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0653/31

May/June 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

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

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

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

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

- 1 (a) Plants make their own food in leaves by the process of photosynthesis.

Fig. 1.1 shows a cross-section of a leaf.

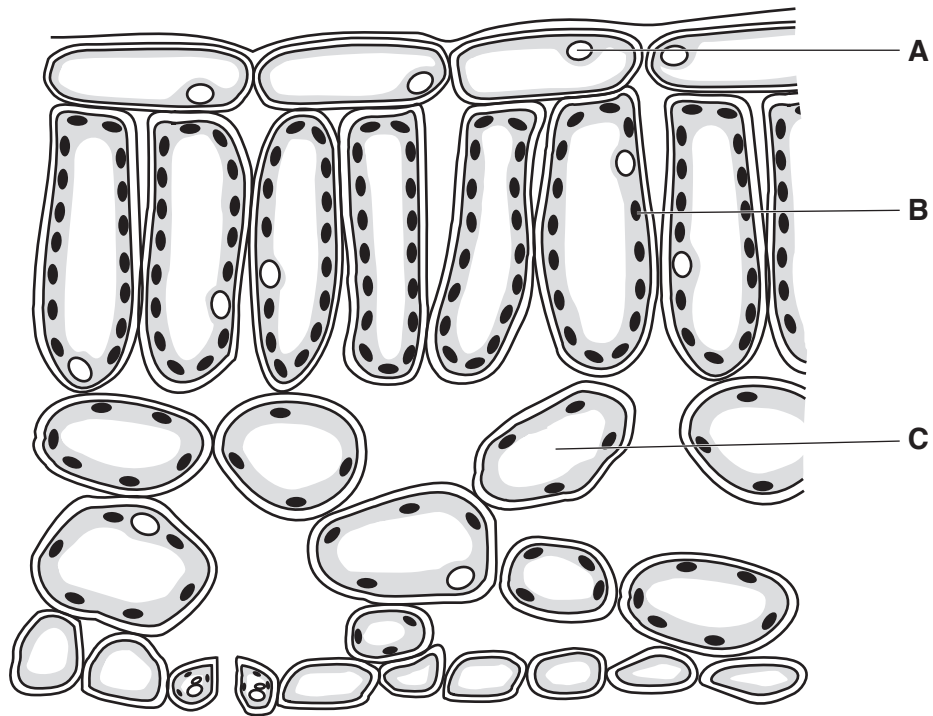


Fig. 1.1

Name cell parts **A**, **B** and **C** shown in Fig. 1.1.

A

B

C

[3]

(b) Fig. 1.2 shows a cross-section of the central structure of a leaf, known as the midrib.

The vascular bundle is shown in the middle of the midrib in Fig. 1.2.

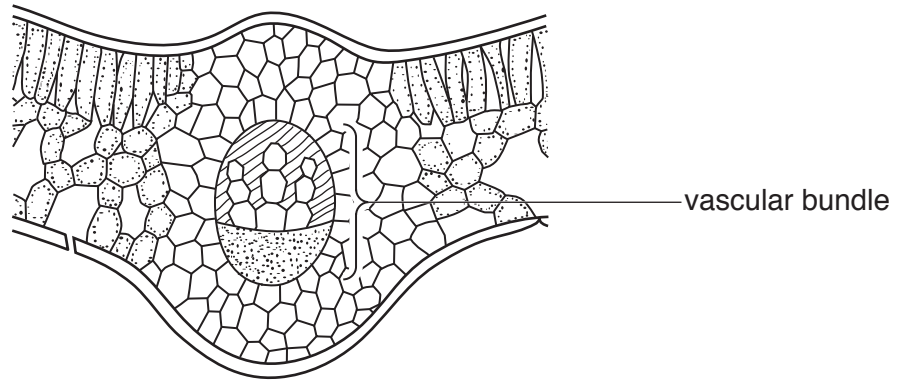


Fig. 1.2

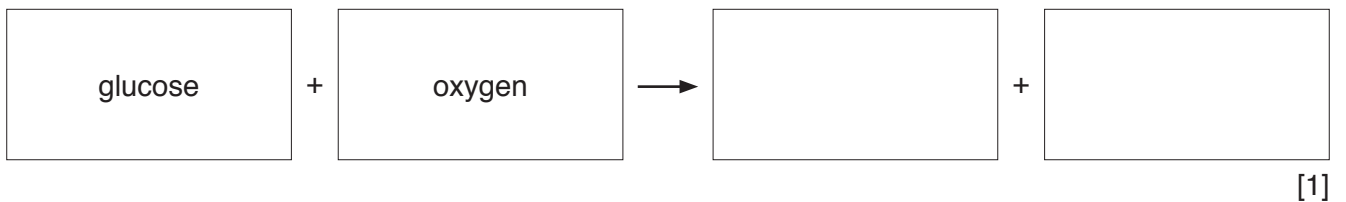
- (i) On Fig. 1.2 use a label line and the letter **X** to label any part of the xylem. [1]
- (ii) On Fig. 1.2 use a label line and the letter **P** to label any part of the phloem. [1]
- (iii) State the function of the phloem.

..... [1]

(c) Glucose and oxygen are produced by cells in the leaves during photosynthesis.

Plant cells can use these products to carry out respiration.

Complete the word equation for respiration.



(d) State **two** uses for the energy released by respiration in the bodies of humans.

1.
2. [2]

[Total: 9]

- 2 (a) The composition of clean air is shown in Fig. 2.1.

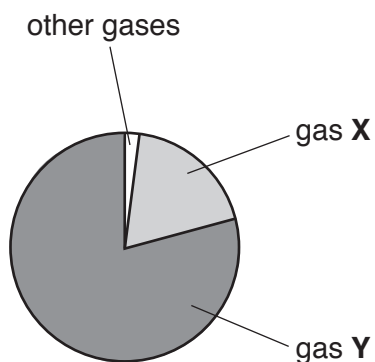


Fig. 2.1

Methane, carbon dioxide and water vapour are three of the other gases.

Identify gas X and gas Y.

gas X

gas Y

[2]

- (b) Methane is the main constituent of a fossil fuel.

(i) Name this fossil fuel.

..... [1]

(ii) State the formula of methane.

[1]

.....

(iii) State the name of the group of saturated hydrocarbons that includes methane.

..... [1]

(iv) Identify the products of the complete combustion of methane.

..... and [1]

- (c) Compound **X** contains only calcium, carbon and oxygen.

When it is heated it decomposes to form carbon dioxide and calcium oxide.

Identify compound **X**.

..... [1]

- (d) Describe a chemical test for water and state the result that shows the presence of water.

test

result [2]

[Total: 9]

3 Fig. 3.1 shows a whale swimming underwater.

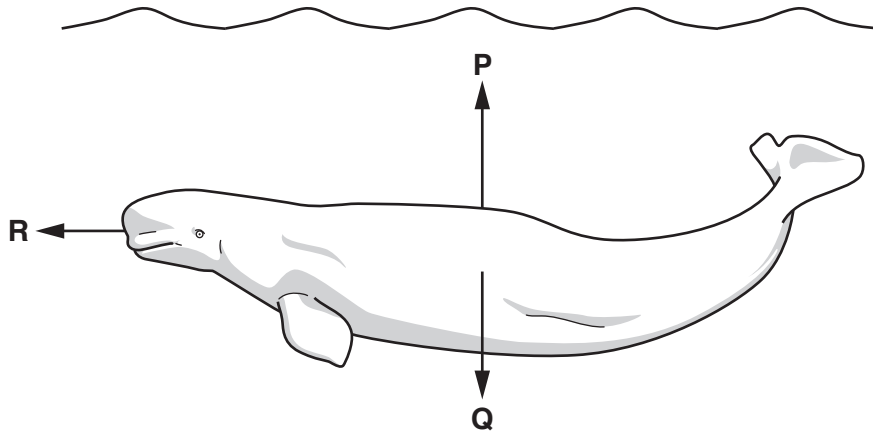


Fig. 3.1

- (a) (i) The force arrows labelled **P** and **Q** show the vertical forces acting on the whale.

Name force **Q**.

..... [1]

- (ii) The whale is swimming at constant depth, using a force **R** to push itself forward.

On Fig. 3.1 draw a force arrow to show the frictional force opposing the motion of the whale, and label it **S**. [1]

- (iii) When force **R** is 500 N, the whale moves at a constant speed of 5.0 km/h.

State the value of force **S**.

force **S** = ... N [1]

- (iv) Force **R** decreases to 400 N. Force **P** increases.

Describe how these **two** changes affect the motion of the whale.

.....

 [2]

- (b) The whale does work against the friction of the water as it swims at a constant speed and a constant depth on a journey.

(i) State the **two** quantities needed to calculate the work done by the whale on its journey.

..... and [2]

(ii) Complete the sequence of energy changes that occur on the whale's journey.

..... energy in the whale

to energy of the whale

to **thermal** energy transferred to the water.

[2]

- (c) The whale makes a sound to call to another whale 9000 m away.

The second whale hears the call 6.0 seconds later.

Calculate the speed of sound in water.

Show your working.

speed = ... m/s [2]

[Total: 11]

- 4 (a) Fig. 4.1 is a diagram of the male reproductive system.

