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0653/31

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 24.

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.

- 1 (a) Complete the sentences below using words or phrases from the list.

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

downwards phloem respiration root hairs transpiration
upwards upwards and downwards xylem

In the plant, water travels upwards in the

Dissolved sugar travels in the and moves

..... The evaporation of water from the

surfaces of the mesophyll cells is called

[4]

- (b) Fig. 1.1 shows a plant cell observed under the microscope.

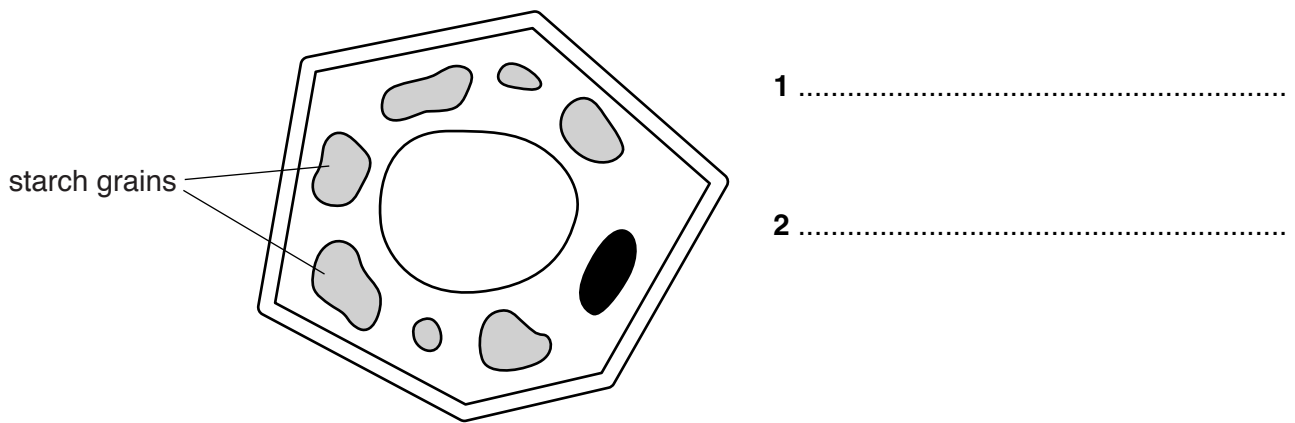


Fig. 1.1

- (i) There are many starch grains in this cell.

On Fig. 1.1, name **two** other structures, **1** and **2**, in this cell that are not found in animal cells.

Draw label lines to these structures from the names you have written on the diagram.

Describe the functions of the structures you have labelled.

function of structure **1**

.....

function of structure **2**

.....
 [4]

- (ii) State **one** piece of evidence from the diagram of the cell in Fig. 1.1 that suggests that the cell is found under the ground.

Explain your answer.

.....

.....

.....[2]

- 2 A student investigates the speed of reaction between dilute hydrochloric acid and calcium carbonate. The reaction produces carbon dioxide gas.

(a) Fig. 2.1 shows some of the apparatus the student uses.

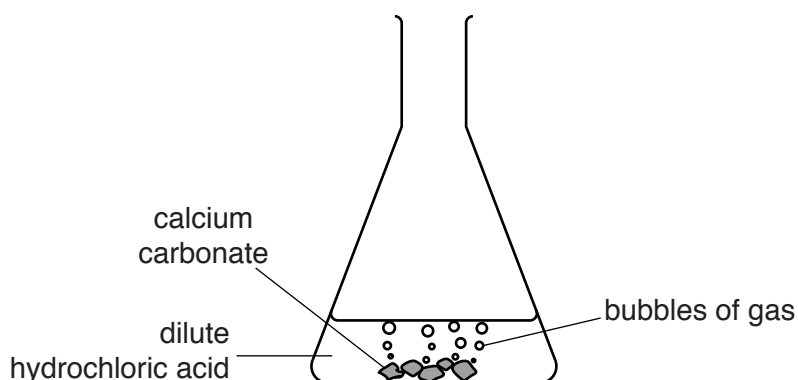


Fig. 2.1

- (i) The student wants to measure the volume of gas produced in this reaction every minute for 10 minutes.

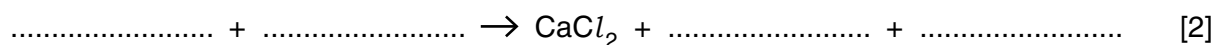
Complete Fig. 2.1 to show how the student collects and measures the volume of the gas. [2]

- (ii) As the reaction proceeds, the speed of the reaction decreases.

Explain this change in terms of collisions between reacting particles.

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

- (b) Complete the symbol equation for the reaction between hydrochloric acid and calcium carbonate.



- (c) Describe the test for carbon dioxide gas.

test.....

result.....[2]

- (d) Suggest the names of an acid and a base that the student can use to make sodium nitrate.

acid.....

base.....[2]

- 3 Fig. 3.1 shows a television camera that moves on rails alongside an athletics track.

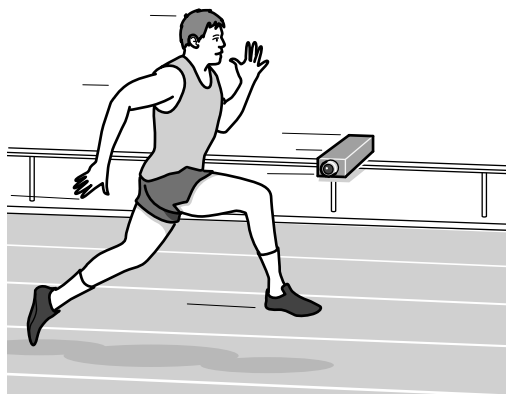


Fig. 3.1

The camera records a race from start to finish. The camera moves alongside the athletes.

The athletes accelerate from the start and quickly reach their maximum speed. They maintain this speed until they cross the finish line.

At the end of the race the athletes and the camera slow to a stop.

- (a) Fig. 3.2 shows the speed/time graph for the camera from the start until it stops after the end of the race.

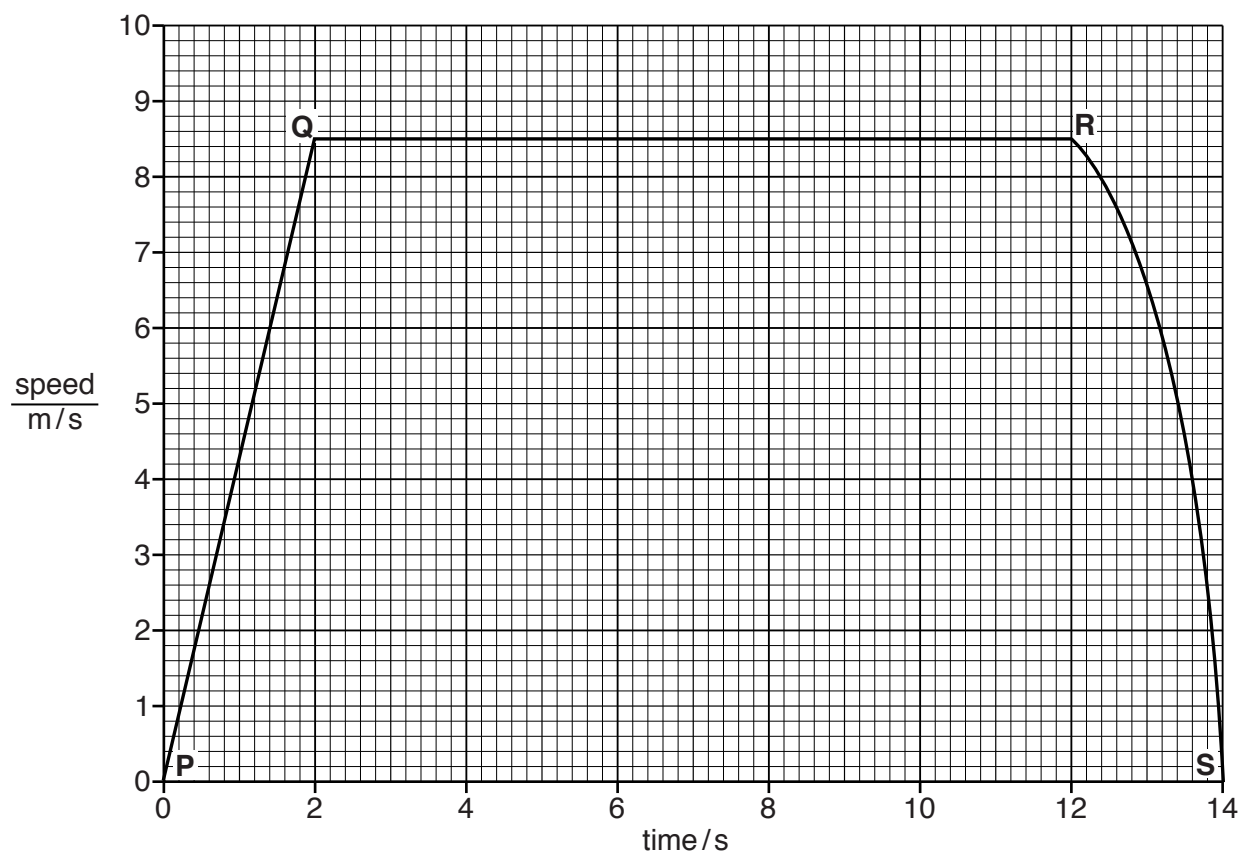


Fig. 3.2

- (i) State how you can tell that the acceleration in section **RS** of the graph is not constant.

.....[1]

- (ii) The camera has constant acceleration over the section **PQ** on Fig. 3.2.

Use the graph in Fig. 3.2 to calculate this acceleration. Show your working.

working

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

- (iii) Use the graph in Fig. 3.2 to calculate the distance travelled by the camera as it followed the sprinters from the start to the finishing time of 12 seconds.

