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0653/21

October/November 2014

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 soft pencil for any diagrams, graphs, tables or rough working.

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.

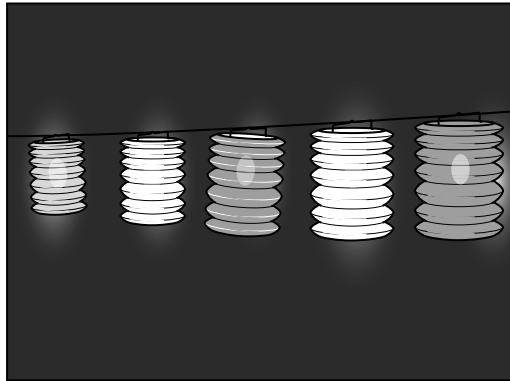
A copy of the Periodic Table is printed on page 20.

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.

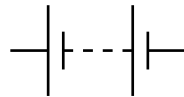
This document consists of **20** printed pages.

- 1 Party lights add light and colour to festive occasions.



A set of party lights has five lamps connected in series with a switch and a battery.

- (a) Complete the circuit diagram using standard circuit symbols for this set of party lights.



[2]

- (b) Each lamp in the set is labelled 1.2V, 0.1 A.

- (i) The term '1.2V' gives important information about the lamp.

Explain why this information is important for the use of the lamp in a circuit.

.....

.....

.....[2]

(ii) Use the formula

$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

to calculate the resistance of one lamp.

$$\text{resistance} = \dots\dots\dots \Omega [1]$$

(iii) Calculate the total resistance of the set of five lamps.

$$\text{total resistance} = \dots\dots\dots \Omega [1]$$

(iv) State the name of the unit of resistance whose symbol is Ω .

..... [1]

2 Gasoline is a product obtained from petroleum (crude oil) following fractional distillation.

- (a) Statements **A** to **D** below describe the processes which occur during fractional distillation to produce gasoline.

The processes have been written in the wrong order.

A	gasoline vapour condenses into a liquid at its boiling point
B	petroleum mixture is heated in a furnace
C	vapour mixture enters the fractionating column
D	vapour mixture rises and cools

In the boxes in Fig. 2.1 write the letters **A** to **D** to show the order in which the processes occur.

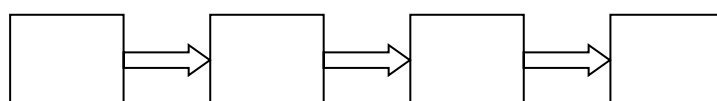


Fig. 2.1

[2]

- (b) Gasoline and diesel oil are different *mixtures* of *compounds* called hydrocarbons.

A hydrocarbon is a *compound* of the *elements* hydrogen and carbon.

Table 2.1 gives four descriptions of materials.

Use the words *compound*, *element* and *mixture* to complete Table 2.1.

You can use each of the words once, more than once or not at all.

Table 2.1

material	description
	can be found in the Periodic Table
	cannot be broken down into simpler substances
	contains different types of molecules
	only contains molecules which are identical but each molecule contains more than one type of atom

[4]

(c) The hydrocarbons present in gasoline and diesel oil are alkanes.

(i) State a use that gasoline and diesel oil have in common.

.....[1]

(ii) State the chemical property of alkanes that make them suitable for this use.

.....[1]

(d) Refinery gas is another product obtained from petroleum.

Refinery gas contains methane and propane.

(i) The chemical formula of methane is CH_4 .

State the products of the complete combustion of methane.

.....[2]

(ii) Propane contains molecules in which carbon atoms and hydrogen atoms are bonded in the ratio 3:8.

Deduce the chemical formula for propane.

chemical formula for propane = ... [1]

- 3 (a) A balanced diet for a person contains all the food groups in the correct amounts.

Fig. 3.1 shows some food substances needed in a balanced diet.

- (i) Using straight lines connect the food substance with their correct functions. One has been done for you.

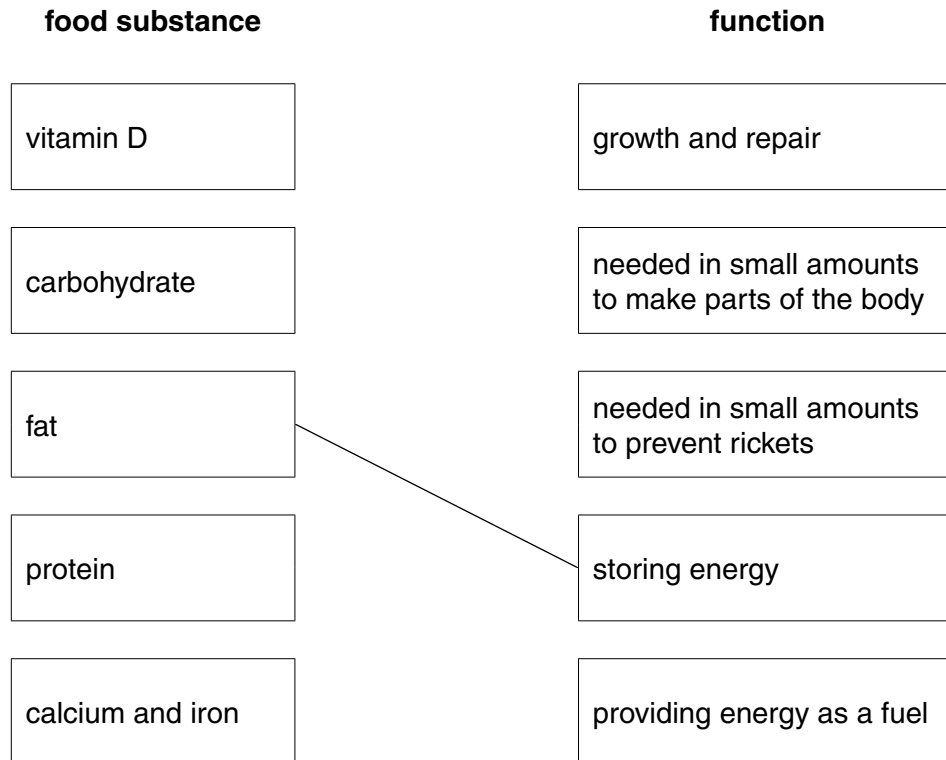


Fig. 3.1

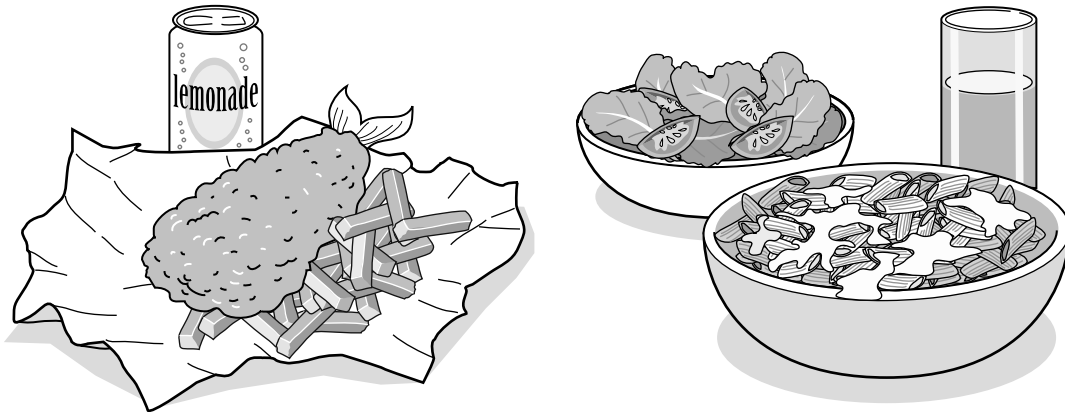
[3]

- (ii) All diets should contain fibre.

Describe the role of fibre in the body.

.....
[1]

- (b) Fig. 3.2 shows two meals. Jill works in an office all day and is 15kg overweight compared to the average weight for her height. In the evenings Jill sits and reads books and watches television.



meal 1 fried fish and fried potato,
can of lemonade

meal 2 pasta with cheese sauce,
lettuce and tomato,
milk

Fig. 3.2

- (i) Give **two** reasons why meal 2 would be more suitable than meal 1 for Jill to eat on a regular basis.

reason 1

.....

.....

reason 2

.....

.....

[2]

- (ii) Suggest **one** other food that Jill could add to meal 1 that would make it more healthy. Explain your choice.

.....

.....

.....[1]

- 4 (a) A student investigates the neutralisation reaction between hydrochloric acid and potassium hydroxide.

Fig. 4.1 shows the apparatus she uses.

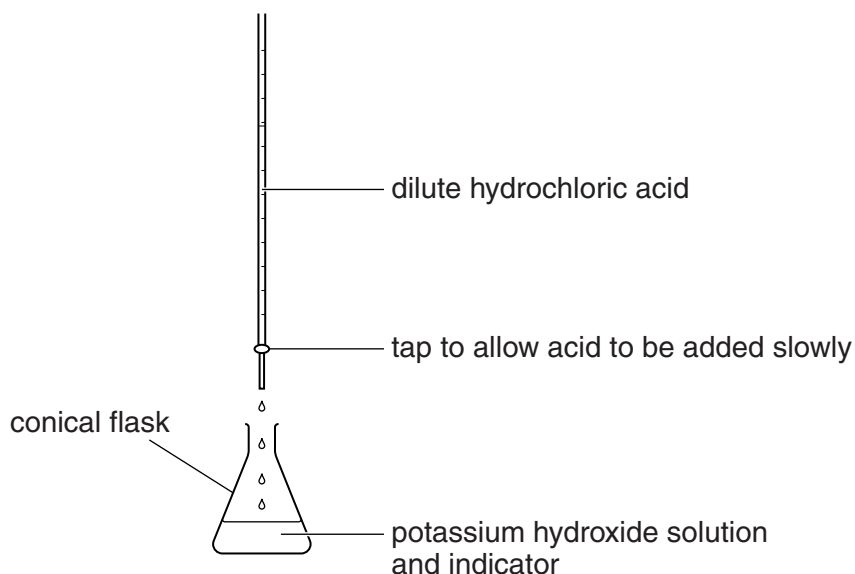


Fig. 4.1

She adds full range indicator (Universal Indicator) solution to the potassium hydroxide solution. Potassium hydroxide solution is alkaline.

She slowly adds some dilute hydrochloric acid to the potassium hydroxide solution until the solution in the flask is neutral.

The colour of the indicator changes as she adds the acid.

Fig. 4.2 shows how the colour of the indicator changes with pH.

pH	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
colour	RED			ORANGE			GREEN			BLUE			PURPLE		

Fig. 4.2

- (i) State the initial and final values of the pH of the solution in the flask.

initial

final

[1]

- (ii) State the initial and final colour of the indicator in the solution in the flask.

initial

final

[1]

- (iii) Explain why a neutral solution is formed when she adds the acid to the alkali.

.....

.....

.....[2]

- (b) (i) The student repeats part (a) in order to prepare a colourless neutral solution of potassium chloride.

She changes the method from that described in part (a) slightly, using information obtained from the first time she carried out the experiment.

Describe the change in method and explain how she uses the results of her first experiment.

.....

.....

.....[2]

- (ii) Describe how a sample of crystals of potassium chloride could be produced from the solution obtained in (b)(i).

