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0653/21

October/November 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 Fig. 1.1 shows a solar-powered pump used to fill a water trough from a well on a farm. Animals in a field on the farm drink from the trough.

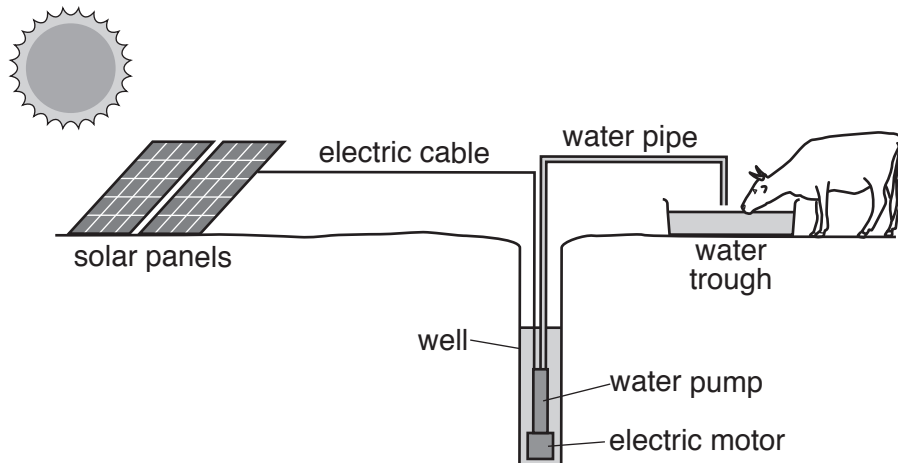


Fig. 1.1

The solar panels use sunlight to generate electricity.

The motor uses the electricity to drive the pump.

The pump moves water from the well to the water trough.

- (a) (i) Complete the sequence of energy transformations that takes place as the water pipe is filled when the pump is switched on.

from energy

to **electrical** energy

to energy

to **potential** energy

[2]

- (ii) The pipe from the pump to the trough is 900 cm long. When the pump starts, it takes 12 s for the water to move from the well to the trough.

Calculate the average speed of the water through the pipe.

State the formula you use and show your working.

formula

working

speed = ... cm/s [2]

- (iii) The area of the cross-section of the pipe is 10 cm^2 .

Use your answer to (ii) to calculate the volume of water in cubic centimetres flowing into the trough in one minute.

State any formula you use and show your working.

formula

working

volume in one minute = ... cm^3 [3]

- (b) The solar panel works well on farms with a lot of sunshine. But farms with less sunshine need a different energy resource to power a water pump in a field.

Suggest a different renewable energy resource the farmer can use to generate the electricity for the pump. Describe how this resource would be used.

.....

 [2]

- 2 (a) Fig. 2.1 shows the structure of an atom of sodium.

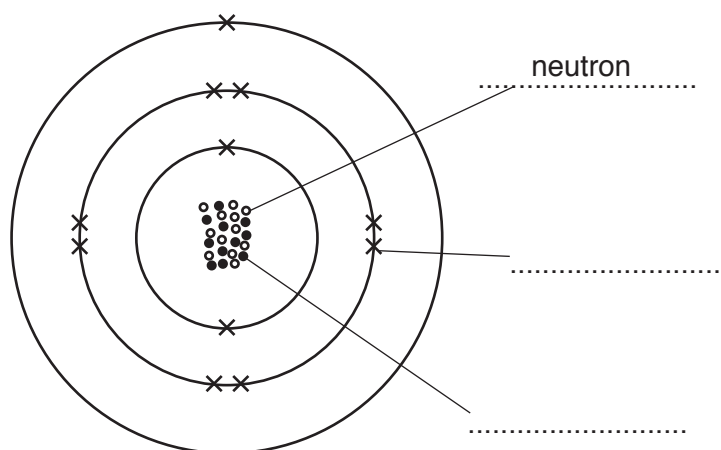


Fig. 2.1

- (i) Complete the labels for the atom of sodium in Fig. 2.1. [2]
- (ii) State the nucleon number for this atom of sodium. [1]

.....

- (b) The word equation for the reaction between sodium and oxygen is



- (i) In this reaction sodium atoms become sodium ions, Na^+ .

Describe, in terms of electrons, how a sodium atom becomes a sodium ion.

.....

.....

.....[2]

- (ii) State the type of chemical reaction in which sodium gains oxygen.

.....[1]

- (iii) In this reaction the temperature of the sodium rises.

State the type of reaction that causes a temperature rise.

.....[1]

- (iv) Sodium oxide contains two sodium ions for each oxide ion.

Deduce the formula of sodium oxide.

.....[1]

(c) In Group I of the Periodic Table, potassium is below sodium.

(i) State the trend in the reactivities of the metals down Group I.

.....[1]

(ii) State the trend in the melting points of the metals down Group I.

.....[1]

- 3 Some cress seeds are placed on damp cotton wool in a dish. They are left to germinate in a light-proof box for a few days.

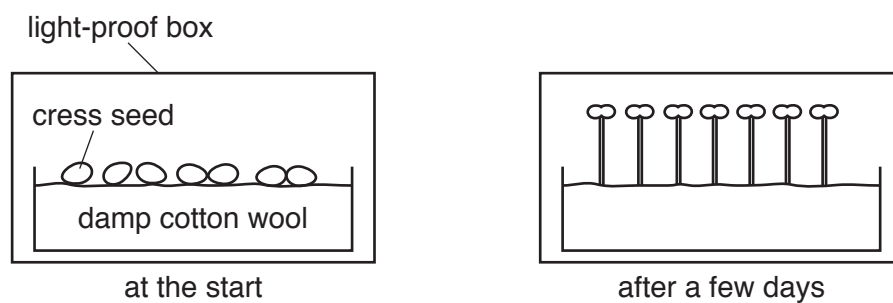


Fig. 3.1

- (a) (i) State **two** environmental conditions, not already mentioned, that are required for the germination of seeds.

1.

2.

[2]

- (ii) Fig. 3.1 shows that the seedlings grow directly upwards.

Name this response.

.....[1]

- (b) The dish of seedlings is removed from the box and lit from one side.

Fig. 3.2 shows what happens.

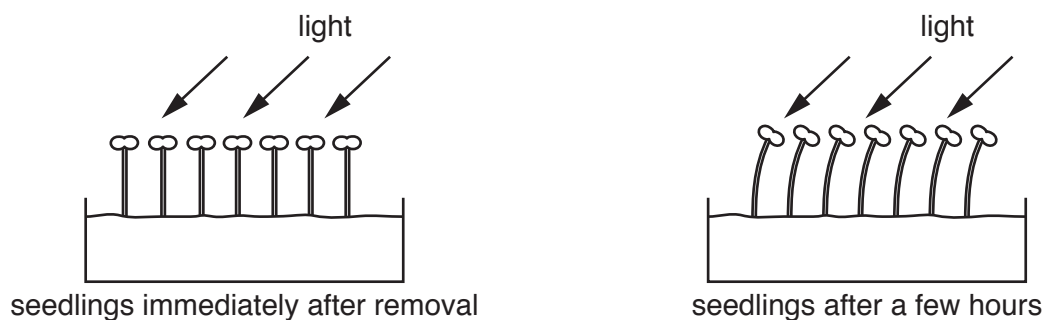


Fig. 3.2

Describe the advantage to the seedlings of the response shown in Fig. 3.2.

.....

[2]

- (c) A student takes three similar pieces of celery and removes the leaves from one of them. He then places the celery in separate beakers of red-coloured water.

He places beakers **A** and **B** outdoors. He keeps beaker **C** indoors as shown in Fig. 3.3.

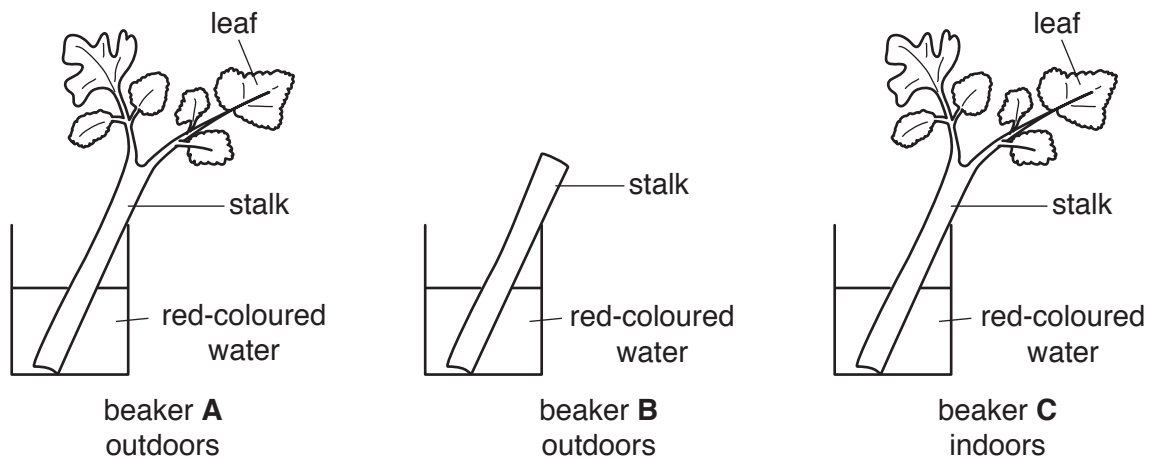


Fig. 3.3

He examines them after two hours. His observations are shown in Table 3.1.

Table 3.1

beaker	observation
A	the leaves turn red
B	the coloured water does not enter the stalk
C	the coloured water reaches half-way up the stalk

- (i) Name the tissue through which the red-coloured water travels to reach the leaves of the celery in beaker **A**.

.....[1]

- (ii) Suggest why the coloured water does not move in the celery in beaker **B**.

.....

.....

.....

.....[2]

- (iii) Describe **two** ways in which the environmental conditions could be different for beaker **C** compared with **A**, which could explain the difference in the results.

1.

2.

[2]

- 4 Fig. 4.1 shows a water trough full of water left in a field on a hot day. In the evening the farmer sees that the level of water in the trough has gone down, as shown in Fig. 4.2. There are no animals in the field.

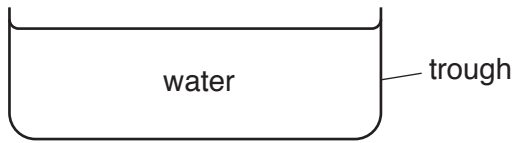


Fig. 4.1

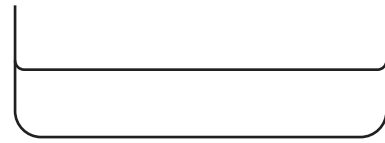


Fig. 4.2

- (a) (i) Name the process that causes the level of water in the trough to go down.