Show your working.

distance = ... m [2]

- (b) The camera focuses light rays coming from the athlete onto the light sensor inside the camera.

An important part of the camera is missing from Fig. 3.3.

Complete the ray diagram in Fig. 3.3 by drawing and labelling the missing part in its correct position.

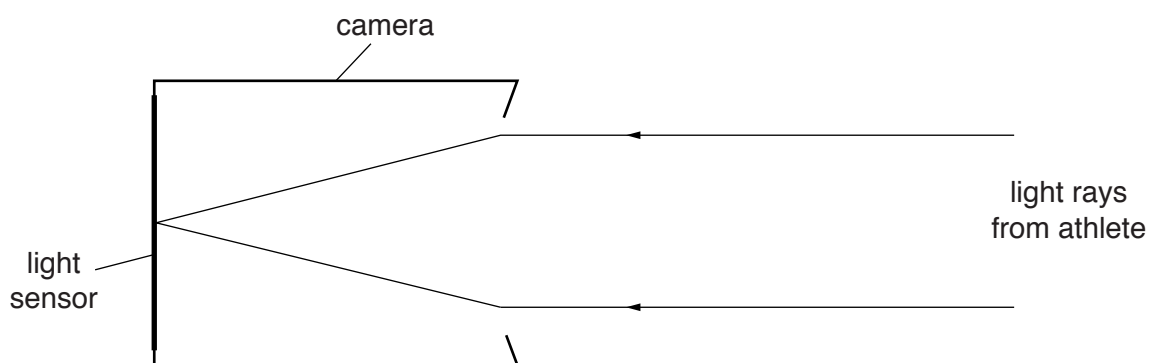


Fig. 3.3

[1]

(c) The camera is moved along the rails by an electric motor powered by a battery.

(i) The camera with motor and battery has a mass of 10 kg.

Calculate the kinetic energy of the camera as it travels at a constant speed of 8.5 m/s.

State the formula you use and show your working.

formula

working

kinetic energy = ... J [2]

(ii) The kinetic energy of the moving camera is much less than the chemical energy supplied by the battery to the electric motor.

Use the principle of the conservation of energy to explain why this happens.

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

Please turn over for Question 4

- 4 (a) Fig. 4.1 is a diagram of the internal structure of the heart.

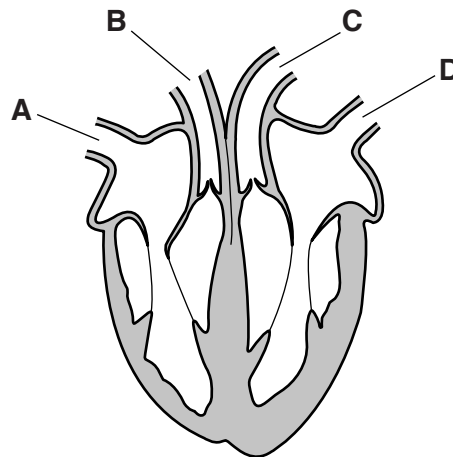


Fig. 4.1

- (i) State which of the vessels labelled **A**, **B**, **C** and **D** are arteries.
[1]
- (ii) State the **name** of the blood vessel with the highest pressure.
[1]
- (iii) Explain why this blood vessel in (ii) needs to have blood at a high pressure.

[1]

- (b) Fig. 4.2 shows a cross section of an artery.

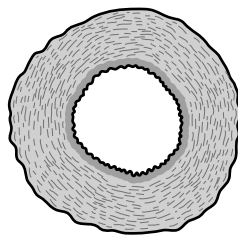


Fig. 4.2

Describe how the structure of this artery adapts it for its function.

.....

[2]

(c) Fig. 4.3 shows a longitudinal section of a diseased coronary artery.

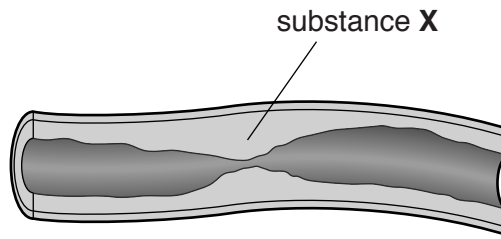


Fig. 4.3

(i) Describe the function of the coronary artery.

.....
[1]

(ii) Identify substance **X**.

.....[1]

(iii) State **two** possible lifestyle choices that could increase the rate of formation of substance **X** in the coronary artery.

1.
2.[2]

- 5 Fig. 5.1 shows the fractional distillation of petroleum (crude oil).

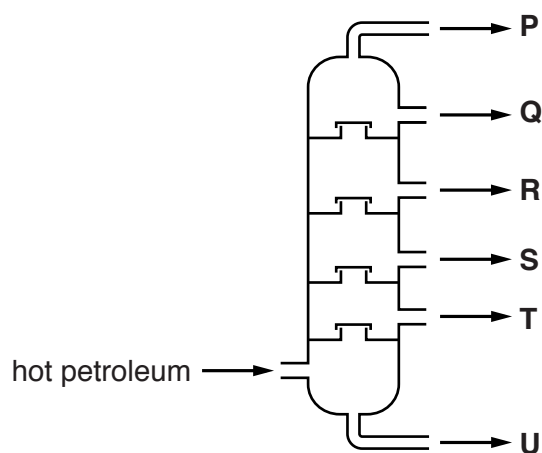


Fig. 5.1

Six fractions, **P**, **Q**, **R**, **S**, **T** and **U**, are produced.

- (a) State which fraction

has the greatest intermolecular forces of attraction between molecules,

.....

contains only gas molecules.

.....

[2]

- (b) Fig. 5.2 shows four molecules.

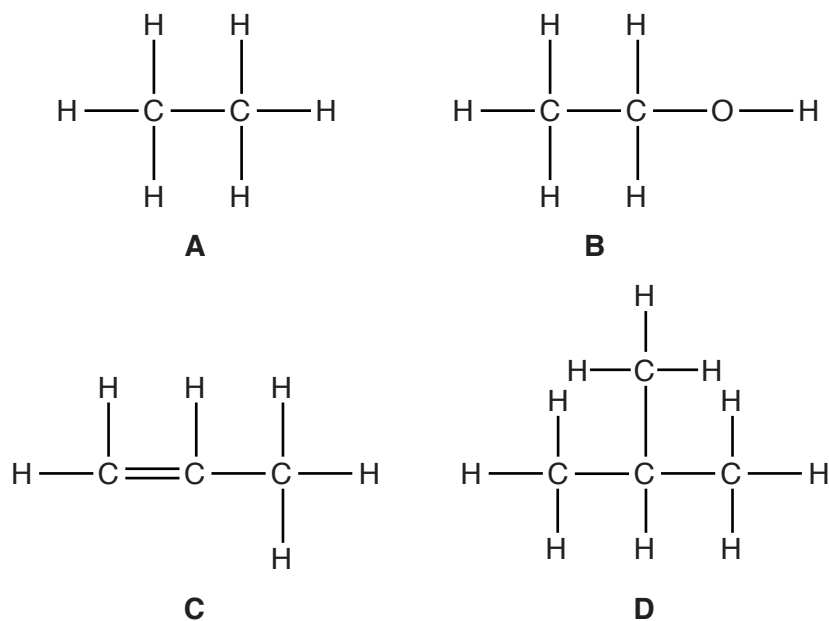


Fig. 5.2

- (i) From Fig. 5.2, give the letter of a molecule of an alkane.

..... [1]

- (ii) From Fig. 5.2, give the letter of a molecule of an alkene. Explain your answer.

.....
 [2]

- (iii) Explain why alkanes and alkenes do not appear in the Periodic Table.

..... [1]

- (c) Complete Fig. 5.3 to show the bonding electrons in one molecule of methane, CH_4 .

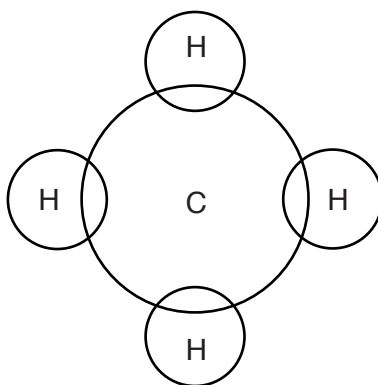


Fig. 5.3

[1]

- (d) In the last one hundred years, the proportion of carbon dioxide in the air has increased.

- (i) State **one** reason for the increased amount of carbon dioxide.

.....
 [1]

- (ii) State **one** reason why the increase in carbon dioxide may harm the environment.

.....
 [1]

- 6 Fig. 6.1 shows a thermometer containing a liquid at 20°C and at 60°C .

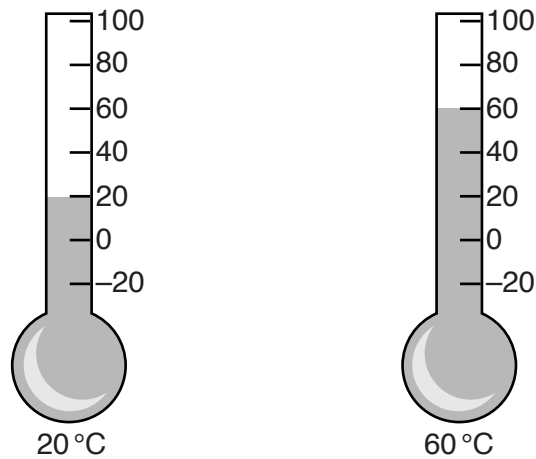


Fig. 6.1

- (a) Complete the sentences below by choosing the correct words from the list.

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

density force mass power work

When the liquid is heated, the of the liquid remains the same. The volume of the liquid increases on heating, which means that the of the liquid decreases. [2]

- (b) Water freezes at 0°C . Explain why the scale on the thermometer in Fig. 6.1 shows that the liquid in the thermometer cannot be water.

.....