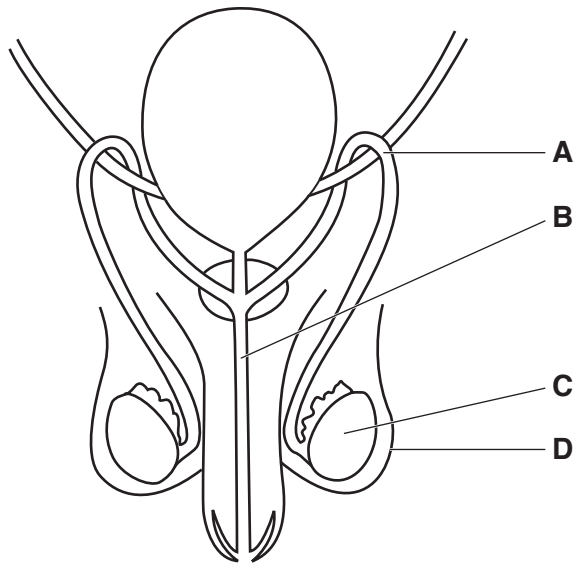


Fig. 4.1

Complete Table 4.1 to show the names and the functions of parts **A**, **B**, **C** and **D** shown in Fig. 4.1.

Table 4.1

letter of structure	name of part	function
A	sperm duct	
B		carries urine and semen out of the body
C		production of male gametes (sperm)
D	scrotum	

[4]

(b) Fig. 4.2 shows the changes to the thickness of the uterus lining during the menstrual cycle.

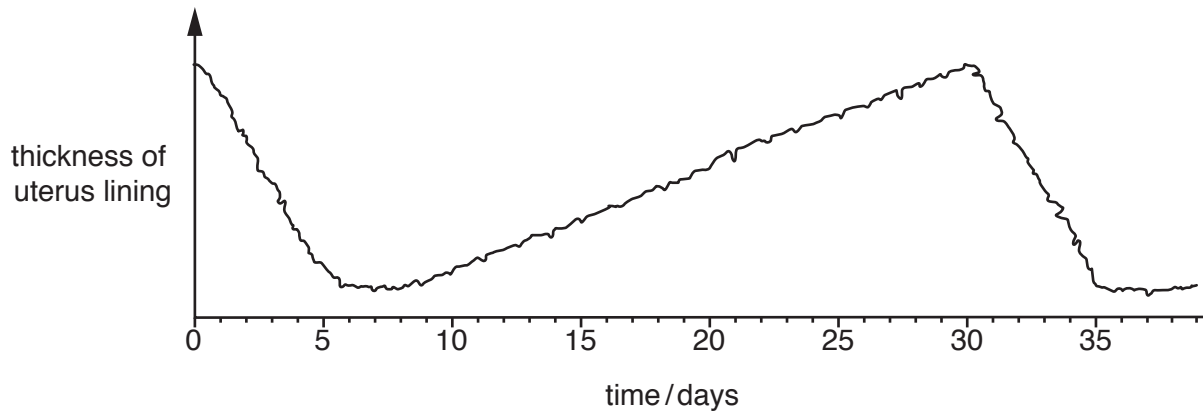


Fig. 4.2

(i) State what happens to the uterus lining during the first five days.

..... [1]

(ii) Use Fig. 4.2 to determine the number of days in a complete menstrual cycle.

number of days = ... [1]

(iii) Suggest why the uterus lining becomes thicker between days 7 and 30.

.....
 [1]

(c) Describe the process of fertilisation of a sperm cell and an egg cell.

.....
 [2]

[Total: 9]

- 5 A student investigates the reactivities of four metals, calcium, magnesium, tin and zinc.

She reacts 1 g pieces of each metal separately with excess dilute hydrochloric acid.

She collects and measures the gas from each reaction using a measuring cylinder, as shown in Fig. 5.1.

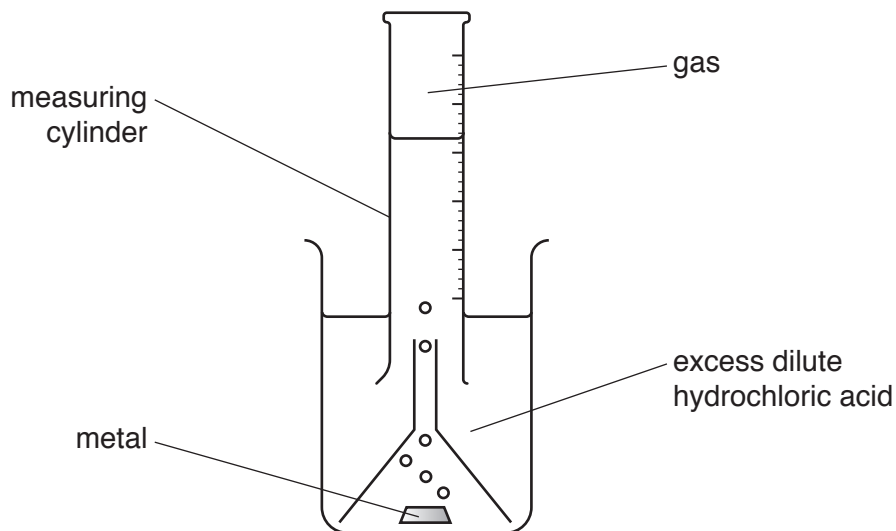


Fig. 5.1

The time taken to collect 20 cm³ of gas in each experiment is recorded in Table 5.1.

Table 5.1

metal	time taken/s
calcium	20
magnesium	55
tin	more than 300
zinc	100

- (a) (i) Deduce the order of reactivity of the four metals, calcium, magnesium, tin and zinc, from most reactive to least reactive.

..... most reactive

 least reactive

[2]

- (ii) Suggest **two** changes that can be made to increase the rate of reaction of a metal with hydrochloric acid.

1.

2.

[2]

- (b) (i) Identify the gas produced when zinc reacts with dilute hydrochloric acid.

..... [1]

- (ii) Fig. 5.2 shows some gases and tests for gases.

The boxes on the left show the gases. The boxes on the right show the tests.

gas	test
ammonia	glowing splint
carbon dioxide	damp red litmus paper
oxygen	limewater

Fig. 5.2

On Fig. 5.2 draw **one** line from each gas to the test used for the gas. [2]

- (c) The four metals, calcium, magnesium, tin and zinc, have high melting points and high boiling points.

Suggest **two** other physical properties of these metals.

1.

2.

[2]

[Total: 9]

- 6 Fig. 6.1 shows an electrical device used in kitchens to kill insects. Insects can spread disease by contaminating food.

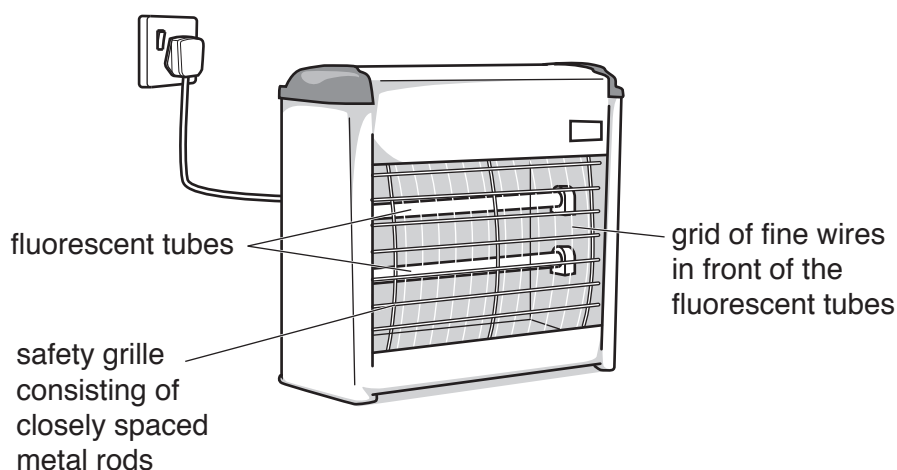


Fig. 6.1

The device is connected to the electricity supply.

- (a) The two fluorescent tubes emit both visible light and ultraviolet radiation. This attracts insects to the device.

- (i) Fig. 6.2 shows an incomplete electromagnetic spectrum.

	X-rays				micro-waves	radio waves
--	--------	--	--	--	-------------	-------------

Fig. 6.2

On Fig. 6.2 place visible light and ultraviolet radiation in their correct boxes in the spectrum. [2]

- (ii) The level of ultraviolet radiation emitted by the device is kept as low as possible when the device is used where people are present.

Explain why this precaution is needed.

.....

.....

..... [2]

- (b) Fig. 6.1 shows a grid of fine wires in front of the two fluorescent tubes. The insects have to fly between the wires as they go towards the light.

A potential difference of 2000 V exists between each pair of wires.

When an insect touches a pair of wires, an electrical circuit is completed. An electric current flows through the insect.

- (i) State what is meant by *electric current*.

..... [1]

- (ii) The current in the wires when an insect touches them and completes the circuit is 0.5 A.

Calculate the resistance of the insect.

Show your working and state the unit of your answer.

resistance = ... unit [3]

- (c) Suggest one safety hazard when operating any electrical device in a kitchen.

.....
 [1]

[Total: 9]

- 7 (a) Cell membranes are partially permeable. They allow small molecules to pass through by diffusion, but not large molecules.

Underline **one** molecule from the list of molecules which can diffuse across a cell membrane.

cellulose fat glycogen oxygen protein

[1]

- (b) Fig. 7.1 shows a bag which acts like a cell membrane. It is partially permeable.

The bag contains a mixture of glucose and starch solutions. The bag is placed in a beaker of water.