.....[1]

- (ii) The thermal energy needed for this process comes from the Sun as electromagnetic radiation.

State the part of the electromagnetic spectrum that is transformed to thermal energy in this process.

.....[1]

- (iii) Explain in terms of the energy and movement of water molecules why the level of water goes down in the trough on a hot day.

.....

[2]

(iv) Fig. 4.3 below shows a close-up of the surface of the water in the trough.

In the box on the diagram, draw the arrangement of water molecules below the surface of the water.

Some molecules have been drawn for you, above and below the surface. You should draw a total of at least 10 more molecules to show the arrangement below the surface.

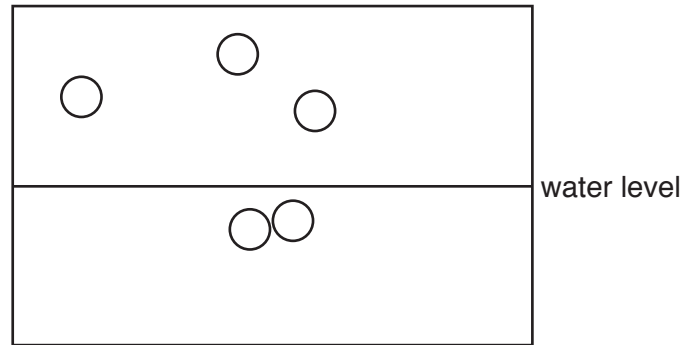


Fig. 4.3

[2]

(b) Fig. 4.4 shows the farmer looking at an image of the evening Sun reflected in the water surface.

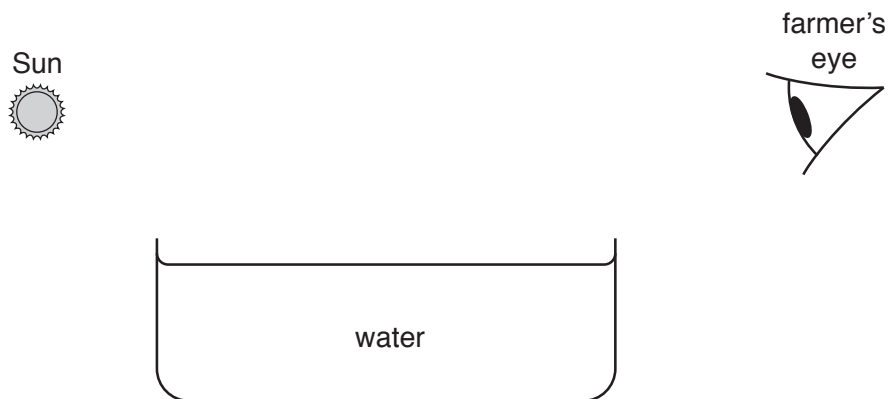


Fig. 4.4

On Fig. 4.4, draw a ray diagram using one ray to show how the farmer is able to see the image of the Sun reflected in the water.

[2]

(c) Fig. 4.5 shows the farmer looking at a stick lying in the water trough.

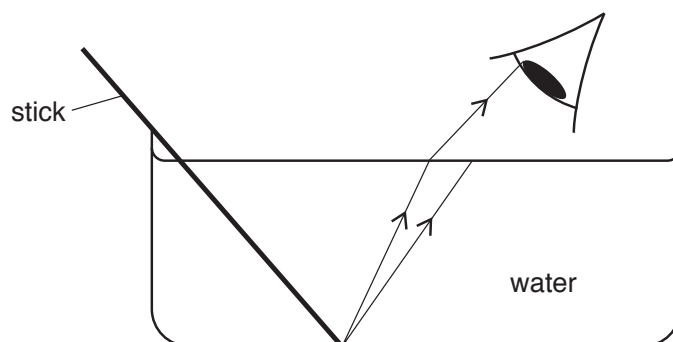


Fig. 4.5

The farmer says that the stick looks bent where it goes into the water.

(i) On Fig. 4.5 complete the second ray on the ray diagram to reach the eye. [1]

(ii) Extend the rays and draw the image of the end of the stick as seen by the farmer. [1]

(d) The farmer speaks to someone on his mobile phone (cell phone).

State the type of electromagnetic radiation used by the mobile phone to communicate with another mobile phone.

.....[1]

- 5 (a) Fig. 5.1 shows how petroleum is separated into useful products.

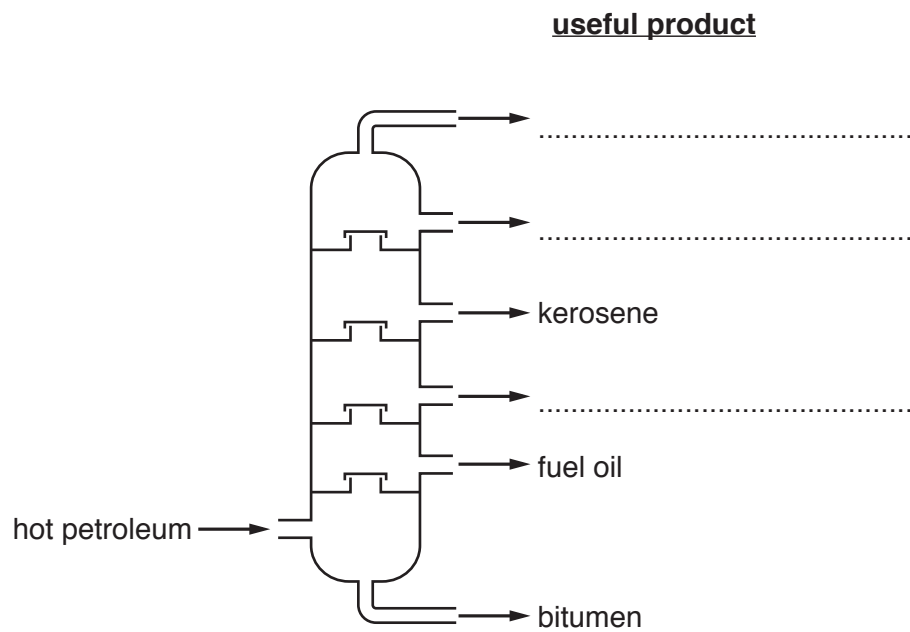


Fig. 5.1

- (i) State the name of this process.

.....[1]

- (ii) Complete Fig. 5.1 by writing the labels for gas oil, gasoline and refinery gas.

[2]

- (iii) Some products obtained from petroleum are used as fuels.
Fig. 5.2 shows some uses and products.

Complete Fig. 5.2 by drawing **three** more straight lines to link the products to their use as fuels.

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

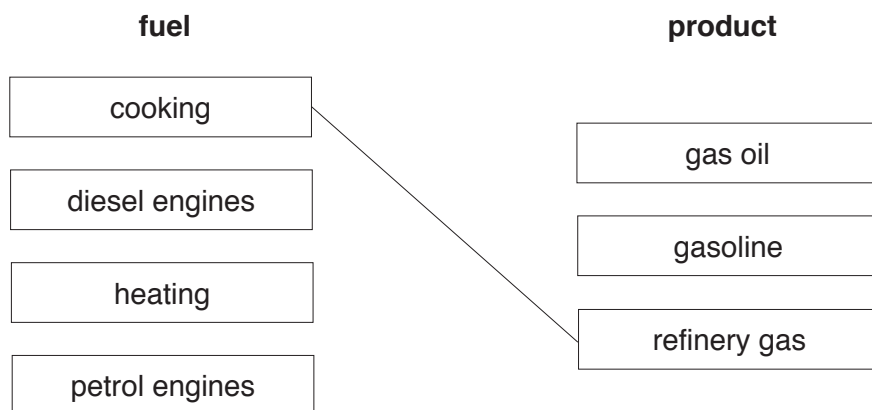
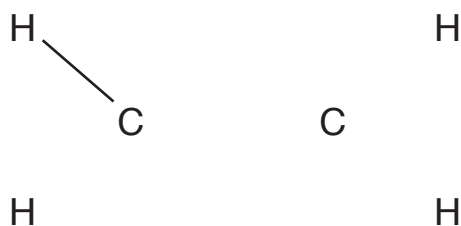


Fig. 5.2

[3]

- (b) (i) Complete the diagram to show the structure of ethene.



[1]

- (ii) When ethene burns, it produces a gas that turns limewater milky.

Name this gas.

.....[1]

- (iii) Water is also produced when ethene burns.

Describe a **chemical** test for water and state the result.

test

result

[2]

- 6 (a) Table 6.1 shows some of the substances present in milk.

Table 6.1

substance	mass/g per 100cm ³ of milk
protein	3.4
fat	3.6
carbohydrate	4.7
calcium (mineral salt)	0.1
fibre	none

- (i) A balanced diet contains five nutrient groups, as well as fibre and water.

Name the nutrient group, present in milk, which is **not** listed in Table 6.1.

.....

Describe the importance of including this nutrient group in a balanced diet.

.....

.....

.....

[2]

- (ii) State the process by which energy is released in the body.

.....[1]

- (iii) List the substances in milk from Table 6.1 that can release energy in the body.

.....[2]

- (iv) There is no fibre contained in the milk.

Suggest one food that would provide fibre.

.....[1]

- (b) Large numbers of cows are bred by farmers to produce milk.

Use the following words or phrases to complete the sentences about the effects on the environment caused by people keeping cows.

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

noble greenhouse digestive disease global warming
methane oxygen respiratory sulfur dioxide

The systems of cows release
..... into the air. This is a
gas which can contribute to

[4]

- 7 Fig. 7.1 shows a circuit diagram for a solar-powered electric motor.

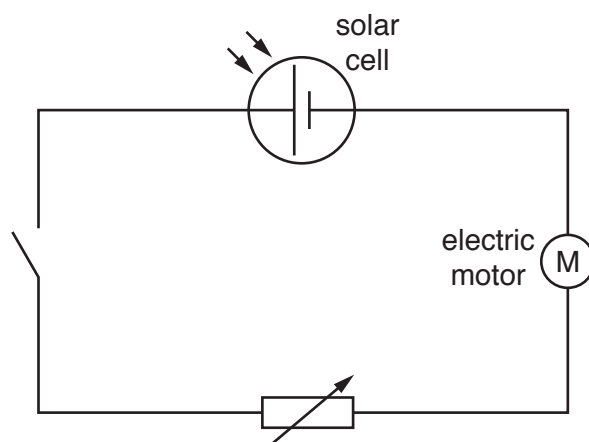


Fig. 7.1

- (a) Use words or phrases from the list to fill in the missing words in the sentences below.

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

decreases electrons increases

neutrons protons stays the same

The current is a flow of in the wires of the circuit.

