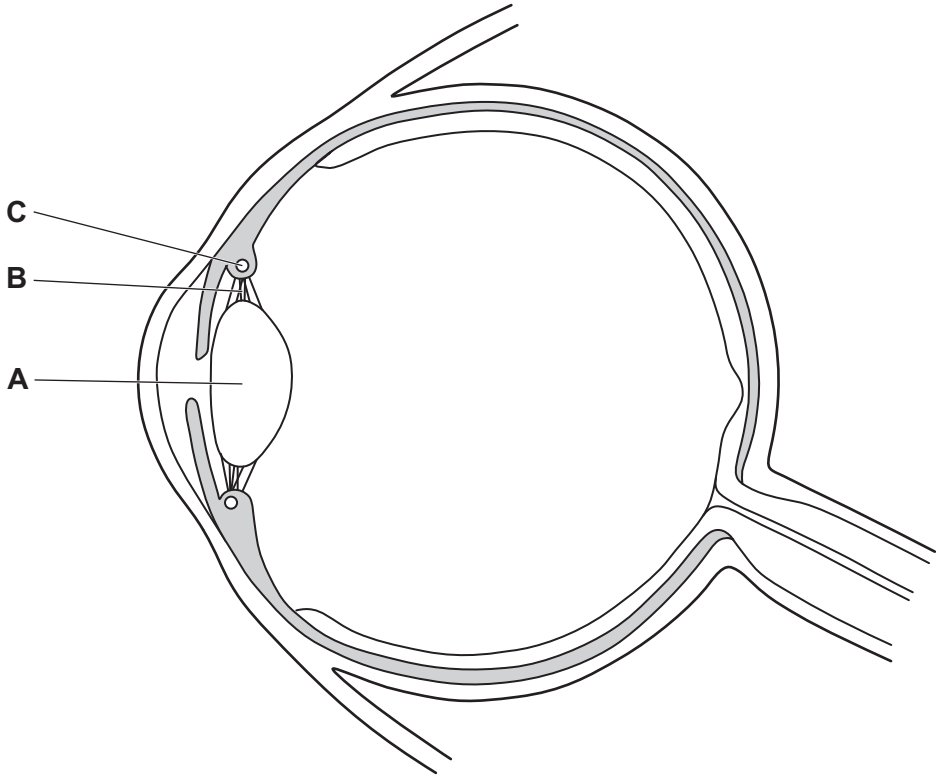

Fig. 6.1

Complete Table 6.1 by naming the structures **A**, **B** and **C** identified in Fig. 6.1.

Table 6.1

letter on Fig. 6.1	name of structure
A	
B	
C	

[3]

(b) Describe how the structures **A**, **B** and **C** in Fig. 6.1 change when the eye changes focus from focussing on a far object to focussing on a near object.

.....

.....

.....

.....

.....

..... [3]

[Total: 6]

7 Fig. 7.1 shows a clinical thermometer.

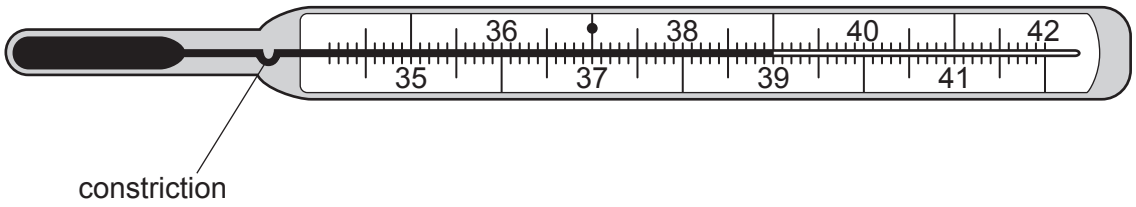

Fig. 7.1

(a) State the temperature shown on the thermometer.

temperature = ... °C [1]

(b) Determine the range of the thermometer scale.

from ..... °C to ..... °C [1]

(c) Explain why the thermometer has a constriction.

.....

