



CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

0653/31

May/June 2021

1 hour 15 minutes

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

DC (PQ/CT) 208342/2
© UCLES 2021

[Turn over

- 1 (a) The boxes on the left show characteristics of living organisms.
The boxes on the right show some definitions of characteristics.

Draw one straight line from each characteristic to its correct definition.

characteristic	definition
excretion	responding to change
	removing waste from the body
nutrition	permanent increase in size
	taking in materials for energy
sensitivity	

[3]

- (b) Respiration is another characteristic of living organisms.
Aerobic respiration needs oxygen.

Complete these sentences to describe how oxygen from the air gets into the blood of a human.

As we breathe in, air passes from our bronchioles into the of the lungs.

The oxygen in this air then moves into red blood cells by the process of

[2]

- (c) Organisms are made up of cells.

Fig. 1.1 is a photomicrograph of an animal cell.

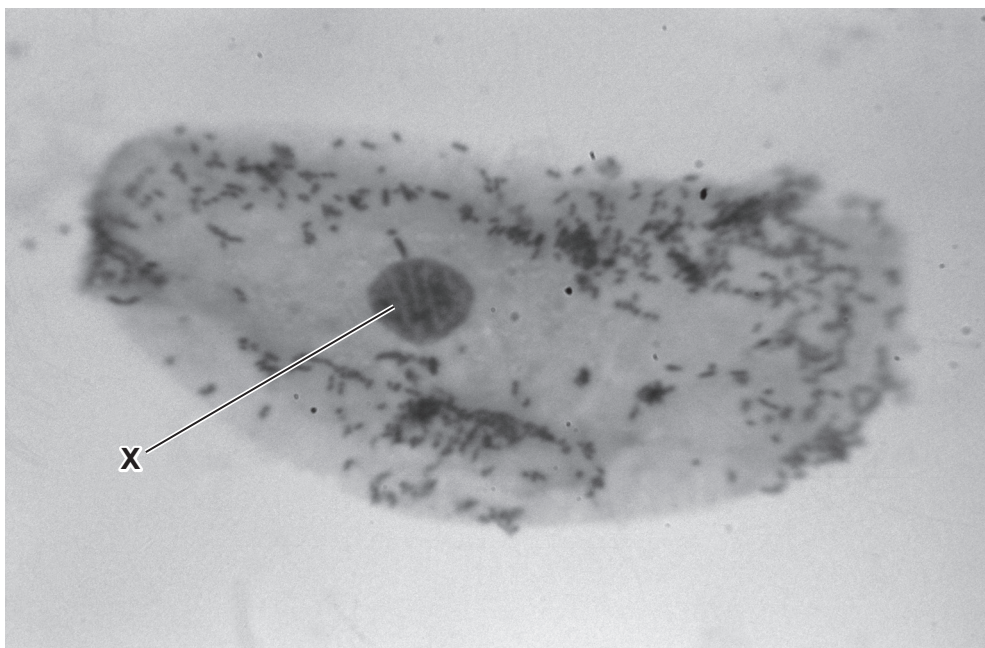


Fig. 1.1

- (i) Identify the part labelled **X** in Fig. 1.1.

..... [1]

- (ii) State **two** pieces of evidence from the cell in Fig. 1.1 that show it is **not** a plant cell.

1

2 [2]

[Total: 8]

- 2 (a) Fig. 2.1 shows part of Group I of the Periodic Table.

3 Li lithium 7
11 Na sodium 23
19 K potassium 39

Fig. 2.1

- (i) State the trend in the reactivity of the elements going down Group I.
 [1]
- (ii) Explain why lithium does **not** react with helium, a Group VIII element.

 [1]
- (iii) Lithium is a solid and helium is a gas.
 Describe **two** differences between the structures of a solid and a gas.
- 1

- 2
 [2]

- (b) A piece of sodium is added to water, as shown in Fig. 2.2.

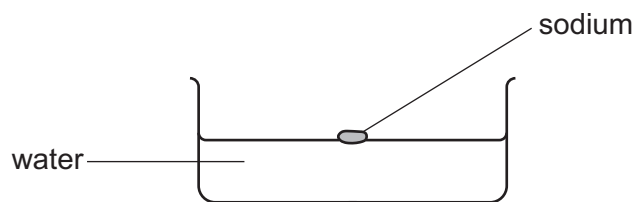


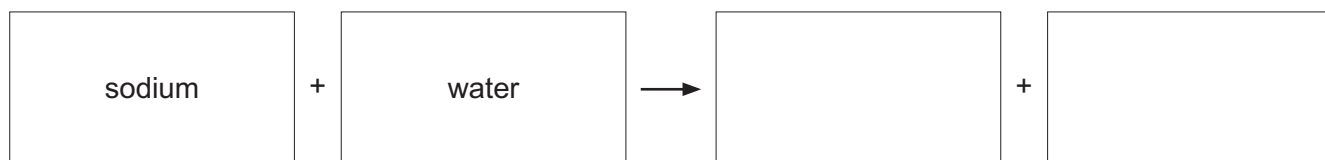
Fig. 2.2

The sodium reacts with water. The reaction is exothermic.

- (i) State one **other** observation that is seen when sodium reacts with water.

..... [1]

- (ii) Complete the word equation for the reaction of sodium with water.



[2]

- (c) **X** is a compound that reacts with dilute hydrochloric acid to form sodium chloride and water.

Suggest the identity of **X**.