The size of the current around the circuit. [2]

- (b) (i) Name the component which has the symbol  [1]

- (ii) Describe how this component controls the speed at which the motor turns.

.....

 [2]

- (iii) On Fig. 7.1 draw the symbol for a voltmeter correctly connected to measure the p.d. across the motor. [1]

8 (a) The Periodic Table lists all of the elements.

Complete the following sentences about the Periodic Table by using words from the list below. Each word may be used once, more than once or not at all.

high low mass metallic
negative non-metallic nucleon
positive proton

Elements are arranged in the Periodic Table in order of
number.

The elements are on the left-hand side of the
Periodic Table and the elements are on the right-hand
side of the Periodic Table.

The transition elements, which have densities and
..... melting points, are found in the middle of the
Periodic Table.

[3]

- (b) (i) Three beakers, **A**, **B** and **C**, are shown in Fig. 8.1.

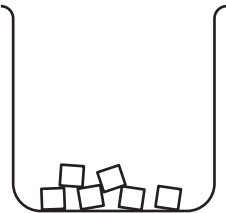
Each beaker contains pieces of a **different** metal.

The three metals are **calcium**, **iron** and **magnesium**.

A student tests the metals in each beaker. Her results are shown next to each beaker.

Complete Fig. 8.1 by writing the correct name of the metal in each beaker.

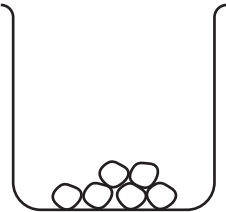
beaker **A**



no visible reaction with water
a few bubbles of gas with dilute hydrochloric acid

name of metal

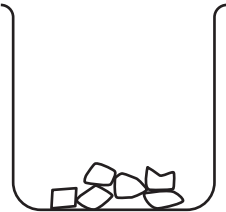
beaker **B**



rapid fizzing in water
violent reaction with dilute hydrochloric acid

name of metal

beaker **C**



slow fizzing in water
lots of bubbles of gas with dilute hydrochloric acid

name of metal

Fig. 8.1

[2]

- (ii) When magnesium reacts with dilute hydrochloric acid, magnesium chloride is formed.

Suggest **one** other substance that reacts with hydrochloric acid to form magnesium chloride.

.....[1]

(c) A solution of a copper compound is electrolysed, as shown in Fig. 8.2.

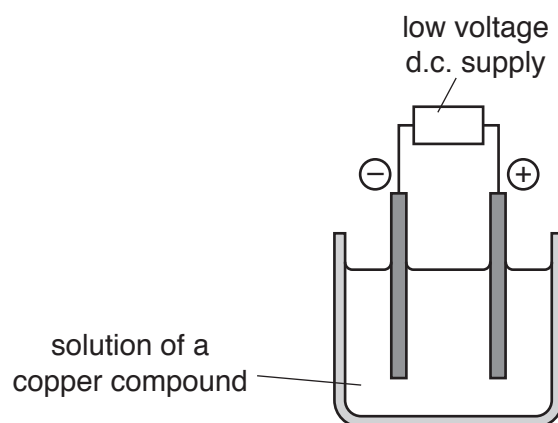


Fig. 8.2

A gas is produced at the anode. It turns damp blue litmus paper red and then white.

Name the gas.

.....[1]

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

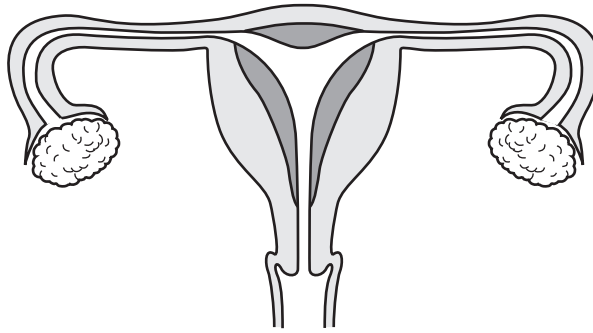


Fig. 9.1

- (a)** On Fig. 9.1 label with the correct names

1. a place where haploid cells are found,
2. a place where fertilisation may take place.

[2]

- (b) (i)** After fertilisation the zygote develops into a ball of cells.

Describe in detail where the ball of cells continues its development.

.....

[2]

- (ii)** Explain why the place you described in **(b)(i)** is a good environment for this ball of cells to develop.

.....
[1]

- (c)** Describe **two** ways in which HIV can be transmitted.

1.

2.
[2]

The Periodic Table of Elements

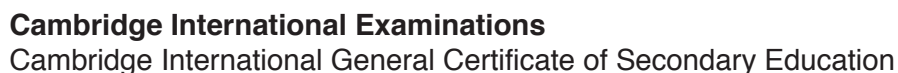
Group																			
I	II	Key										III	IV	V	VI	VII	VIII		
		atomic number atomic symbol name relative atomic mass										1 H hydrogen 1							2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20		
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40		
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84		
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium —	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131		
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —		
87 Fr francium —	88 Ra radium —	89–103 actinoids	104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —						116 Lv livermorium —		

lanthanoids

actinoids

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

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



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0653/22

October/November 2016

1 hour 15 minutes

No Additional Materials are required.

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 **22** printed pages and **2** blank pages.

- 1 Fig. 1.1 shows a wireless doorbell to alert people inside the house to someone coming to visit.

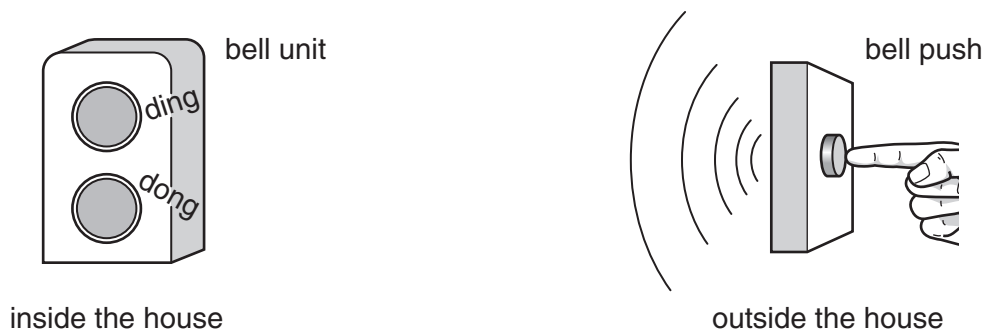


Fig. 1.1

When the button in the bell push is pressed, a radio signal is sent to the bell unit, and the bell sounds.

- (a) Table 1.1 shows part of the electromagnetic spectrum.

Table 1.1

	X-rays	ultraviolet		infra-red		
--	--------	-------------	--	-----------	--	--

highest frequency ←————→ lowest frequency

In Table 1.1, write the name of the electromagnetic waves used for radio signals in the correct position in the electromagnetic spectrum. [1]

- (b) The bell push contains an electrical circuit including a source of stored energy.

- (i) Name the component in an electrical circuit that provides the energy.

.....[1]

- (ii) Name the form of energy stored in the component named in (b)(i).

.....[1]

- (c) The bell unit also contains an electrical circuit.

Fig. 1.2 shows two different bells, **A** and **B**, inside the bell unit. When the radio signal is received, an arm moves and hits the two bells.

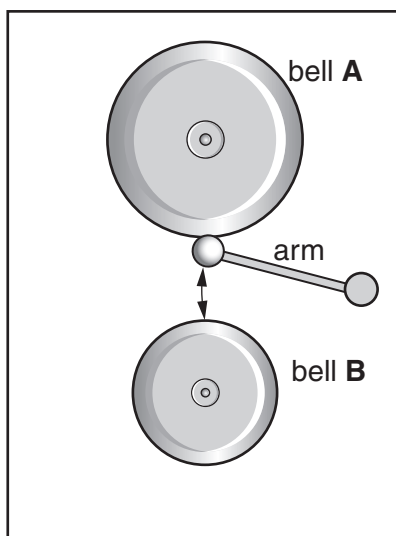


Fig. 1.2

- (i) Complete the sequence of useful energy transfers when someone hears the bells.

from electrical energy

to energy

to energy.

[2]

- (ii) Bell **A** emits a loud sound of frequency 500 Hz.

Bell **B** emits a quieter sound of frequency 250 Hz.

State which bell, **A** or **B**, produces the sound with the

1. higher pitch, ...

2. larger amplitude.

[1]

- (d) Fig. 1.3 shows a mains powered bell unit plugged into the mains electricity supply at 220 V in a kitchen.

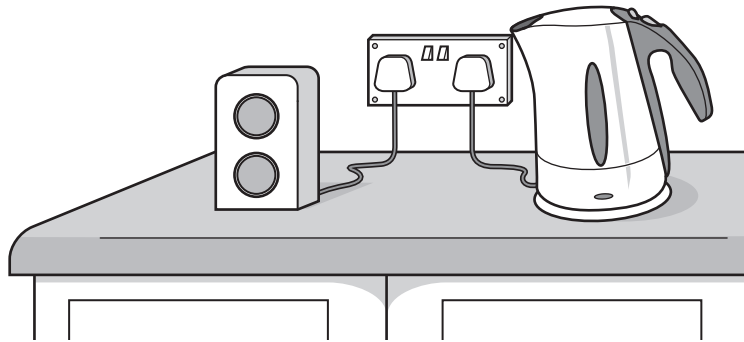


Fig. 1.3

- (i) There are hazards when using any appliance connected to the mains electricity supply.

Describe **one** electrical hazard that might affect the bell unit shown in Fig. 1.3.

.....
[1]

- (ii) Name a safety component you would expect to find in the bell unit.

.....[1]

- (e) The bell push also contains a small lamp which lights up when the bell sounds.

Fig. 1.4 shows a lens in front of the lamp. The light from the lamp is concentrated by the lens to form a parallel beam.

- (i) On Fig. 1.4, draw rays to show how the light from the lamp emerges from the lens as a parallel beam.

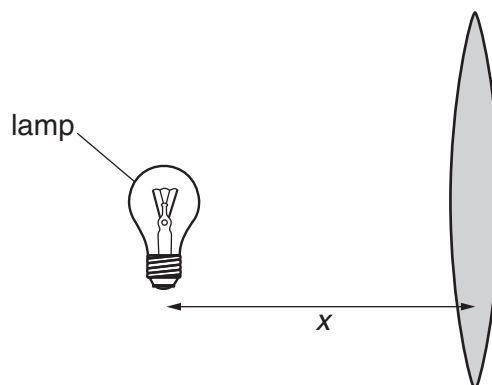


Fig. 1.4

[1]

- (ii) State the name of distance x shown on Fig. 1.4.