.....

.....[1]

- 5 (a) Fig. 5.1 shows two cells **X** and **Y** which were taken from different areas of the same leaf.

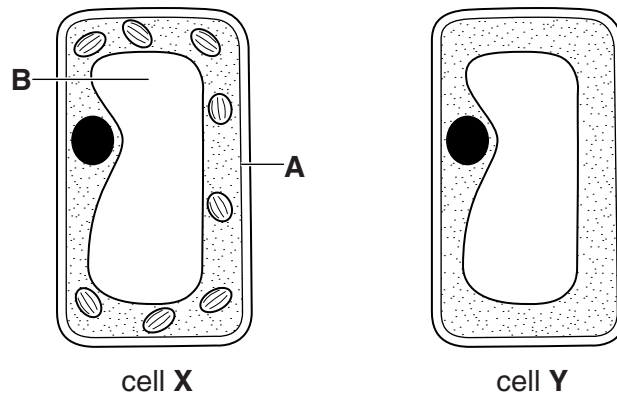


Fig. 5.1

- (i) State the names of cell parts **A** and **B**.

A

B

[2]

- (ii) Fig. 5.2 shows a leaf similar to the one from which these cells were taken.



Fig. 5.2

On Fig. 5.2, use label lines and the letters **X** and **Y** to show where these cells came from.

Explain your answer below.

.....

[3]

- (iii) The leaf was then tested with iodine solution for the presence of starch.

On Fig. 5.3 draw the result of the starch test on this leaf.

Label the leaf with the colours that are observed in different areas.

[1]

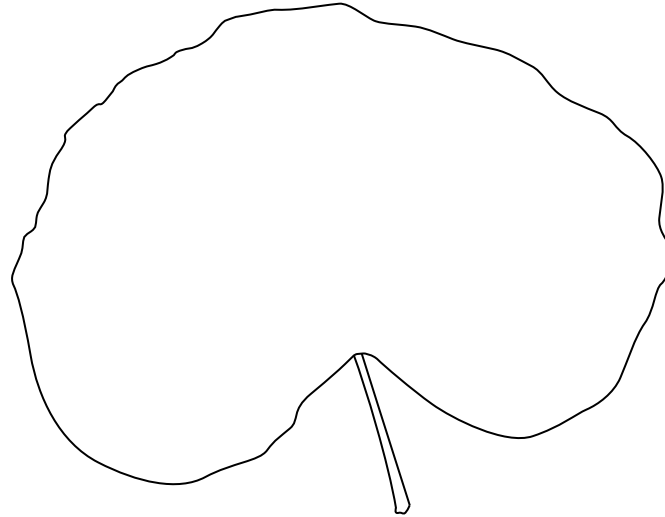


Fig. 5.3

- (iv) Explain why only parts of the leaf show the presence of starch.

.....
[1]

- (b) In humans, starch in food is digested by the enzyme amylase. The action of amylase starts when food is present in the mouth cavity.

- (i) Explain why amylase stops working after the food is swallowed and it reaches the acidic conditions of the stomach.

.....

[2]

- (ii) Name **one** organ in the body which produces digestive enzymes.

.....[1]

- 6 (a) Fig. 6.1 shows an aircraft at rest on an airport runway waiting to take off.

The engines are running, but the pilot is using the brakes to prevent it moving.

The diagram shows four forces, labelled **P**, **Q**, **R** and **S**, acting on the aircraft as it waits to take-off.

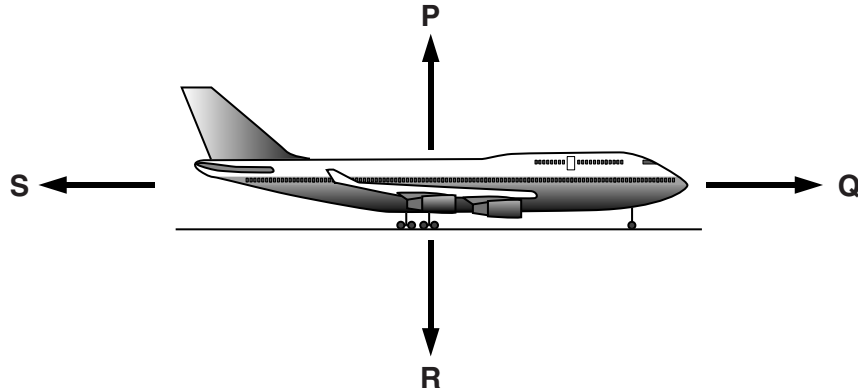


Fig. 6.1

- (i) State which force from **P**, **Q**, **R** and **S** is

the weight of the aircraft

the thrust of the engines

the force of the brakes

[2]

- (ii) Explain, in terms of balanced forces, why the aircraft remains at rest.

.....

 [2]

- (b) (i) State the form of energy carried by the aircraft in its fuel tanks.

..... [1]

- (ii) The aircraft takes off and climbs.

The energy in the aircraft's fuel is transferred to the aircraft as it takes off and climbs.

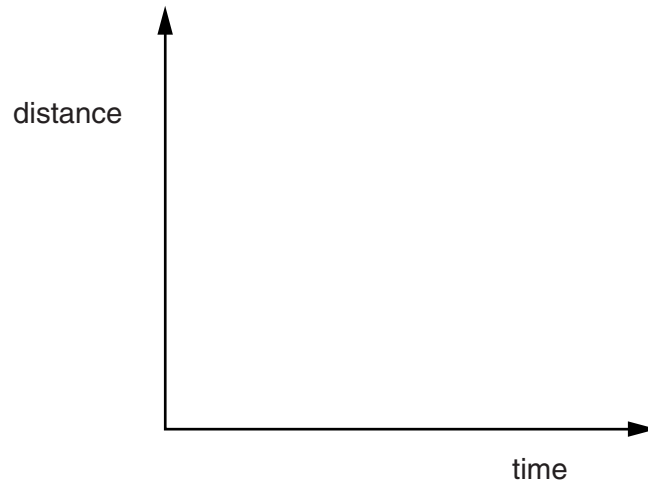
Identify the **two** useful forms of energy that the aircraft has gained.

..... and [2]

(iii) Identify **one** form of energy produced by the aircraft that is not useful.

.....[1]

(c) On the axes below, sketch a distance/time graph for the aircraft as it cruises at a constant speed.



[1]

7 (a) Fig. 7.1 shows the carbon cycle.

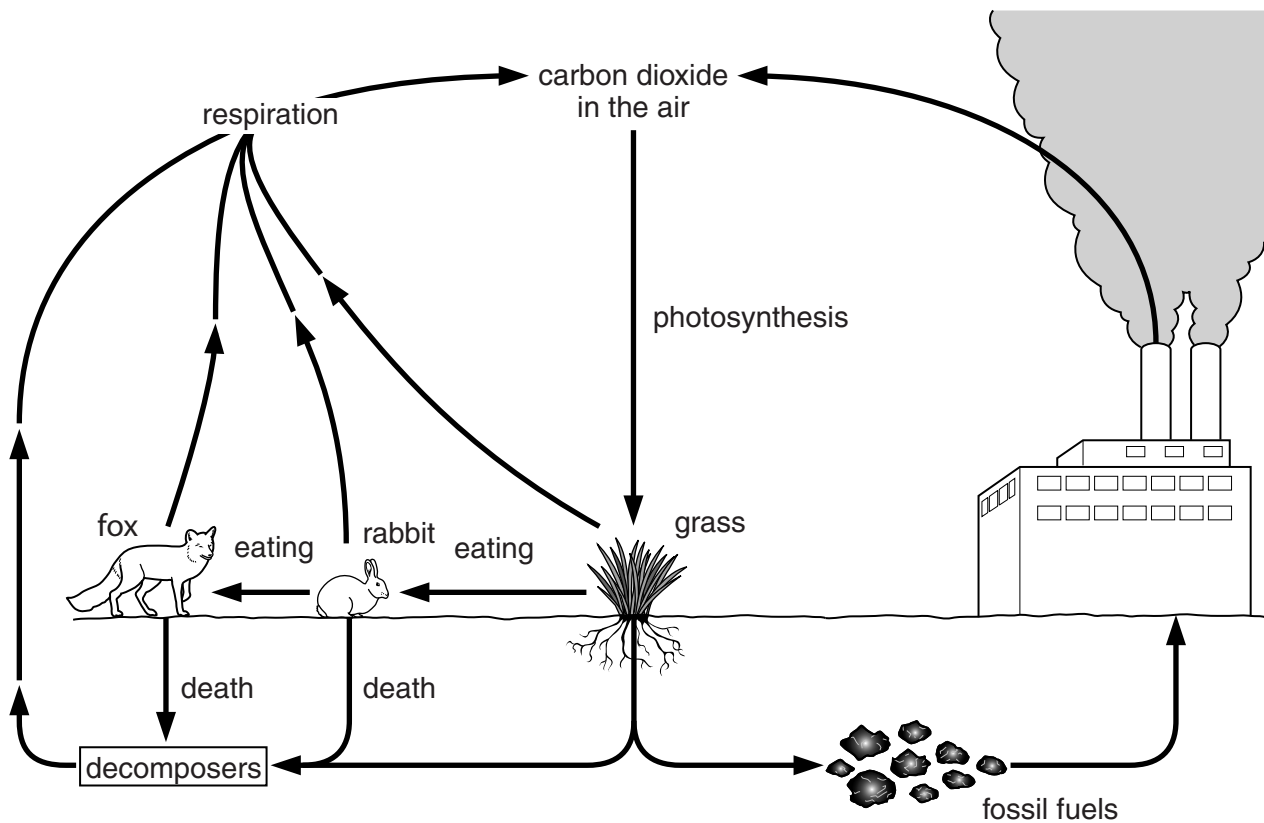
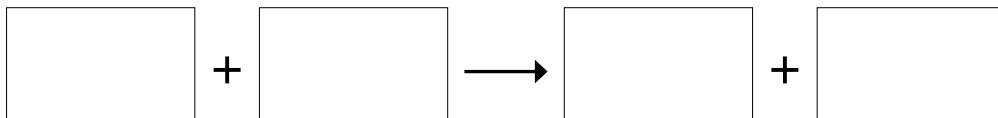


Fig. 7.1

(i) Describe the importance of respiration in the carbon cycle.

.....
[1]

(ii) Give the word equation for respiration.



[2]

(iii) In Fig. 7.1 find a food chain containing three organisms and write the food chain in the space below.

[2]

- (iv) Decomposers are organisms found in the soil. Suggest the role of the decomposers in the carbon cycle shown in Fig. 7.1.

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

- (b) (i) With reference to Fig. 7.1 explain why the amount of carbon dioxide in the air is increased by

coal-fired factories,

.....
.....

the removal of large amounts of grass.

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

- (ii) Describe how increased carbon dioxide levels could affect the environment.

.....
.....[1]

- 8 (a) Complete the sentences below using words from this list:

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

drops boils energy evaporates
infra-red molecules ultraviolet

The Earth is warmed by radiation from the Sun.

After it has rained, the Sun's heat water on the ground,

and the ground dries as water escape from the water

surface. [3]

- (b) Fig. 8.1 shows a thermometer containing mercury which is taken from a dark room into bright sunlight.

