Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

9546516165

COMBINED SCIENCE **0653/33**

Paper 3 (Extended) **May/June 2016**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 20.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **20** printed pages.

CAMBRIDGE International Examinations

[Turn over

1 Paper chromatography can be used to separate and identify a compound in a mixture of compounds. A compound consists of one or more elements that are chemically combined.

(a) (i) Define the term *mixture*.

.....

.....

.....

..... [2]

(ii) A student uses paper chromatography to find out which compounds a mixture **Y** contains. Fig. 1.1 shows the chromatogram of the student's results.

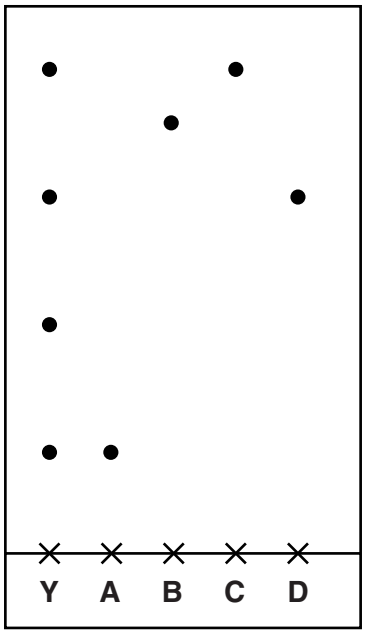


Fig. 1.1

Deduce which of the compounds **A**, **B**, **C** and **D** the mixture **Y** contains.

Explain your answer.

.....

.....

.....

.....[2]

(b) Scientists use chromatography to detect the presence of the compound ethanol in blood.

Complete Fig. 1.2 to show the structure of one molecule of ethanol.

Fig. 1.2

[2]

(c) (i) Ethanol is produced when ethene reacts with steam. No other product is made in this reaction.

Write the word equation for the reaction of ethene with steam to make ethanol.

..... [1]

(ii) Draw a dot-and-cross diagram to show the bonding in ethene.

You only need to show the arrangement of the outer electrons.

[2]

(iii) Ethane and ethene are both hydrocarbons.

Describe a chemical test to distinguish between ethane and ethene.

test .....

.....

result for ethane .....

.....

result for ethene .....

.....

[3]

[Turn over

2 Fig. 2.1 shows an electric circuit.

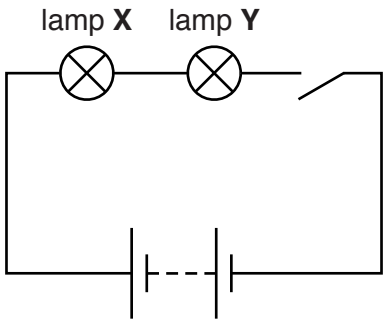


Fig. 2.1

(a) The potential difference (p.d.) supplied by the battery is 12 V. The p.d. across lamp **X** is 2 V.

Calculate the p.d. across lamp **Y**.

potential difference = ... V [1]

(b) The current through lamp **X** is 0.4 A.

(i) Calculate the resistance of lamp **X**.

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

formula

working

resistance = ... unit = ... [3]

(ii) Calculate the power in the circuit when the current in the circuit is 0.4 A.

State the formula you use and show your working.

formula

working

power = ... W [2]

(iii) Explain why the energy transferred in lamp **X** is less than the energy transferred in lamp **Y**.

.....

.....

..... [1]

(c) Fig. 2.2 shows a different circuit.

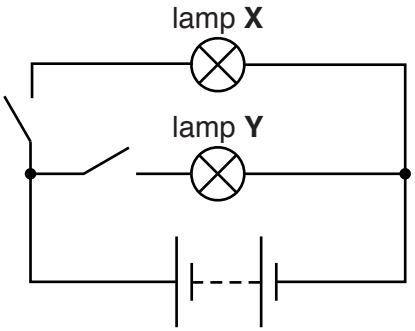


Fig. 2.2

Explain why lights in a house are connected as in the circuit in Fig. 2.2 and not as shown in the circuit in Fig. 2.1.

.....

.....

.....

.....[2]

3 The apparatus in Fig. 3.1 is used to investigate the effect of light intensity on the rate of photosynthesis in the aquatic plant *Elodea*.