..... [1]

- (d) Concentrated aqueous sodium chloride is broken down by electrolysis.

- (i) State the type of chemical bond in sodium chloride.

..... [1]

- (ii) Identify the product that forms at the anode (positive electrode).

..... [1]

[Total: 10]

- 3 (a) State the name of the particles that flow in an electric current in a metal wire.

..... [1]

- (b) Fig. 3.1 shows an incomplete circuit diagram.

- (i) Complete the circuit diagram by adding:

- an ammeter to measure the current in the lamp
- a voltmeter to measure the potential difference across the lamp.

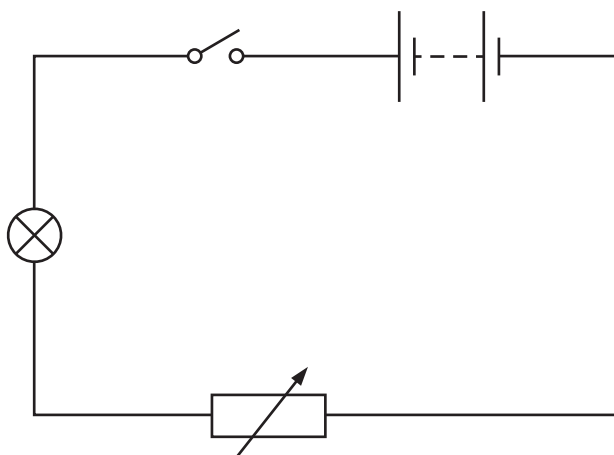


Fig. 3.1

[3]

- (ii) When the variable resistor is adjusted, the brightness of the lamp changes. Explain why this happens.

.....

 [2]

- (iii) The lamp has a resistance of $20\ \Omega$. The current in the lamp is 0.5 A .

Calculate the potential difference (p.d.) across the lamp.

p.d. = ... V [2]

- (iv) A second lamp of resistance 20Ω is connected in parallel with the first lamp.

State the effect this has on the total resistance of the circuit.

..... [1]

[Total: 9]

- 4 (a) A student investigates the effect of temperature on enzyme activity.

They use an enzyme called amylase to breakdown starch into a reducing sugar.

They measure the activity of the enzyme at different temperatures.

Fig. 4.1 is a graph of their results.

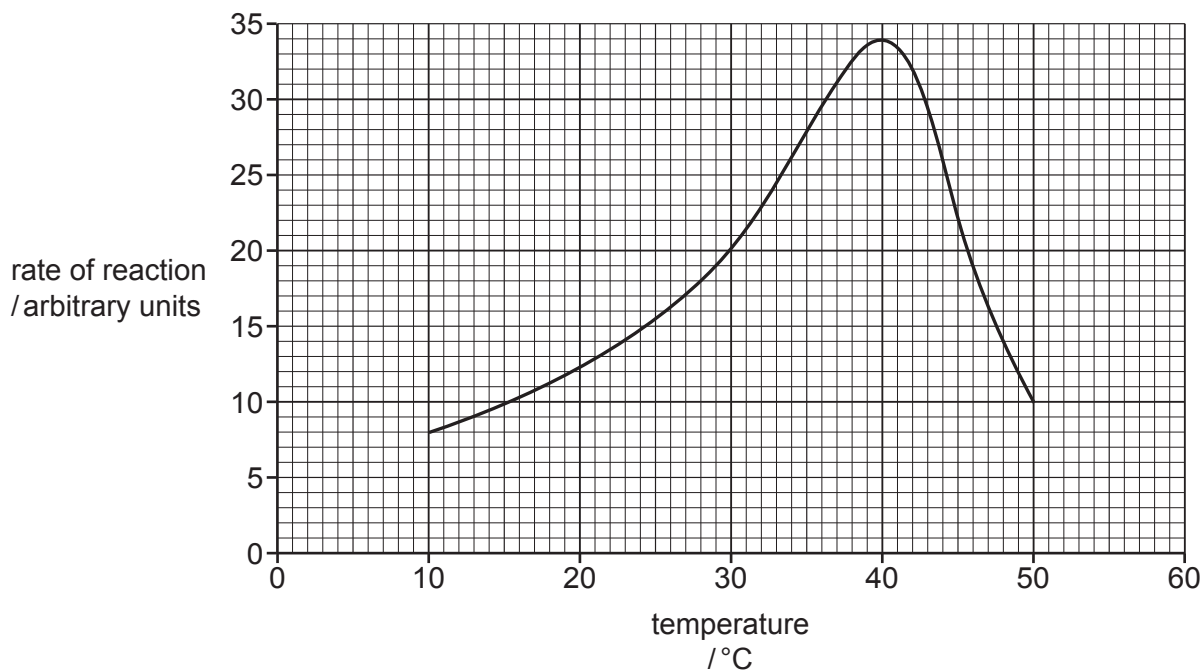


Fig. 4.1

- (i) Describe the effect of temperature on the enzyme activity shown in Fig. 4.1.

Include data from the graph in your answer.

.....

.....

.....

..... [2]

- (ii) Complete this sentence to define the term enzyme.

Enzymes are that function as

biological

[2]

- (iii) Enzymes are transported in the blood plasma.

State the molecule in red blood cells that transports oxygen.

..... [1]

- (b) Glucose is made by plants during photosynthesis, transported as sucrose and stored as starch.

Fig. 4.2 shows apparatus used to investigate one factor that affects photosynthesis.