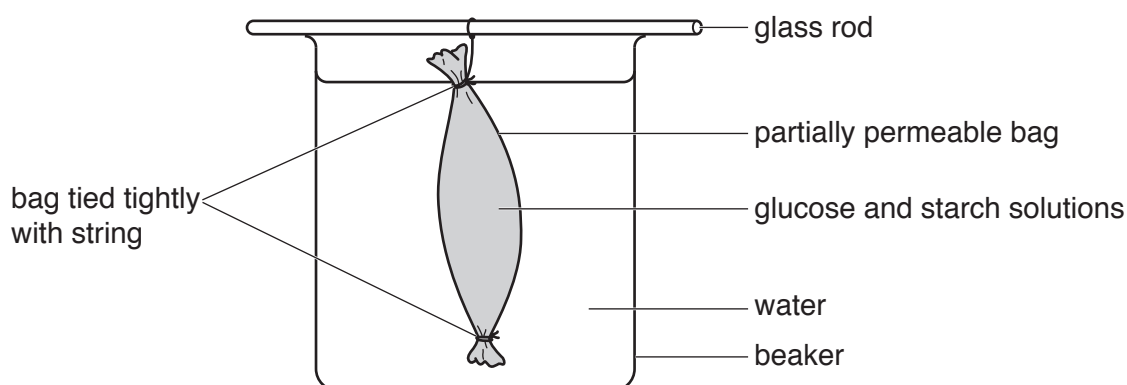


Fig. 7.1

After 30 minutes the water in the beaker is tested for starch and glucose.

The results of these tests are shown in Table 7.1.

Table 7.1

test solution	molecule tested for	result	final colour of test solution
iodine solution	starch	negative	
Benedict's solution	glucose	positive	

- (i) Complete Table 7.1 with the final colour of the test solutions. [2]

- (ii) State where the starch molecules are at the end of the experiment.

..... [1]

- (iii) Describe what has happened to the glucose molecules during the experiment.

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

- (iv) Use the information in Table 7.1 to compare the sizes of the glucose molecule and the starch molecule.

Explain your answer.

sizes of molecules
explanation
.....
..... [2]

- (c) The plasma is the component of blood which carries soluble nutrients around the body.

Name **one** other substance that is transported by the plasma.

..... [1]

[Total: 9]

- 8 (a) An atom of aluminium is represented by the symbol:



State the number of protons and the number of neutrons in this atom.

protons

neutrons

[2]

- (b) Aluminium is extracted from aluminium oxide.

Aluminium oxide is obtained from the ore bauxite.

- (i) State the method of extraction used.

..... [1]

- (ii) State the type of bonding in aluminium oxide.

..... [1]

- (iii) Suggest **one** reason, other than cost, why aluminium is recycled.

.....
 [1]

- (c) Copper forms coloured compounds, but aluminium does not.

Explain this observation.

.....
 [1]

- (d) Copper is extracted from copper oxide by heating with a non-metallic element.

- (i) Name this non-metallic element.

..... [1]

- (ii) State whether the copper oxide is oxidised or reduced during this process.

Explain your answer.

copper oxide is

explanation

..... [1]

[Total: 8]

- 9 Fig. 9.1 shows a laboratory water-bath used to keep experiments at a constant temperature.

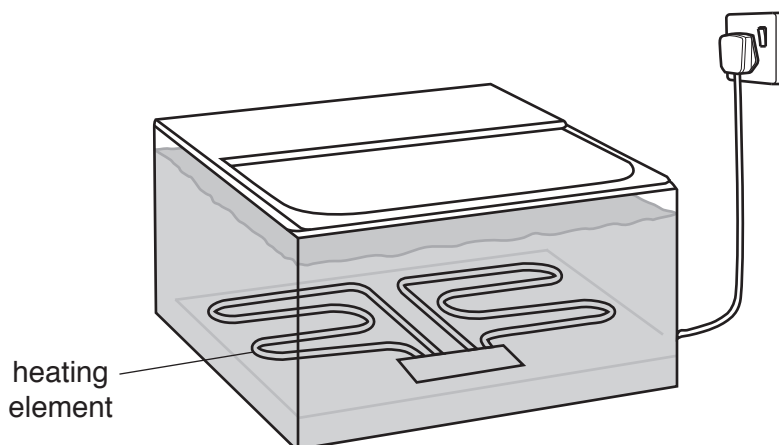


Fig. 9.1

The water is heated by an electric heating element at the bottom of the water-bath.

Fig. 9.2 shows the structure inside the tube of the heating element.

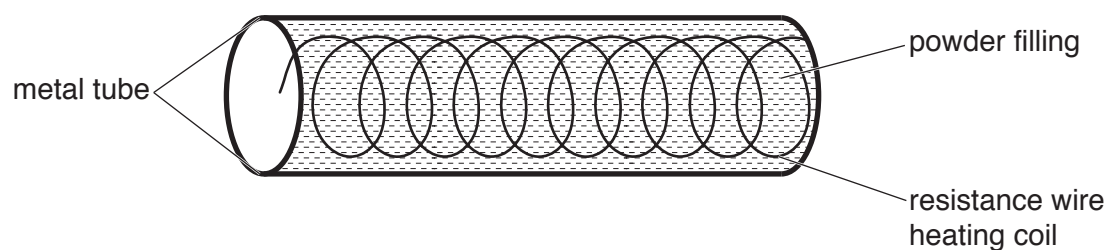


Fig. 9.2

- (a) The water-bath is filled with cold water at 10°C . The heating element is turned on to heat the water to 40°C .
- (i) State the electrical property that the powder surrounding the hot resistance wire should have.

..... [1]

- (ii) Explain why the powder filling must be a good thermal conductor.

.....

.....

..... [1]

- (iii) Describe how the thermal energy is transferred by the water to raise the water temperature to 40 °C.

.....

.....

.....

.....

..... [2]

- (b) The electrical circuit in the water-bath contains a switch, a heater and a fuse.

- (i) On Fig. 9.3 complete the circuit diagram for the water-bath, including the symbols for a switch and a fuse.

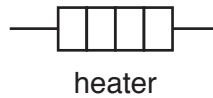
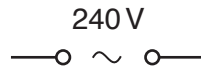


Fig. 9.3

[2]

- (ii) The current through the heater when switched on is 3A. A 5A fuse is used in the circuit.

Explain why a 3A fuse would **not** be suitable for use in this circuit.

.....

..... [1]

[Total: 7]

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Group																	
I	II	1 H hydrogen 1					III	IV	V	VI	VII	VIII					
		Key atomic number atomic symbol name relative atomic mass															
3 Li lithium 7	4 Be beryllium 9																
11 Na sodium 23	12 Mg magnesium 24																
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 —	118 Og oganeson —	119 Ts tennessine —	120 Nh nihonium —	121 Lr lawrencium —

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	europlum	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
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	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	mendeleevium	—
102	No	nobelium	—
103	Lr	lawrencium	—



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0653/32

May/June 2019

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 (a) Fig. 1.1 is a diagram showing five of the characteristics of living organisms.

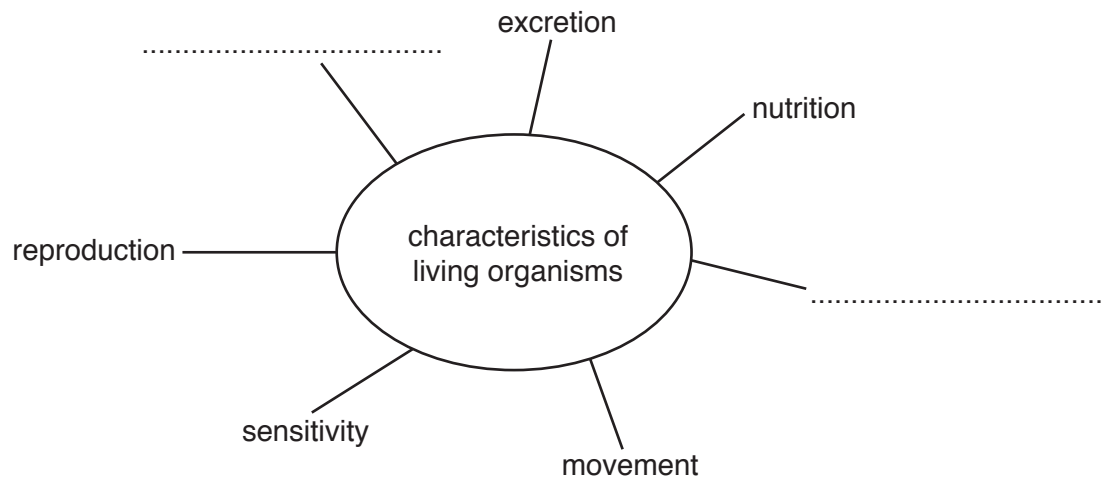


Fig. 1.1

- (i) Complete Fig. 1.1 by adding the **two** missing characteristics of living organisms. [2]
- (ii) Describe the differences in how plants and animals obtain their nutrition.

Plants obtain their nutrition by

.....

Animals obtain their nutrition by

.....

[2]

(b) Plants and animals can detect and respond to changes in their environment.

(i) Name this characteristic.

..... [1]

(ii) Use words in the list to complete the following sentences about plant responses.

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

downwards gravitropism gravity photosynthesis
phototropism sideways upwards

When a seed germinates in the soil the radicle (young root) grows

.....

This response is called When the plumule

(young shoot) is above ground it grows towards light. This response is called

.....

[3]

(c) Animals can use hormones to produce responses. An example of a hormone is adrenaline which is secreted into the blood when the body is under stress.

State **two** effects of adrenaline on the body.

1.

2.

[2]

[Total: 10]

- 2 (a) Sodium chloride is an ionic compound. It dissolves in water.

Water is a covalent compound.