The intensity of light is varied by changing the distance of the plant from the lamp. The light intensity increases as the distance from the plant decreases.

The rate of photosynthesis is measured by counting the number of bubbles of oxygen produced by the plant per minute.

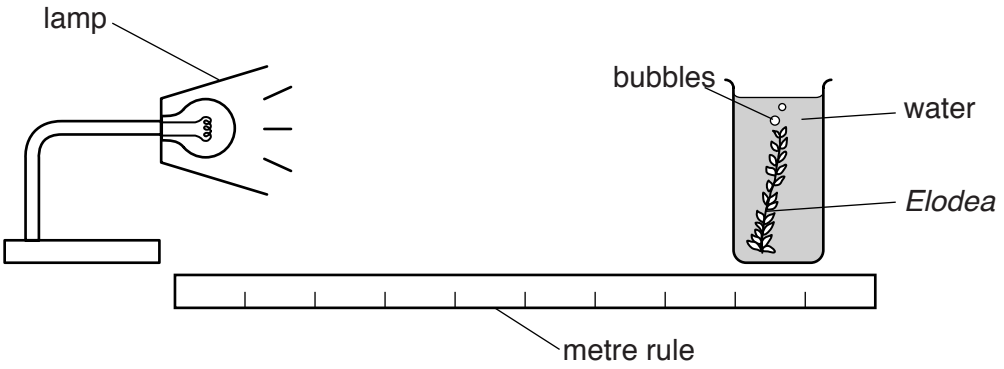


Fig. 3.1

The results are used to produce the graph shown in Fig. 3.2.

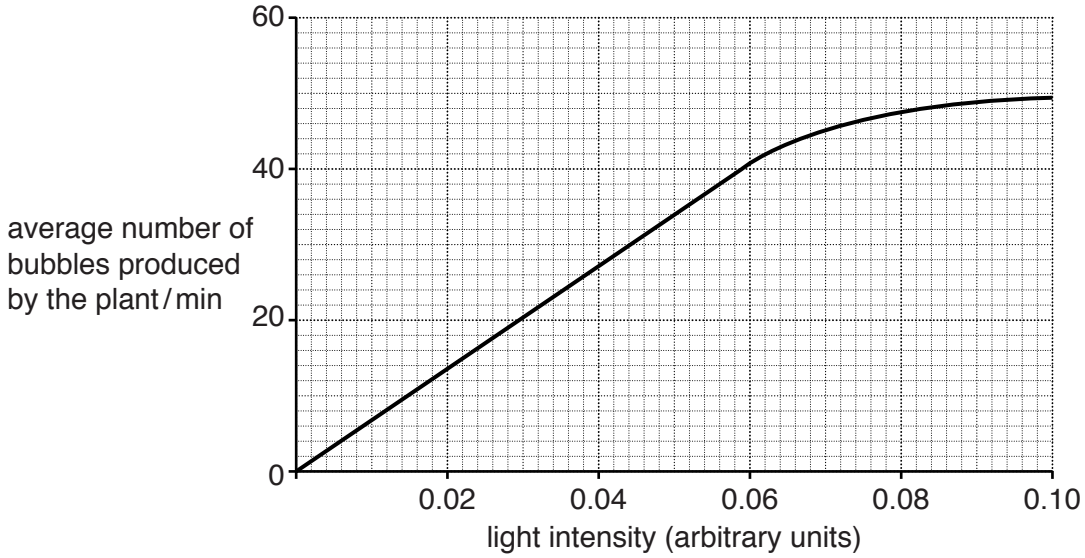


Fig. 3.2

(a) Use data from the graph in Fig. 3.2 to describe the effect of light intensity on the rate of photosynthesis.

.....

.....

.....

.....[2]

(b) (i) The piece of *Elodea* is then cut into two pieces of equal size. The experiment is repeated with **one** of these pieces.

On Fig. 3.2 draw a line to suggest how the number of bubbles per minute would change with increasing light intensity when one of these smaller pieces of *Elodea* is used. [1]

(ii) Explain your reasons for the line you drew in **(i)**.

.....

.....

.....[2]

(c) *Elodea* forms part of a food chain in a garden pond. The food chain is shown in Fig. 3.3.