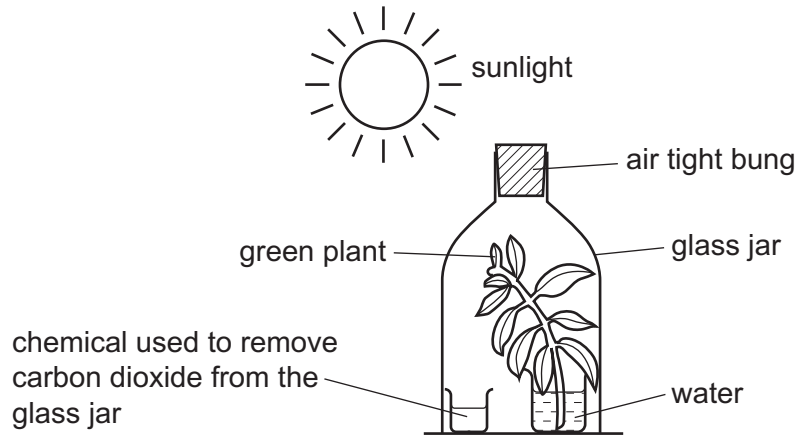


Fig. 4.2

- (i) Place a tick (✓) in **one** box to show the factor being investigated in Fig. 4.2.

carbon dioxide

☐

chlorophyll

☐

light

☐

water

☐

[1]

- (ii) The plant is left for 48 hours in the glass jar.

After 48 hours a leaf is prepared and then tested using iodine solution.

Complete these sentences about the expected result.

When placed on the leaf the iodine solution will be in colour.

This is because the plant does not make any

[2]

- (iii) State the name of the ions needed to make chlorophyll.

..... [1]

[Total: 9]

- 5 (a) Petroleum is a mixture of hydrocarbons.
Useful products are obtained by process **X** and process **Y**, as shown in Fig. 5.1.

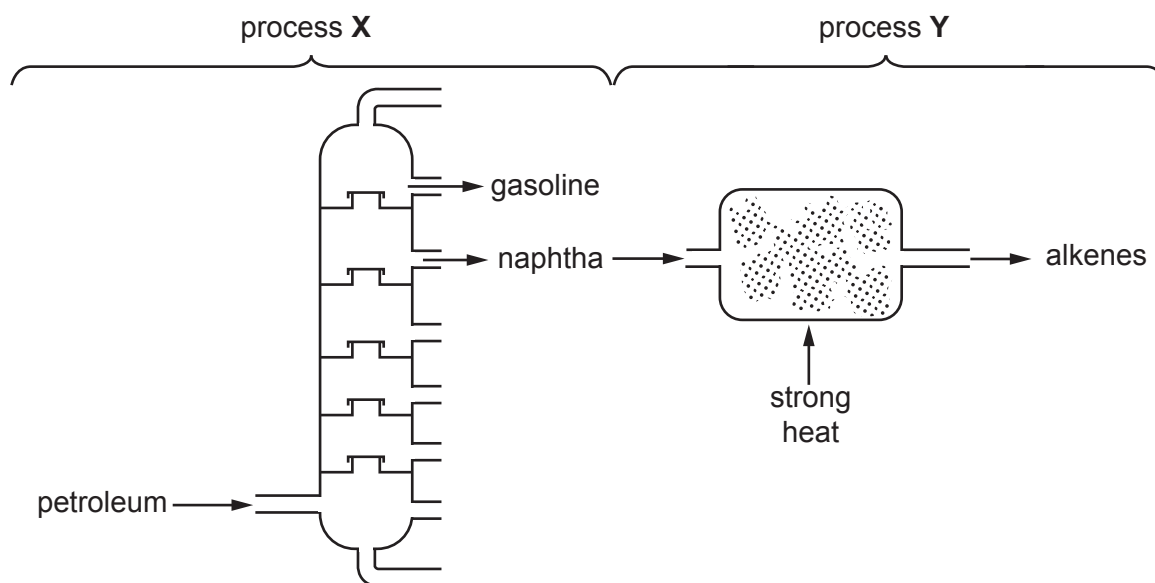


Fig. 5.1

- (i) Process **X** separates gasoline and naphtha from petroleum.
Name process **X**.
..... [1]
- (ii) Process **Y** produces alkenes.
Name process **Y**.
..... [1]
- (iii) State whether process **Y** is a chemical change or a physical change.
Explain your answer.
change
explanation
..... [1]
- (iv) Describe a **chemical** test for alkenes, and state the observation for a positive result.
test
result [2]

(b) The structure of a molecule of propene, an alkene, is shown in Fig. 5.2.

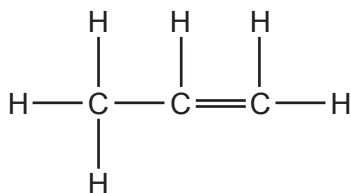


Fig. 5.2

Water is formed during the complete combustion of propene.

(i) Identify the other substance that is formed during this combustion.

..... [1]

(ii) Name the gas in air that reacts with propene during combustion, and state the percentage of this gas in clean air.

gas

percentage

[1]

(iii) Use Fig. 5.2 to deduce the formula of propene.

..... [1]

[Total: 8]

- 6 (a) Fig. 6.1 shows a thermometer in a solution of salt in water.
 Fig. 6.2 shows the thermometer reading as the salt solution freezes.
 Fig. 6.3 shows the thermometer reading as the same salt solution boils.