- (i) State the formula of sodium chloride.

..... [1]

- (ii) Describe the formation of ionic bonds and of covalent bonds.

Use ideas about electrons in your answer.

ionic bonds

.....

.....

covalent bonds

.....

..... [2]

- (iii) Use the words *solvent*, *solute* and *solution* to describe sodium chloride, water and aqueous sodium chloride.

Sodium chloride is a

Water is a

Aqueous sodium chloride is a [2]

- (b) A student uses the apparatus shown in Fig. 2.1 for the electrolysis of concentrated aqueous sodium chloride.

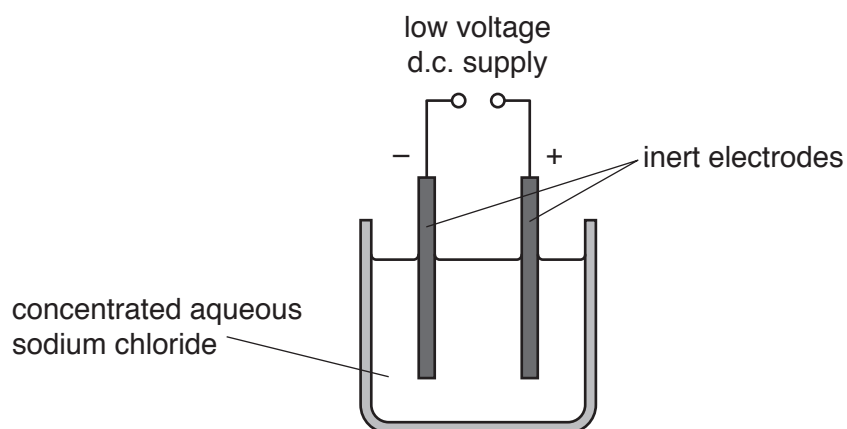


Fig. 2.1

- (i) State whether this electrolysis is a physical change or a chemical change.

Explain your answer.

change

explanation

[1]

- (ii) Name the non-metallic element used to make the inert electrodes.

[1]

- (iii) Name the positive and the negative electrodes.

positive

negative

[1]

- (iv) During this electrolysis two gases are produced.

Identify the gases produced at the positive and at the negative electrodes.

positive

negative

[2]

[Total: 10]

- 3 (a) Below is a list of some types of wave.

gamma infrared microwave sound
ultraviolet visible light X-rays

State **one** wave from the list that is:

- (i) **not** an electromagnetic wave

..... [1]

- (ii) used in the transmission of satellite television

..... [1]

- (iii) can cause sunburn.

..... [1]

- (b) In some swimming pools a wave machine is used to generate water waves.

Fig. 3.1 shows how the machine's electric motor moves a large paddle backwards and forwards in the water to make the waves.

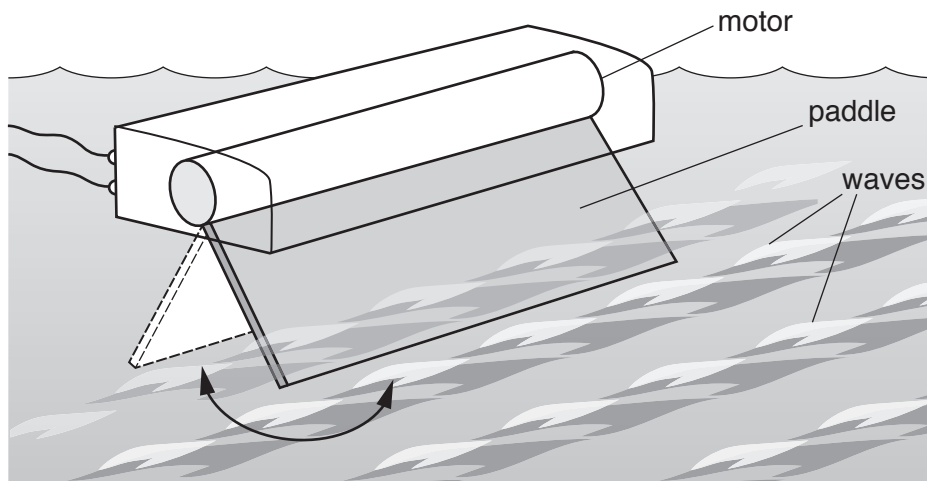


Fig. 3.1

Fig. 3.2 shows part of the circuit diagram for the electric motor.

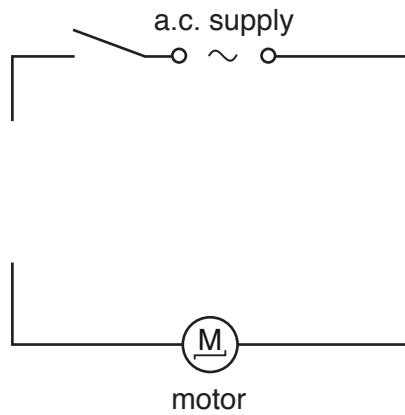


Fig. 3.2

On Fig. 3.2 complete the circuit diagram by adding the circuit symbols for:

1. an ammeter to measure the current through the motor
2. a circuit component that enables the value of the current in the circuit to be changed
3. a voltmeter to measure the voltage of the a.c. supply. [4]

(c) The motor speed is increased so the paddle moves faster.

Suggest **one** effect this will have on the waves produced by the paddle.

..... [1]

[Total: 8]

- 4 (a) When a banana is peeled the exposed surface turns from white to brown, as shown in Fig. 4.1.

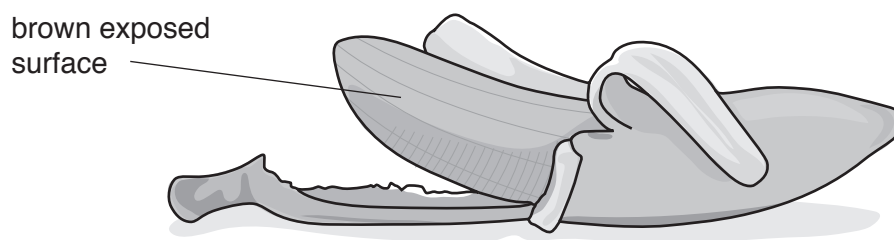


Fig. 4.1

A banana is cut into four equal slices. The slices are treated as shown in Fig. 4.2 and left in dishes on a laboratory bench for 30 minutes.

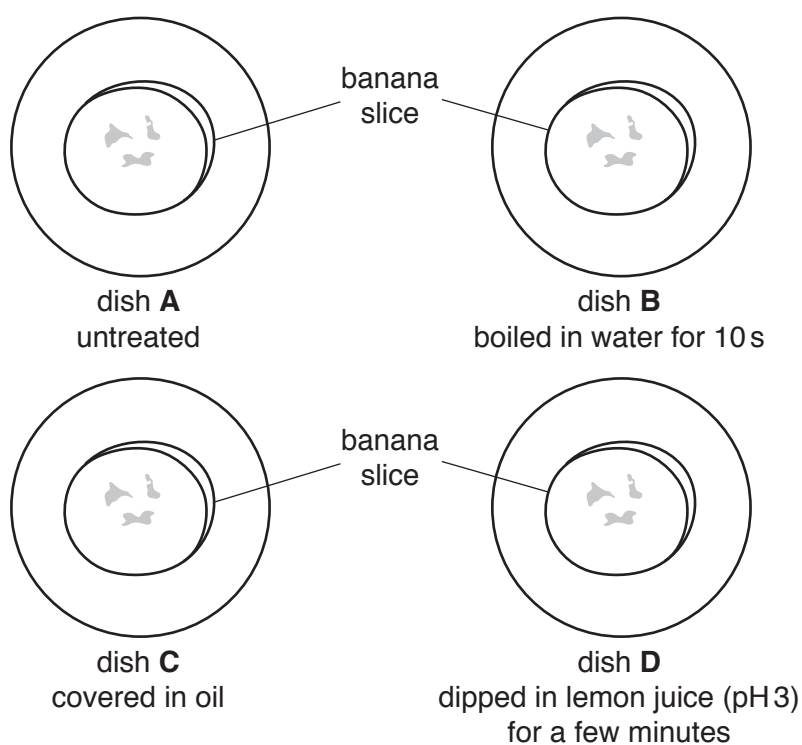


Fig. 4.2

The results are shown in Table 4.1.

Table 4.1

dish	colour of banana after 30 minutes
A	changes from white to brown
B	stays white
C	stays white
D	stays white

- (i) Oxygen in the air is needed for a banana slice to change colour from white to brown.

Explain this using evidence from dish **C** in Fig. 4.2, and Table 4.1.

.....

 [2]

- (ii) An enzyme is also needed for a banana slice to change colour from white to brown.

Explain this using evidence from dish **B** in Fig. 4.2 and Table 4.1.

.....

 [2]

- (iii) Suggest why the banana does not go brown in dish **D**.

.....
 [1]

- (b) When a boy eats the banana, it tastes sweet because it contains reducing sugar.

Describe the test for reducing sugar, and state the positive result.

test

result

[2]

[Total: 7]

- 5 (a) Petroleum contains hydrocarbons. These are separated into useful fractions by fractional distillation, as shown in Fig. 5.1.