.....[1]

- 2 (a) A molecule of ethanol contains two carbon atoms, six hydrogen atoms and one oxygen atom.

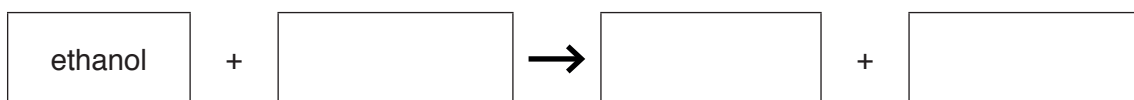
Deduce the formula of ethanol.

.....

[1]

- (b) Ethanol burns completely to form carbon dioxide and water.

Complete the word equation for this reaction.



[2]

- (c) Complete Table 2.1 to show the chemical tests and the results for carbon dioxide and for oxygen.

Table 2.1

	test	result
carbon dioxide		
oxygen		

[4]

- (d) The combustion of ethanol is exothermic.

Describe the temperature change in an exothermic reaction.

.....[1]

- (e) A mixture contains liquid ethanol and water.

Name the process that is used to separate two liquids in a mixture.

.....[1]

3 Fig. 3.1 shows a plant palisade cell as seen under the microscope.

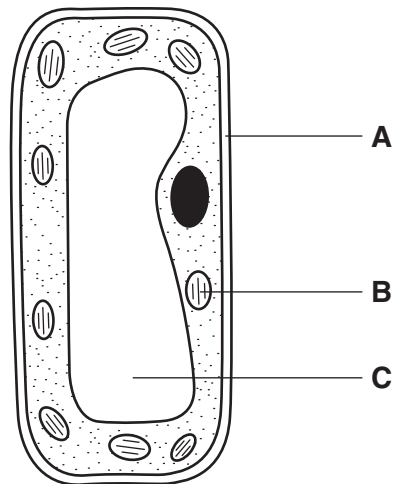


Fig. 3.1

(a) Name the cell parts **A**, **B** and **C**.

A

B

C

[3]

(b) The cell in Fig. 3.1 is found in the leaf. Fig. 3.2 shows a cross-section of a leaf with most of the cells missing.

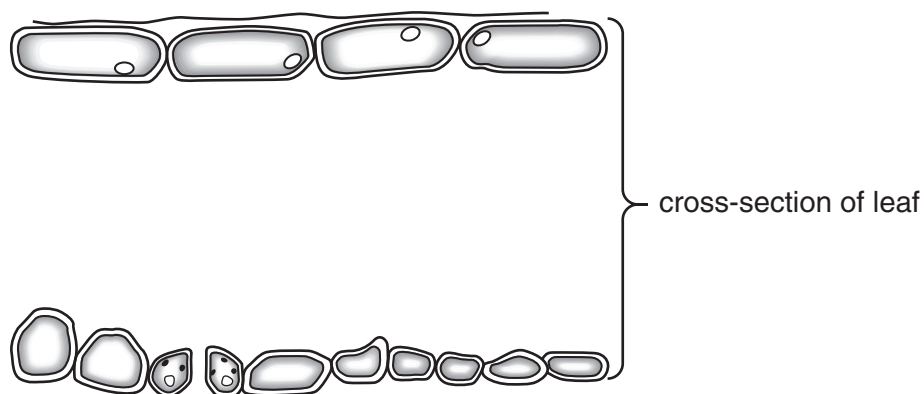


Fig. 3.2

(i) On Fig. 3.2 label the cuticle of the leaf.

[1]

(ii) Draw the outline of the cell shown in Fig. 3.1 on the diagram of the leaf in Fig. 3.2 to show where the cell is found.

[1]

- (c) There are many palisade cells in the leaf. They carry out photosynthesis.

Complete the word equation for photosynthesis.

carbon dioxide + water →[1]

- (d) The palisade cells need a supply of carbon dioxide and water for photosynthesis.

Describe how each of these substances is supplied to the cells.

carbon dioxide

.....

.....

water

.....

.....[4]

- 4 Fig. 4.1 shows an electric iron for smoothing clothes. An electric heater inside the iron is connected to the mains electricity supply.

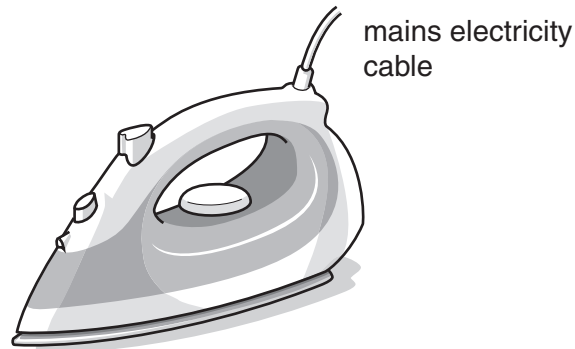


Fig. 4.1

- (a) The heating element inside the electric iron is made of two long thin wires.

The wires are connected in parallel with each other, and connected to the mains a.c. power supply through a switch.

In Fig. 4.2 complete the circuit diagram for this arrangement. Use the resistor symbol to represent each of the wires connected in parallel.



Fig. 4.2

[3]

- (b) The thermal energy from the heating element is transferred through a thin solid metal base to the clothes being ironed.

(i) Name the method of thermal energy transfer through the base of the iron.

.....[1]

(ii) The base is made of steel of density 8.0 g/cm^3 .

The mass of the base is 128 g.

Calculate the volume of the base.

State the formula that you use and show your working.

formula

working

volume = ... cm^3 [2]

(iii) The area of the base of the iron is 160 cm^2 .

Use your answer to (ii) to calculate the average thickness of the base.

Show your working.

thickness = ... cm [1]

(c) A steam iron uses steam to help iron the clothes.

Fig. 4.3 below shows a close-up of the molecules of steam and water in a steam iron. Some molecules have been drawn above and below the surface of the water.

Draw 4 more molecules to show the arrangement in the steam above the water surface.

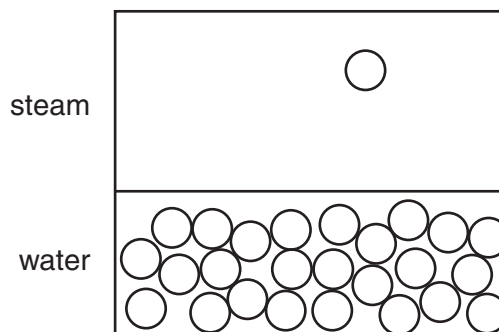


Fig. 4.3

[1]

(d) Fig. 4.4a and Fig. 4.4b show another switch included inside the iron to control the temperature.

This type of switch uses a bimetallic strip, made of two different metals, brass and steel, joined together.

Fig. 4.4a shows the switch when the iron is cold.

Fig. 4.4b shows the switch when the iron has reached the correct temperature for ironing.

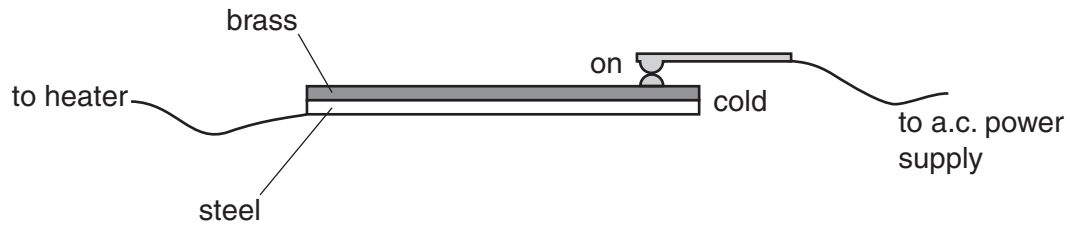


Fig. 4.4a

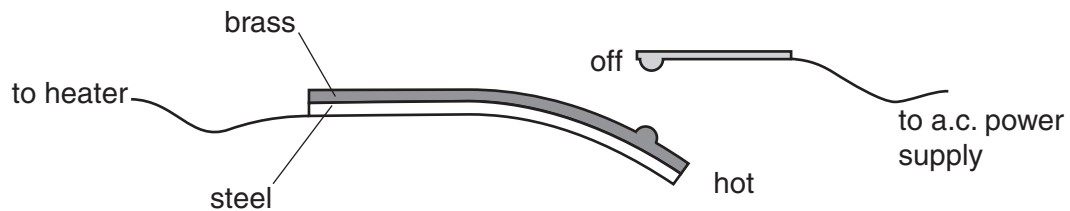


Fig. 4.4b

Explain why this bimetallic strip switches off the heating element when the temperature increases.

.....

.....

.....

.....[2]

Please turn over for Question 5.

- 5 Fig. 5.1 shows the apparatus used to pass an electric current through an aqueous copper chloride solution.

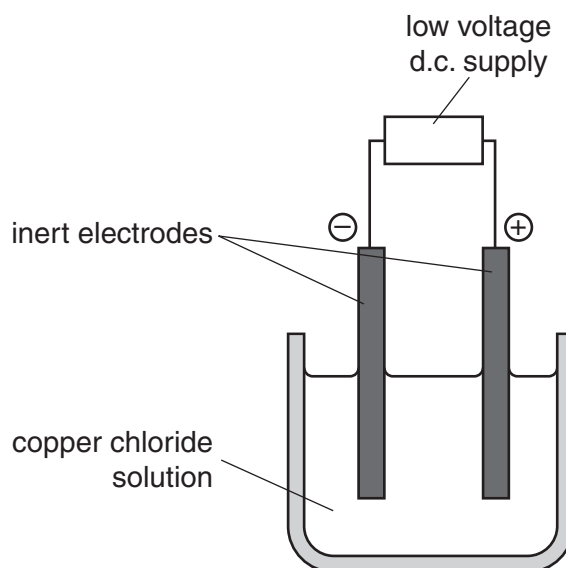


Fig. 5.1

- (a) Complete the sentences.

The positive electrode is called the and the negative electrode is called the

The solution through which the electric current passes is called the

[3]

- (b) Name the substances formed at each electrode.

positive electrode

negative electrode [2]

- (c) Copper chloride is made in the reaction between copper oxide and dilute hydrochloric acid.



- (i) Name **one other** compound that reacts with dilute hydrochloric acid to form copper chloride.

..... [1]

- (ii) The speed of a reaction is increased by stirring.

Suggest **one other** way of increasing the speed of a reaction.

..... [1]

(d) Copper is a transition element.

Sodium is in Group I of the Periodic Table.

Copper is more dense than sodium.

Copper is less reactive than sodium.

State **two other** properties of copper that are different from the properties of sodium.

1.

2.

[2]

(e) Bronze is an alloy made by mixing copper and tin.

Explain why ancient cutting tools were made of bronze rather than pure copper.

.....