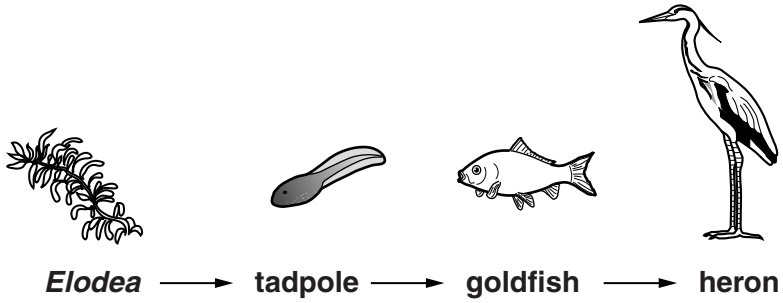


Fig. 3.3

(i) State **all** the consumers in this food chain.

.....[1]

(ii) When a goldfish eats a tadpole, most of the chemical energy in the tadpole is lost and does **not** become part of the goldfish's body.

Describe **two** reasons for this energy loss.

1. .....

.....

2. .....

.....
[2]

[Turn over

(d) Fig. 3.3 on page 7 shows the following food chain.

Elodea → **tadpole** → **goldfish** → **heron**

A second food chain in the pond is shown in Fig. 3.4.

Fig. 3.4

In the space below combine the food chains in Fig. 3.3 and Fig. 3.4 to produce a food web.

[2]

4 Fig. 4.1 shows Group I of the Periodic Table of elements.

3	Li lithium 7
11	Na sodium 23
19	K potassium 39
37	Rb rubidium 85
55	Cs caesium 133
87	Fr francium –

Fig. 4.1

(a) Deduce the number of electrons in each shell of one atom of sodium.

.....[1]

(b) (i) Sodium reacts vigorously with water to form sodium hydroxide solution and hydrogen gas.

Balance the equation below and complete the state symbols. One state symbol has been done for you.

$$Na(s) + H_2O(\quad) \rightarrow NaOH(\quad) + H_2(\quad)$$

[2]

(ii) Predict what is observed when rubidium reacts with water.

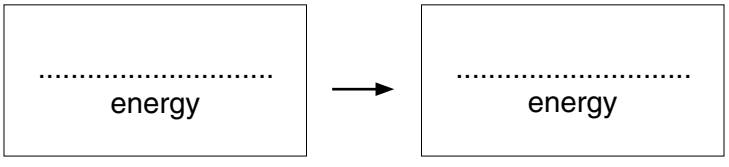
.....

.....

.....

.....[2]

(iii) State one energy transfer that occurs during the reaction between rubidium and water.



[1]

(c) Explain why elements in Group I are more reactive than elements in Group VIII (noble gases).

.....

.....

.....

.....

.....

.....[2]

(d) Unpolluted air contains nitrogen, oxygen, noble gases, water vapour and carbon dioxide.

(i) Explain how increasing levels of carbon dioxide in the Earth's atmosphere contribute to global warming.

.....

.....

.....

.....[1]

(ii) Suggest **one** negative effect of global warming.

.....

.....[1]

5 A man is climbing a mountain.

(a) State the form of energy the man has gained at the top of the mountain.

.....[1]

(b) The man makes a loud noise as he climbs. The echo from another mountain 990 m away reaches him 6 seconds later. This is shown in Fig. 5.1.