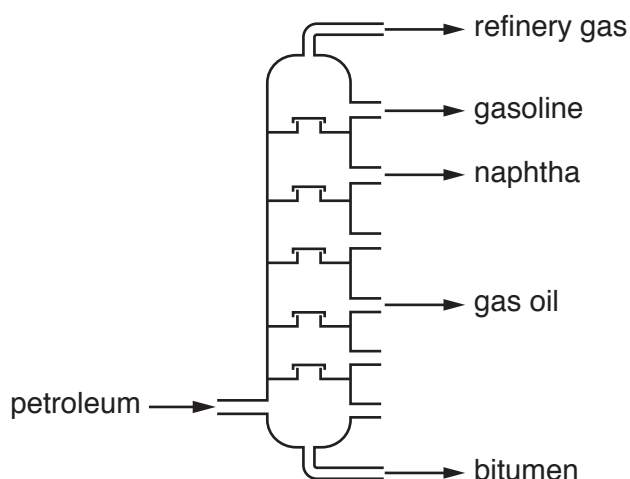


Fig. 5.1

- (i) Identify a fraction shown in Fig. 5.1 used for fuel in cars.
 [1]
- (ii) Identify a fraction shown in Fig. 5.1 used for bottled gas for heating and cooking.
 [1]
- (b) (i) Name the type of hydrocarbon which contains only single bonds.
 [1]
- (ii) Identify the products of the complete combustion of hydrocarbons.
 and [1]
- (c) Compound **X** is made from large hydrocarbon molecules in a reaction called cracking.
 Compound **X** reacts with aqueous bromine, changing it from orange to colourless.
 Molecules of compound **X** join together to form a polymer.
- (i) Suggest the identity of compound **X**.
 [1]
- (ii) State the type of polymerisation in which molecules of compound **X** form a polymer.
 [1]

(d) Hydrocarbon molecules contain atoms of the elements carbon and hydrogen only.

(i) A carbon atom has 6 electrons.

Complete Fig. 5.2 to show the electronic structure of this carbon atom.

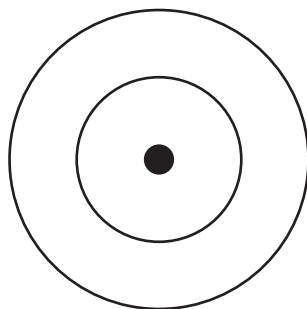


Fig. 5.2

[1]

(ii) Complete the dot-and-cross diagram in Fig. 5.3 to show the covalent bond in a molecule of hydrogen gas, H_2 .



Fig. 5.3

[1]

(iii) State why covalent bonds, rather than ionic bonds, form between carbon atoms and hydrogen atoms.

.....

..... [1]

[Total: 9]

- 6 (a) Fig. 6.1 shows the Celsius temperature scale from -273°C up to 300°C .

Six points on the scale are labelled **A**, **B**, **C**, **D**, **E** and **F**.

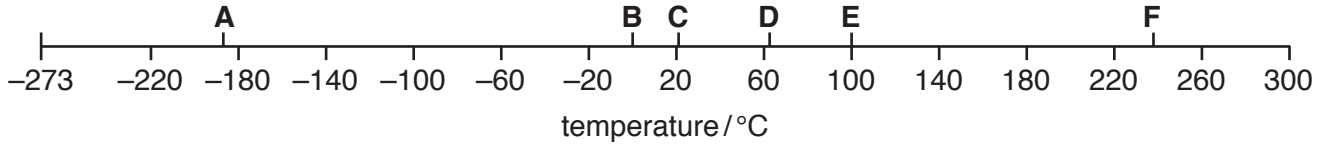


Fig. 6.1

On Fig. 6.2 draw lines to link each description to the letter showing the correct temperature in Fig. 6.1. One has been done for you.

description	temperature
	A
melting point of ice	B
room temperature	C
boiling point of liquid air	D
boiling point of water	E
	F

Fig. 6.2

[3]

- (b) Fig. 6.3 and Fig. 6.4 show two different kinds of thermometer.

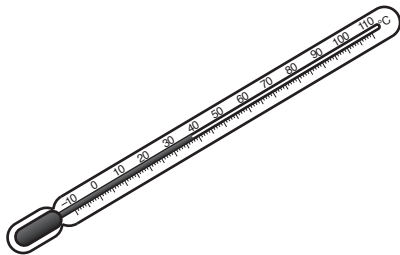


Fig. 6.3

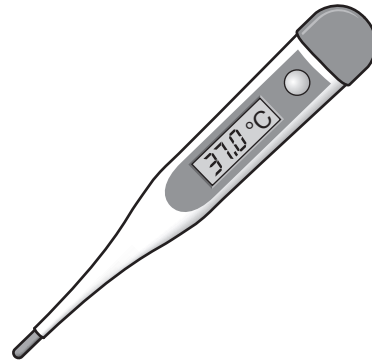


Fig. 6.4

- (i) Describe the property of liquids that is used in the thermometer in Fig. 6.3.

.....
 [1]

- (ii) The thermometer in Fig. 6.4 uses electrical properties to measure temperature.

Suggest an electrical property of materials that might change with temperature and so be used to measure temperature.

..... [1]

- (c) The temperature at the surface of the Sun is nearly 6000°C , so it is losing a lot of energy into space all the time.

- (i) On Earth, people feel the thermal energy as the energy from the Sun falls on their skin.

State how energy from the Sun is transferred through space to the Earth.

..... [1]

- (ii) The Sun is made of very hot gases. The centre of the Sun is hotter than the surface of the Sun.

Suggest the main method of thermal energy transfer from inside the Sun to the surface of the Sun.

Give a reason for your answer.

method

reason

..... [2]

[Total: 8]

- 7 (a) A person's balanced diet must contain all nutrients in the correct amounts according to the person's needs.

The person eats the meal shown in Fig. 7.1. The food items and the main nutrients they contain are labelled.

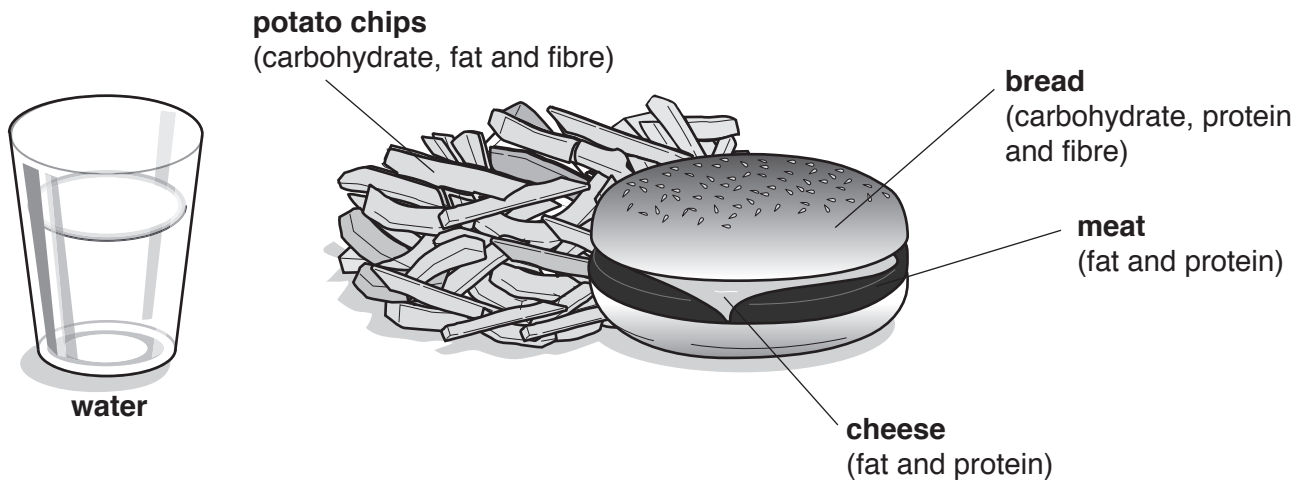


Fig. 7.1

- (i) State **two** reasons why the meal shown in Fig. 7.1 is unbalanced.

1.
 2.
- [2]

- (ii) Suggest **one** food the person can add to the meal to make it balanced.

Explain your answer.

food

explanation.....

.....

[2]

- (b) Some carbohydrates have small molecules, others have very large molecules called polymers which are made when many glucose molecules join together.

Fig. 7.2 shows a molecule of glucose, and a part of a polymer of glucose.

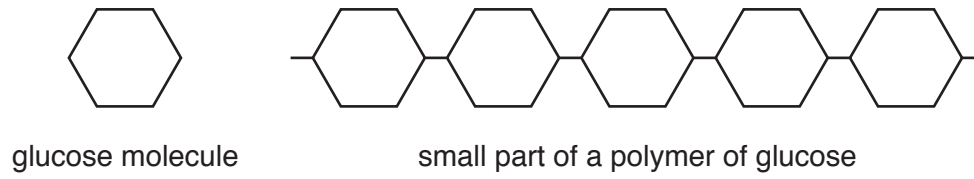


Fig. 7.2

- (i) Underline the names of **two** polymers of glucose in the list.

amino acid fat enzyme glycogen hormone
oil protein starch sugar

[2]

- (ii) Explain why chemical digestion of large molecules is needed in the alimentary canal.

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

- (iii) State **two** areas in the alimentary canal where chemical digestion takes place.

1.
2. [2]

[Total: 10]

- 8 (a) Aluminium reacts with iron oxide to form iron in an exothermic reaction.

Aluminium does not react with calcium oxide.

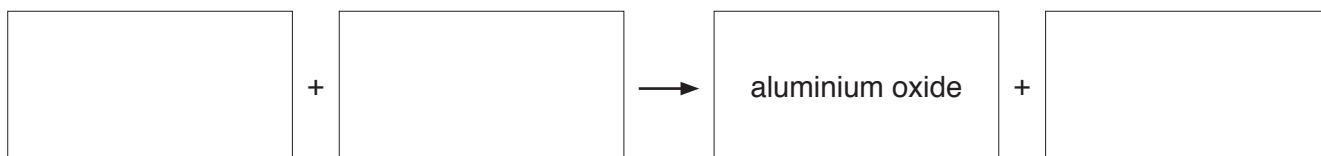
- (i) Place the three metals, aluminium, iron and calcium, in order from most to least reactive.