 [1]

(c) Bright sunlight shines on the thermometer. The temperature reading rises slowly.

- (i) In Fig. 6.2 below, write the name of the radiation from the Sun responsible for the temperature rise in the correct position in the electromagnetic spectrum.

	X-rays				microwaves	radio waves
--	--------	--	--	--	------------	-------------

Fig. 6.2

[2]

- (ii) A student said he thought the radiation in (i) travelled from the Sun faster than sunlight.

Explain why the student is not correct.

.....
[1]

- (iii) Suggest one way of making the temperature reading rise more quickly when exposed to bright sunshine.

.....
[1]

7 Fig. 7.1 shows two simple food chains.

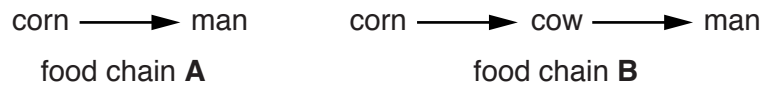


Fig. 7.1

- (a) Explain why food chain **A** transfers a greater proportion of the chemical energy in the corn to the man.

Assume that the food chains apply to two identical areas of land.

.....

.....

.....[2]

- (b) The farmer tries to improve the efficiency of food chain **B** by keeping the cows in heated buildings.

Suggest how this improves the efficiency of food chain **B**.

.....

.....

.....[2]

- (c) When the farmer adds fertiliser to the corn in the field, some of the fertiliser enters a nearby lake.

- (i) Suggest what causes the fertiliser to enter the lake.

.....[1]

- (ii) Describe and explain how the fertiliser affects
plants near the surface of the water,

.....

.....

plants lower down in the lake.

.....

.....

.....[3]

8 Lithium and sodium are metals in Group I of the Periodic Table of Elements.

(a) (i) The electronic structure of lithium is 2,1.

State the electronic structure of sodium.

.....[1]

(ii) Rubidium is another Group I metal.

It is stored in a liquid.

Suggest a liquid in which rubidium is stored and explain why it is stored in this liquid.

liquid

explanation

.....[2]

(iii) Predict the **two** products of the electrolysis of molten rubidium chloride.

..... and[1]

(b) The reaction between lithium and oxygen is exothermic.

(i) State the change that always occurs in an **exothermic** reaction.

.....[1]

(ii) State the charges on the ions formed in this reaction, and explain how these ions form.

lithium ion

oxide ion

explanation

.....[3]

- 9 A student investigates the current through a lamp as she varies the potential difference (p.d.) across the lamp.

She designs the circuit in Fig. 9.1 to use in her investigation.

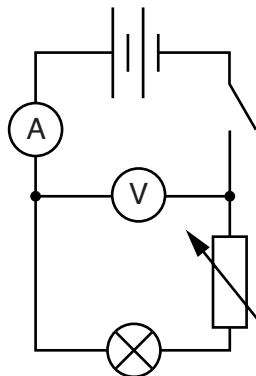
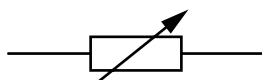


Fig. 9.1

- (a) (i) Name the component represented by this symbol



.....[1]

- (ii) State and explain why the student includes this component in her circuit.

.....

[2]

- (b) The student has included all the correct components in the circuit diagram shown in Fig. 9.1, but she has not connected them correctly.

In the space below, draw the diagram for a circuit that will allow the p.d. across the lamp and the current through the lamp to be measured.

[2]

- (c) The student used the correct circuit to carry out her experiment.

Fig. 9.2 shows her results plotted as a graph.

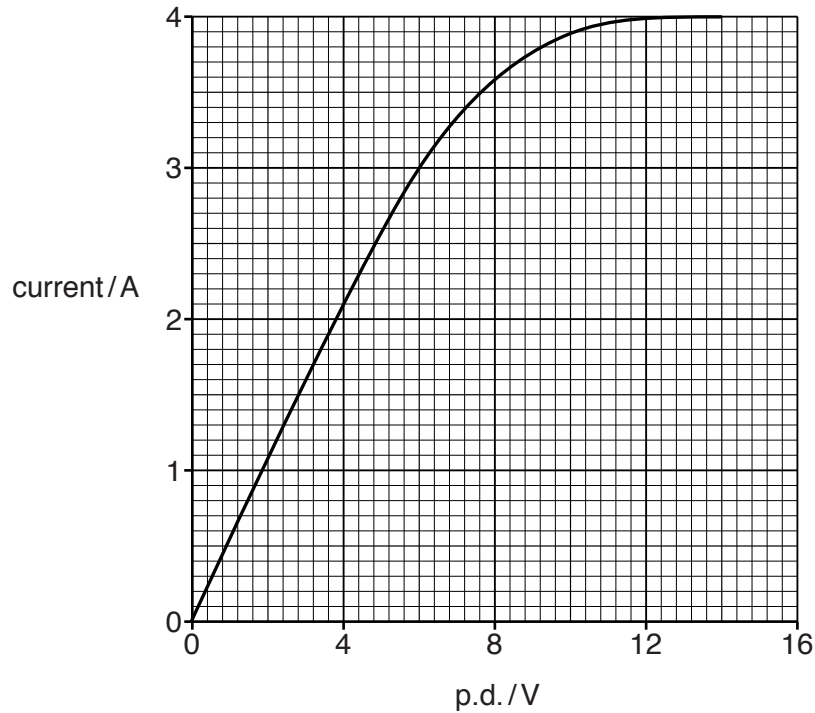


Fig. 9.2

- (i) Use the graph in Fig. 9.2 to calculate the resistance of the lamp filament when the p.d. across the filament is 6V.

State the formula you use and show your working.

formula

working

resistance = ... Ω [2]

- (ii) Use the graph to describe how the resistance of the lamp filament changes as the p.d. across the filament increases.

.....

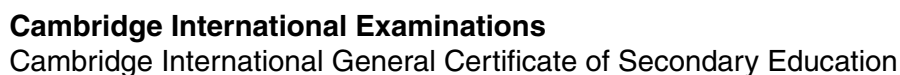
[2]

The Periodic Table of Elements

Group																				
I	II	1 Hhydrogen1										III	IV	V	VI	VII	VIII			
		Key atomic number atomic symbol name relative atomic mass																		
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 117	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 Cr copernicium —	113 Nh nihonium —	114 Fl flerovium —	115 Lv livermorium —	116 Uu ununoctium —	117 Ts tennessine —	118 Og oganeson —

lanthanoids		57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
		La lanthanum 139	Ce cerium 140	Pr praseodymium 141	Nd neodymium 144	Pm promethium —	Sm samarium 150	Eu europium 152	Gd gadolinium 157	Tb terbium 159	Dy dysprosium 163	Ho holmium 165	Er erbium 167	Tm thulium 169	Yb ytterbium 173	Lu lutetium 175
actinoids		89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
		Ac actinium —	Th thorium 232	Pa protactinium 231	U uranium 238	Np neptunium —	Pu plutonium —	Am americium —	Cm curium —	Bk berkelium —	Cf californium —	Es einsteinium —	Fm fermium —	Md mendelevium —	No nobelium —	Lr lawrencium —

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



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1 hour 15 minutes

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This document consists of **22** printed pages and **2** blank pages.

- 1 Fig. 1.1 shows some parts of the human alimentary canal and its associated organs.

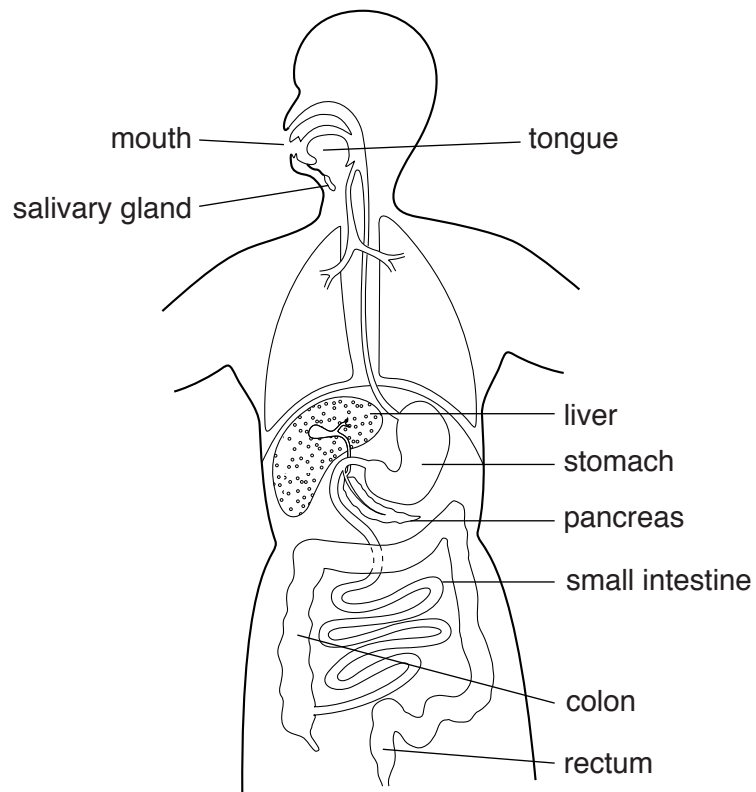


Fig. 1.1

- (a) Use the labels in Fig. 1.1 to complete Table 1.1.

Table 1.1

function	name of organ(s)
ingestion	
absorption of digested food	
secrete digestive enzymes	stomach and and

[4]

- (b) The nutrients that have been absorbed from the digestive system travel in the blood to the body cells.

Fig. 1.2 shows a longitudinal section of a capillary next to some body cells.