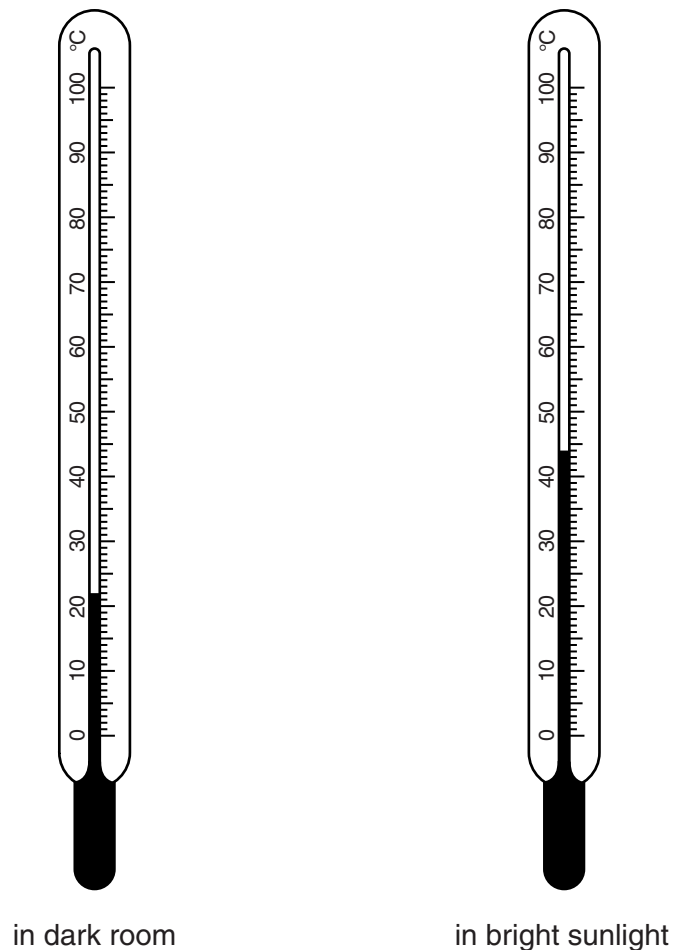


Fig. 8.1

Explain, in terms of particles, why the level of mercury in the thermometer goes up.

.....

 [2]

- (c) The Sun emits many different frequencies of electromagnetic radiation including visible light, infra-red, ultra-violet and X-rays.

Complete Table 8.1 to show the types of electromagnetic radiation emitted by the Sun.

Table 8.1

highest frequency					lowest frequency	
gamma radiation					microwaves	radio waves

[3]

- (d) The Sun produces sound waves as well as electromagnetic radiation.

Explain why we cannot hear any sound from the Sun.

.....

.....

.....[2]

- 9 A student performs an experiment to extract copper by heating copper oxide on a carbon block.

Fig. 9.1 shows the apparatus he uses.

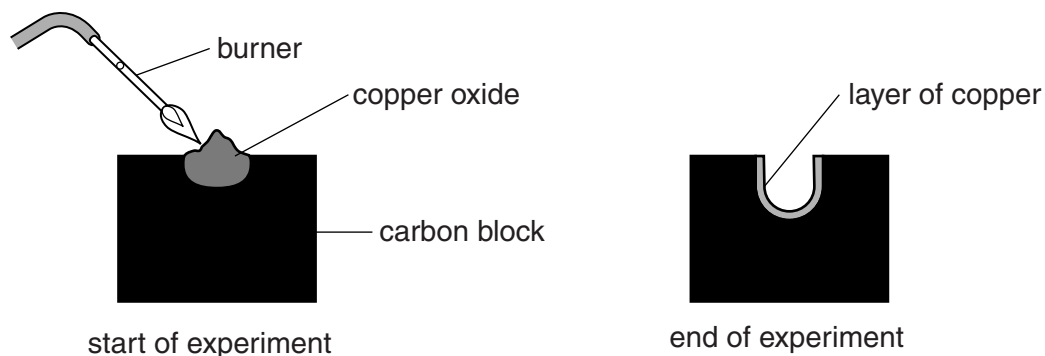
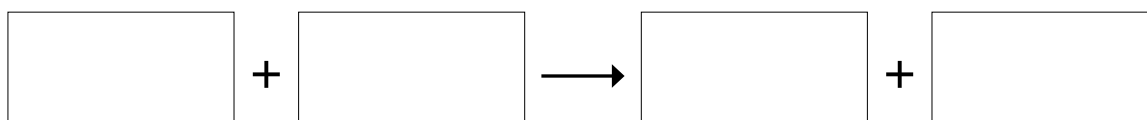


Fig. 9.1

- (a) The copper oxide reacts with the carbon.

(i) Write a chemical **word** equation for the reaction between copper oxide and carbon.



[2]

(ii) Explain why this reaction is an example of a redox reaction.

.....

.....

.....[2]

- (b) After the experiment the student tries to remove the copper from the block. He pours dilute hydrochloric acid into the hole in the block.

Predict whether or not the hydrochloric acid will remove the copper. Explain your answer by referring to the reactivity series.

.....

.....

.....[2]

- (c) Impurities in the copper oxide can produce sulfur dioxide gas when it is heated. Sulfur dioxide forms a strongly acidic solution when it dissolves in water.

Describe how the environment is damaged by sulfur dioxide gas.

.....

.....

.....

.....[3]

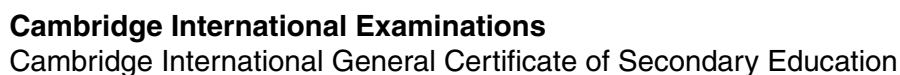
DATA SHEET

Group																		
I	II											III	IV	V	VI	VII	O	
		1 H Hydrogen 1																
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18	
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 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54	
133 Cs Caesium 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	209 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86	
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89																
* 58–71 Lanthanoid series † 90–103 Actinoid series																		
</																		

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

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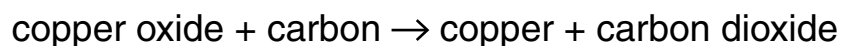
At the end of the examination, fasten all your work securely together.

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

This document consists of **19** printed pages and **1** blank page.

- 1 (a) Copper metal can be extracted from copper oxide by heating it with carbon.

The word equation for this reaction is shown below.



Explain why this reaction could be described as a redox reaction.

.....
[2]

- (b) Lead can be extracted from lead bromide by electrolysis.

Stage 1. Lead bromide crystals are melted.

Stage 2. The molten lead bromide is electrolysed.

Fig. 1.1 shows the apparatus that could be used for the electrolysis of molten lead bromide.

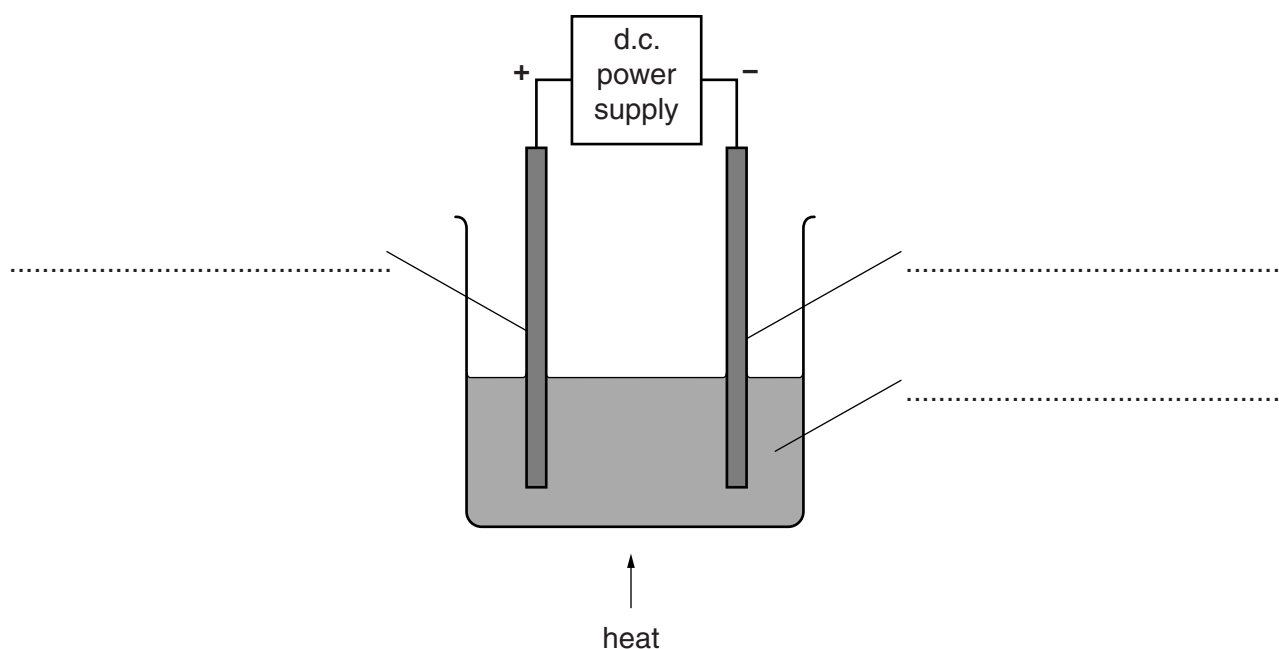


Fig. 1.1

- (i) Use the following terms to complete the labelling of the diagram in Fig. 1.1.

anode

cathode

electrolyte

[2]

- (ii) Name and describe the appearance of the products that appear at or near

the **positive** electrode, ...

.....

the **negative** electrode.

.....[3]

- 2 Fig. 2.1 shows a special bicycle used to break the world speed record for a human-powered bicycle.

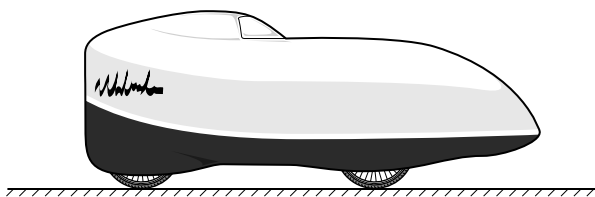


Fig. 2.1

On one run along a measured distance of 200 m, the rider's speed is 40 m/s.

- (a) (i) Calculate the time taken by the rider over the measured distance of 200 m.

State the formula you use and show your working.

formula

working

time = ... s [2]

- (ii) Calculate the rider's speed in kilometres per hour (km/h).

Show your working.

speed = ... km/h [2]

- (b) After pedalling at constant speed for 200 m, the rider uses the brakes to stop the bicycle over the next 300 m.

On the axes below, sketch the shape of the speed/time graph for this motion.



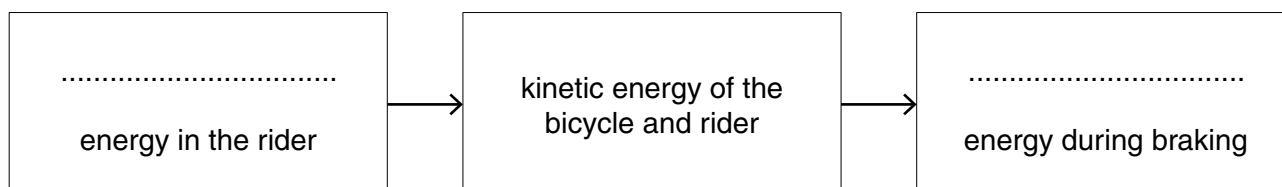
[2]

- (c) While moving at a constant speed of 40 m/s, the bicycle is moved forward by a constant force of 400 N against the opposing forces.