..... [1]

(d) The thermometer contains a liquid which expands when heated.

Use ideas about particles to describe what happens during thermal expansion.

.....

..... [1]

[Total: 4]

8 Carbon dioxide dissolves in water and forms a solution with a pH of 5.

(a) State the colour of universal indicator when it is added to a solution of carbon dioxide.

..... [1]

(b) The structure of a molecule of carbon dioxide is shown in Fig. 8.1.

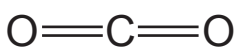

Fig. 8.1

Complete Fig. 8.2 to show the outer shell electrons in a molecule of carbon dioxide.

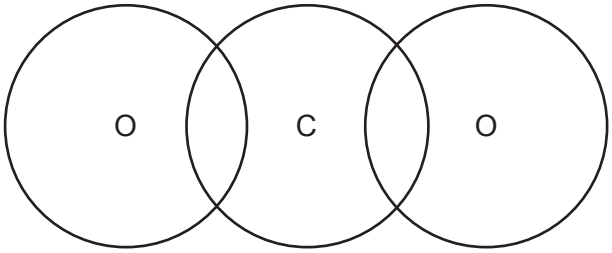

Fig. 8.2

[2]

(c) Limewater is an alkaline solution.

Suggest how the pH of the limewater changes when carbon dioxide is bubbled through the limewater.

..... [1]

(d) Carbon dioxide is produced when methane burns in an excess of oxygen.

Complete and balance the equation for the combustion of methane.

$$CH_4 + ...O_2 \longrightarrow CO_2 + ...$$ [2]

[Total: 6]

9 **(a)** Complete the word equation for aerobic respiration.

..... + ... → ..... + ... [2]

(b) In an investigation, an athlete exercises on a running machine for 12 minutes.

The number of breaths he takes per minute is recorded every three minutes.

The average volume of each breath is also recorded.

The results are shown in Table 9.1.

Table 9.1

time / min	number of breaths per minute	average volume of each breath / dm^3
0	10	0.5
3	17	1.4
6	23	2.8
9	28	3.6
12	30	4.2

(i) Calculate the total volume of air the athlete breathes in per minute when t = 0 minutes.

volume of air breathed in at t = 0 minutes = ... dm^3 per minute [1]

(ii) Calculate the increase in the total volume of air breathed in per minute by the athlete after 12 minutes.

increase in total volume of air breathed in per minute = ... dm^3 [2]

(iii) Explain why the volume of air breathed in per minute by the athlete increases during the exercise.

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

10 Table 10.1 shows how the voltage output of a simple a.c. generator varies with time.

Table 10.1

time / s	0	0.02	0.04	0.06	0.08	0.10
voltage output / V	0	+6	0	– 6	0	+6

(a) The simple a.c. generator contains a coil of wire.

State **one** other component of the a.c. generator.

..... [1]

(b) Explain why the voltage output varies between +6 V and − 6 V.

.....

.....

.....

..... [3]

[Total: 4]

11 Fig. 11.1 shows a motor connected to an electrical circuit in the home.

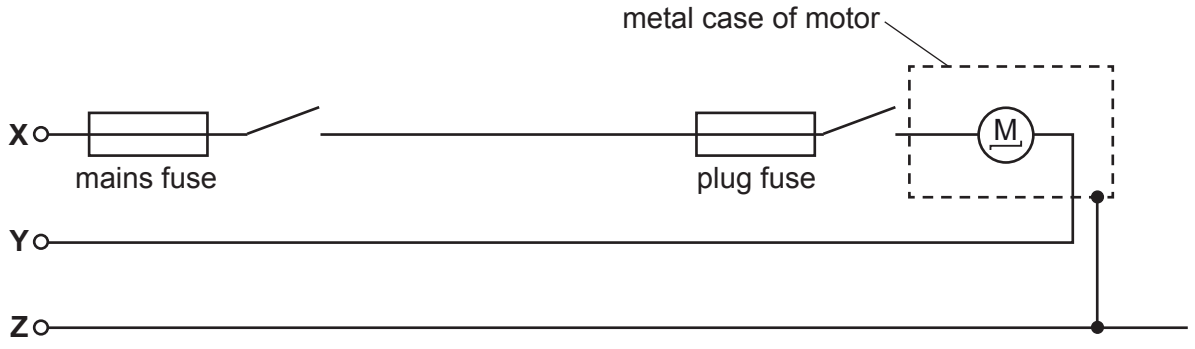

Fig. 11.1

X, **Y** and **Z** are wires in the circuit.