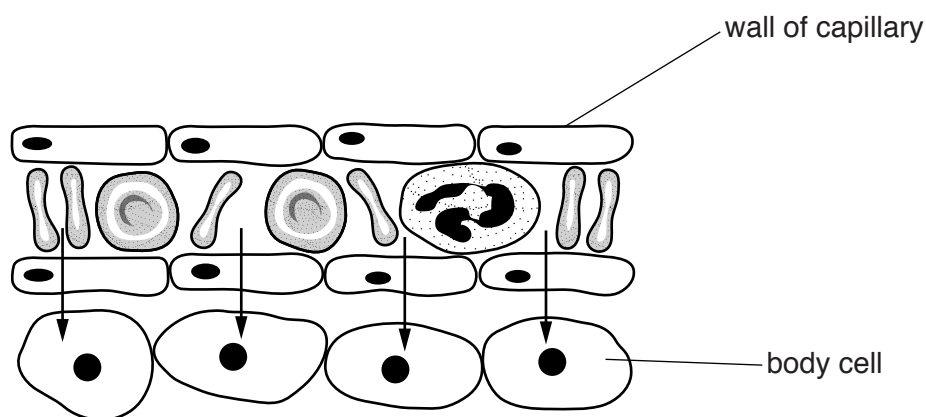


Fig. 1.2

The arrows show the direction of movement of glucose from the blood to the cells of the body.

Describe how the structure of the capillary allows this movement to take place effectively.

.....

.....

.....

..... [2]

- (c) Fig. 1.3 shows the effect of pH on the activity of an enzyme which is secreted into the food in the stomach. The environment in the stomach has a low pH because of the presence of hydrochloric acid.

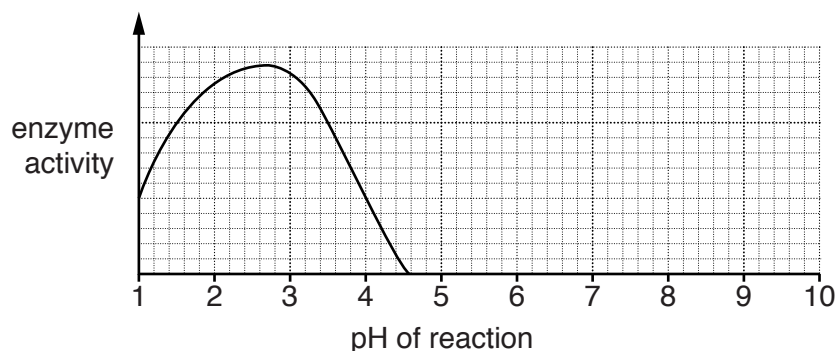


Fig. 1.3

- (i) State the optimum pH for this enzyme.

..... [1]

- (ii) The stomach contents enter the duodenum. The pH there is approximately 8.

Explain in detail why the enzyme shows no activity when it enters the duodenum.

.....

 [2]

- (iii) There are enzymes in the duodenum which digest the food after it has left the stomach.

On Fig. 1.3 draw a curve to suggest how the activity of an enzyme secreted into the duodenum varies with pH. [2]

Please turn over for Question 2

- 2 (a) Lead bromide, PbBr_2 , can be broken down into its elements using the apparatus shown in Fig. 2.1.

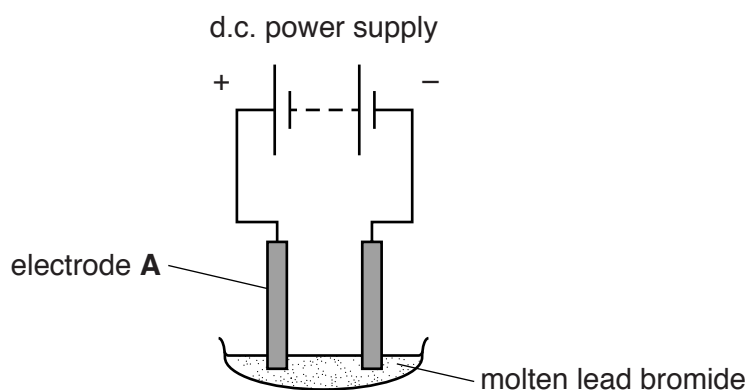


Fig. 2.1

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

..... [1]

- (ii) Give the symbols of the ions present in molten lead bromide.

..... [1]

- (iii) Name the element produced at electrode A and state the colour of this element.

name

colour [2]

- (b) In a similar process, aqueous copper chloride solution is broken down into a metal and chlorine gas.

- (i) Write the symbol equation for the reaction, including state symbols.

..... [2]

- (ii) Describe the chemical test for chlorine gas.

test

result

..... [2]

- (c) (i) Describe the trend in the boiling points of the elements going down Group VII of the Periodic Table, from chlorine to iodine.

..... [1]

- (ii) Fluorine is another element in Group VII.

Use the Periodic Table to determine the electronic structure of an atom of fluorine.

..... [1]

- (iii) An atom of fluorine has a nucleon number of 19.

Calculate the number of neutrons in this atom.

number of neutrons = ... [1]

- 3 Fig. 3.1 shows a gravity racer. A gravity racer is a small cart with four wheels and no engine. It is steered by a driver as it runs down a sloping track.

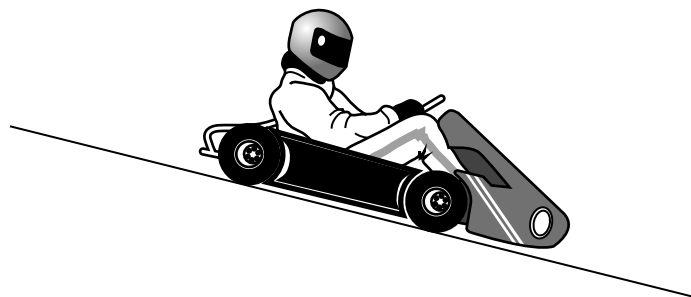


Fig. 3.1

- (a) The mass of the cart and driver is 100 kg.

State the name given to the force on this mass due to the effect of gravity.

..... [1]

- (b) Fig. 3.2 shows the track becoming horizontal at the bottom of the slope.

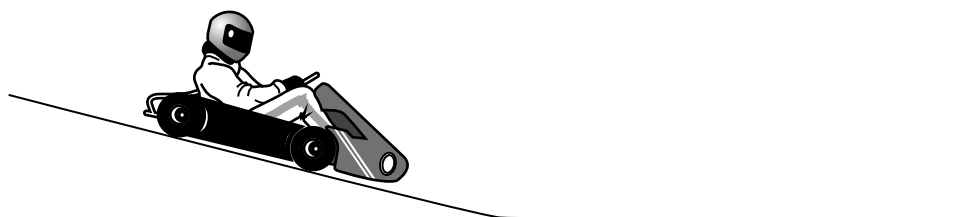


Fig. 3.2

The cart accelerates down the slope and then moves along the horizontal track for a distance before the driver applies the brakes and the cart stops.

Fig. 3.3 shows a speed/time graph for the motion of the cart.

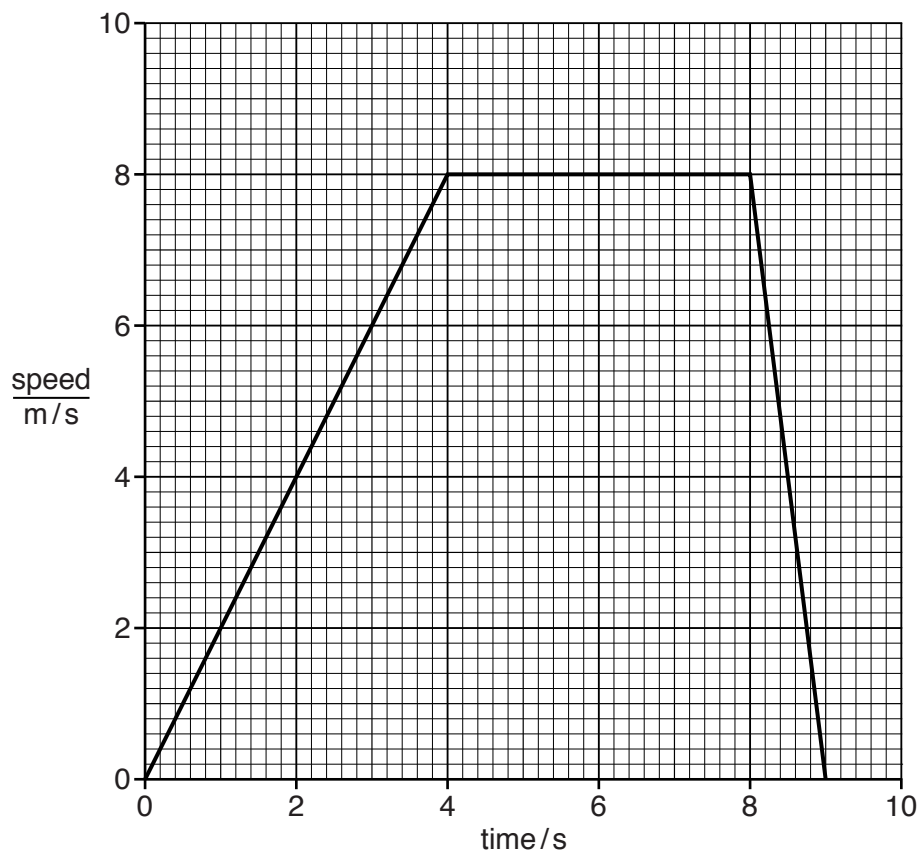


Fig. 3.3

- (i) On Fig. 3.3 write the letter **P** at the point when the brakes are first applied. [1]
- (ii) Use Fig. 3.3 to calculate the distance travelled by the cart

1. while it moves at constant speed.

State any formula you use and show your working.

formula

working

distance = ... m

2. from the time the brakes are applied until it comes to a stop.

Show your working.

distance = ... m
[3]

- (c) Another cart with driver has a mass of 150 kg.

This cart travels down the slope through a vertical height of 10 m before entering the horizontal section of the track.

- (i) Complete the energy transfers that take place while the cart is moving.