- (i) State the magnitude of the opposing forces. Give a reason for your answer.

.....
[1]

- (ii) Complete the sequence of energy transfers that occurs during the run.



[2]

- 3 (a) Fig. 3.1 shows the human gas exchange system.

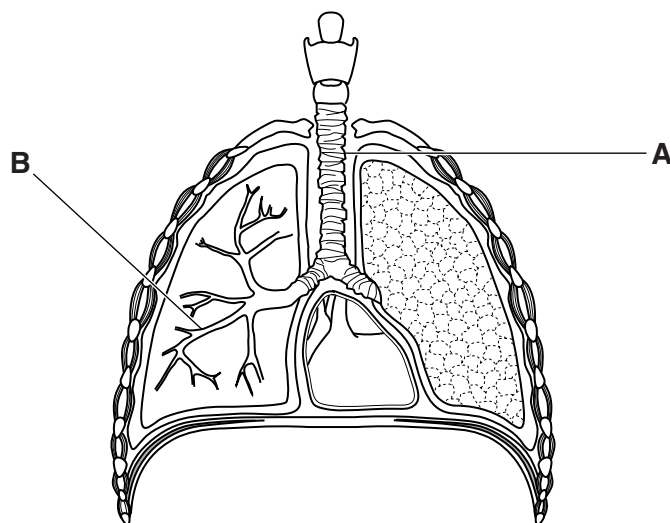


Fig. 3.1

Name structures **A** and **B**.

A

B [2]

- (b) A student investigates his breathing before and after exercise. He measures the number of breaths taken during one minute. He also measures the average volume of one breath during this minute.

His results are shown in Table 3.1.

Table 3.1

	number of breaths per minute	average volume of one breath / dm ³
at rest	20	0.5
immediately after exercise	35	1.6

Describe **two** ways in which the breathing of the athlete changes with exercise.

1.....

.....

2

.....[2]

- (c) The student uses the apparatus in Fig. 3.2 to compare inhaled and exhaled air. The inhaled air passes through the limewater in flask **P**. The exhaled air passes through the limewater in flask **Q**. The limewater changes to a milky colour when enough carbon dioxide passes through it.

The student breathes in and out of the apparatus until the limewater goes milky in one of the flasks. He times how long this takes.

The experiment is done twice, once before exercise and once after exercise.

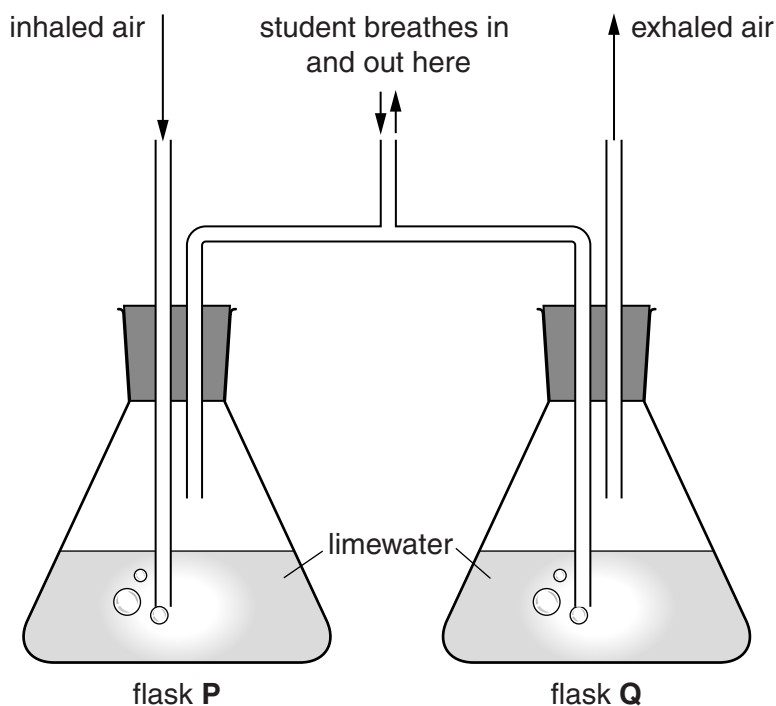


Fig. 3.2

Table 3.2 shows the results obtained.

Table 3.2

	observation of limewater in flask P	time taken for limewater to change in flask Q /s
before exercise	no change	20
immediately after exercise	no change	4

- (i) Use the information in Table 3.2 to compare the carbon dioxide content of inhaled and exhaled air.

.....
[1]

- (ii) Study the times taken for the limewater to turn milky in Table 3.2 before and after exercise.

Draw a conclusion from these results.

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

- (iii) Suggest why there is no change observed in flask **P**.

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

- 4 Fig. 4.1 shows the circuit symbols for an electric bell and a push-switch.



Fig. 4.1

- (a) (i) Complete the circuit diagram in Fig. 4.2 for a circuit for a door-bell with a push-switch, powered by a battery with four cells, for the front door of a house.

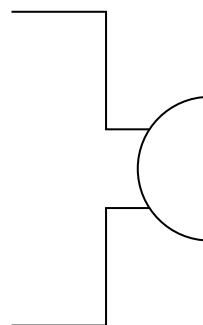


Fig. 4.2

[2]

- (ii) Add a voltmeter to the completed circuit diagram in Fig. 4.2 to measure the voltage across the battery. [1]
- (b) The ringing bell emits a sound of frequency 400 Hz.

- (i) State the meaning of the term *frequency*.

.....
[1]

- (ii) The house owner makes the sound of the bell louder by adding another cell to the battery, but the pitch of the sound from the bell remains unchanged.

State the effect this change has on the amplitude and frequency of the sound emitted.

effect on the amplitude

 effect on the frequency
[2]

- (c) (i) The voltage provided by the battery is 6V. When the bell is rung, a current of 2A flows through the bell.

Use the formula

$$R = \frac{V}{I}$$

to calculate the resistance of the bell.

Show your working and state the unit of your answer.

working

resistance = ... unit [2]

- (ii) The house owner adds a second identical bell in the circuit in parallel to the first bell. When the switch is pushed, both bells ring.

Suggest the effect the second bell will have on the current taken from the battery when the bells are rung. Give a reason for your answer.

.....

[2]

- 5 (a) An atom of carbon has a proton (atomic) number 6 and nucleon (mass) number 12.

(i) Complete Table 5.1 to show the structure of this carbon atom.

Table 5.1

	in nucleus	outside nucleus
number of protons		
number of neutrons		
number of electrons		

[2]

(ii) Explain why a carbon atom is electrically neutral.

.....

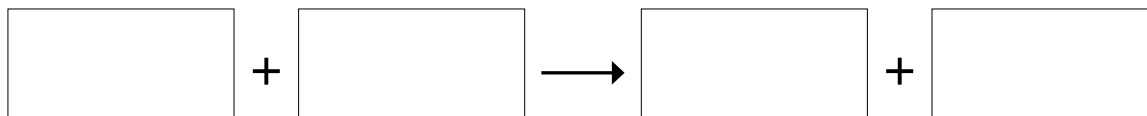
[2]

- (b) Methane is a carbon compound which is used as a fuel.

(i) Suggest a source of methane.

.....[1]

(ii) Write a **word** equation for the complete combustion of methane.



[2]

- (c) Fig. 5.1 shows the structure of a molecule of methane.

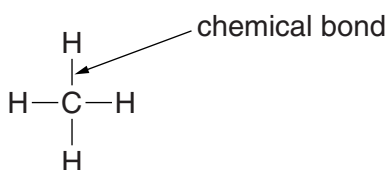


Fig. 5.1

(i) State the chemical formula of methane.

.....[1]

(ii) Name the type of chemical bond present in a methane molecule.

.....[1]

(iii) State the number of electrons found in the chemical bond shown in Fig. 5.1.

.....[1]

- 6 Fig. 6.1 shows a method that uses solar energy to purify drinking water. The method is used in hot desert countries.

The impure water is heated by the sun and distilled. The pure water is collected separately, while the impurities are left behind.

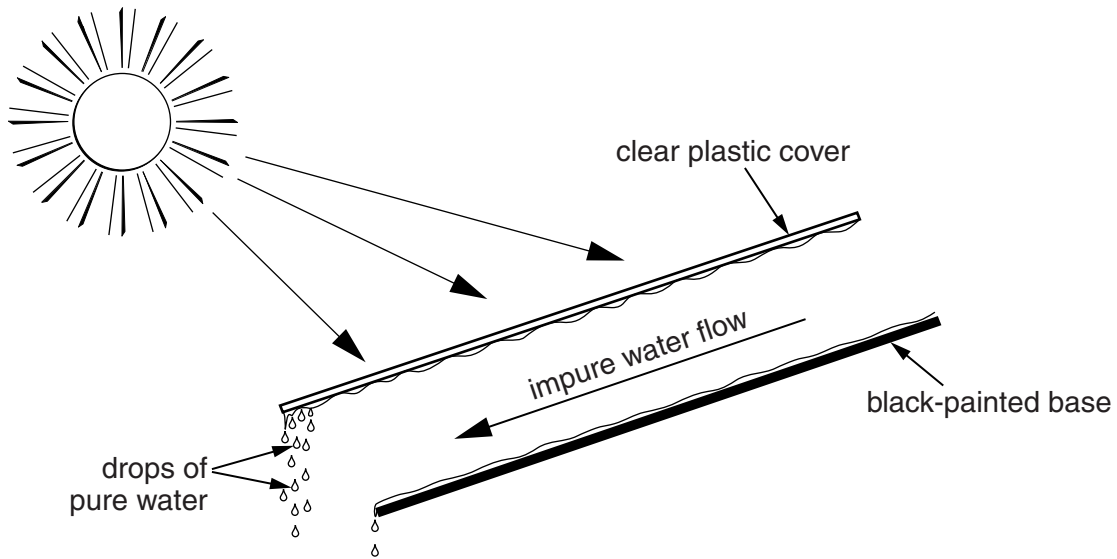


Fig. 6.1

- (a) State the part of the Sun's electromagnetic spectrum that heats the water.

.....[1]

- (b) Solar energy produces water vapour from the impure water.

Explain why water molecules are able to escape more easily from warm water than from cold water.

.....

[2]

- (c) Explain why thermal energy transfer from the Sun only occurs by radiation and not by conduction or convection.

.....
[1]

(d) Fig. 6.2 shows a ray of sunlight about to pass through the plastic cover.

Draw the path of the ray from the point where it enters the plastic to show what happens at the lower face of the plastic. Indicate the angles of incidence and refraction at the upper face.

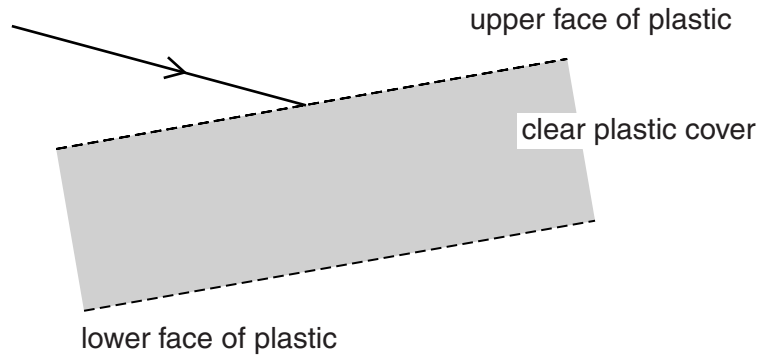


Fig. 6.2

[3]

- 7 (a) Fig. 7.1 shows what happens when a plant is placed near a window where bright light is coming from one side.