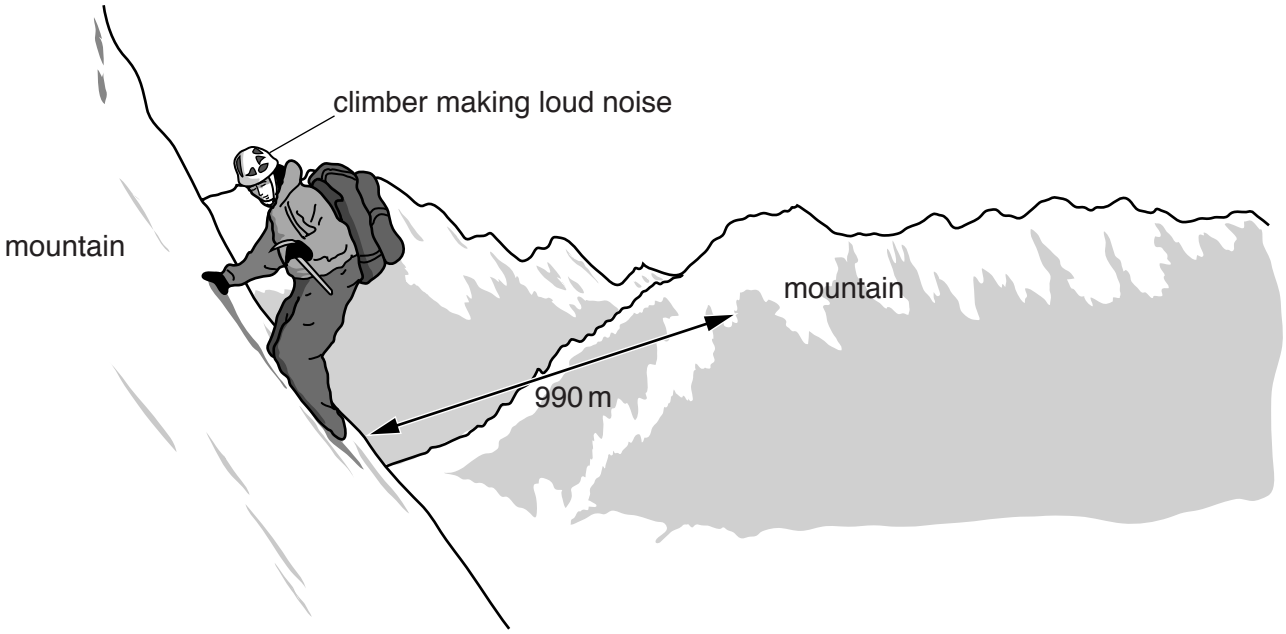


Fig. 5.1 (not to scale)

Use this data to calculate the speed of sound in the air between the two mountains.

State the formula you use and show your working.

formula

working

speed = ... m/s [2]

(c) A physics website states that sound is a longitudinal wave with a frequency within the human audible frequency range.

(i) Describe one difference between the properties of a longitudinal wave and a transverse wave.

.....

.....

.....

.....[1]

(ii) State the approximate range of human audible frequencies.

lowest frequency ..... Hz

highest frequency ..... Hz [1]

(d) On the mountain, the climber sees some ice melting.

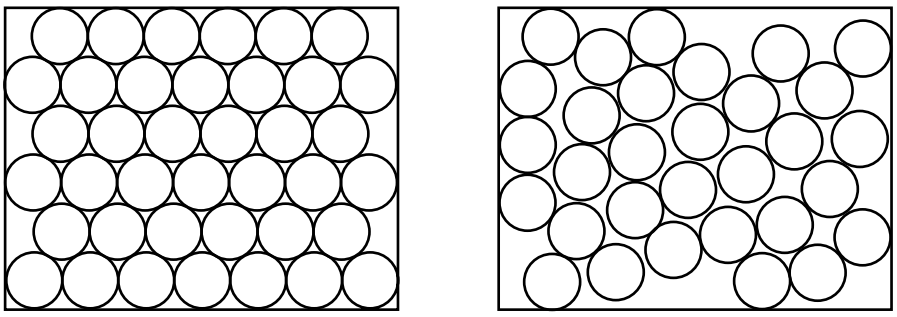
(i) State the meaning of the term *melting point*.

.....

.....

.....[1]

(ii) Fig. 5.2 shows the arrangement of particles in a solid and a liquid.



A **B**

Fig. 5.2

When ice melts it forms liquid water.

Describe how diagram **B** represents the way particles are arranged in water.

.....

.....

.....[2]

(e) On the mountain, the climber is exposed to both infra-red and ultraviolet radiation.

Infra-red and ultraviolet radiation are both electromagnetic waves.

Infra-red waves travel at a speed of 3×10^8 m/s.

State the speed at which ultraviolet waves travel. Explain your answer.

speed = ... m/s

explanation .....

.....[1]

6 **(a)** Fig. 6.1 shows an artery and a vein in longitudinal section.