..... most reactive

 least reactive

[1]

- (ii) Complete the word equation for the reaction between aluminium and iron oxide.



[2]

- (iii) State whether aluminium is oxidised or reduced during this reaction.

Explain your answer.

aluminium is

explanation

.....

[1]

- (b) Copper oxide, CuO, contains copper(II) ions.

When copper oxide is mixed with carbon, there is no reaction.

- (i) State what must be done to this mixture to obtain copper.

..... [1]

- (ii) State the test for copper(II) ions.

Give the result that shows the presence of copper(II) ions.

test

result

.....

[2]

[Total: 7]

- 9 Fig. 9.1 shows a forklift truck moving a large heavy box towards a shelf.

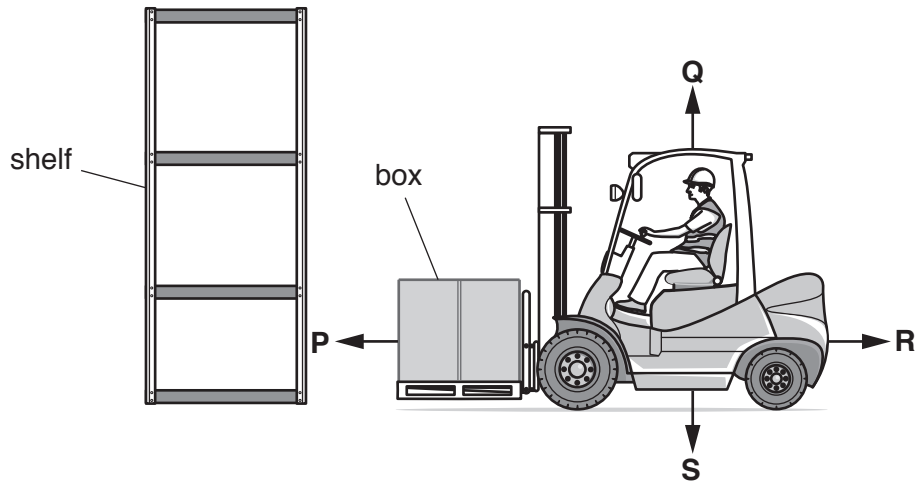


Fig. 9.1

- (a) The arrows labelled **P**, **Q**, **R** and **S** show four forces acting on the forklift truck.
- (i) State which letter represents the frictional forces acting on the moving truck.

.....

[1]

- (ii) The truck stops and the motor is switched off. State the letters of all the forces that now have a value of 0 N.

.....

[1]

- (b) The box has a mass of 500 kg.

The forklift truck lifts the box upwards from rest on the ground using a force to push the box up. Fig. 9.2 shows the directions of the forces acting on the box.

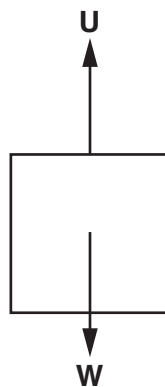


Fig. 9.2

- (i) The gravitational field strength g is 10 N/kg.

Calculate the weight **W** of the box.

W = ... N [1]

- (ii) State how the upward force **U** on the box compares with the weight **W** of the box as the box begins to move upwards.

..... [1]

- (iii) The truck lifts the box towards two shelves, one at 1 m above the ground, the other at 3 m above the ground.

Compare the work required to lift the box from the ground to the higher shelf with the work required to lift the box from the ground to the lower shelf.

Explain your answer.

.....

 [2]

- (c) The truck is driven a distance of 225 m to collect another box.

Fig. 9.3 shows the speed–time graph for this journey.

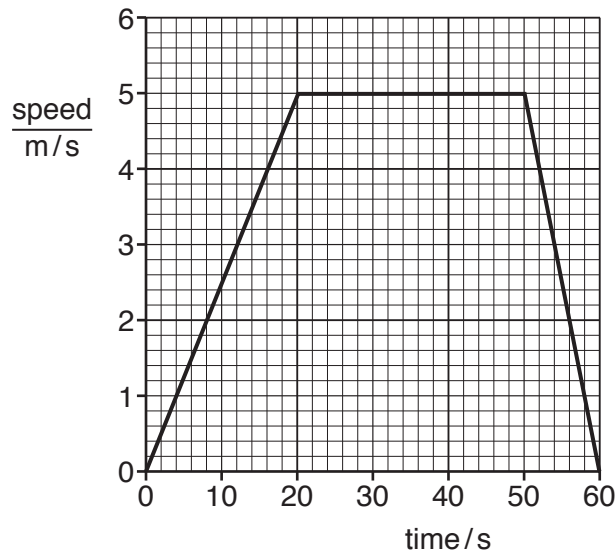


Fig. 9.3

- (i) Calculate the average speed of the truck on this journey.

Show your working.

average speed = ... m/s [2]

- (ii) Describe the motion of the truck between 0 s and 20 s.

..... [1]

- (iii) The truck is driven by an electric motor powered by a battery.

Complete the energy transfers involved.

from energy in the battery

to energy driving the motor

to kinetic energy of the truck.

[2]

[Total: 11]

The Periodic Table of Elements

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

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

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



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0653/33

May/June 2019

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 **19** printed pages and **1** blank page.

- 1 (a) Fig. 1.1 shows the human gas exchange system.

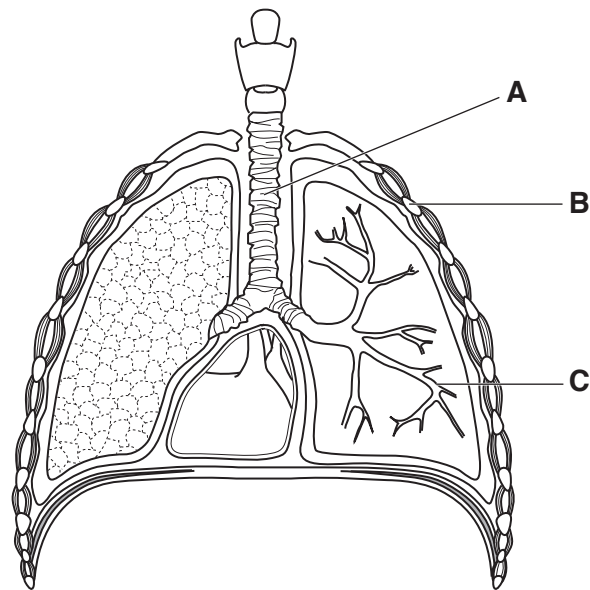


Fig. 1.1

Name structures **A**, **B** and **C** as shown in Fig. 1.1.

A

B

C

[3]

- (b) Table 1.1 shows some of the composition of inspired air and of expired air.

Table 1.1

gas	composition of air/%	
	inspired air (breathed in)	expired air (breathed out)
carbon dioxide	0.04	
nitrogen	78	78
oxygen	21	16

In Table 1.1 write the percentage of carbon dioxide in expired air.

[1]

(c) Oxygen enters the blood at the lungs.

(i) Describe how oxygen is transported in the blood.

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

(ii) Explain why **all** living cells need a supply of oxygen.

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

(d) State **two** ways in which the pattern of breathing changes during exercise.

1.
 2.
- [2]

[Total: 10]

2 Chlorine, bromine, and iodine are Group VII elements.

(a) These three elements exist as molecules.

Fig. 2.1 shows the physical states of these elements.

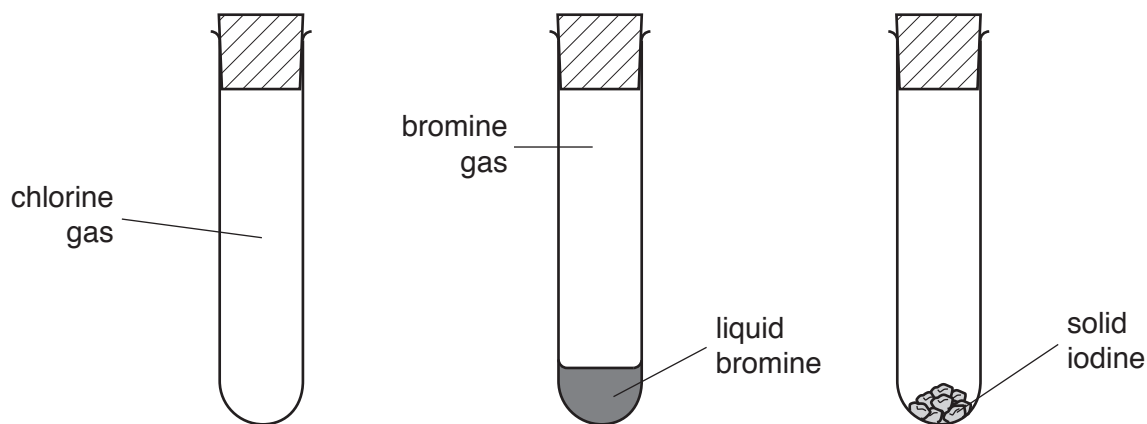


Fig. 2.1

(i) Explain what is meant by the term *molecule*.

Use ideas about atoms in your answer.

.....
 [1]

(ii) Name the change of state that occurs when liquid bromine turns into bromine gas.