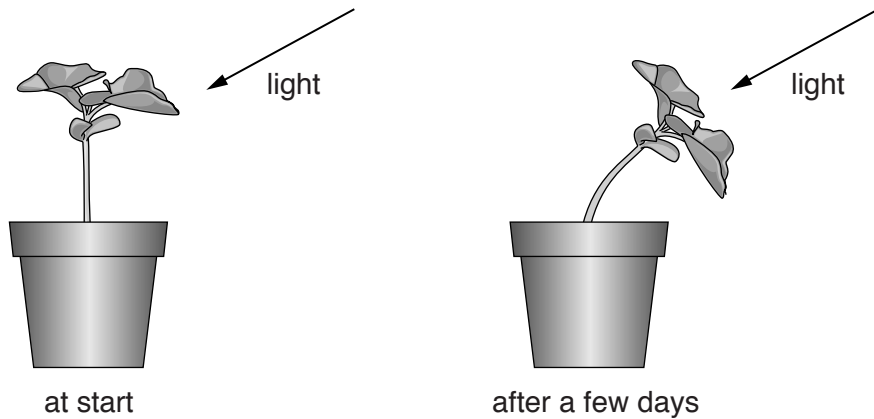


Fig. 7.1

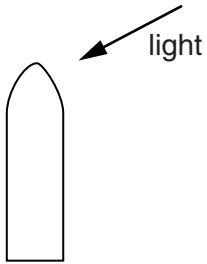
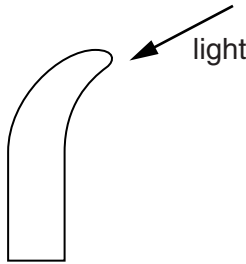
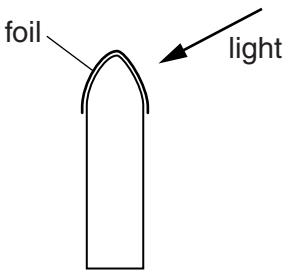
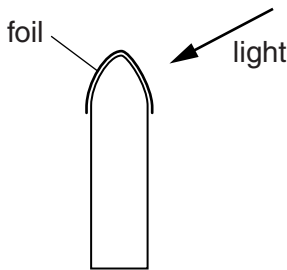
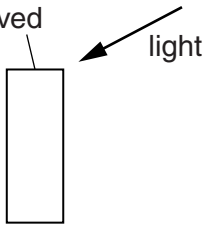
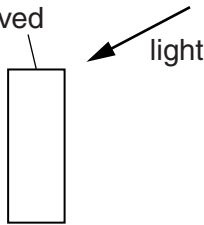
- (i) Name the response shown by the plant.
[1]
- (ii) Explain why the response shown in Fig. 7.1 is an advantage to the plant.

[2]
- (iii) Using the information in Fig. 7.1 name **two** characteristics of living things shown by this plant.
 1
 2[2]

- (b) A student carries out an experiment to find out more about plant responses. He uses simple shoots and light coming from one side.

The results are shown in Table 7.2.

Table 7.2

at the start	after a few days
 shoot X	 shoot X
 shoot Y	 shoot Y
 shoot Z	 shoot Z

- (i) Describe the results shown in Table 7.2.

.....

[2]

- (ii) Suggest a possible conclusion about the control of plant responses in the shoots.

Explain your answer.

.....

[2]

- (c) Animals are able to respond to situations by secreting the hormone adrenaline.

Adrenaline is secreted into the blood when an athlete starts to run a race.

Suggest how this helps the athlete to run fast.

.....

.....

.....[2]

8 Some sulfur has become contaminated with a small amount of aluminium powder.

(a) A liquid is added to the mixture which dissolves the sulfur.

Fig. 8.1 shows how sulfur is separated from the mixture of aluminium and sulfur.

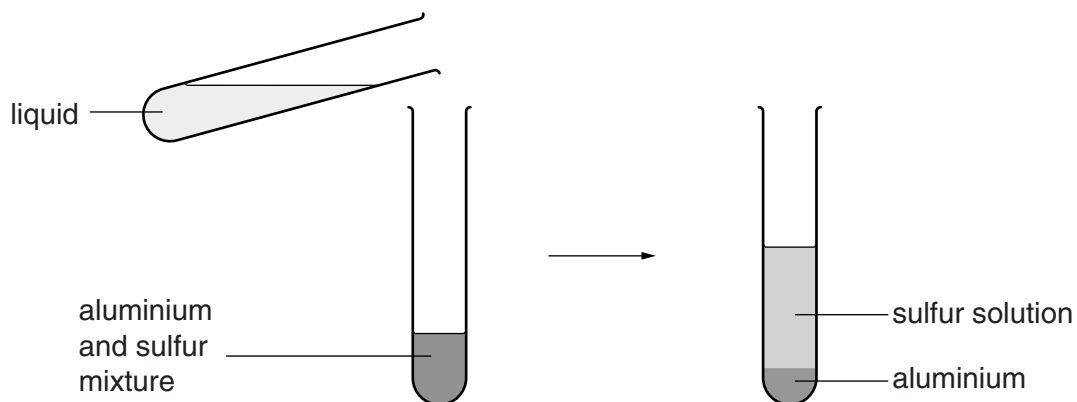


Fig. 8.1

Suggest how the processes of filtration and crystallisation could be used to obtain pure sulfur from the sulfur solution and aluminium.

You should draw diagrams to show your arrangement of apparatus.

.....
.....
.....
.....[3]

- (b) Aluminium sulfide is a *compound* made by heating a *mixture* of aluminium and sulfur. Aluminium sulfide is a compound of the *elements* aluminium and sulfur.

The left hand column in Fig. 8.2 gives four descriptions of materials.
The right hand column shows three different types of materials.

Draw a line from each description on the left hand side to the correct material on the right.

cannot be broken down into simpler substances		
contains different atoms chemically bonded together	compound	
contains more than one type of atom which are not bonded together	element	
contains one type of atom	mixture	

Fig. 8.2

[4]

- (c) (i) When aluminium and sulfur atoms react together, positive aluminium ions and negative sulfide ions are formed.

Describe, in terms of electrons, how these ions are formed from atoms.

.....

[2]

- (ii) Aluminium sulfide consists of two aluminium ions to every three sulfide ions.

State the chemical formula of aluminium sulfide.

.....[1]

9 Fig. 9.1 shows the reproductive system of a female.

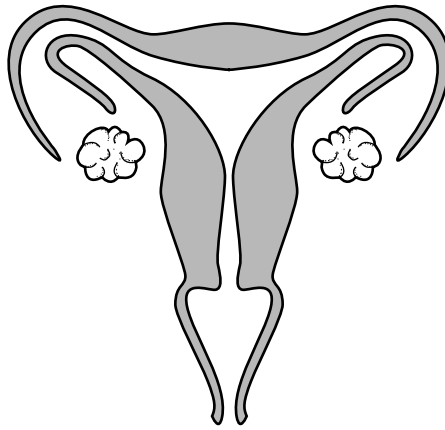


Fig. 9.1

- (a) (i) On Fig. 9.1 use label lines to label the cervix and the vagina. [2]
- (ii) On Fig. 9.1 use a label line and the letter **H** to show where haploid cells are found. [1]
- (b) (i) State the area where fertilisation occurs.
[1]
- (ii) The fertilised egg cell (the zygote) divides to form a ball of cells.
 Describe where this ball of cells settles (implants) to continue development into a baby.

[2]
- (c) One way in which the human immunodeficiency virus (HIV) can be transmitted is through sexual intercourse.
 State one other way in which HIV can be transmitted.

[1]

DATA SHEET
The Periodic Table of the Elements

Group																																				
I	II											III	IV	V	VI	VII	0																			
		1 H Hydrogen 1																4 He Helium 2																		
7 Li Lithium 3	9 Be Beryllium 4																11 B Boron 5		12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10													
23 Na Sodium 11	24 Mg Magnesium 12																27 Al Aluminium 13					28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18										
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	127 I Iodine 53	128 Te Tellurium 52	122 Sb Antimony 51	119 Sn Tin 50	115 In Indium 49	112 Cd Cadmium 48	108 Ag Silver 47	106 Pd Palladium 46	103 Rh Rhodium 45	101 Ru Ruthenium 44	101 Rh Rhodium 45	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 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	209 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86																			
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89																																		
* 58–71 Lanthanoid series † 90–103 Actinoid series													140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71										
Key													a	X	a = relative atomic mass X = atomic symbol b = atomic (proton) number										260 Lr Lawrencium 103											

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

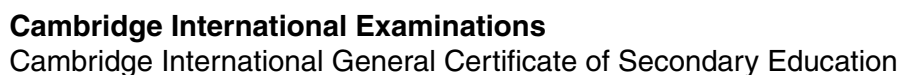
Key

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

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

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0653/23

October/November 2014

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 soft 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 **23** printed pages and **1** blank page.

1 A student performs some experiments to find out what makes iron rust.

(a) Fig. 1.1 shows his first experiment.

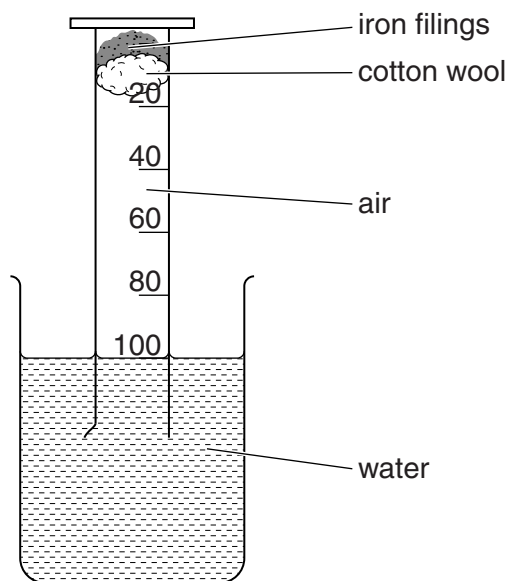


Fig. 1.1

The student makes sure that the water levels inside and outside the measuring cylinder are in line with the 100 cm³ mark.

Fig. 1.2 shows the apparatus after a few days.

The iron has rusted and the water has started to rise up the cylinder.

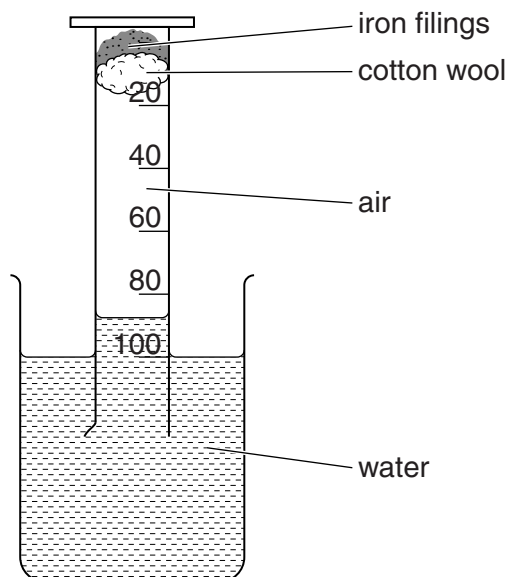


Fig. 1.2

- (i) One of the compounds present in rust is iron oxide.