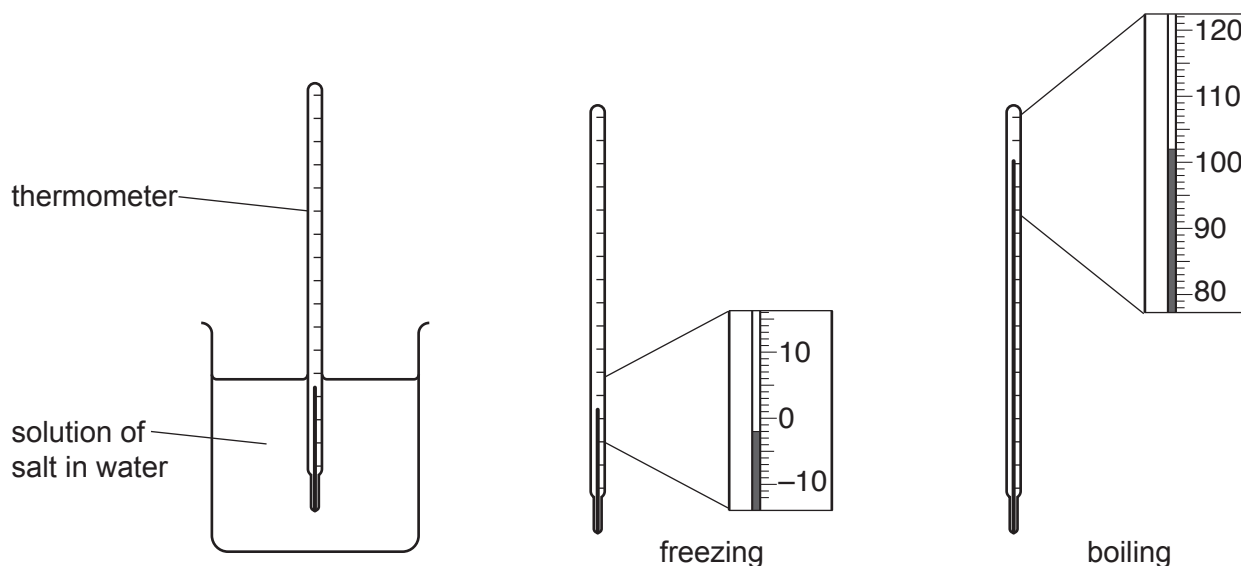


Fig. 6.1

Fig. 6.2

Fig. 6.3

- (i) State the temperature at which **pure water** melts. °C [1]
- (ii) State the temperature at which **pure water** boils. °C [1]
- (iii) Use the information in Fig. 6.2 and Fig. 6.3 to state how the addition of salt to water **changes** the melting point and boiling point of water.

melting point

boiling point

[1]

- (b) (i) The salt solution in the beaker has a volume of 0.00025 m^3 and a mass of 0.28 kg .

Calculate the density of the salt solution.

State the units of your answer.

density = ... units [3]

- (ii) A student carefully adds some pure water at 20°C to the beaker containing salt solution.

Suggest why the pure water floats on top of the salt solution before mixing.

.....

..... [1]

[Total: 7]

BLANK PAGE

- 7 (a) Fig. 7.1 is a diagram of the alimentary canal and associated organs.

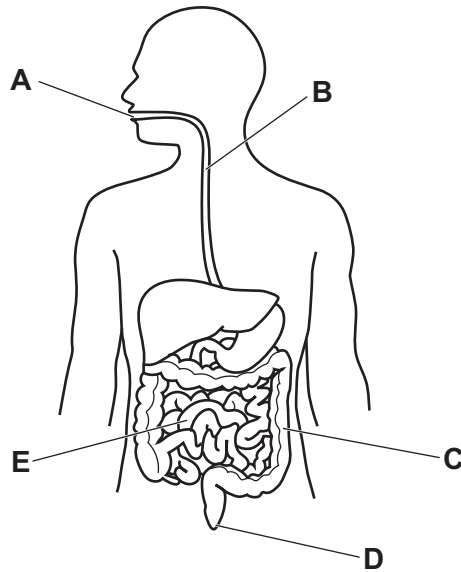


Fig. 7.1

- (i) State the letters on Fig. 7.1 that identify where egestion and ingestion take place.
 egestion
 ingestion [2]
- (ii) State **one** function of the part labelled **E** in Fig. 7.1.
 [1]
- (iii) Name the part of the blood that transports the products of digestion around the body.
 [1]
- (b) In one day a person eats a diet that includes cheese, eggs, fish, kidney beans and meat. The protein, carbohydrate and fibre content of each food is shown in Table 7.1.

Table 7.1

foodstuff	protein /g per 100 g of food	carbohydrate /g per 100 g of food	fibre /g per 100 g of food
cheese	18	1	0
eggs	13	1	0
fish	22	0	0
kidney beans	24	50	25
meat	26	0	0

One part of this diet is needed to move food through the alimentary canal.

Identify the part of the diet and explain your answer.

part of diet

explanation [2]

(c) Fig. 7.2 shows the male reproductive system.