.....[1]

6 Fig. 6.1 is a diagram of an alveolus in the lungs.

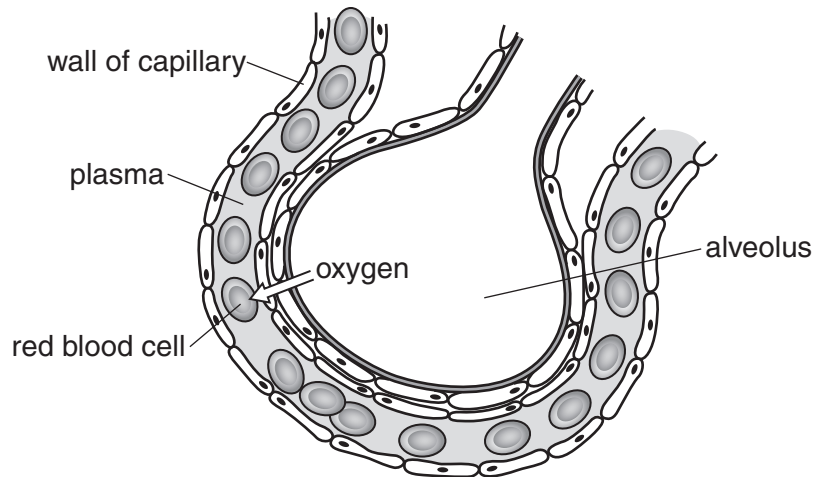


Fig. 6.1

(a) An arrow in Fig. 6.1 shows the diffusion of oxygen.

Draw another arrow to show the diffusion of carbon dioxide.

[1]

(b) A student uses a machine to measure the volume of air breathed in and out of his lungs. The machine produces a graph showing the results.

Fig. 6.2 shows how the volume of his lungs changes as he breathes in and out while resting.

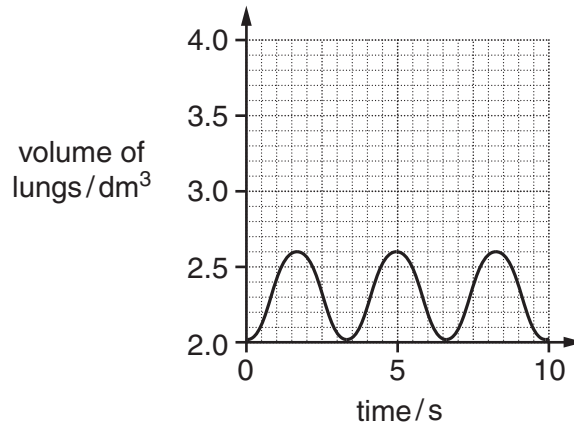


Fig. 6.2

(i) State the volume of air he breathes in with each breath.

volume = ... dm³ [1]

- (ii) Calculate the total volume that he breathes in during ten seconds.

Show your working.

total volume = ... dm^3 [1]

- (c) The student then does a running exercise. His breathing pattern changes.

Fig. 6.3 shows how the volume of his lungs changes as he breathes in and out while exercising.

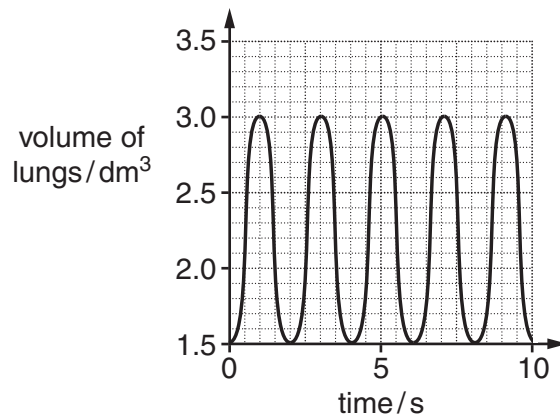


Fig. 6.3

Describe **two** ways in which the student's breathing changes when he starts to exercise.

1.

2.

[2]

- (d) The student uses oxygen to release energy through respiration.

State **two** uses in humans of the energy released by respiration.

1.

2.

[2]

- 7 A boy uses a catapult to launch a ball vertically upwards as shown in Fig. 7.1.

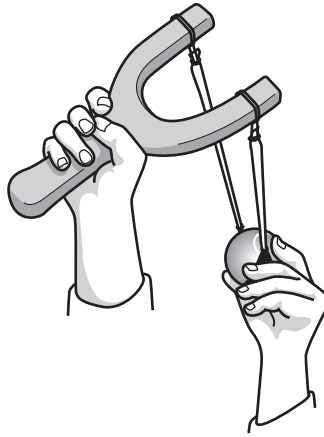


Fig. 7.1

The boy places a ball of mass 0.055 kg in the catapult.

He applies a force to stretch the elastic cords before the ball is launched. This is shown in Fig. 7.2.

When the elastic cords are fully stretched, the boy holds the ball at rest in the catapult.

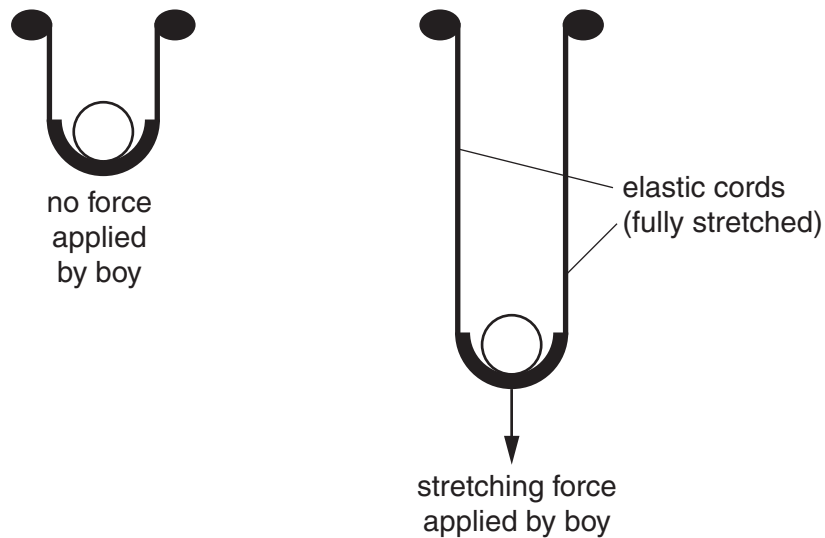


Fig. 7.2

- (a) (i) State the name of the unit of force.

.....[1]

- (ii) Before the boy stretches the catapult, there is already a small force stretching the elastic cords.

State the name of this force.

.....[1]

(b) Fig. 7.3 shows part of a force (load)/extension graph for the elastic cords.

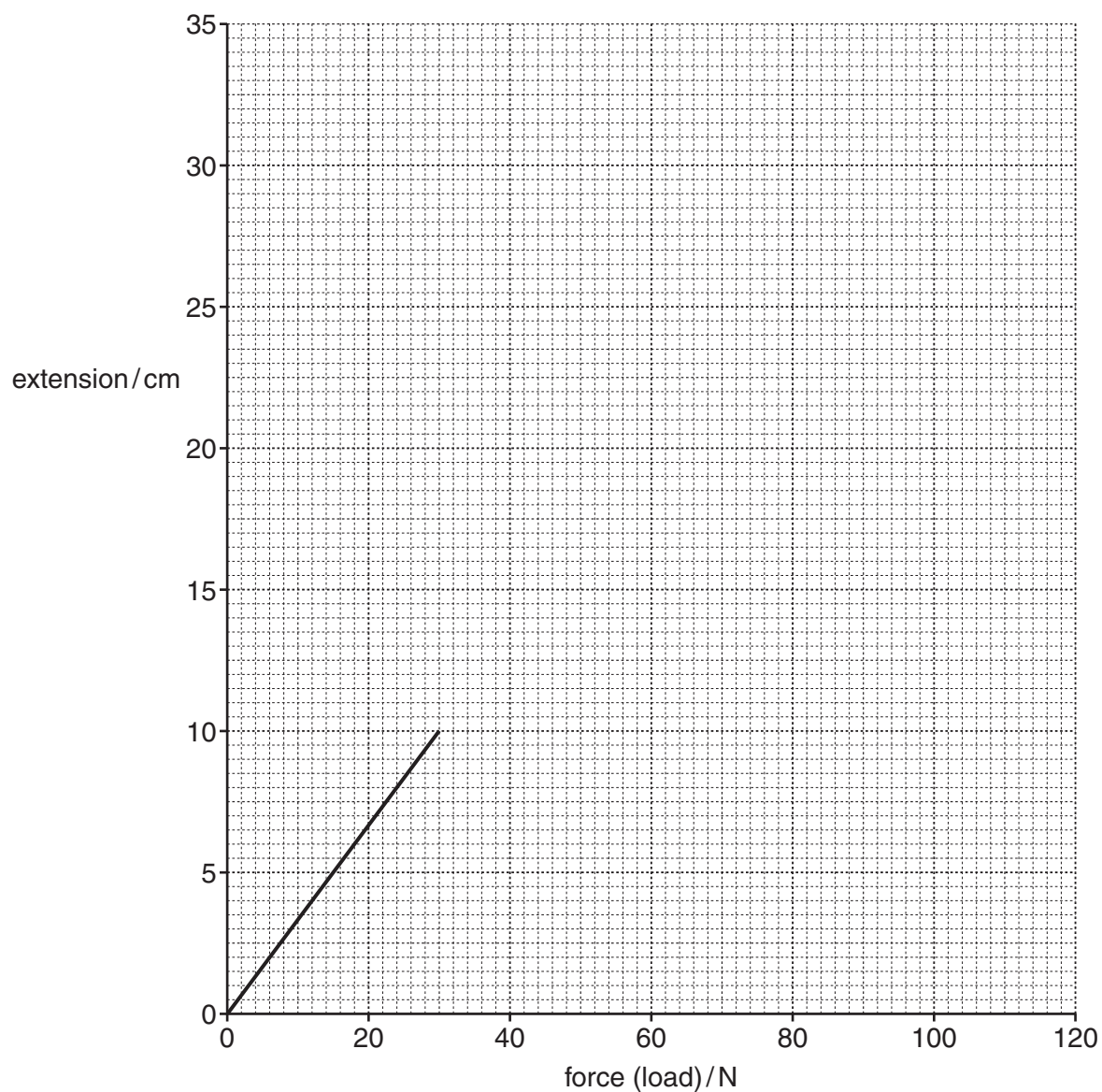


Fig. 7.3

When a force of 45 N is applied, the extension is 15 cm.

When a force of 60 N is applied, the extension is 20 cm.

(i) On Fig. 7.3 plot this data and draw the line of best fit. [2]

(ii) Predict the extension when a force of 90 N is applied.

extension = ... cm [1]

- (c) As the elastic stretches, the forces in the two elastic cords change.