In this compound there are two iron atoms for every three oxygen atoms.

State the chemical formula of iron oxide.

..... [1]

- (ii) Explain why the water has risen up the cylinder.

.....
 [1]

- (iii) After a week, the water stops rising although some of the iron has not rusted.

Predict the mark the water finally reaches.

..... [1]

- (iv) Name the main element in the gas remaining in the measuring cylinder after one week.

..... [1]

- (b) Fig. 1.3 shows the first experiment repeated with the beaker containing oil instead of water.

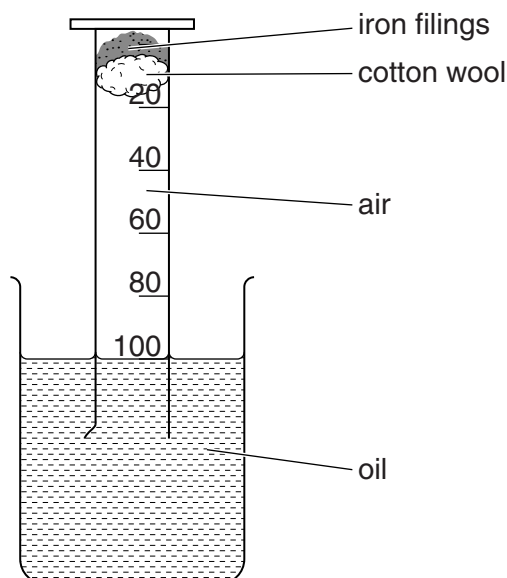


Fig. 1.3

State what happens in this version of the experiment.

.....

Explain your answer.

.....

..... [2]

(c) Describe and explain **one** method that is used to prevent an iron object from rusting.

.....

.....

.....[2]

- 2 (a) Fig. 2.1 shows a man paddling a canoe up a river.

The man is paddling gently, but the canoe remains stationary alongside the river bank.

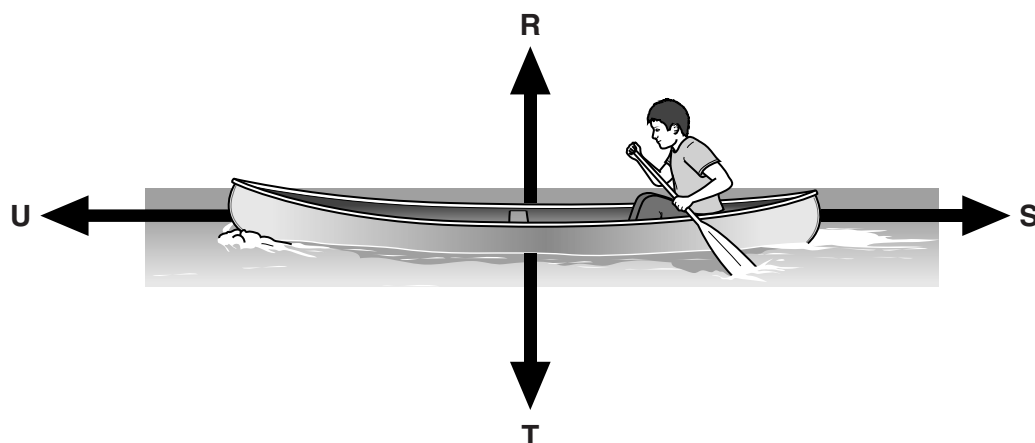


Fig. 2.1

- (i) State which force from **R**, **S**, **T** and **U** is

the weight of the canoe and the man, ...

the force propelling the canoe forward, ...

the force due to the water current.

[2]

- (ii) Explain, in terms of balanced forces, why the canoe remains stationary alongside the river bank.

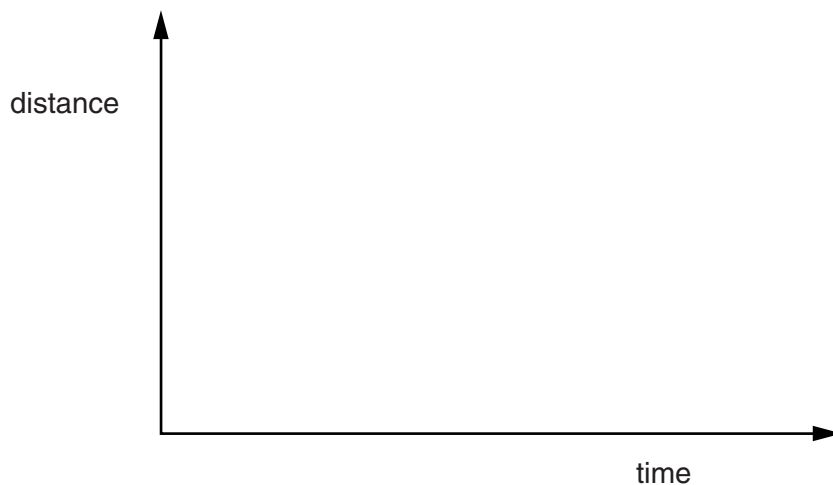
.....

.....

.....[2]

- (b) The man now paddles the canoe steadily so that it moves along the river at a constant speed.

On the axes below, sketch a distance/time graph for the canoe as it moves along the river.



[1]

- (c) (i) State the form of stored energy in the man that is transferred from him as he paddles the canoe.

.....[1]

- (ii) State the useful form of energy gained by the canoe as a result of this transfer.

.....[1]

- (iii) Identify **one** form of energy that is **not** useful that is transferred from the man paddling the canoe.

.....[1]

- (d) The man now paddles the canoe at a steady speed of 2 m/s.

Calculate the time in seconds taken by the canoe to travel 2400 m.

State the formula you use and show your working.

formula

working

time = ... s [2]

- 3 (a) Fig. 3.1 shows one undecayed human tooth and one with decay.

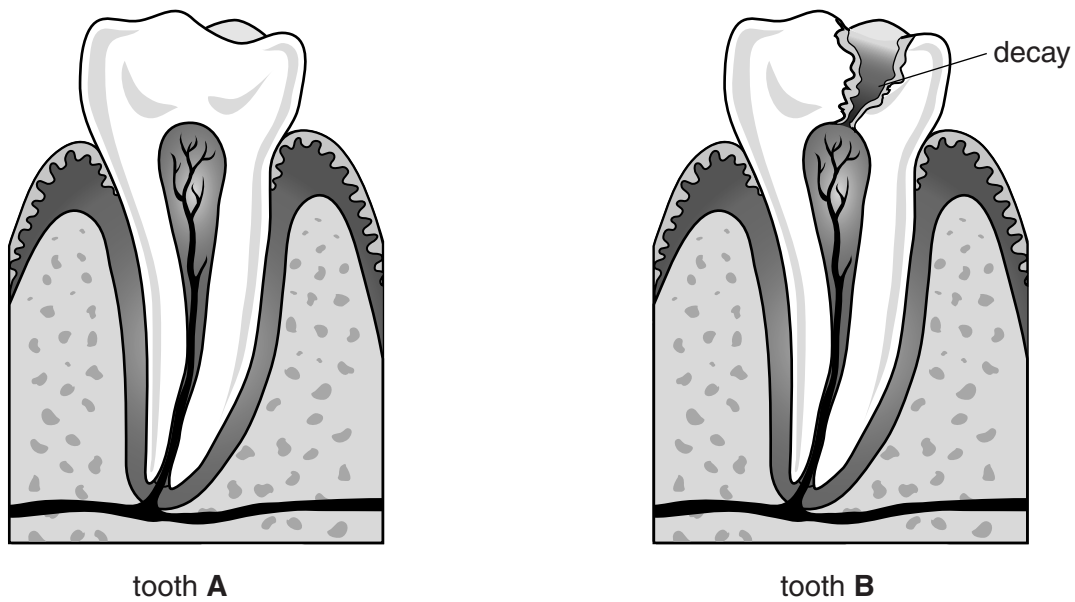


Fig. 3.1

State which type of tooth is shown in both diagrams in Fig. 3.1.

.....

[1]

- (b) Tooth **B** shows tooth decay.

- (i) Suggest why the person had toothache.

.....

.....[1]

- (ii) Explain fully how eating sugary foods can cause tooth decay.

.....

.....

.....

.....

.....[3]

- (c) When babies start to eat solid food they do not have enough teeth to chew their food.

Explain why it is important that the food should be broken down for them into very small pieces.

.....

.....

.....

.....[2]

- (d) In the mouth, the process of chemical digestion starts.

Explain what is meant by the term *chemical digestion*.

.....

.....

.....

.....[3]

- (e) Protease (protein-digesting enzyme) digests protein in the acidic environment of the stomach.

Predict whether this protease will continue to digest proteins in the alkaline environment of the small intestine.

Explain your answer.

.....

.....

.....[2]

- 4 Fig. 4.1 shows an electric hairdryer that uses mains electricity.



Fig. 4.1

A heater inside the hairdryer warms the air. A fan blows the warm air out of the hairdryer.

- (a) The hairdryer contains a switch, a heater to warm the air and an electric motor to drive the fan. The heater and the motor are connected in parallel.

Fig. 4.2 shows the circuit symbols for a switch, a heater and an electric motor.

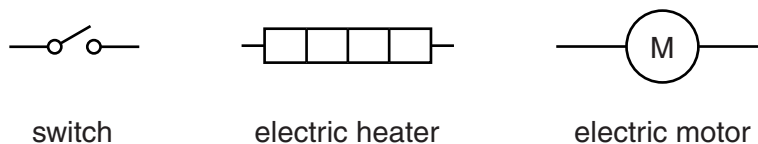


Fig. 4.2

On Fig. 4.3 use the symbols in Fig. 4.2 to complete the circuit diagram for the hairdryer connected to the mains electricity supply. The mains electricity supply has been drawn for you.

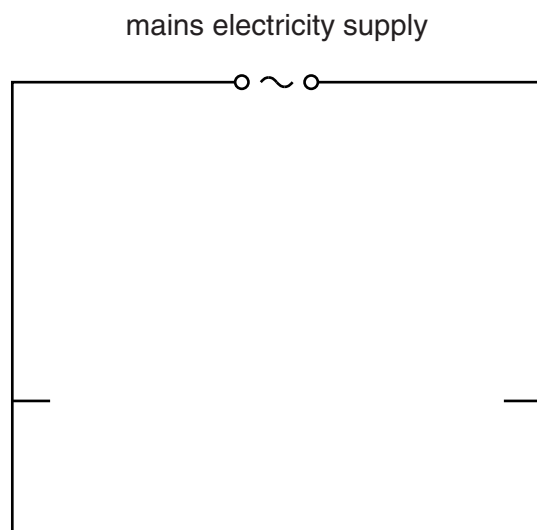


Fig. 4.3

[2]

- (b) The flow of warm air dries the wet hair by evaporation.

Explain, in terms of molecules, why using warm air helps to dry wet hair.

.....

.....

.....[2]

- (c) When air is heated, it rises.

State the name of the process by which heated air rises.