(a) Name wire **X** and explain why switches are connected in wire **X**.

name of **X** .....

explanation for switches .....

.....

[2]

(b) Name wire **Z** and explain why it is connected to the metal case of the appliance.

name of **Z** .....

explanation for connection .....

.....

[2]

(c) A label on the motor states

Not suitable for use in damp conditions

State one hazard of operating the motor in damp conditions.

..... [1]

[Total: 5]

12 Sodium is in Group I of the Periodic Table.

When sodium is added to water, an alkaline solution is produced.

The equation for the reaction is:

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2$$

(a) State the name given to the elements in Group I.

..... [1]

(b) Name the ion present in the solution that causes it to be alkaline.

..... [1]

(c) When the alkaline solution is added to ammonium chloride and warmed, a colourless gas is produced.

State the name of the colourless gas.

..... [1]

(d) Describe the trend in melting point and the trend in reactivity of the elements as Group I is descended.

melting point .....

reactivity .....
[2]

(e) Explain why sodium cannot be extracted from its oxide by heating with carbon.

.....

..... [1]

[Total: 6]

13 Use words or phrases from the list to complete the sentences about blood.

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

antibodies	**arteries**	**blood clotting**	**capillaries**
fibrinogen	**phagocytosis**	**plasma**	**platelets**
	red blood cells	**veins**	**water**

The blood consists of different types of blood cells and a liquid called ..... .

Blood is pumped round the body by the heart. It leaves the heart in blood vessels called

..... .

Chemicals can enter and leave the blood when it passes through ..... .

Some types of white blood cells make ..... .

Other types of white blood cells carry out ..... .

Urea is transported in ..... of the blood.

[6]

14 The diameter of a cylinder is measured using a vernier caliper as shown in Fig. 14.1.

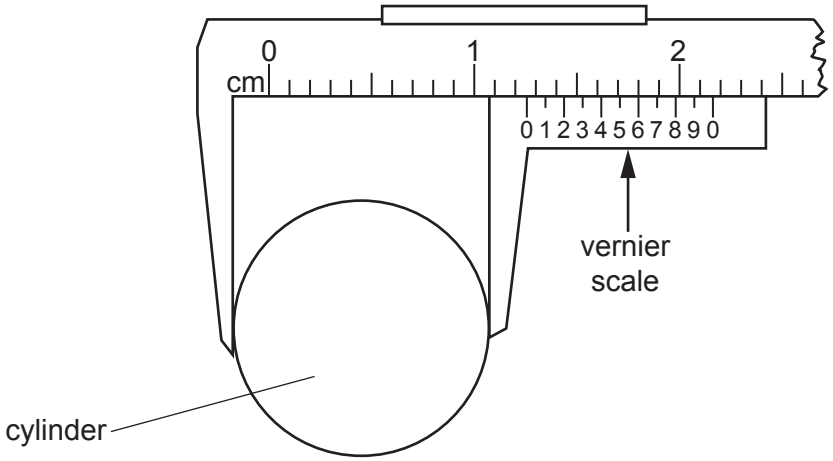

Fig. 14.1

(a) Determine the reading shown on the vernier scale in Fig. 14.1.

reading = ... cm [1]

(b) The cylinder is placed on a beam as shown in Fig. 14.2.