When the cords are fully stretched by a total force of 100 N, the boy holds the ball without moving the catapult.

State the total upward force exerted by the elastic cords.
Give a reason for your answer.

total upward force = ... N

reason

.....[2]

- 8 Petroleum is a mixture of hydrocarbons. Fig. 8.1 shows how it is separated.

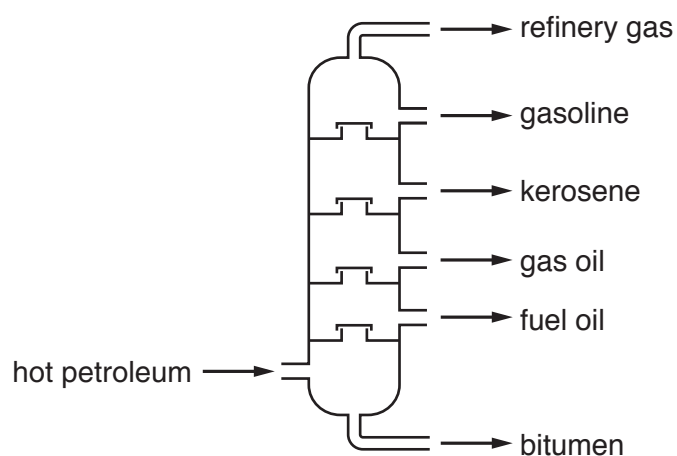


Fig. 8.1

- (a) Explain why this process is described as a physical change and not a chemical change.

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

- (b) State what is meant by the term *hydrocarbon*.

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

- (c) Suggest **one** use for each of the three substances below.

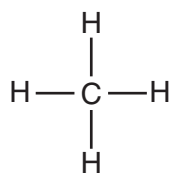
refinery gas

gasoline

gas oil[3]

- (d) Methane, CH_4 , and ethane, C_2H_6 , are found in petroleum.

The structure of methane is shown in Fig. 8.2.



methane

Fig. 8.2

Complete the structure of ethane below.



ethane

[2]

9 Fig. 9.1 shows a food web in a lake.

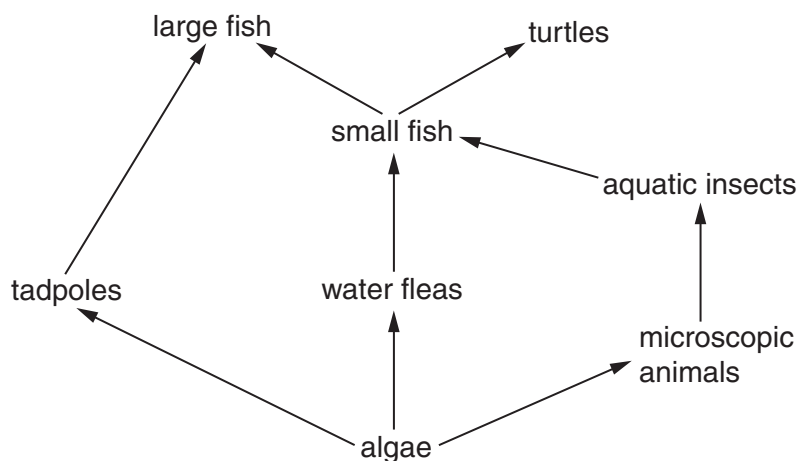


Fig. 9.1

(a) Define the term *food web*.

.....

.....

.....[2]

(b) Use the words or phrases in the list below to complete the following sentences.

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

consumers Earth environment lake parasites

producers turtles Sun water fleas

The source of energy for this food web is the The algae are because they make their own food by photosynthesis.

All the remaining organisms are In this food web
 are an example of herbivores and
 are an example of carnivores.

[5]

- (c) Later in the year the tadpoles develop into frogs and leave the lake.

Predict and explain how this would affect

- (i) the algae,

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

- (ii) the large fish.

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

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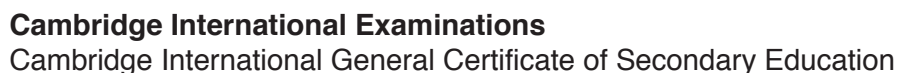
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The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	VIII
3 Li lithium 7	4 Be beryllium 9	Key atomic number atomic symbol name relative atomic mass										5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium —	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —
87 Fr francium —	88 Ra radium —	89–103 actinoids	104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	114 Fl flerovium —	116 Lv livermorium —	—	—	—	—

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

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



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0653/23

October/November 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 Fig. 1.1 shows a man using a longbow to fire arrows at a target.

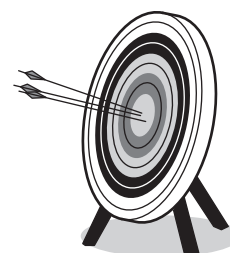
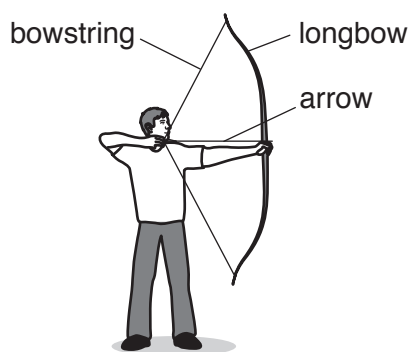


Fig. 1.1

- (a) The man uses a force to pull the arrow back through several centimetres.

- (i) State the name of the unit of force.

.....[1]

- (ii) Explain why work is done by the man when he pulls the arrow back.

.....

.....[1]

- (b) (i) Complete the sequence of energy transfers from when the man pulls the arrow back, to when he releases the arrow towards the target.

from energy in the man

to energy in the longbow and bowstring

to energy in the flying arrow. [3]

- (ii) Suggest why the efficiency of the energy transfer between the energy in the longbow and bowstring, and the energy of the flying arrow is not 100%.

.....

.....[1]

- (c) The arrow flies 100m to a target at an average speed of 180km/hour.

- (i) Calculate the average speed of the arrow in metres per second.

Show your working

average speed = ... m/s [1]

- (ii) Use your answer to (c)(i) to calculate the time in seconds taken for the arrow to reach the target after release.

State the formula you use and show your working.

formula

working

time = ... s [2]

- 2 The chemical symbol of an atom of magnesium is shown below.



- (a) Complete Table 2.1 to show the names and numbers of the two types of particle in the nucleus of this magnesium atom.

Table 2.1

particle	number

[2]

- (b) A student uses the apparatus in Fig. 2.1 to burn some magnesium in air.

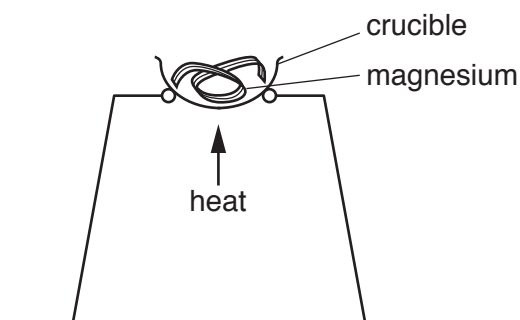


Fig. 2.1

A white solid, magnesium oxide, is formed.

Write the word equation for this reaction.



[2]

- (c) Fig. 2.2 shows test-tubes **A** and **B** which both contain dilute sulfuric acid. The student adds some magnesium to test-tube **A**. He adds some magnesium oxide to test-tube **B**.

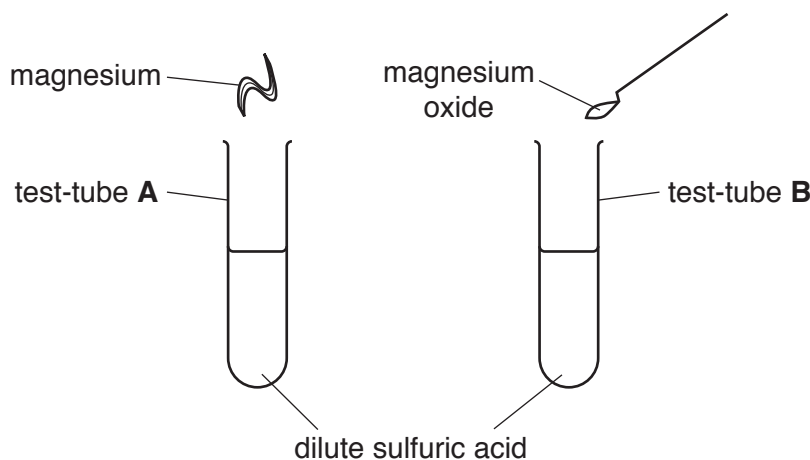


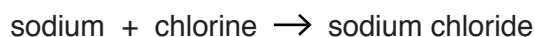
Fig. 2.2

State which of the two test-tubes produces a gas which burns with a squeaky pop. Identify the gas which is produced.

test-tube

gas [1]

- (d) (i) Sodium, a Group I element, reacts with chlorine, a Group VII element, as shown in the equation below.



Identify the substance in the word equation which contains ionic bonds. Explain your answer.

substance

explanation

..... [2]

- (ii) Sodium also reacts with water, as shown in the word equation below.



Identify a substance in the word equation which contains covalent bonds. Explain your answer.

substance

explanation

..... [2]

- 3 (a) Fig. 3.1 shows a plan of the human circulatory system.

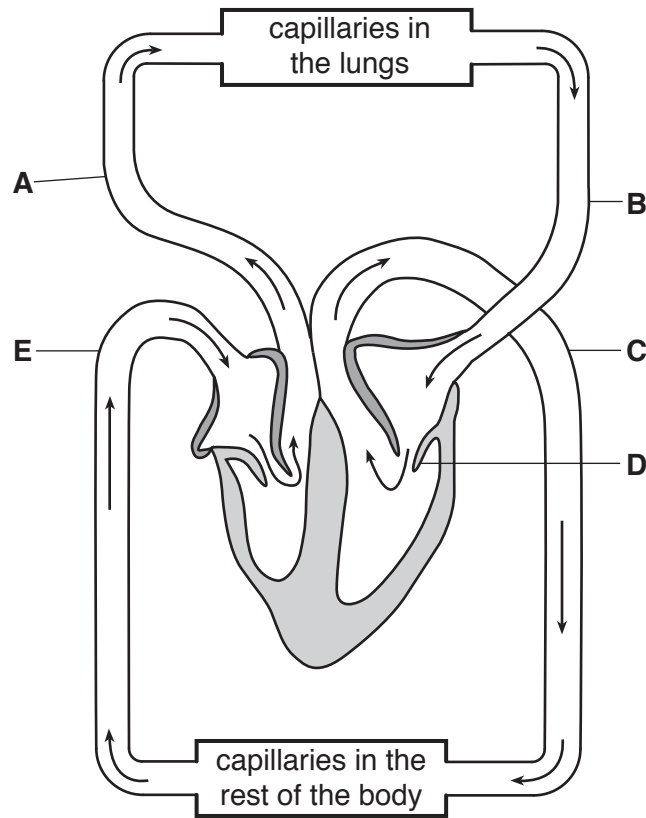


Fig. 3.1

- (i) State the letter and name of a vein shown in Fig. 3.1.

letter

name[1]

- (ii) Name the type of structure within the heart labelled **D** and describe its function.