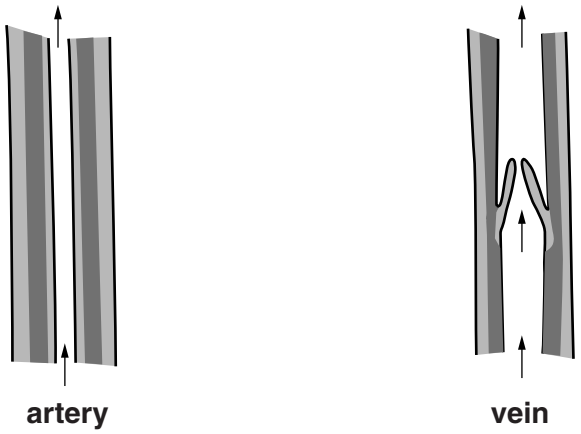


Fig. 6.1

Describe **one** structural adaptation of each blood vessel for its function.

artery

.....

.....

.....

vein

.....

.....

.....

[3]

(b) Complete the following paragraph with the correct terms from the list.

You may use each term once, more than once, or not at all.

away from **blue** **deoxygenated** **hepatic vein** **inside**
oxygenated **pulmonary vein** **red** **towards** **vena cava**

Veins transport blood ..... the heart. They usually contain ..... blood. One vein that contains ..... blood is the ..... which transports blood ..... the lungs. [5]

7 Electrolysis breaks down ionic compounds into their elements. Fig. 7.1 shows the electrolysis of molten magnesium chloride, $MgCl_2$.

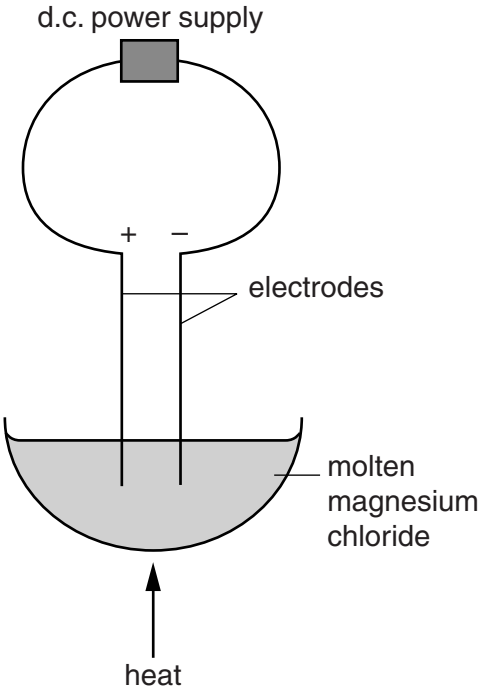


Fig. 7.1

(a) Predict the product that forms at the positive electrode (anode).

..... [1]

(b) Magnesium alloys are often used to make car parts because the alloy is strong.

(i) Draw a diagram in the box to show the arrangement of atoms in a typical alloy.

[2]

(ii) Suggest why magnesium alloys are stronger than magnesium metal.

.....

.....

.....[1]

[Turn over

8 A truck travels at a constant speed for 60 seconds and then slows down. It takes another 40 seconds to come to a stop.

Fig. 8.1 shows the speed/time graph for the 100 second journey.