.....[1]

- (d) Fig. 4.4 shows information on a label fixed to the hairdryer.

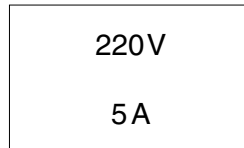


Fig. 4.4

- (i) State the name of the unit whose symbol is V.

.....[1]

- (ii) Use the formula

$$R = \frac{V}{I}$$

to find the combined resistance of the circuit components in the hairdryer when in use.

Show your working and state the unit of your answer.

resistance = ... unit = ... [2]

- (e) The plug on the mains lead of the hairdryer is fitted with a fuse. One day, the fuse blows while the hairdryer is being used.

- (i) Give **one** possible cause for the fuse blowing.

.....
[1]

- (ii) The fuse has to be replaced.

The current through the hairdryer when in use is 5 A. Several new fuses with different current ratings are available, as shown in this list:

2 A 5 A 10 A 15 A

Explain which of these four fuses should be used.

Fuse should be used because

[2]

- 5 (a) A student investigates the effect of gravity on the growth of a seedling.

The student germinates a seed. When the radicle is clearly visible, he pins the seedling to a board, as shown in Fig. 5.1 (a). He positions the board so that the radical is horizontal.

The radicle continues to grow and curves downwards, as shown in Fig. 5.1 (b).

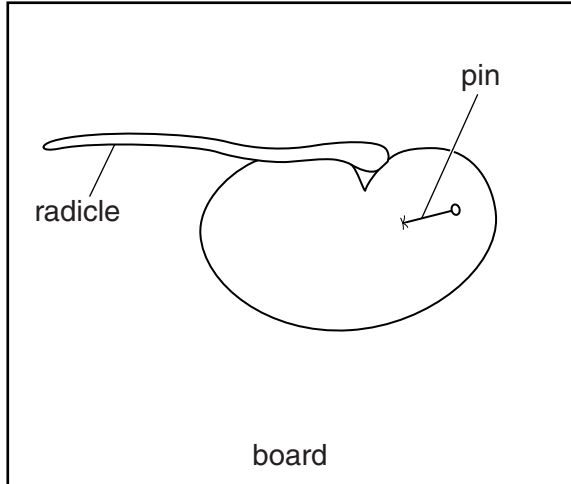


Fig. 5.1 (a)

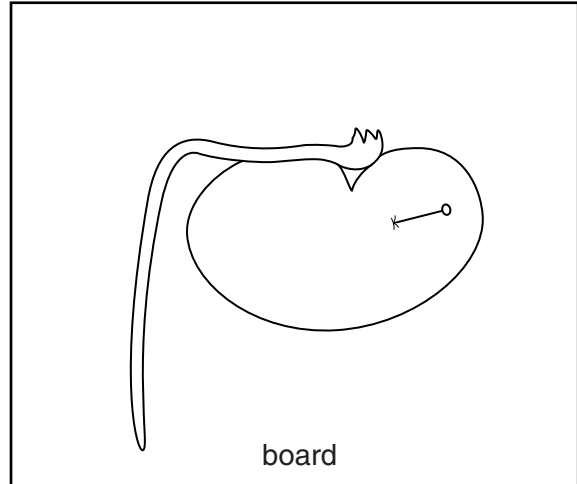


Fig. 5.1 (b)

- (i) Name the growth response shown by the seedling.

.....

[1]

- (ii) Explain how this growth response is an advantage to the seedling.

.....

.....

.....[2]

- (iii) In a second experiment the seedling is pinned on the board in a different position, as shown in Fig. 5.2(a).

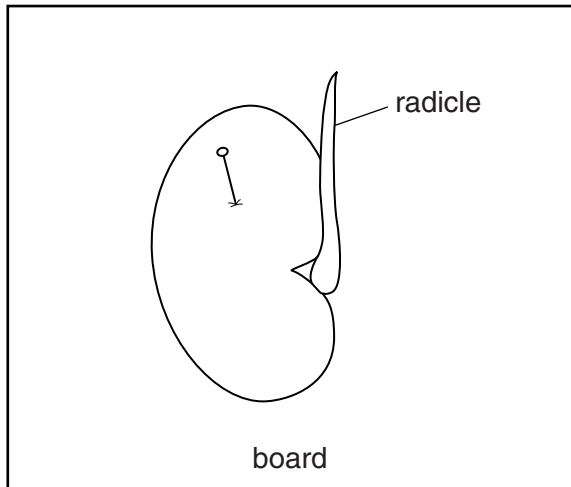


Fig. 5.2(a)

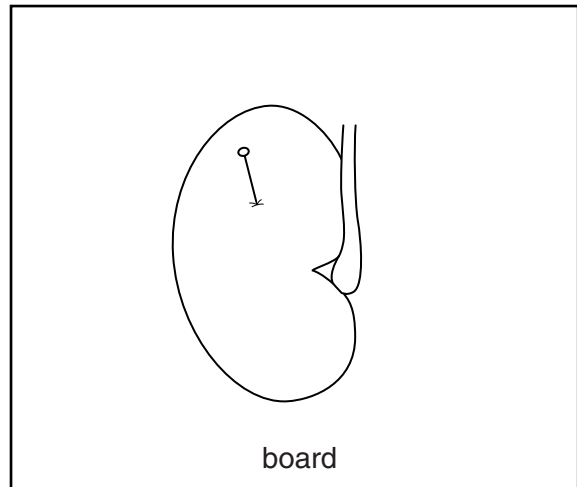


Fig. 5.2(b)

Complete Fig. 5.2(b) to show the appearance of the radicle after a few days.

[1]

- (b) Fig. 5.3 shows a strawberry plant. The strawberry plant can reproduce both asexually and sexually.

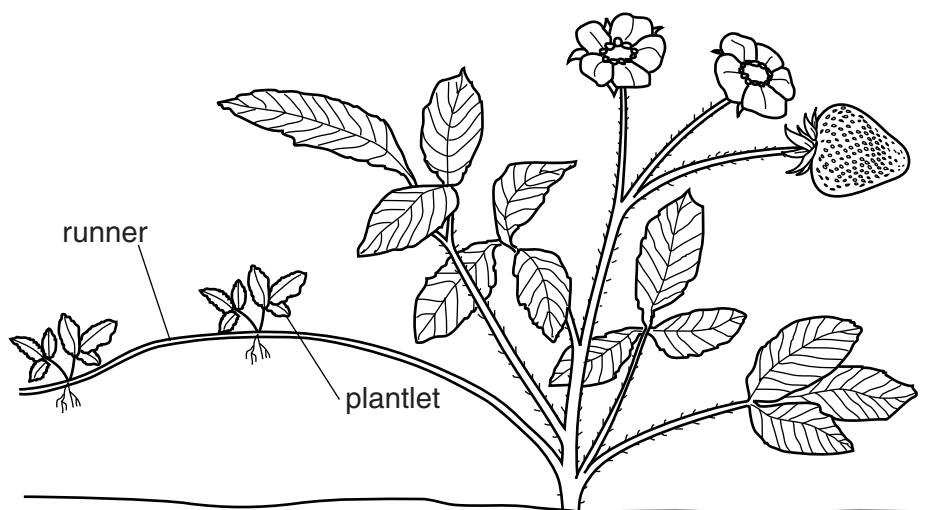


Fig. 5.3

The strawberry plant produces runners with plantlets. The runners are stems produced by the parent plant. If the roots of a plantlet come into contact with damp soil, the plantlet can grow into a new independent plant.

- (i) Use the information provided to explain why reproduction with runners is asexual.

.....
[1]

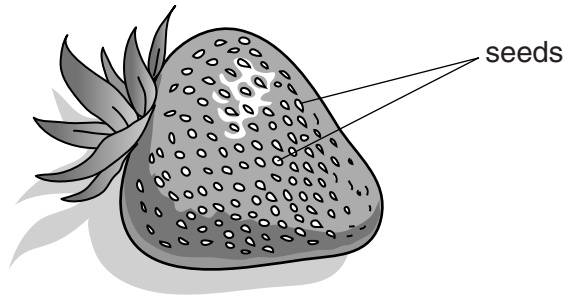


Fig. 5.4

Fig. 5.4 shows a strawberry produced by the plant after one of the flowers is pollinated. The seeds on the strawberry will produce new plants when they are germinated.

- (ii) Explain why this method of reproduction is sexual.

.....
[1]

- (iii) Describe and explain how a group of plants grown from runners will be different from a group of plants produced when seeds germinate.

.....

[2]

- 6 (a) Dilute hydrochloric acid reacts with zinc to produce a colourless gas.

Describe a test to show that the gas is hydrogen.

test

result [2]

- (b) Fig. 6.1 shows the apparatus a student uses to investigate the effect of changing the temperature of acid on the rate of reaction with zinc.

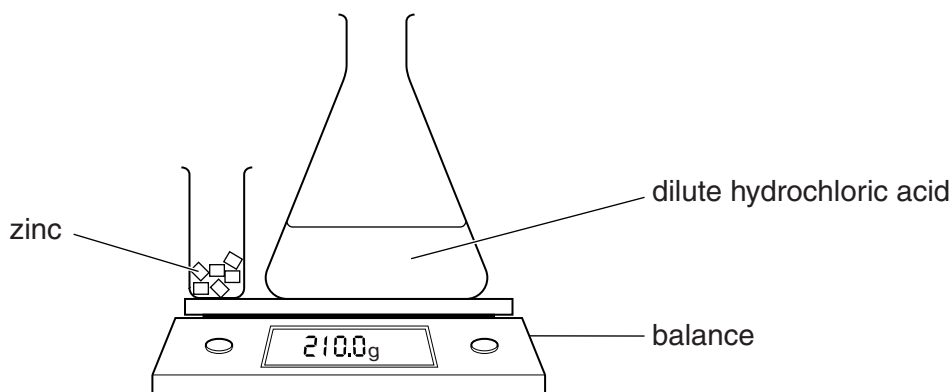


Fig. 6.1

At the start of the experiment, the student adds the zinc to acid at a temperature of 20°C.

- (i) The student expects the balance reading to decrease while zinc reacts with the acid.

Suggest the measurements the student makes to find the rate of reaction.

.....

 [2]

- (ii) Suggest what he should do to find the effect of temperature on the rate of reaction.

.....
 [1]

- (iii) Describe the expected effect of temperature on the rate of reaction.

.....
 [1]

(c) The student investigates what happens if he uses copper in place of zinc in the apparatus in Fig. 6.1.

(i) Name the part of the Periodic Table in which copper is found.

.....[1]

(ii) Describe and explain what he observes.

.....

.....

.....[2]

- 7 Astronomers use telescopes to study the electromagnetic radiation that reaches the Earth from the stars.

- (a) (i) Complete the sentences below using words from the list. You may use each term once, more than once or not at all.

radio waves sound waves ultra-violet visible light water waves

People can see stars with their eyes because the stars emit

Astronomers need special telescopes to see other types of electromagnetic radiation from stars. Examples of such types of radiation are and

[2]

- (ii) We are able to see the Moon, even though the Moon itself does not emit electromagnetic radiation.

State a characteristic behaviour of electromagnetic radiation that enables us to see the Moon.

.....[1]

- (b) Some stars emit electromagnetic radiation with a very high frequency, such as X-rays.