.....

[2]

- (iii) Describe how the composition of blood changes as it passes through the capillaries of the lungs.

.....

[2]

(b) A student is running. His heart beats more quickly. His muscles need more blood for respiration.

(i) State the word equation for respiration.

.....[1]

(ii) The energy released by respiration can be used for contraction of his muscles.

State **two** other uses of the energy released.

1.

2.

[2]

(c) A student measures his pulse rate during the day. He takes a reading while sitting, and also as he does different activities. Some of his readings are shown in Table 3.1.

Table 3.1

activity	number of beats per minute
sitting	68
running	164
Y	90

Suggest an activity for **Y**. Explain your answer.

activity

explanation

.....[1]

4 Fig. 4.1 shows a simple solar heating system to provide hot water for a house.

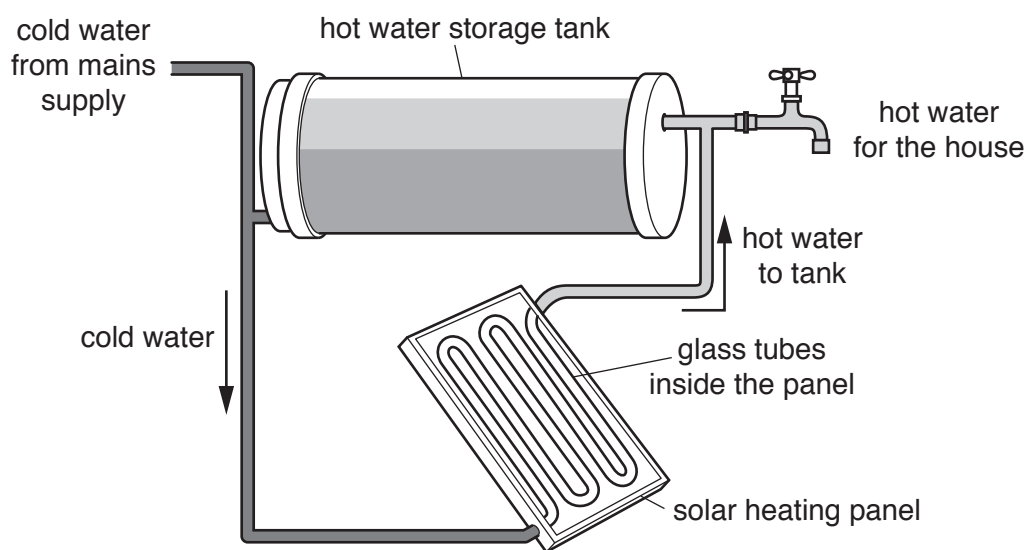


Fig. 4.1

- Cold water in glass tubes inside the panel is heated by energy from the Sun.
- The hot water then flows to the hot water storage tank above.
- Cold water from the tank flows back to the panel.
- A supply of hot water for the house can be taken from the tank.

(a) The Sun emits energy as electromagnetic radiation, some of which is absorbed by the solar panel.

On Table 4.1, in the correct box write the name of the main part of the electromagnetic spectrum which heats the solar panel.

Table 4.1

gamma radiation		ultraviolet				radio waves
-----------------	--	-------------	--	--	--	-------------

[2]

- (b) The solar panel is made of glass tubes through which the water flows.

Fig. 4.2 shows how each glass tube is placed inside an outer glass tube. The space between the outer and inner tubes has had all the air pumped out, leaving a vacuum between the tubes.

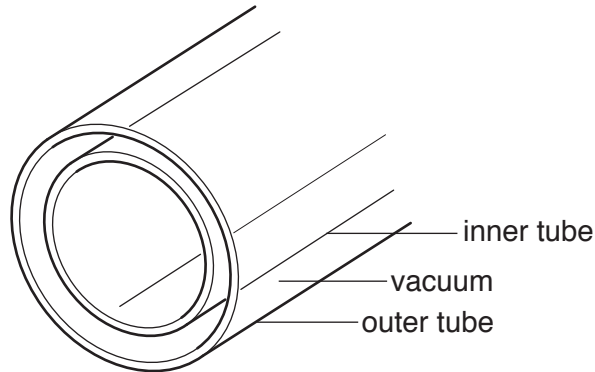


Fig. 4.2

State the method of thermal energy transfer

1. from the outer glass tube across the vacuum to the inner tube which contains the water,

.....

2. from the hot water in the glass tubes up to the storage tank on top of the panel.

.....

[2]

- (c) The water in the storage tank reaches a temperature of 60°C on a sunny day.

Suggest how the storage tank is designed to prevent the stored hot water cooling down again at night.

.....

.....[1]

- (d) The storage tank is made of metal.

Describe the change to the storage tank caused by the increase in temperature.

.....

.....

.....[1]

- (e) On a cold night in winter, the temperature falls below the melting point of water.

Suggest one problem this might cause for this solar heating system on the roof of a house.

.....

.....[1]

- (f) Light from the Sun has to pass through the walls of the glass tubes.

On Fig. 4.3 complete the ray diagram to show the path of light from the Sun through the outer glass tube into the vacuum between the tubes.

Show the angles of incidence and refraction at the air-to-glass surface.

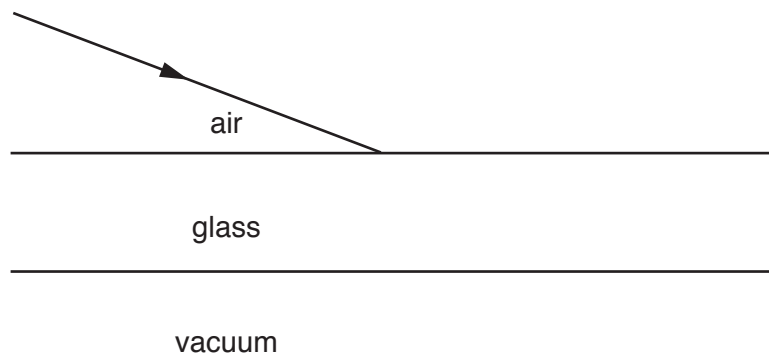


Fig. 4.3

[3]

- 5 Fig. 5.1 shows a bottle labelled copper(II) chloride solution.

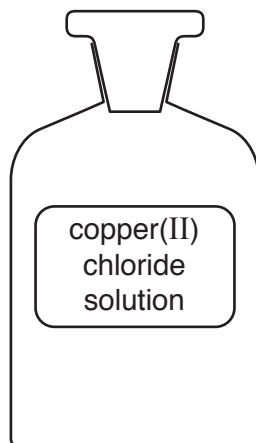


Fig. 5.1

- (a) A student tests the solution in the bottle to make sure that it contains copper chloride.

Complete Table 5.1. State the reagents and give the positive result for the test for each ion.

Table 5.1

ion	reagent	result
copper(II)		
chloride		

[4]

(b) Fig. 5.2 shows the electrolysis of the copper chloride solution using inert electrodes.

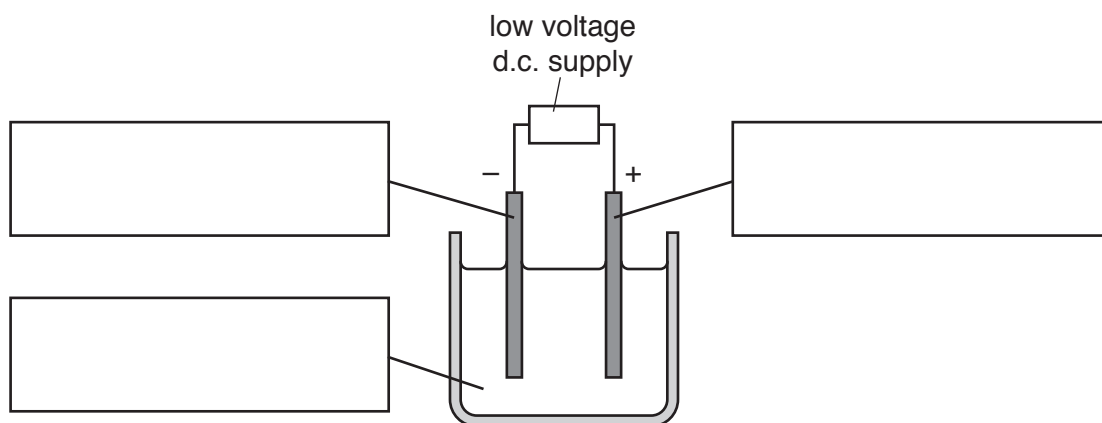


Fig. 5.2

(i) Use the words *anode*, *cathode* and *electrolyte* in the correct boxes to complete Fig. 5.2. [2]

(ii) After a few minutes a coloured solid forms on the negative electrode.

Name the solid and state its colour.

name

colour

[2]

(iii) Chlorine gas forms at the positive electrode and is tested with damp blue litmus paper.

State the colour of chlorine gas and the final colour of the litmus paper.

colour of chlorine gas

colour of litmus paper

[2]

- 6 (a) A student takes a flower apart and displays all the flower parts as shown in Fig. 6.1.

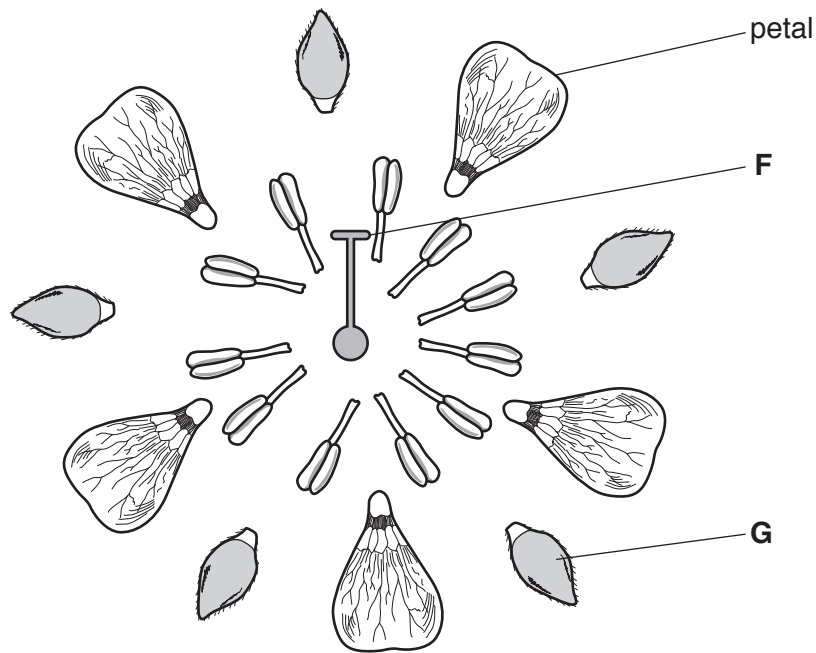


Fig. 6.1

- (i) Name flower parts **F** and **G**.