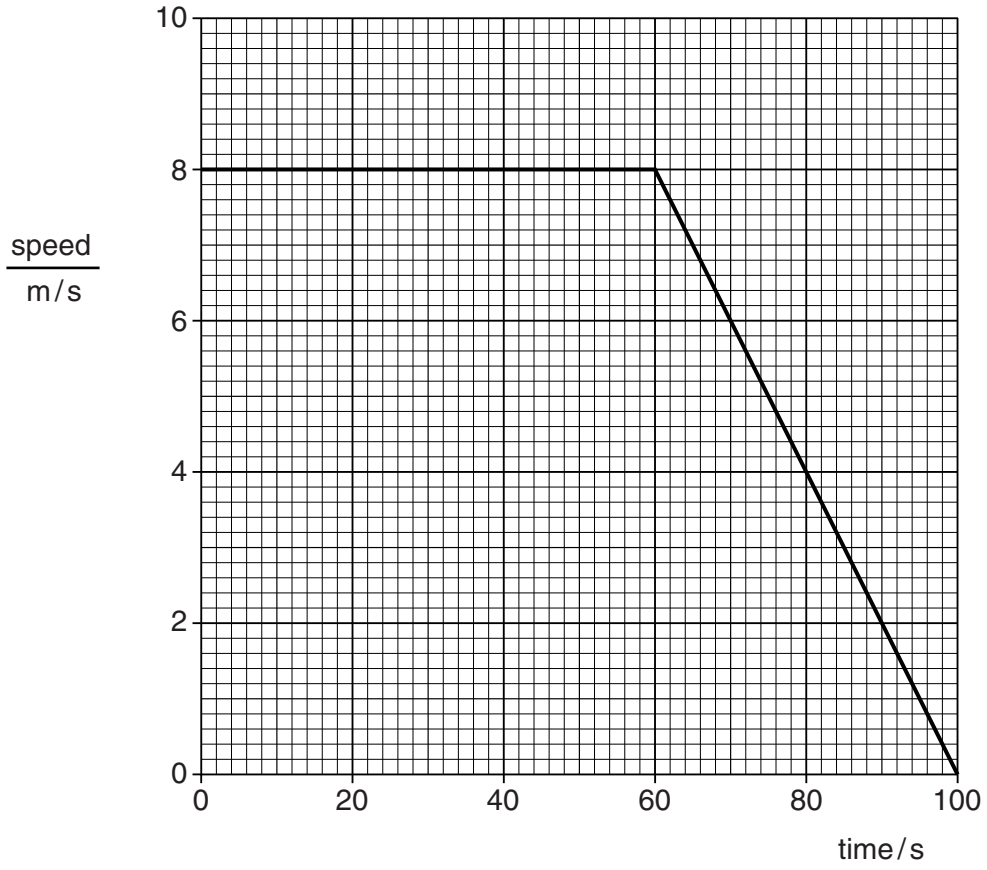


Fig. 8.1

(a) Calculate the deceleration of the truck between 60 s and 100 s.

Show your working.

deceleration = ... m/s^2 [2]

(b) Describe how to use the graph to find the total distance travelled by the truck.

.....

.....

.....[2]

(c) Fig. 8.2 shows the forces on the truck when it is travelling at constant speed.

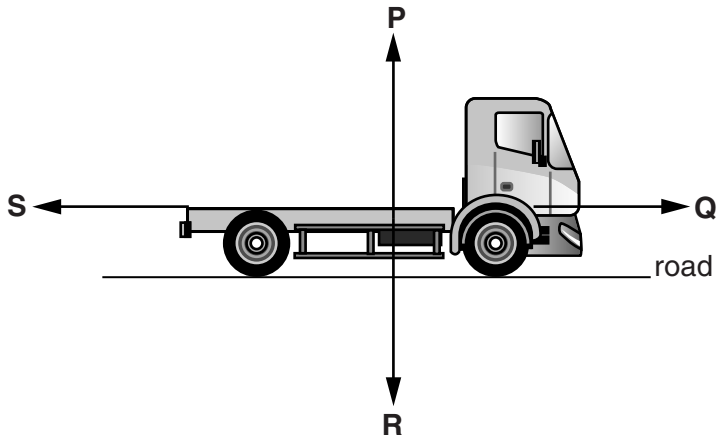


Fig. 8.2

Four forces **P**, **Q**, **R** and **S** are shown.

State which force from **P**, **Q**, **R** and **S** is

1. the weight of the truck, ...

2. the force exerted by the push of the engine. .....

[1]

(d) In modern trucks, computers are used to control the engine. Information is passed between the computer and engine along optical fibres.

Light passes through an optical fibre by total internal reflection.

Complete Fig. 8.3 to show how a ray of light travels down an optical fibre by total internal reflection. The first angle of incidence (*i*) has been labelled for you.