From*potential energy*..... at the top of the slope

to*kinetic*..... energy on the track

to energy as the cart stops.

[1]

- (ii) Calculate the potential energy lost.
(gravitational field strength, $g = 10 \text{ N/kg}$).

State the formula you use and show your working.

formula

working

potential energy = ... J [2]

- (iii) Calculate the maximum possible speed of the cart at the bottom of the slope.

State the formula you use and show your working.

formula

working

speed = ... m/s [3]

- 4 Fig. 4.1 shows a germinating seed and a diagram of one of the root hair cells as seen through the microscope.

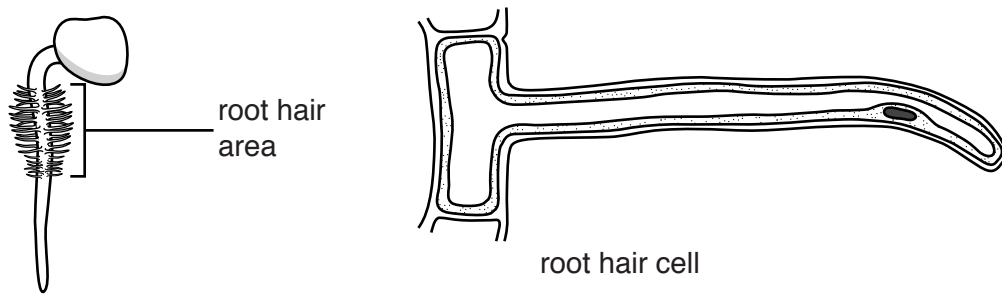


Fig. 4.1

- (a) Use the following terms to complete the sentences.

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

amino acids

cell membrane

cell wall

ions

nucleus

phloem

xylem

The root hair cell has a to control what enters and leaves the cell. It has a large surface area to absorb water and Water goes from the cell to the to be taken to the rest of the plant. [3]

- (b) A few days later the seedling in Fig. 4.1 develops leaves above ground and starts to photosynthesise.

- (i) Write the symbol equation for photosynthesis.

$$\xrightarrow[\text{chlorophyll}]{\text{light}}$$

..... [2]

- (ii) Describe the role of chlorophyll in photosynthesis.

.....

.....

.....

..... [2]

5 Fig. 5.1 shows the fractional distillation of petroleum.

Four of the fractions are labelled **P**, **Q**, **R** and **S**.

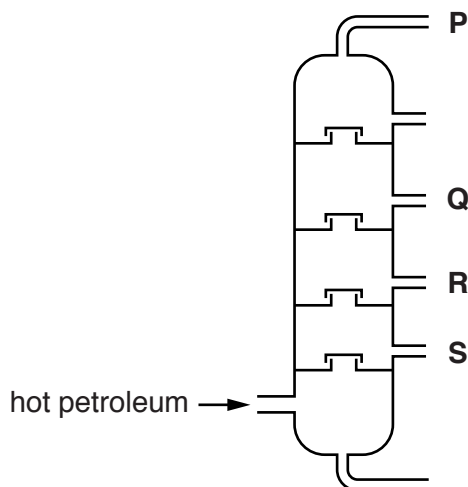


Fig. 5.1

(a) State which fraction from Fig. 5.1 has

the lowest boiling point range,

.....

the greatest molecular size.

.....

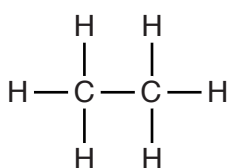
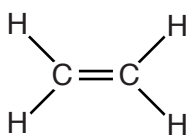
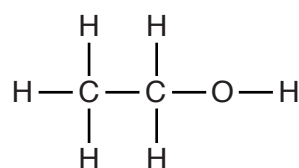
[2]

(b) Alkanes and alkenes are two types of hydrocarbon.

(i) Name the process used in the manufacture of alkenes from alkanes.

..... [1]

(ii) Fig. 5.2 shows three molecules.

**A****B****C****Fig. 5.2**

State which molecule is an alkene and give a reason for your answer.

molecule

reason

[1]

(iii) Alkanes and alkenes can be distinguished by a chemical test.

Name the chemical used in this test and state the observations for propane and for propene.

chemical name

propane observation

propene observation

[3]

6 Global warming causes ice caps to melt. This causes a rise in sea level.

(a) Warming of the water in the oceans causes the sea level to rise for a different reason.

Explain this reason.

.....
 [1]

(b) Global warming happens when more of the infra-red radiation coming from the Sun is trapped in the Earth's surface and atmosphere.

(i) Table 6.1 shows part of the electromagnetic spectrum.

Table 6.1

gamma rays	X-rays					radio waves
------------	--------	--	--	--	--	-------------

In Table 6.1, place infra-red radiation in the correct position in the electromagnetic spectrum. [1]

(ii) A student said he thought infra-red radiation travels from the Sun more slowly than sunlight.

Explain why the student is **not** correct.

.....
 [1]

(c) Global warming causes more water to evaporate from the sea, as the average speed of the molecules in the sea increases. This causes the temperature of the water in the sea surface to decrease slightly.

Suggest why evaporation causes a decrease in temperature in terms of the movement of water molecules.

.....

 [2]

(d) When the Sun is shining on the Earth's surface, the temperature of the land increases more quickly than the temperature of the sea.

Suggest **one** reason why this happens.

.....
 [1]

- 7 Fig. 7.1 shows the energy flow in an ecosystem on an island. The unit for each flow is $\text{kJ/m}^2/\text{year}$.

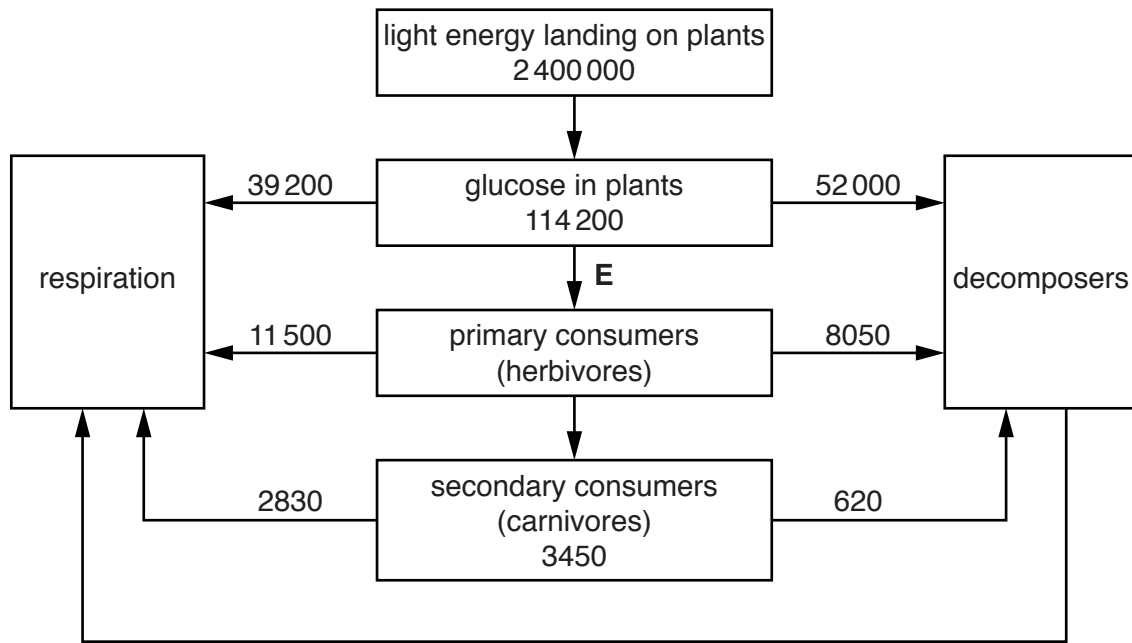


Fig. 7.1

- (a) (i) Calculate the efficiency with which light energy landing on the plants is converted to glucose.

Show your working.

$$\text{efficiency} = \dots\dots\dots\% \quad [2]$$

- (ii) Calculate **E**, the amount of energy passed on to the primary consumers.

Show your working

$$\mathbf{E} = \dots\dots\dots \text{kJ/m}^2/\text{year} \quad [1]$$

- (iii) Explain why there are not many trophic levels in this ecosystem.

.....

 [1]

- (iv) Describe **one** way in which the plants use the energy released by respiration.

..... [1]

(b) Acid rain can affect ecosystems. The island is affected by acid rain that is carried by the wind from a factory on a different island.

(i) Describe how the factory could cause this acid rain.

.....

.....

.....

..... [2]

(ii) The acid rain reduces the growth of the plants on the island.

Suggest and explain how this affects the number of carnivores in the ecosystem in Fig. 7.1.

.....

.....

.....

..... [2]

- 8 Fig. 8.1 shows a piece of calcium reacting with dilute hydrochloric acid.

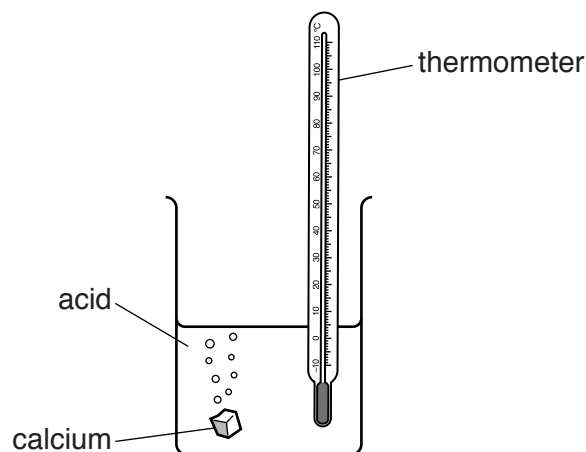


Fig. 8.1

- (a) Complete the sentences about this reaction.