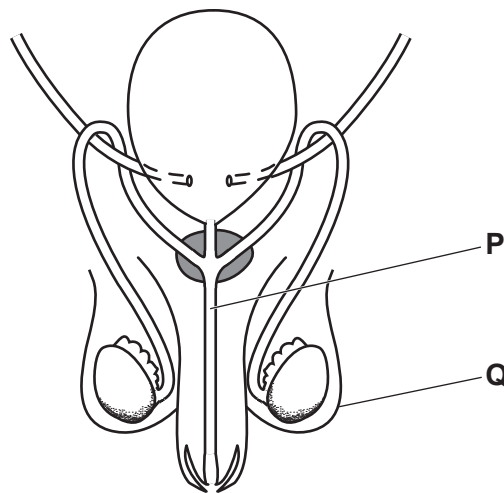


Fig. 7.2

Identify the parts labelled **P** and **Q** in Fig. 7.2.

P

Q

[2]

(d) Table 7.2 compares asexual and sexual reproduction.

Place ticks (✓) **and** crosses (✗) to show the correct features of asexual and sexual reproduction.

One row has been done for you.

Table 7.2

	asexual reproduction	sexual reproduction
genetically identical offspring		
involves fusion of nuclei		
involves gametes		
usually involves two parents	✗	✓

[2]

[Total: 10]

- 8 (a) A student reacts a piece of magnesium with dilute hydrochloric acid, as shown in Fig. 8.1. A funnel holds the magnesium under a measuring cylinder to collect the gas formed.

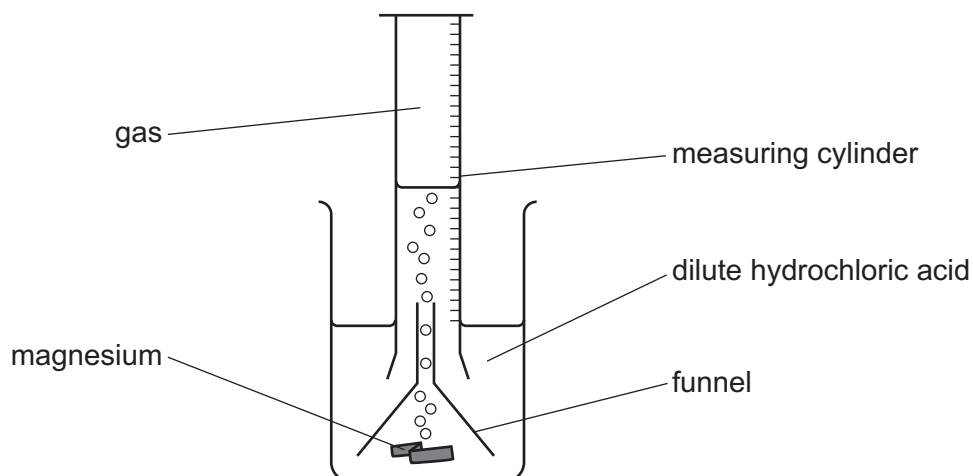


Fig. 8.1

- (i) State **one** other piece of apparatus that the student needs to use to determine the rate of this reaction.

..... [1]

- (ii) Suggest **one** change that increases the rate of this reaction.

..... [1]

- (iii) The student repeats the experiment under the same conditions, using the same mass of zinc instead of magnesium.

State and explain the effect of this change on the rate of reaction.

effect

explanation

[1]

- (b) Brass is a mixture of zinc and copper.

- (i) State the general name of mixtures such as brass that contain different metals.

..... [1]

- (ii) Suggest why brass, and not pure copper, is used to make coins.

.....

..... [1]

- (c) Some copper compounds are used as catalysts.

Name the collection of metals in the Periodic Table that includes copper.

..... [1]

- (d) Copper is extracted from copper oxide using carbon.

- (i) Describe **one** condition needed for this process.

..... [1]

- (ii) State and explain whether copper is oxidised or reduced in this process.

copper is

explanation

..... [1]

[Total: 8]

- 9 Fig. 9.1 shows a motor boat moving forward across the sea.

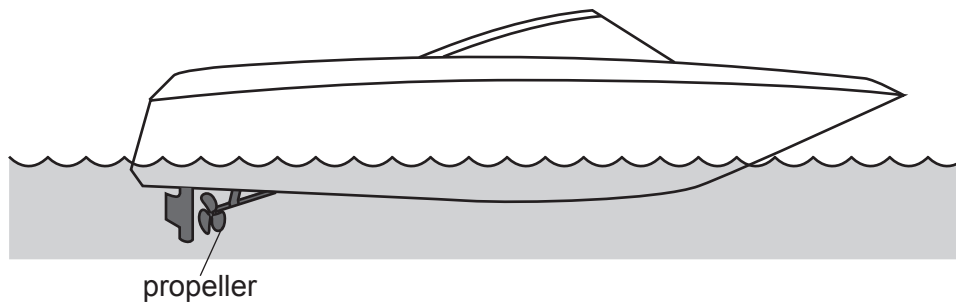


Fig. 9.1

- (a) The boat is travelling at a constant speed across the surface of the sea.
Fig. 9.2 shows four forces, **P**, **Q**, **R** and **S**, acting on the boat.