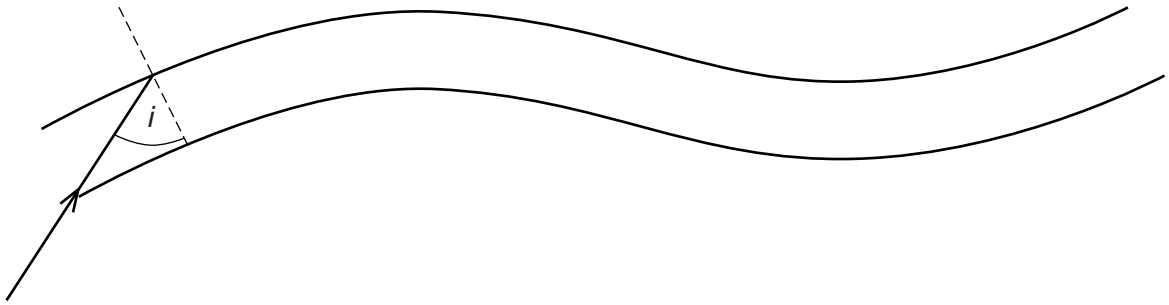


Fig. 8.3

[2]

(e) **(i)** State one use of optical fibres in medicine.

.....

.....[1]

(ii) Suggest the advantage of using optical fibres for the use stated in **(i)**.

.....

.....[1]

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

..... + $6O_2$ ⟶ $6CO_2$ + ... [1]

(b) During aerobic respiration, carbon dioxide is produced which is excreted at the lungs. Fig. 9.1 shows part of the tissue that lines the trachea.

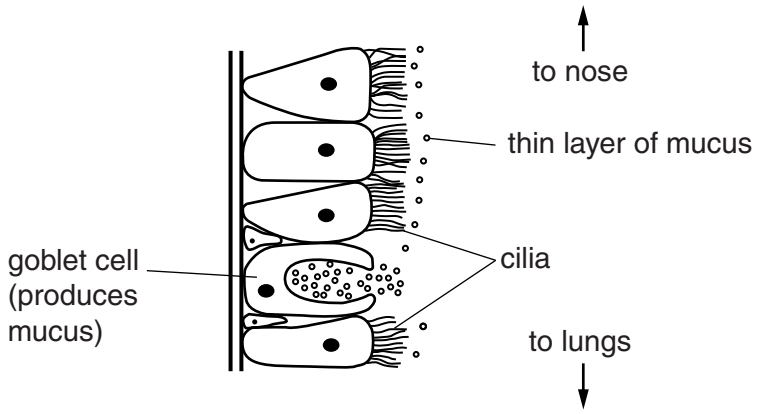


Fig. 9.1

(i) Describe how the lungs are protected by the mucus and cilia shown in Fig. 9.1.

mucus

.....

.....

cilia

.....

.....
[2]

(ii) Describe and explain the harmful effect of tobacco smoke on the cilia.

.....

.....

.....[2]

(c) Fig. 9.2 shows a fetus in the uterus. The fetus cannot breathe inside the uterus, so oxygen is supplied by a different method.

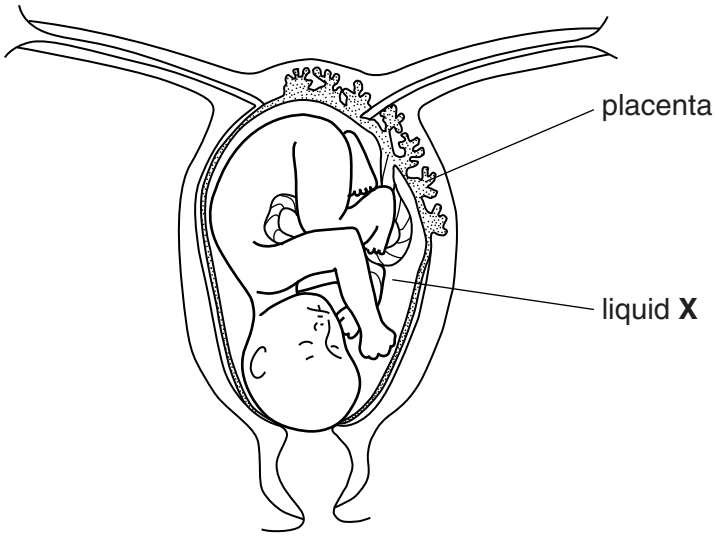


Fig. 9.2

Describe how the placenta supplies the fetus with oxygen.

.....

.....

.....[2]

(d) **(i)** One problem that can occur during pregnancy is the loss of the liquid **X** shown in Fig. 9.2.

Name liquid **X**.

.....[1]

(ii) Suggest why the loss of liquid **X** would be harmful to the growing fetus.

.....

.....[1]

The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

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 –		

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.)