- (i) State the meaning of the term *frequency*.

.....

.....[1]

- (ii) Fig. 7.1 shows an incomplete diagram of the electromagnetic spectrum.

gamma radiation					microwaves	
-----------------	--	--	--	--	------------	--

Fig. 7.1

Mark with an **X** on Fig. 7.1 the part of the spectrum where X-rays are situated. [1]

- (c) Increasing the amplitude of sound waves makes sound louder.

Suggest what effect will be seen when the amplitude of light waves is increased.

.....

.....[1]

Question 8 begins on page 20

- 8 (a) *Diffusion* is the net movement of molecules from a region of higher concentration to a region of lower concentration. It is how some substances enter and leave cells.

A student carries out an experiment to study diffusion. He uses gelatine cubes of different sizes which represent differently-sized cells. See Fig. 8.1.

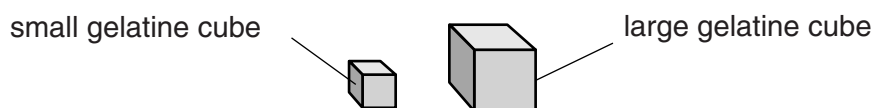


Fig. 8.1

The student immerses the cubes in acid. The gelatine contains a purple indicator that turns colourless when the acid reaches it. See Fig. 8.2.

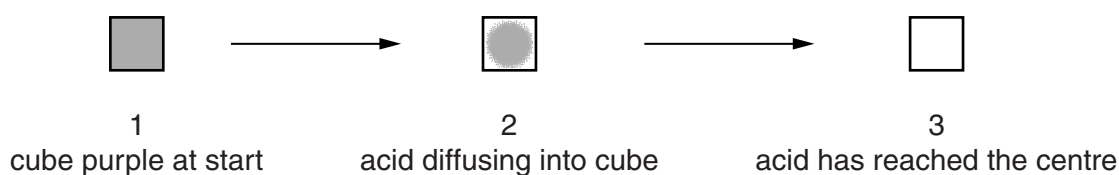


Fig. 8.2

The student measures the time taken for the acid to reach the centre of the cubes.

The results are shown by the graph in Fig. 8.3.

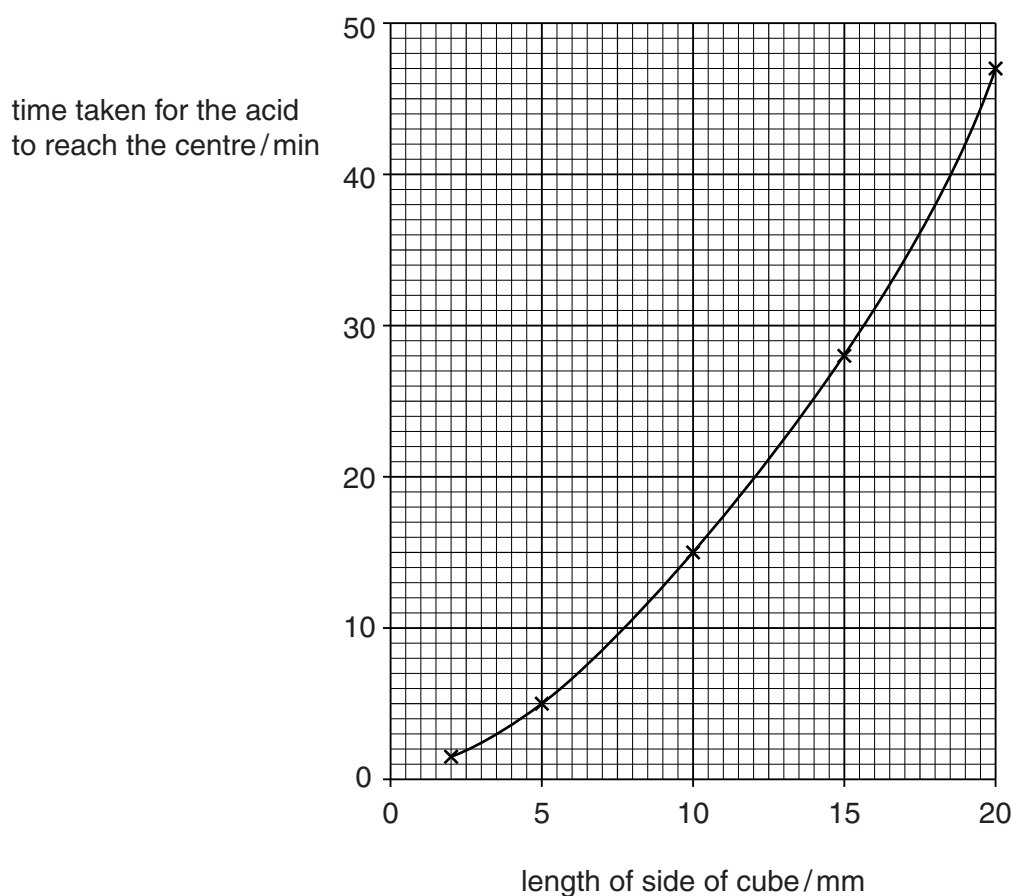


Fig. 8.3

- (i) Describe how the time taken for the acid to reach the centre varies as the size of the cube increases.

.....

[2]

- (ii) From Fig. 8.3 find the time taken for cubes with a length of

6 mm, ...

12 mm.[2]

- (iii) In living cells, oxygen and food substances must diffuse across the cell membrane and reach the centre of the cell.

Use this information to suggest why cells cannot grow to a large size.

.....
[1]

- (b) Fig. 8.4 shows a red blood cell.

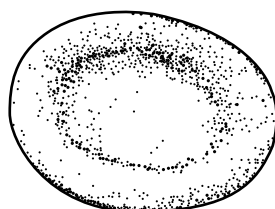


Fig. 8.4

Describe **one** feature of the red blood cell that enables oxygen to get to all parts of the cell quickly.

.....
[1]

- 9 (a) Fig. 9.1 shows the apparatus used to demonstrate the electrolysis of copper chloride solution.

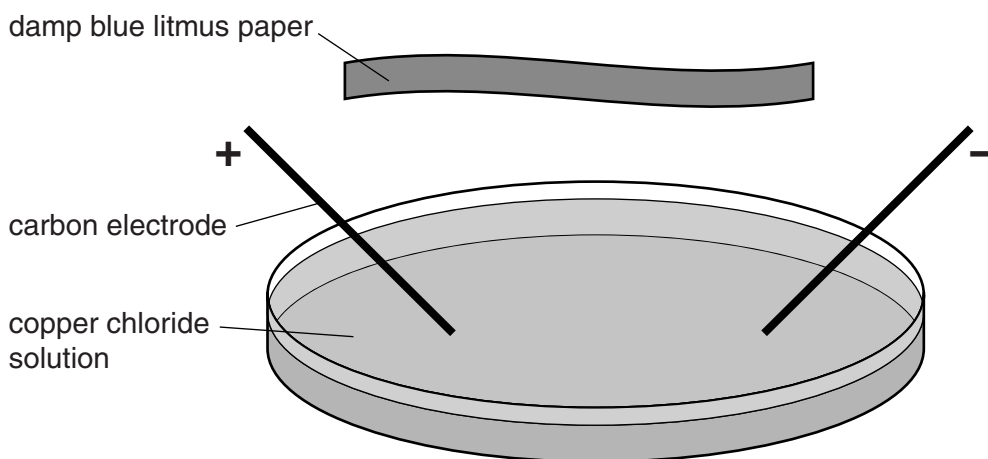


Fig. 9.1

- (i) State the names given to the electrodes.

The **positive** electrode is called the

The **negative** electrode is called the [2]

- (ii) A substance **X** is formed on the negative electrode.

Name and describe the appearance of substance **X**.

name of **X**

description

..... [2]

- (iii) A substance **Y** is formed at the positive electrode.

Name **Y** and describe its effect on the damp blue litmus paper.

name of **Y**

description

..... [2]

- (b) State whether each of the substances involved in the experiment is
 an element **or** a compound **or** a mixture.

Write your answers in Table 9.1.

Table 9.1

substance	element or compound or mixture
copper chloride	
copper chloride solution	
substance X	
substance Y	
water	

[2]

- (c) (i) Explain **one** difference between an element and a compound.

.....

[1]

- (ii) Explain **one** difference between a compound and a mixture.

.....

[1]

DATA SHEET

Group																	
I	II											III	IV	V	VI	VII	O
		1 H Hydrogen 1															
7 Li Lithium	9 Be Beryllium											11 B Boron	12 C Carbon	14 N Nitrogen	16 O Oxygen	19 F Fluorine	20 Ne Neon
3	4											5	6	7	8	9	10
23 Na Sodium	24 Mg Magnesium											27 Al Aluminium	28 Si Silicon	31 P Phosphorus	32 S Sulfur	35.5 Cl Chlorine	40 Ar Argon
11	12											13	14	15	16	17	18
39 K Potassium	40 Ca Calcium	45 Sc Scandium	48 Ti Titanium	51 V Vanadium	52 Cr Chromium	55 Mn Manganese	56 Fe Iron	59 Co Cobalt	59 Ni Nickel	64 Cu Copper	65 Zn Zinc	70 Ga Gallium	73 Ge Germanium	75 As Arsenic	79 Se Selenium	80 Br Bromine	84 Kr Krypton
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
85 Rb Rubidium	88 Sr Strontium	89 Y Yttrium	91 Zr Zirconium	93 Nb Niobium	96 Mo Molybdenum	99 Tc Technetium	101 Ru Ruthenium	103 Rh Rhodium	106 Pd Palladium	108 Ag Silver	112 Cd Cadmium	115 In Indium	119 Sn Tin	122 Sb Antimony	128 Te Tellurium	127 I Iodine	131 Xe Xenon
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
133 Cs Caesium	137 Ba Barium	139 La Lanthanum	178 Hf Hafnium	181 Ta Tantalum	184 W Tungsten	186 Re Rhenium	190 Os Osmium	192 Ir Iridium	195 Pt Platinum	197 Au Gold	201 Hg Mercury	204 Tl Thallium	207 Pb Lead	209 Bi Bismuth	209 Po Polonium	210 At Astatine	222 Rn Radon
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
		223 Fr Francium	226 Ra Radium		227 Ac Actinium												
87	88	89															
* 58–71 Lanthanoid series † 90–103 Actinoid series																	
		140 Ce Cerium	141 Pr Praseodymium	144 Nd Neodymium	147 Pm Promethium	150 Sm Samarium	152 Eu Europium	157 Gd Gadolinium	159 Tb Terbium	162 Dy Dysprosium	165 Ho Holmium	167 Er Erbium	169 Tm Thulium	173 Yb Ytterbium	175 Lu Lutetium		
		58	59	60	61	62	63	64	65	66	67	68	69	70	71		
		232 Th Thorium	231 Pa Protactinium	238 U Uranium	237 Np Neptunium	244 Pu Plutonium	243 Am Americium	247 Cm Curium	247 Bk Berkelium	251 Cf Californium	252 Es Einsteinium	257 Fm Fermium	258 Md Mendelevium	259 No Nobelium	260 Lr Lawrencium		
		90	91	92	93	94	95	96	97	98	99	100	101	102	103		
Key		a	X	b	a = relative atomic mass x = atomic symbol b = atomic (proton) number												

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

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