..... [1]

(iii) State whether the change of state that occurs when liquid bromine turns into bromine gas is a physical change or a chemical change.

Explain your answer.

change

explanation

..... [1]

(b) Sodium reacts with chlorine in an exothermic reaction.

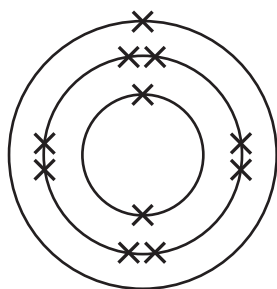
Sodium chloride, an ionic compound, is formed. This compound contains sodium ions and chloride ions.

(i) State what is meant by an *exothermic* reaction.

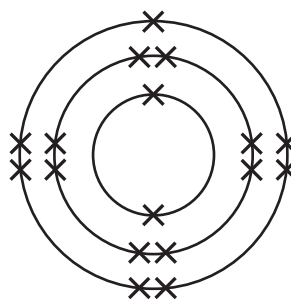
.....
 [1]

- (ii) Fig. 2.2 shows the electronic structure of a sodium atom and of a chlorine atom.

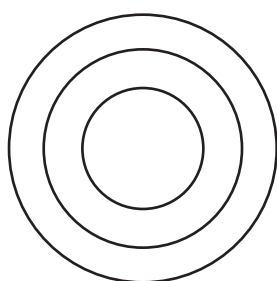
Complete Fig. 2.2 to show the electronic structure of a sodium ion and of a chloride ion.



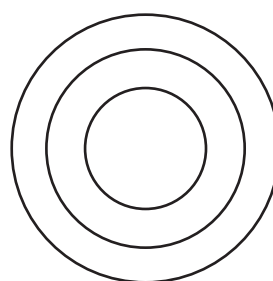
sodium atom



chlorine atom



sodium ion



chloride ion

Fig. 2.2

[2]

- (iii) Describe the electrical conductivity of solid sodium chloride and of liquid sodium chloride.

solid

liquid

[1]

- (iv) Suggest the type of chemical bond that forms between carbon atoms and chlorine atoms.

Explain your answer.

type of chemical bond

explanation

.....

[1]

[Total: 8]

- 3 Fig. 3.1 shows a boy in a swimming pool.

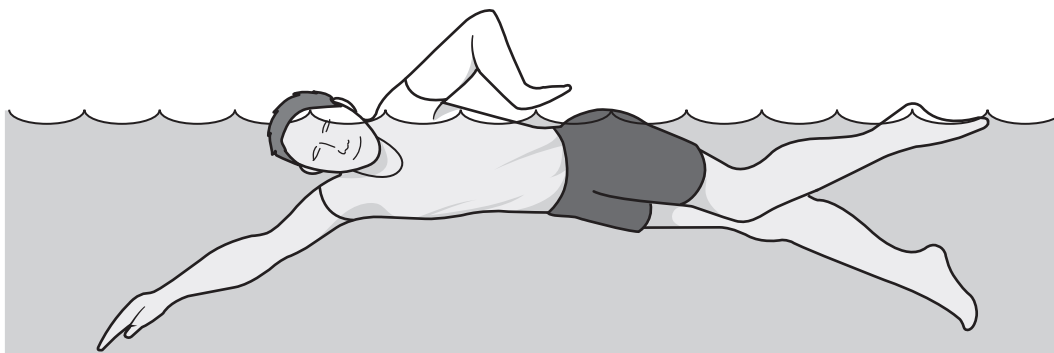


Fig. 3.1

The boy swims a length of the pool.

- (a) (i) On Fig. 3.1 draw an arrow to show the frictional force of water resistance on the boy. [1]

- (ii) He exerts a force of 40 N to swim at constant speed.

State the value of the frictional force of water resistance.

Give a reason for your answer.

force = ... N

reason

.....

[1]

- (b) The boy swims at a speed of 0.80 m/s.

Calculate the time taken by the boy to swim 25 m at this speed.

Show your working.

time = ... s [2]

(c) Fig. 3.2 shows a speed–time graph for another swimmer.

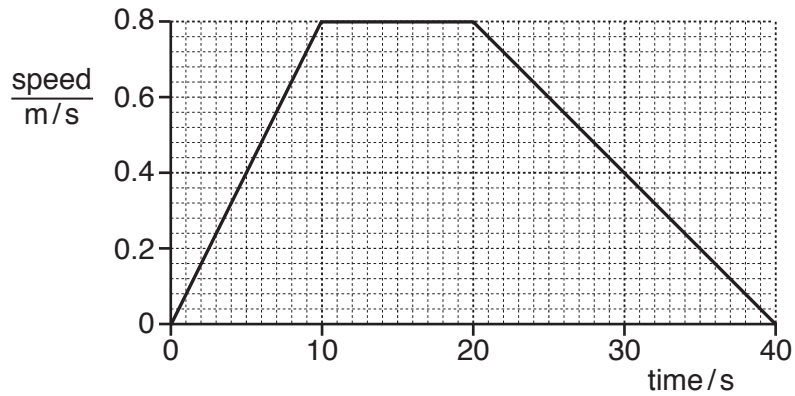


Fig. 3.2

Describe the motion of the swimmer between 10 s and 40 s.

.....

.....

..... [2]

(d) The time taken by the swimmer in (c) is measured by an electronic stop-clock. The stop-clock is stopped when the swimmer crosses a beam of infrared radiation.

(i) Suggest **one** reason why X-rays would not be suitable for this purpose.

.....

..... [1]

(ii) Fig. 3.3 shows the electromagnetic spectrum.

On Fig. 3.3 write infrared radiation in its correct place in the spectrum.

	X-rays		visible light			radio waves
--	--------	--	------------------	--	--	----------------

Fig. 3.3

[1]

[Total: 8]

- 4 (a) Fig. 4.1 shows some leaves of the plant *Mimosa pudica*.

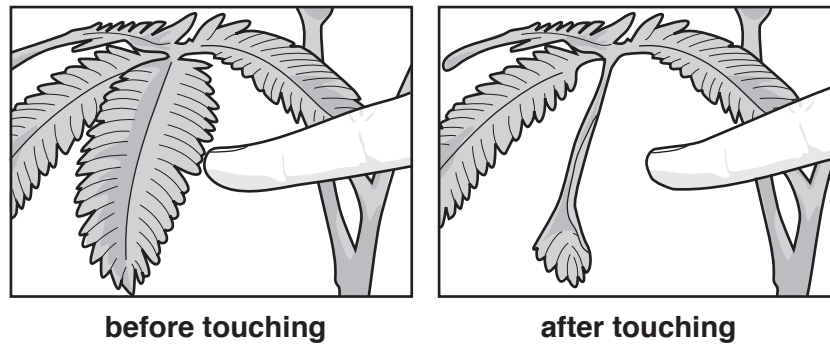


Fig. 4.1

When a person touches a leaf, the leaf closes within three seconds.

- (i) State which **two** characteristics of living things are being shown by the leaf after it is touched.

1.
2.
- [2]

- (ii) Predict how the rate of photosynthesis is affected by leaves showing the response in Fig. 4.1.

Explain your answer.

prediction

explanation

.....

[1]

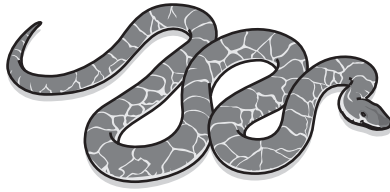
(b) (i) Fig. 4.2 shows some organisms found in a field.



mouse (primary consumer)



badger (tertiary consumer)



snake (secondary consumer)



wheat (producer)

Fig. 4.2

Draw a food chain of the four organisms. You do not need to include the pictures.

[2]

(ii) Name a carnivore and a herbivore from the organisms shown in (b)(i).

carnivore

herbivore

[2]

(c) State the principal source of energy for the food chain you wrote in (b)(i).

..... [1]

[Total: 8]

5 (a) Calcium hydroxide, a base, is used to control the acidity of soil.

(i) Describe the effect of calcium hydroxide on the pH value of acid soil.

..... [1]

(ii) On Fig. 5.1 complete the word equation for the reaction between calcium hydroxide and dilute sulfuric acid.

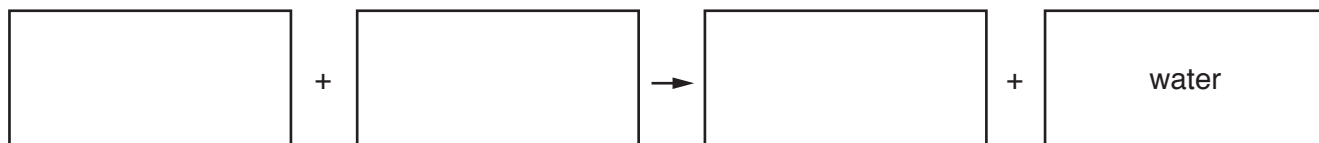


Fig. 5.1

[2]

(iii) Describe the test for aqueous calcium ions, Ca^{2+} .

State the result that shows the presence of calcium ions.

test

result

..... [2]

(b) A student makes pure crystals of copper sulfate.

She adds excess copper oxide powder to dilute sulfuric acid.

A blue solution of copper sulfate forms.

(i) Explain why excess copper oxide is used.

..... [1]

(ii) Describe how she separates the unreacted copper oxide powder from the blue solution.

..... [1]

(iii) State **two** processes that she uses to obtain crystals of copper sulfate from the blue solution.

1.

2.

[2]

[Total: 9]

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- 6 (a) Complete the sentences using words from the list.