In this reaction the temperature increases. This shows that this is an
 reaction. The temperature rises because energy is converted into
 energy. [3]

- (b) Describe and explain, in terms of colliding particles, any effect on the speed of the reaction caused by reducing the temperature of the acid.

effect
 explanation
 [2]

- (c) (i) Describe and explain any effect on the speed of the reaction in Fig. 8.1 caused by replacing the piece of calcium by a piece of copper.

effect
 explanation
 [2]

- (ii) Describe the method of extraction of copper from copper oxide.

.....
 [1]

- 9 A student wants to investigate the current through an electric buzzer. He designs the circuit in Fig. 9.1 to use in his investigation.

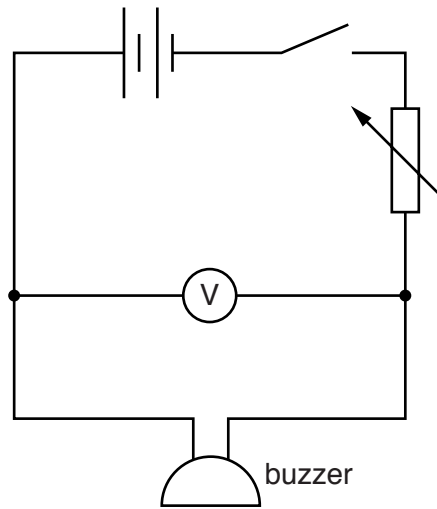
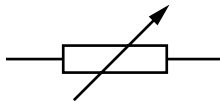


Fig. 9.1

- (a) (i) Name the component represented by this symbol.



..... [1]

- (ii) State and explain why the student includes this component in his circuit.

.....

.....

.....

..... [2]

- (iii) The student has left out an important component from his circuit that is needed to measure the current.

On Fig. 9.2 complete the circuit diagram and include the symbol for this missing component in its correct place.

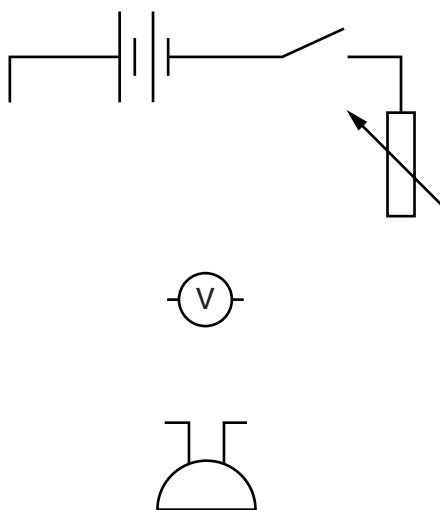


Fig. 9.2

[2]

- (b) The student uses the correct circuit for his experiment. Fig. 9.3 shows his results plotted as a graph.

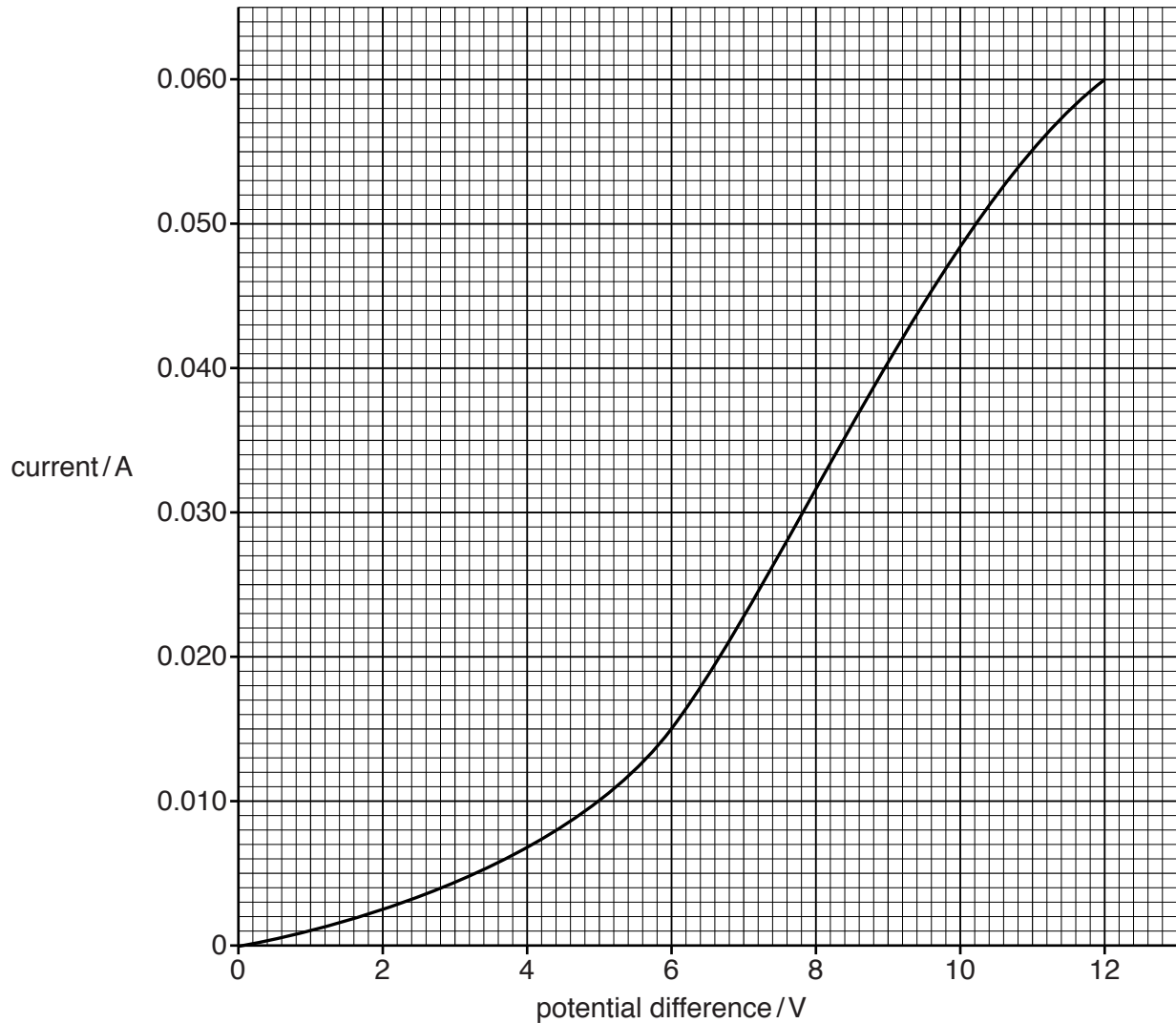


Fig. 9.3

The resistance of the buzzer is given by the formula

$$\text{resistance} = \frac{\text{potential difference (p.d.)}}{\text{current}}$$

The student says that the resistance of the buzzer is lower when the p.d. is 12V than when the p.d. is 6V. The resistance at 12V is $200\,\Omega$.

Use information from the graph in Fig. 9.3 to calculate the resistance at 6V to show that he was correct.

resistance at 6V = ... Ω [2]

- (c) The buzzer emits a very loud sound at 3000 Hz with a wavelength of 0.11 m. A student 1 km away from the buzzer hears the sound after a short time.

Calculate the time taken by the sound to reach the student.

State any formula you use and show your working.

formula

working

time = ...s [3]

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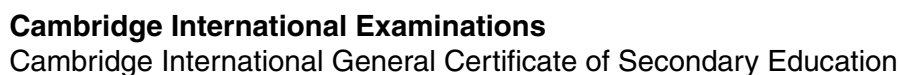
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The Periodic Table of Elements

[illegible]

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	europtium	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	227	90	Th	thorium	232	91	Pa	protactinium	231	92	U	uranium	238	93	Np	neptunium	237	94	Pu	plutonium	244	95	Am	americium	243	96	Cm	curium	247	97	Bk	berkelium	247	98	Cf	californium	251	99	Es	einsteinium	252	100	Fm	fermium	257	101	Md	mendelevium	258	102	No	nobelium	259	103	Lr	lawrencium	262

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)



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0653/33

May/June 2016

1 hour 15 minutes

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

A copy of the Periodic Table is printed on page 20.

The number of marks is given in brackets [] at the end of each question or part question.

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

- 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.

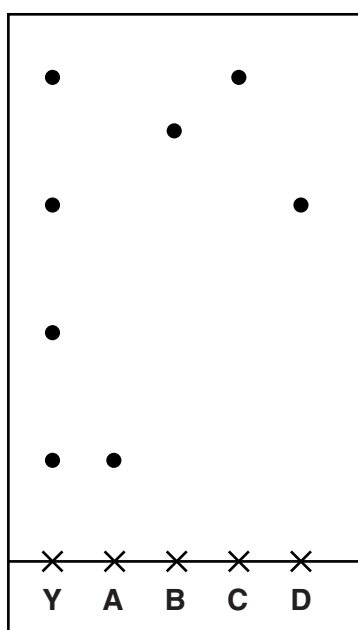


Fig. 1.1

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]

2 Fig. 2.1 shows an electric circuit.

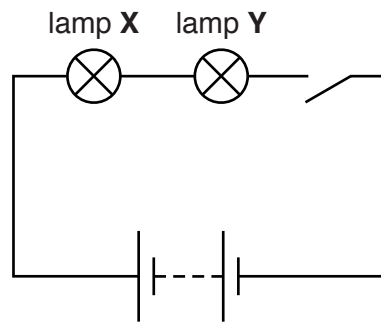


Fig. 2.1

(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.

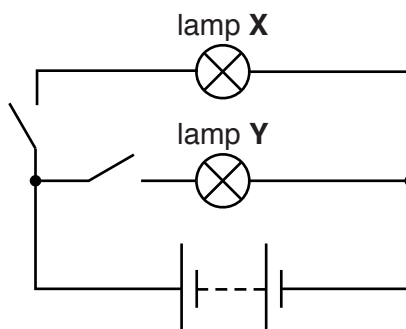


Fig. 2.2

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.