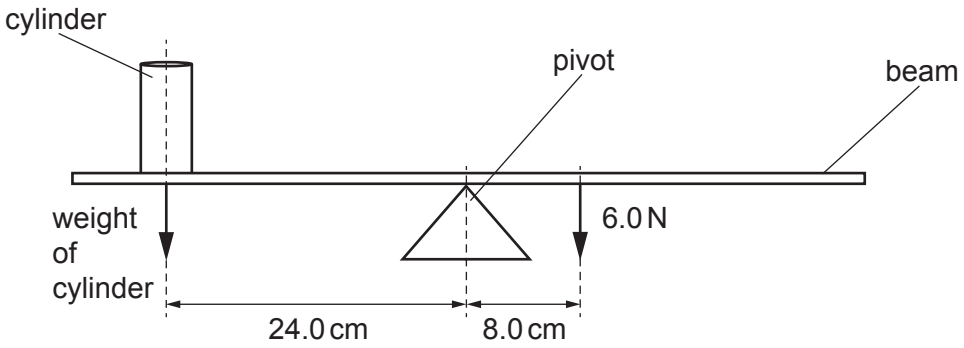

Fig. 14.2

The beam is held in the horizontal position when a force of 6.0 N is applied at a distance of 8.0 cm from the pivot.

The beam has negligible weight.

Calculate the weight of the cylinder.

weight = ... N [2]

[Total: 3]

15 Some reactions of ethene are shown in Fig. 15.1.

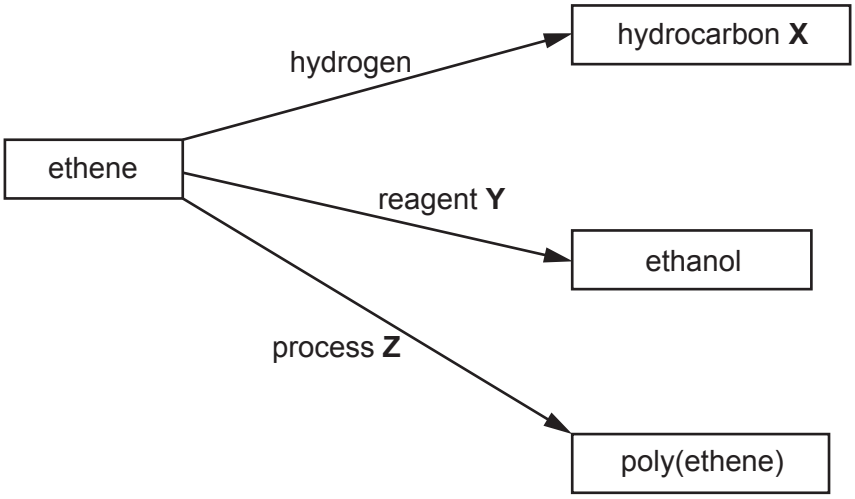

Fig. 15.1

(a) Identify:

hydrocarbon **X** .....

reagent **Y** .....

process **Z**. .....

[3]

(b) Draw the structure of poly(ethene).

[2]

[Total: 5]

16 Fig. 16.1 shows the human male reproductive system.

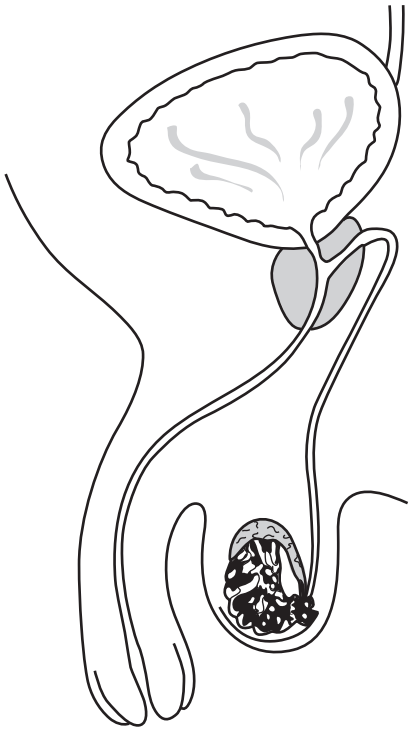

Fig. 16.1

Draw label lines and labels on Fig. 16.1 to show the position of:

- penis
- prostate gland
- sperm duct.