F

G

[2]

- (ii) On Fig. 6.1 label and name a part of the flower that contains many haploid cells.

Explain your answer.

.....

.....[2]

- (iii) The flower is insect-pollinated.

Suggest **one** feature that helps with insect pollination.

.....

.....[1]

- (b) A student investigates the rate of transpiration from a leafy twig under different conditions. Fig. 6.2 shows the apparatus he uses.

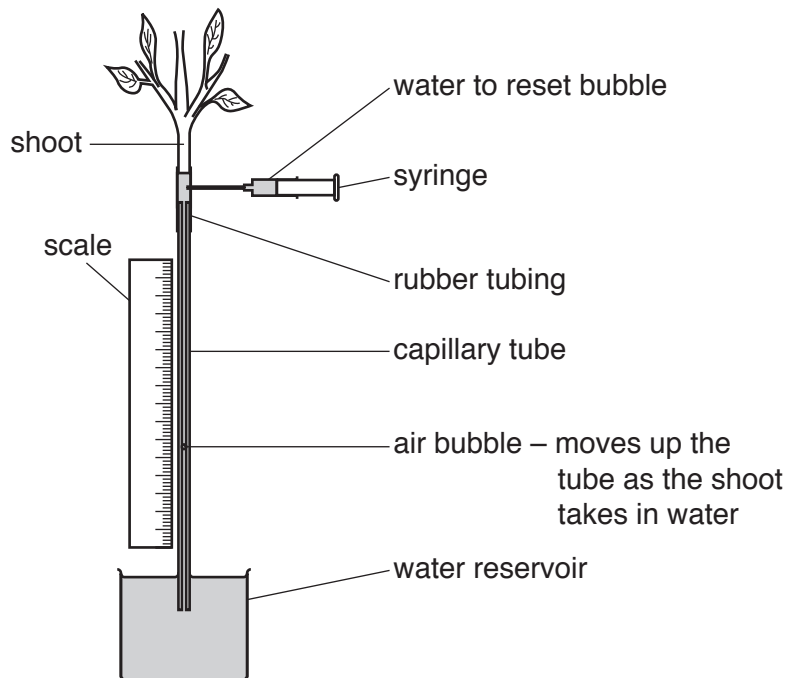


Fig. 6.2

- He measures how far the air bubble moves upwards in one minute.
- He uses the syringe of water to reset the apparatus.
- The student repeats the experiment under different environmental conditions.
- His readings are shown in Table 6.1.

Table 6.1

conditions	distance moved by bubble in one minute / cm
dry air at 22 °C	1.1
dry air at 27 °C	6.8
humid air at 22 °C	

- (i) Explain why the distance the bubble moves increases when the temperature rises to 27 °C.

.....

.....

.....

.....[2]

- (ii) Suggest a possible reading for humid air at 22 °C. Explain your answer.

reading

explanation

.....[1]

- (c) In the ground the plant takes in water at the roots.

Fig. 6.3 shows the distribution of the tissues in the cross-sections of two similar roots of the same size.

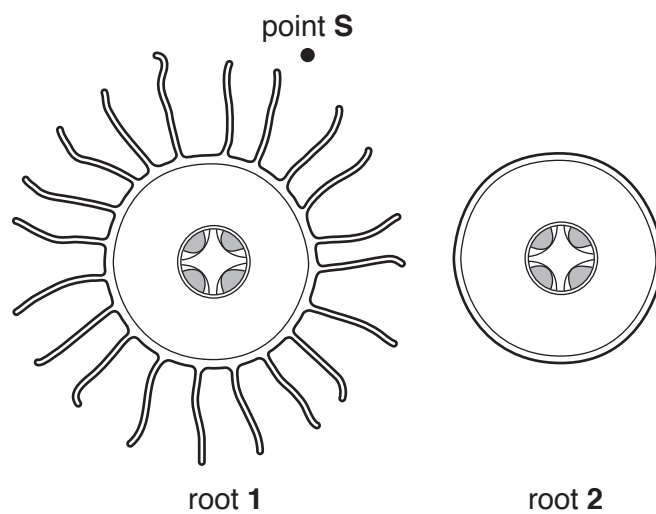


Fig. 6.3

- (i) Suggest which root takes in water more quickly. Explain your answer.

root

explanation

.....[1]

- (ii) On Fig. 6.3 draw a line to show a path taken by water from point **S** to the xylem. [2]

- 7 (a) Fig. 7.1 shows a wave generated in a string. One end of the string is fixed to a stand and clamp, while the other end is attached to a vibrator driven by an electric motor.

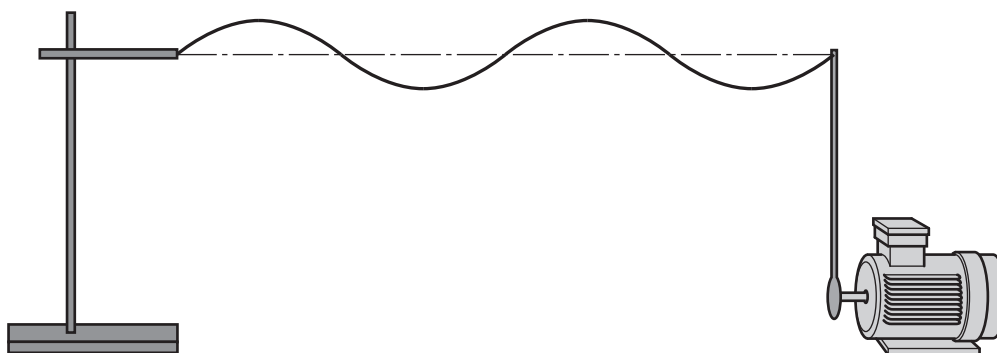


Fig. 7.1

- (i) The length of the string is 100 cm.

State the wavelength of the wave motion shown in Fig. 7.1.

..... cm [1]

- (ii) On Fig. 7.1 draw a double-headed arrow ($\longleftrightarrow$ or $\updownarrow$) to show the *amplitude* of the wave. [1]

- (b) Fig. 7.2 shows part of the circuit diagram for the circuit used to drive the vibrator.

The vibrator is driven by the electric motor. The speed of the motor is controlled by a variable resistor.

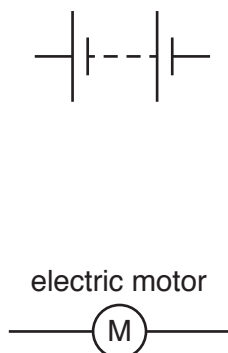


Fig. 7.2

Complete the circuit diagram by including the correct symbols in the correct places in the circuit for

1. a variable resistor to control the current through the motor,
2. a way of measuring the current through the motor.

[3]

- (c) The variable resistor is adjusted so that the current through the motor is 2A. The potential difference (p.d.) across the motor is 3.0V.

- (i) State the name of the property of the motor given by the expression

$$\frac{\text{p.d.}}{\text{current}}.$$

.....[1]

- (ii) Calculate the value of this property and give the unit of your answer.

Show your working.

value of property = ... unit[2]

- 8 Fig. 8.1 shows the processes a student uses to make the salt, zinc sulfate.

She reacts zinc carbonate powder with dilute sulfuric acid.

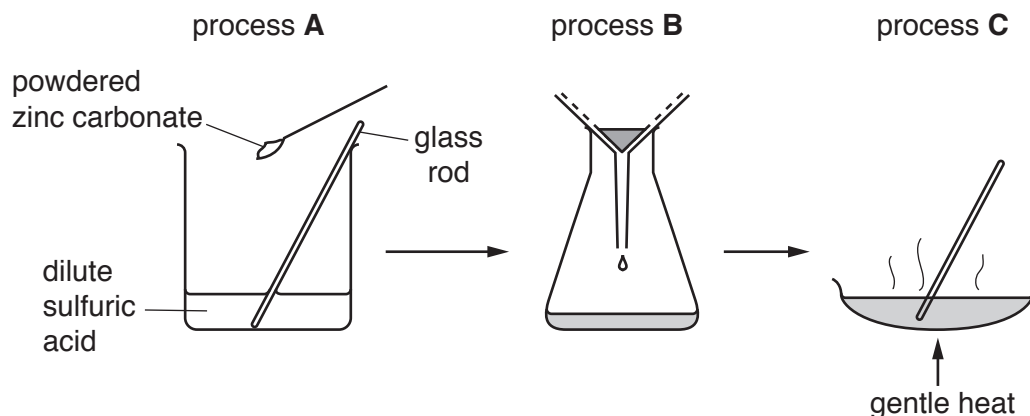


Fig. 8.1

- (a) Name processes **B** and **C**.

process **B**

process **C**

[2]

- (b) The student stirs the mixture to increase the speed of the reaction in process **A**.

Suggest **two** other ways of increasing the speed of this reaction.

1.

2.

[2]

- (c) (i) Deduce the identity of the salt and name the gas which forms when the student adds sodium carbonate to dilute sulfuric acid.

salt

gas

[2]

- (ii) Describe what happens to the pH of the acid as it reacts with sodium carbonate.

.....[1]

- (iii) The formula of sodium carbonate is Na_2CO_3 .

State the number of different elements in sodium carbonate.

.....

[1]

- 9 (a) Many human activities can affect the environment.

Draw **one** line from each human activity to its effect. One line is drawn for you.

human activity	effect
adding sewage to rivers	can lead to soil erosion
adding mercury to water	adds methane to the air
cutting down forests	reduces the carbon dioxide concentration in water
keeping large numbers of cows	reduces the oxygen concentration in water
	can poison animals in the food chain

[3]

- (b) Human activities can cause an increase in the concentration of carbon dioxide in the atmosphere.

- (i) State one large-scale activity of humans which increases the concentration of carbon dioxide in the atmosphere.

.....
[1]

- (ii) Explain why an increase in the concentration of carbon dioxide in the atmosphere is undesirable.

.....

[2]

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 europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167
69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175			
actinoids					
89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —
95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —
101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —			

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