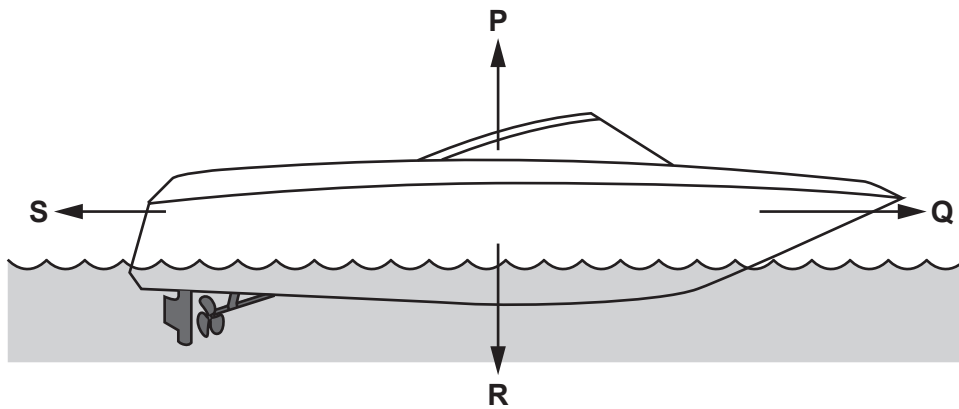


Fig. 9.2

- (i) State the letter of the force driving the boat forward.

.....

[1]

- (ii) Some of these forces are equal to each other.
Place a tick in the box next to each pair of forces that must be equal in magnitude to each other.

P and **Q**

☐

P and **R**

☐

P and **S**

☐

Q and **R**

☐

Q and **S**

☐

R and **S**

☐

[2]

(b) The motor boat is driven by a gasoline (petrol) engine that turns the propeller.

- (i) Complete the sequence of useful energy changes that take place from the gasoline to the motion of the boat.

..... energy in the gasoline

→ thermal energy in the engine

→ energy of the propeller

→ energy of the moving boat.

[3]

- (ii) The boat takes 5.0 minutes to travel 960 metres.

Calculate the speed of the boat in metres per second.

speed = ... m/s [3]

- (c) The boat makes water waves behind it. Fig. 9.3 shows a graph of the height of the water waves against distance.

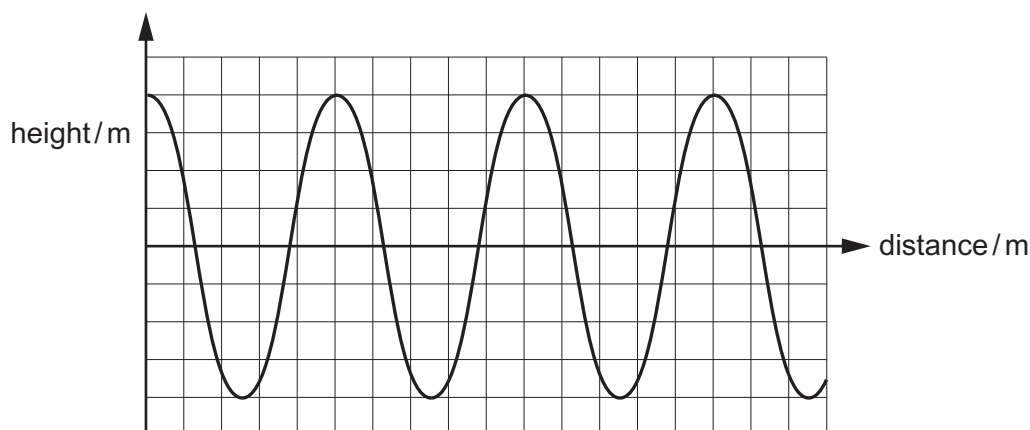


Fig. 9.3

The waves have a wavelength of 5 m and an amplitude of 0.8 m.

On Fig. 9.3 label the axes with the correct scales for these waves.

[2]

[Total: 11]

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.

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

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

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



CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

0653/32

May/June 2021

1 hour 15 minutes

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

This document has **24** pages. Any blank pages are indicated.

- 1 (a) Reproduction is one of the characteristics of living organisms.

Identify the characteristics of living organisms defined as

the removal of toxic material from the body

an action allowing an organism to change position

[2]

- (b) Fig. 1.1 shows the parts of a flower.

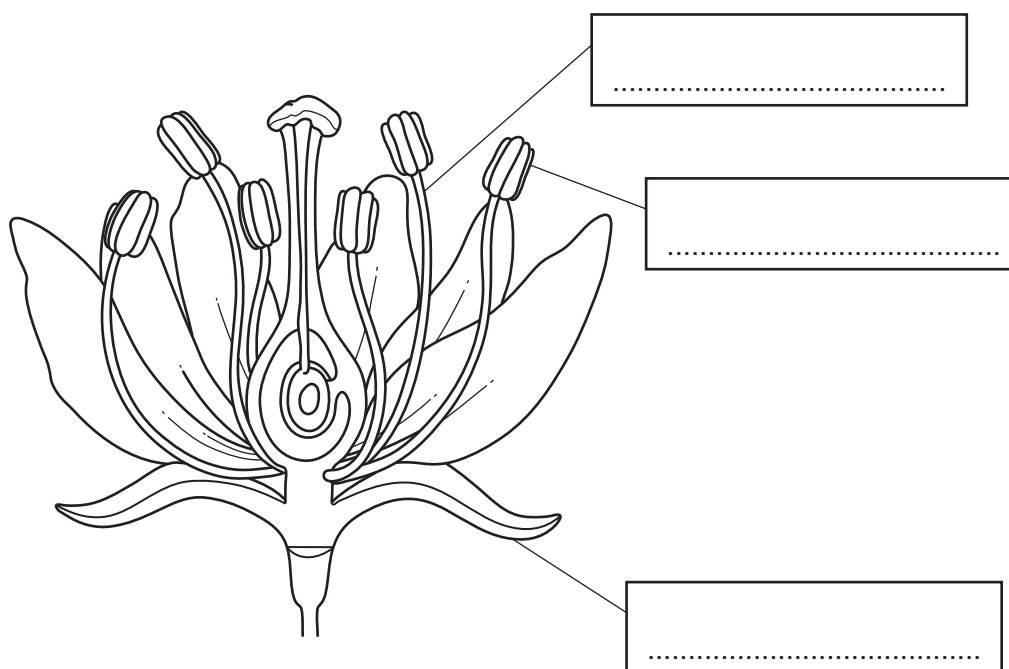


Fig. 1.1

- (i) Complete the labels on Fig. 1.1.
Choose words from the list.