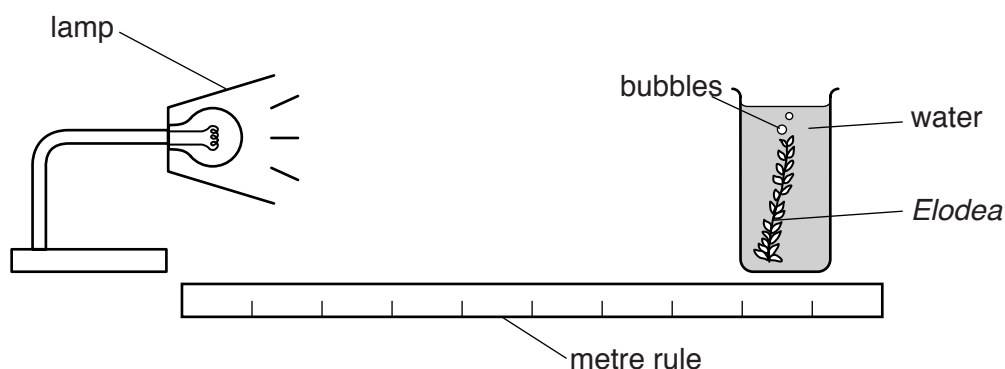


Fig. 3.1

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

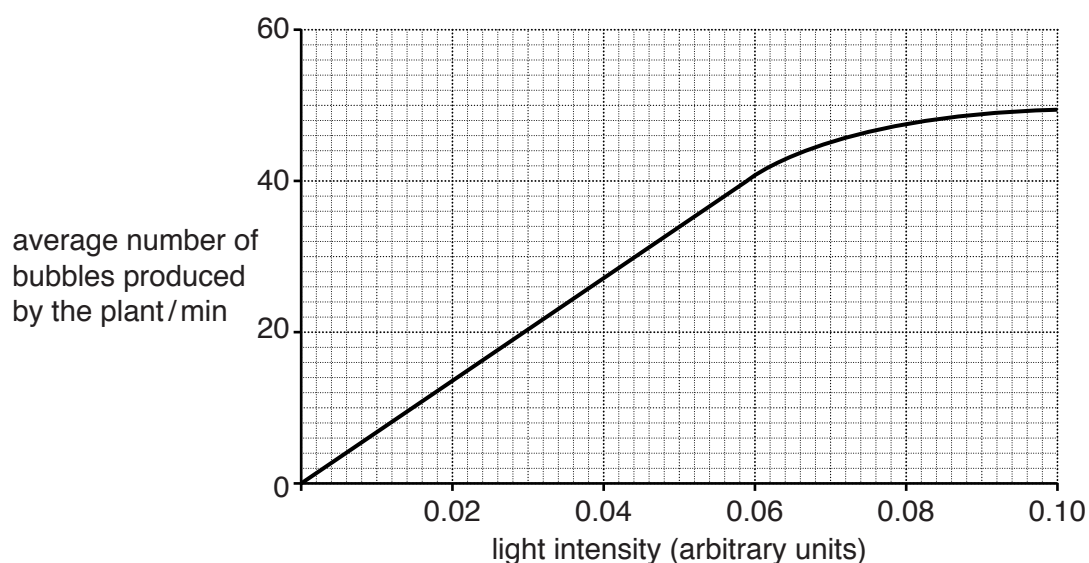


Fig. 3.2

- (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.

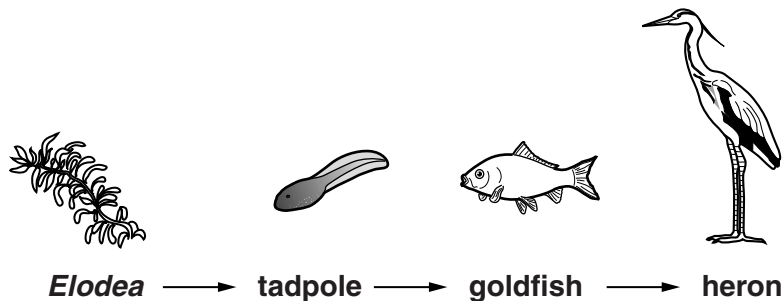


Fig. 3.3

- (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]

(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.

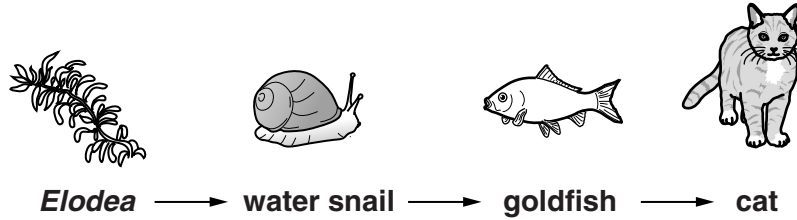


Fig. 3.4

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 —

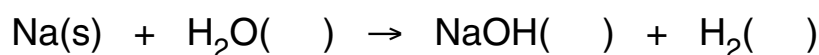
Fig. 4.1

(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.



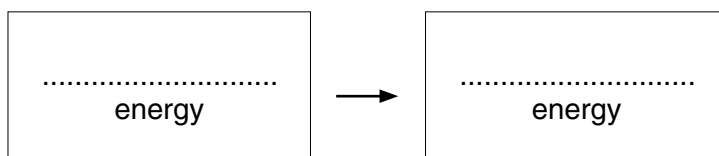
[2]

(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 990m away reaches him 6 seconds later. This is shown in Fig. 5.1.

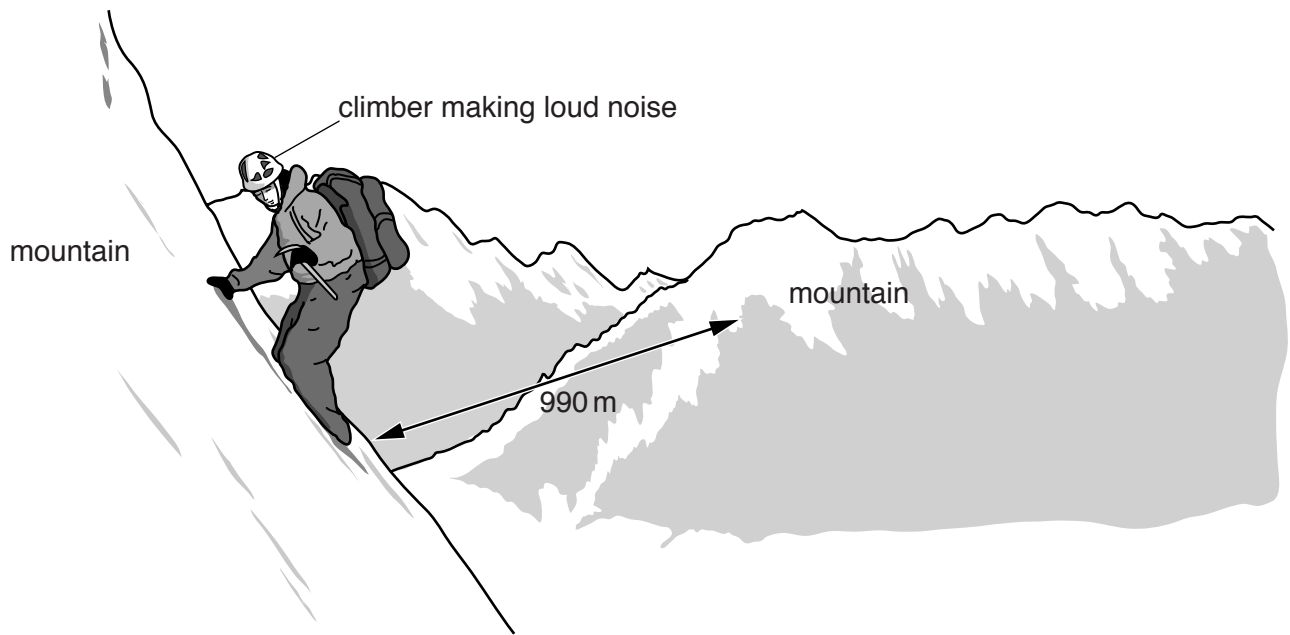


Fig. 5.1 (not to scale)

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.

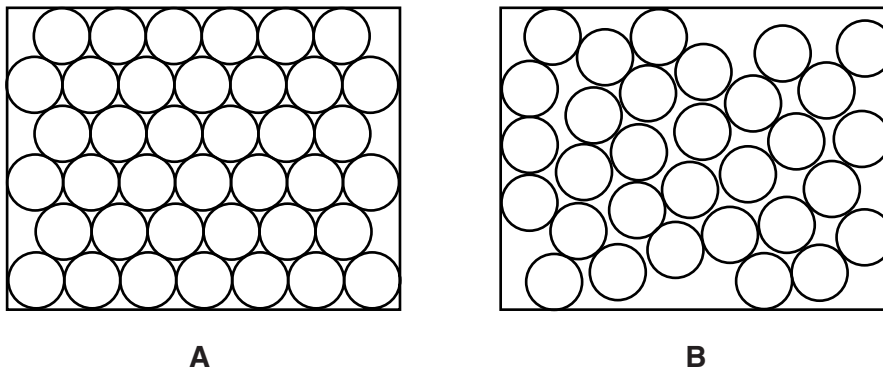


Fig. 5.2

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.

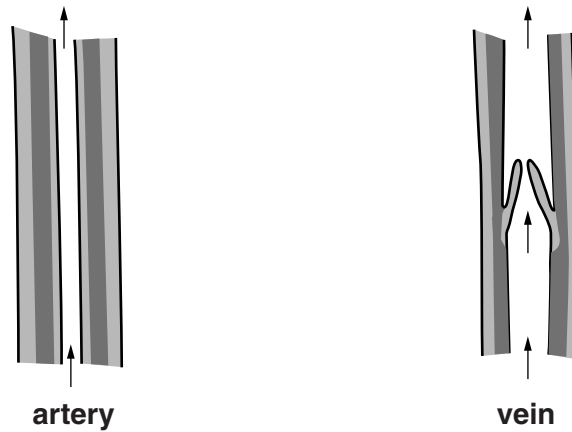


Fig. 6.1

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 .