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

atoms boils evaporates faster molecules slower

On a warm day, sea-water as energy from the Sun makes water move and escape from the surface. [2]

- (b) Fig. 6.1 shows a cylinder of compressed air (air at high pressure) used by scuba divers in the sea.



Fig. 6.1

The air at high pressure in the cylinder is at the same temperature as the air in the room.

Describe how the arrangement and movement of the gas molecules in the cylinder compares with the arrangement and movement of the gas molecules in air in the room.

arrangement

.....

movement

.....

[2]

- (c) (i) State the approximate lowest frequency of human hearing in air. Give the unit of your answer.

frequency = ... unit [2]

- (ii) Scuba divers are said to be able to hear sounds with a higher frequency underwater than humans can normally hear in air.

Suggest a value for a frequency which a scuba diver might be able to hear underwater, but not in air.

..... [1]

- (d) Scuba divers use underwater torches (flashlights) when diving in caves.

Fig. 6.2 shows a design for an underwater torch (flashlight) to produce a parallel beam of light using a lamp and a converging lens of focal length 3 cm.

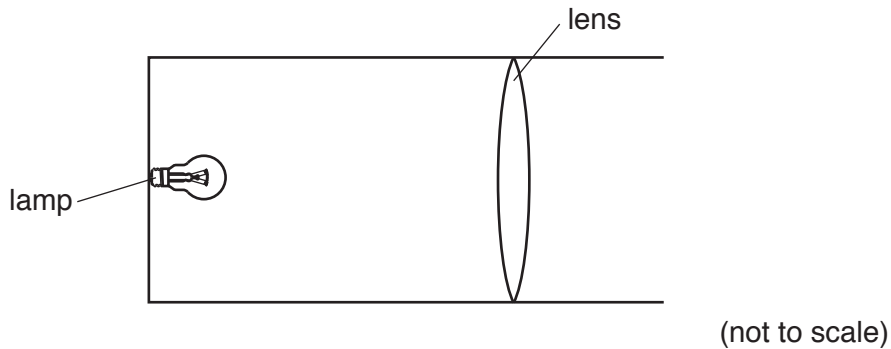


Fig. 6.2

- (i) State the distance that the lens should be placed from the lamp.

Give a reason for your answer.

distance = ... cm

reason

..... [1]

- (ii) On Fig. 6.2, draw **two** rays to show how the lamp produces a parallel beam of light. [1]

[Total: 9]

- 7 (a) Fig. 7.1 is a simplified diagram which shows the human alimentary canal.

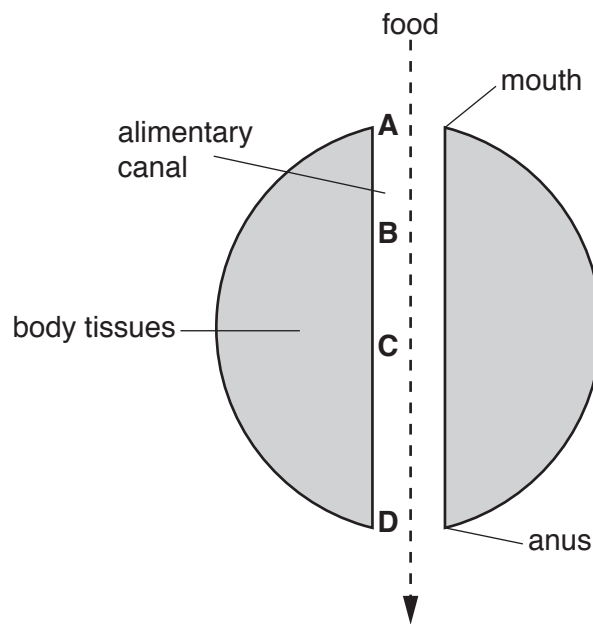


Fig. 7.1

The alimentary canal is a tube going through the body from mouth to anus. The tube is surrounded by body tissues.

The letters **A**, **B**, **C** and **D** show the basic stages of digestion of food.

On Fig. 7.2 the boxes on the left show the letters of the stages of digestion of food as shown in Fig. 7.1.

The boxes in the middle show the names of these stages.

The boxes on the right show descriptions of what is happening to the food.

Draw **one** line to link each letter with its stage, and draw **one** line to link each stage with its description. Stage **B**, digestion, is done for you.

letter of stage	name of stage	description
A	absorption	faeces leave the body
B	digestion	food is taken into the body
C	egestion	insoluble food molecules are broken down
D	ingestion	soluble food molecules enter the blood

Fig. 7.2

[3]

(b) Describe the function of the gall bladder.

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

(c) (i) State what is meant by the term *balanced diet* for humans.

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

(ii) State why proteins are needed as part of a balanced diet.

..... [1]

(iii) Describe the chemical test for protein, and the colour of the positive result.

chemical test
colour of positive result
[2]

[Total: 9]

8 (a) When zinc oxide is heated with carbon, zinc and carbon dioxide are formed.

(i) State the type of chemical reaction that occurs when zinc loses oxygen.

..... [1]

(ii) Suggest **one** effect on the reaction between zinc oxide and carbon of using a lower temperature.

..... [1]

(iii) Explain why argon, a Group VIII gas, does not react with zinc oxide.

..... [1]

(b) When aluminium oxide is heated with carbon, there is no reaction.

Explain why aluminium oxide does not react with carbon.

Use ideas about the reactivity series in your answer.

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

(c) (i) Name the ore from which aluminium is extracted.

..... [1]

(ii) State the method used to extract aluminium.

..... [1]

(d) Iron is a transition element.

Sodium is a Group I element.

Describe **one** difference and **one** similarity between the physical properties of iron and of sodium.

difference

.....

similarity

..... [2]

- (e) Recycled metals can cost less than metals extracted from their ores.

Suggest **one other** reason why metals are recycled.

.....

..... [1]

[Total: 9]

- 9 Fig. 9.1 shows an electricity line supplying a voltage of 11 000 V.

Fig. 9.2 shows a battery which supplies a voltage of 24 V.

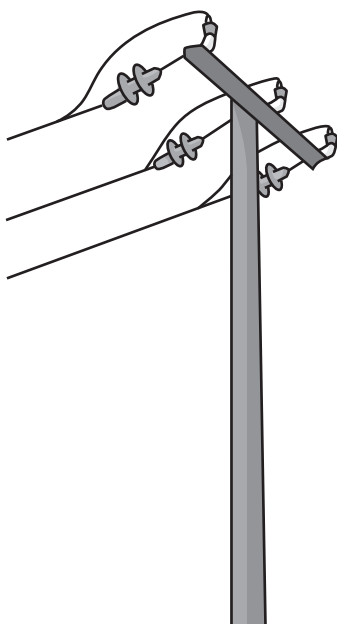


Fig. 9.1

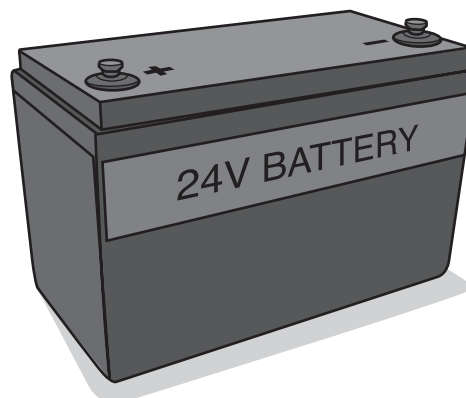


Fig. 9.2

- (a) The electricity supply line has a warning notice about the 11 000 V, but there is no warning on the 24 V battery.
- (i) State the electromotive force (e.m.f.) of the battery.

e.m.f. = ... [1]

- (ii) Suggest why the electricity supply line has a warning notice, but the battery does not.

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

- (b) A man's hand touches a live electric cable at a voltage of 240 V. A current of 0.0050 A flows through his body to the ground, and he receives an electric shock.

- (i) Calculate the electrical resistance of the man's body.

Show your working.

resistance = ... Ω [2]

- (ii) Explain why he might not have received a shock if he had been wearing rubber gloves.

.....
 [1]

- (c) The battery in Fig. 9.2 is used to power two lamps and an electric motor that drives a vehicle.

The vehicle can be driven by the motor without switching on the lamps.

Fig. 9.3 shows part of the circuit in the vehicle.

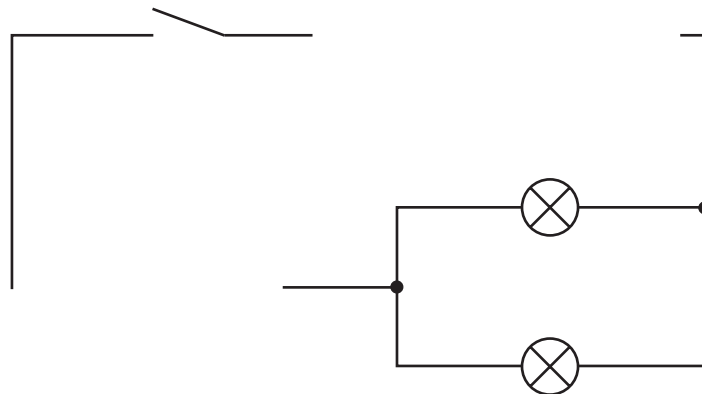


Fig. 9.3

Complete the circuit by adding the correct symbols and connecting wires for:

- the battery
- an electric motor with a switch to control the motor only
- a switch that will turn both lamps on and off but not affect the motor.

The symbol for an electric motor is —  — .

[4]

[Total: 10]

The Periodic Table of Elements

Group																		
I	II											III	IV	V	VI	VII	VIII	
</																		

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