anther

carpel

filament

ovary

stigma

sepal

style

[3]

- (ii) Name the part of the plant that receives pollen from another plant.

..... [1]

- (iii) Name the part of the plant where fertilisation takes place.

..... [1]

- (c) (i) The boxes on the left show parts of the female reproductive system in humans. The boxes on the right show functions of these parts.

Draw one straight line from each part to its function.

name of part	function
cervix	ring of muscle at the opening of the uterus
ovaries	receives penis during sexual intercourse
vagina	release of female gametes (eggs)

[2]

- (ii) During reproduction in humans, a ball of cells implants into the uterus wall.

State the name of this ball of cells.

..... [1]

[Total: 10]

2 (a) A mixture contains water, dissolved sodium chloride and an insoluble solid compound.

(i) State what is meant by insoluble and compound.

insoluble

.....

compound

.....

[2]

(ii) Describe how crystals of sodium chloride are obtained from this mixture.

.....

.....

.....

.....

..... [3]

(b) Water is a covalent molecule.

Complete Fig. 2.1 to show the dot-and-cross diagram of a molecule of water.

Show all the outer shell electrons.



Fig. 2.1

[2]

- (c) An atom of oxygen contains 8 electrons and it has the nucleon number (mass number) 16.

State what is meant by nucleon number.

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

- (d) Complete Table 2.1 to show the charges and approximate relative masses of neutrons and protons.

Table 2.1

particle	charge	relative mass
neutron		
proton		

[2]

[Total: 10]

- 3 (a) Fig. 3.1 shows a cylinder made of solid copper.

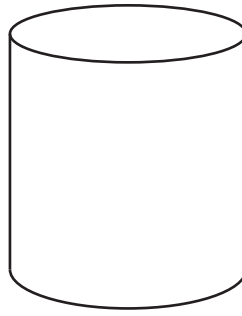


Fig. 3.1

The cylinder has a:

- height of 25 cm
 - radius of 10 cm
 - mass of 70 000 g.
- (i) Show that the volume of the copper cylinder is 7850 cm^3 .
 $\pi = 3.14$

[2]

- (ii) Use the information above to calculate the density of copper in g/cm^3 .

density = ... g/cm^3 [2]

(b) Fig. 3.2 shows two electrically charged copper spheres next to each other.

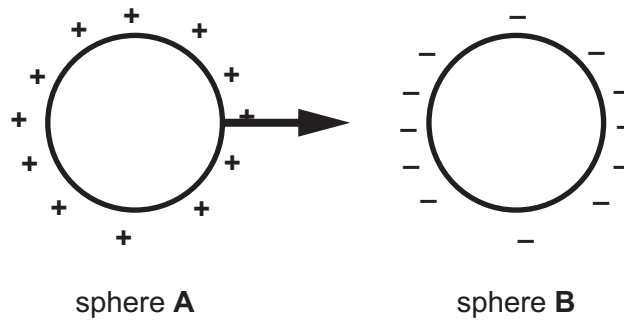


Fig. 3.2

- (i) State which sphere is charged with an excess of electrons.
Give a reason for your answer.

sphere

reason

[1]

- (ii) On Fig. 3.2 the force arrow shows the direction of the force exerted on sphere **A** by sphere **B**.

Explain why sphere **B** exerts this force on sphere **A**.

.....

..... [2]

- (c) A length of thin copper wire has a resistance of $3\ \Omega$.
The potential difference (p.d.) across the wire is 12 V .
Calculate the current in the copper wire.
State the unit of your answer.

current = ... unit [3]

[Total: 10]

- 4 (a) A student investigates water loss from the leaves of a plant.

The student takes four leaves from the same plant and covers each leaf with petroleum jelly as described in Table 4.1.

The petroleum jelly stops water loss from the leaves.

The mass of each leaf is recorded and then the leaves are placed on a line for 48 hours as shown in Fig. 4.1.

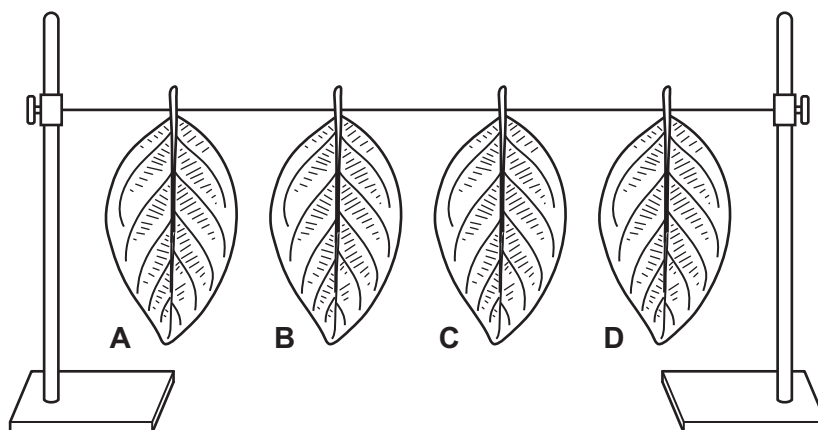


Fig. 4.1

After 48 hours the mass of each leaf is recorded again.