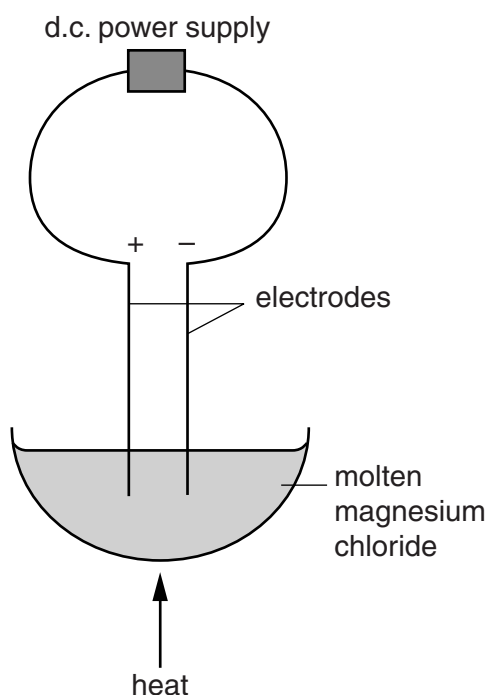


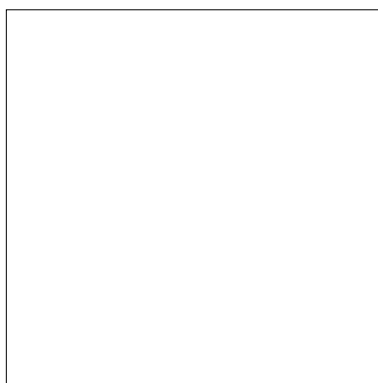
Fig. 7.1

- (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]

- 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.

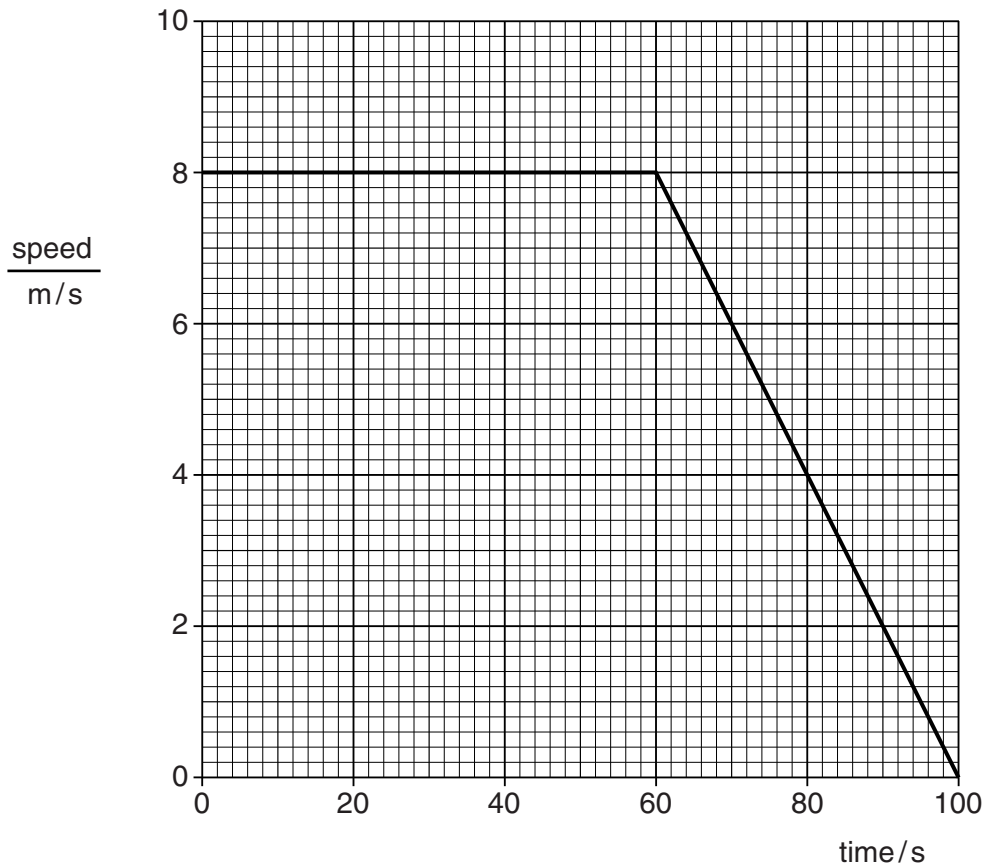


Fig. 8.1

- (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.

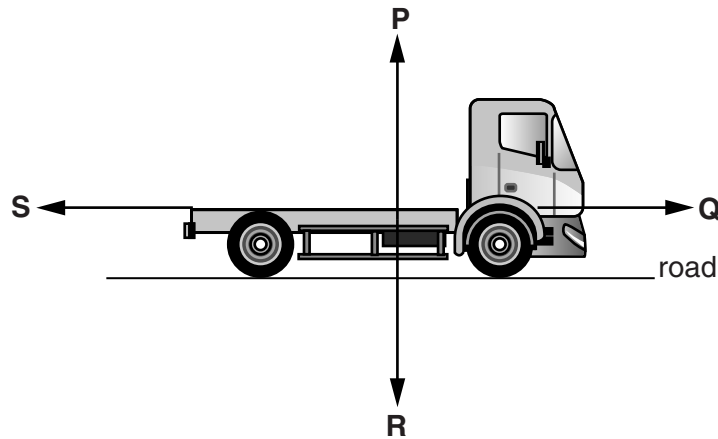


Fig. 8.2

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.

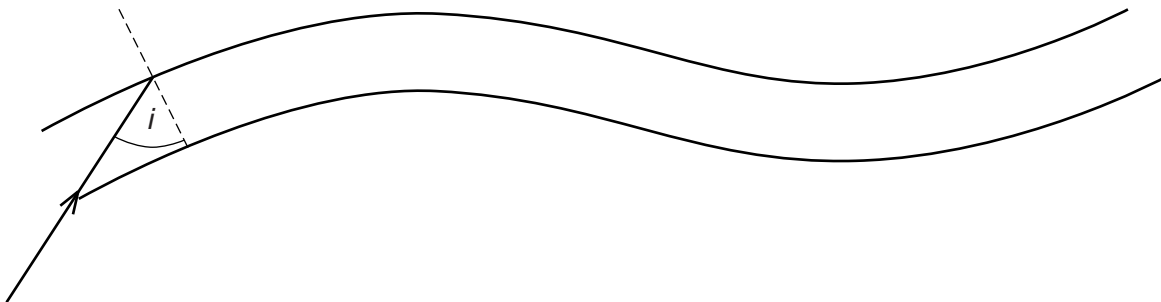


Fig. 8.3

[2]

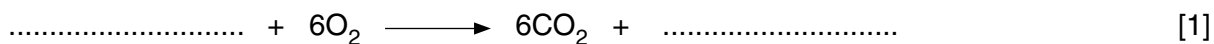
(e) (i) State one use of optical fibres in medicine.

.....
[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.



- (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.

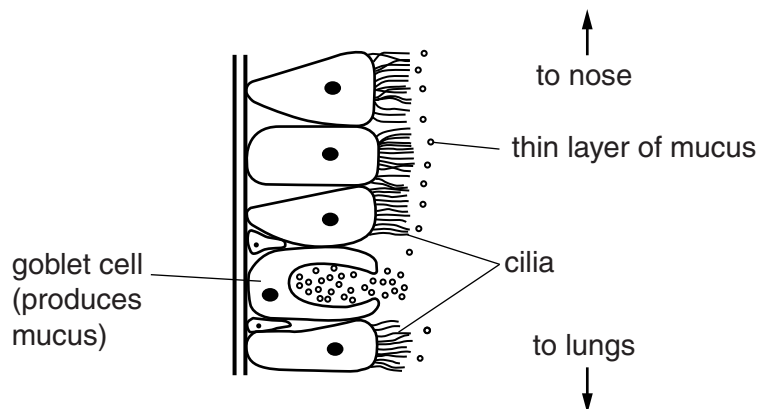


Fig. 9.1

- (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.

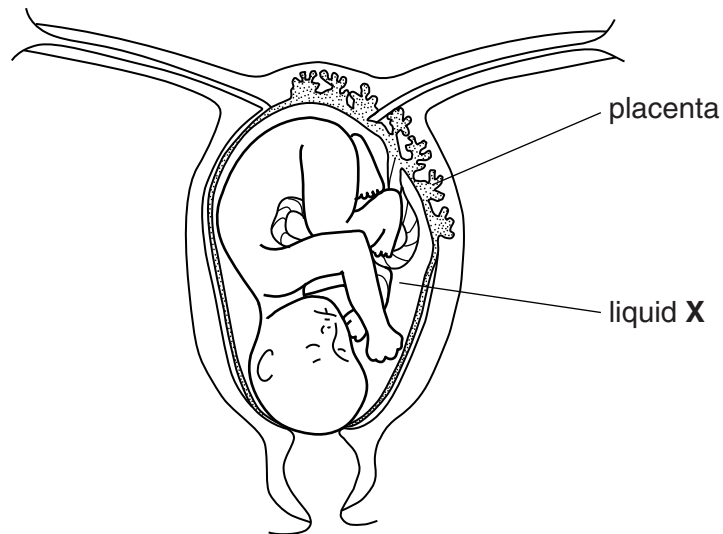


Fig. 9.2

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]

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	euroium	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
	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	—

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