[3]

17 Fig. 17.1 shows a pump being used to push air into a balloon.

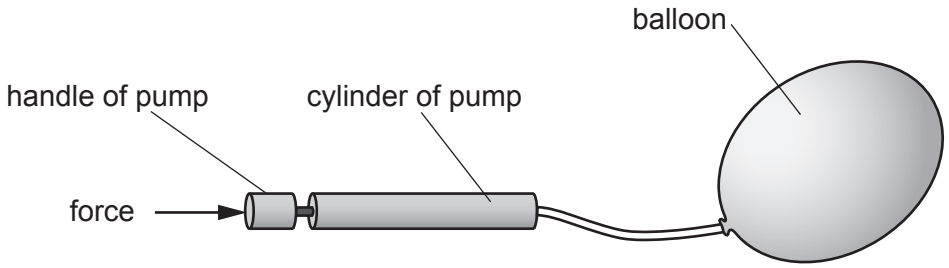

Fig. 17.1

A force applied to the handle of the pump causes air in the cylinder to move into the balloon.

(a) The air inside the balloon creates a force.

Describe how this force affects the balloon.

.....

..... [1]

(b) A force of 12.0 N is applied to push the handle of the pump 0.15 m.

Calculate the work done.

work done = ... J [2]

(c) The balloon is made from rubber.

Describe an experiment that would show that rubber is an elastic material.

You may draw a diagram if it helps your explanation.

.....

.....

.....

..... [3]

[Total: 6]

18 Fig. 18.1 shows representations of elements, compounds and mixtures.

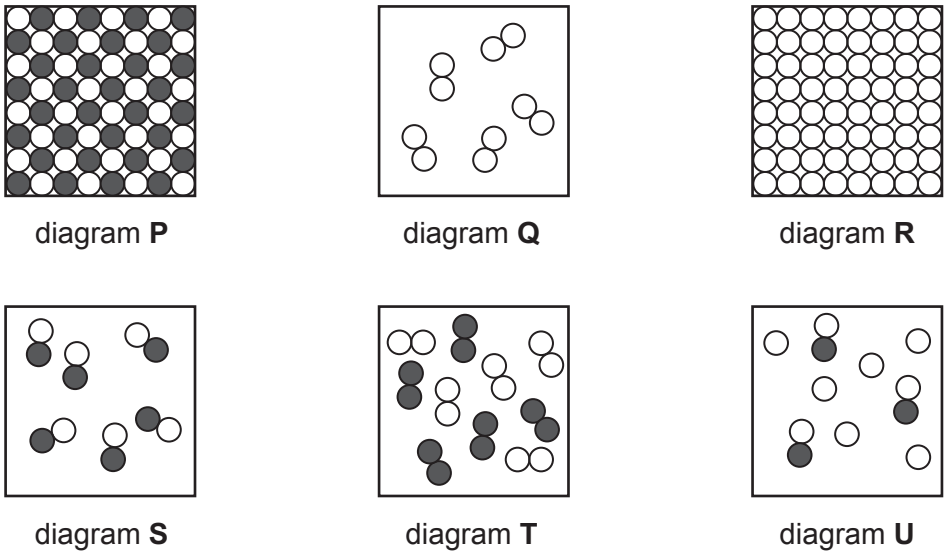

Fig. 18.1

Choose the diagram from Fig. 18.1 that represents:

- a mixture of two elements .....
- a compound that conducts electricity when molten .....
- a gaseous diatomic compound .....
- a mixture of a compound and an element. .....

[4]

19 **(a)** State a medical treatment for gonorrhoea.

.....

..... [1]

(b) **(i)** State **two** signs or symptoms of syphilis.

1 .....

.....

2 .....

.....

[2]

(ii) State **two** methods used to prevent the spread of the human immuno-deficiency virus (HIV).

1 .....

.....

2 .....

.....

[2]

[Total: 5]

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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											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.).