Table 4.1 shows the results.

Table 4.1

leaf	treatment with petroleum jelly	mass at start /g	mass after 48 hours /g	change in mass /g
A	both surfaces covered	3.2	3.2	0.0
B	lower surface covered	3.3	3.2	0.1
C	upper surface covered	3.4	2.8	0.6
D	not covered	3.3	2.6	

- (i) Calculate the change in mass for leaf **D**.

mass = ... g [1]

- (ii) Explain why leaf **C** lost more mass than leaf **B**.

Include ideas about stomata in your answer.

.....

 [2]

- (b) Water is transported from the roots to the leaves in the xylem vessels.

Fig. 4.2 shows a cross-section of a root.

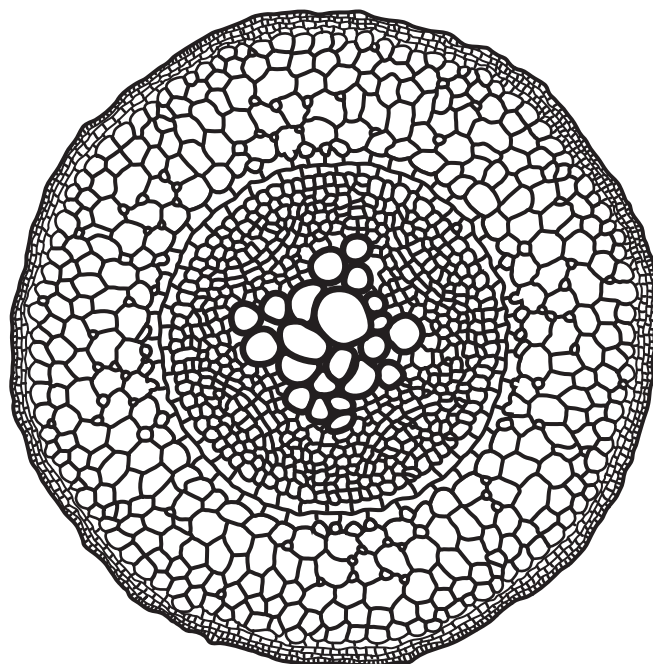


Fig. 4.2

- (i) Use a label line and the letter **X** to show the position of xylem vessels in Fig. 4.2. [1]
- (ii) Xylem vessels also transport mineral ions.

State the name of the mineral ions needed to make amino acids.

..... [1]

- (c) A clinostat can be used to investigate tropic responses in plants.

Fig. 4.3 shows a plant growing in a pot placed on its side (plant **A**) and a plant growing on a clinostat (plant **B**). The clinostat slowly turns plant **B**.

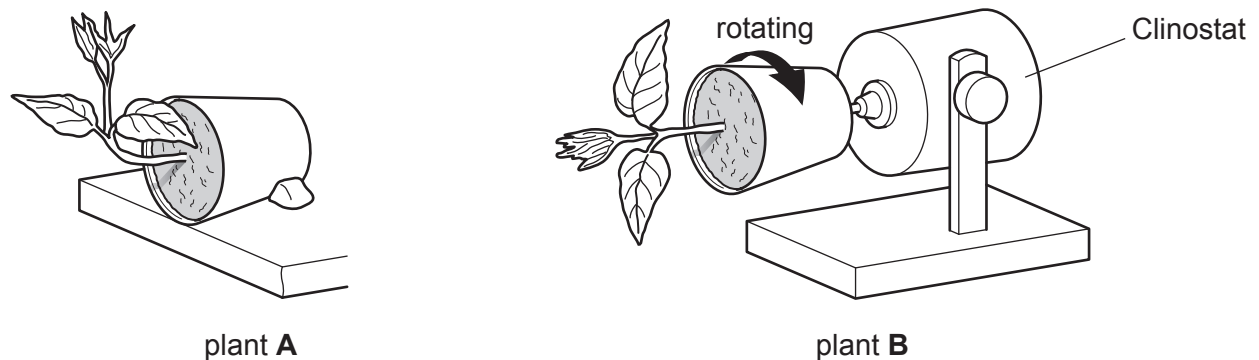


Fig. 4.3

The plants are left to grow in these positions for one week. They receive plenty of light from all directions.

- (i) Complete the sentences to explain the results.

Plant **A** grows upwards from gravity.

This response is called

Plant **B** grows because each side of the plant experiences the same gravitational force.

[3]

- (ii) Responses in humans are controlled by chemical substances.

Place a tick (✓) in **one** box to show a correct statement about these chemical substances.

They are enzymes transported in red blood cells.

☐

They are enzymes transported in blood plasma.

☐

They are hormones transported in red blood cells.

☐

They are hormones transported in blood plasma.

☐

[1]

[Total: 9]

BLANK PAGE

- 5 (a) A student investigates the reaction between dilute hydrochloric acid and a 5.0g piece of zinc using the apparatus shown in Fig. 5.1.

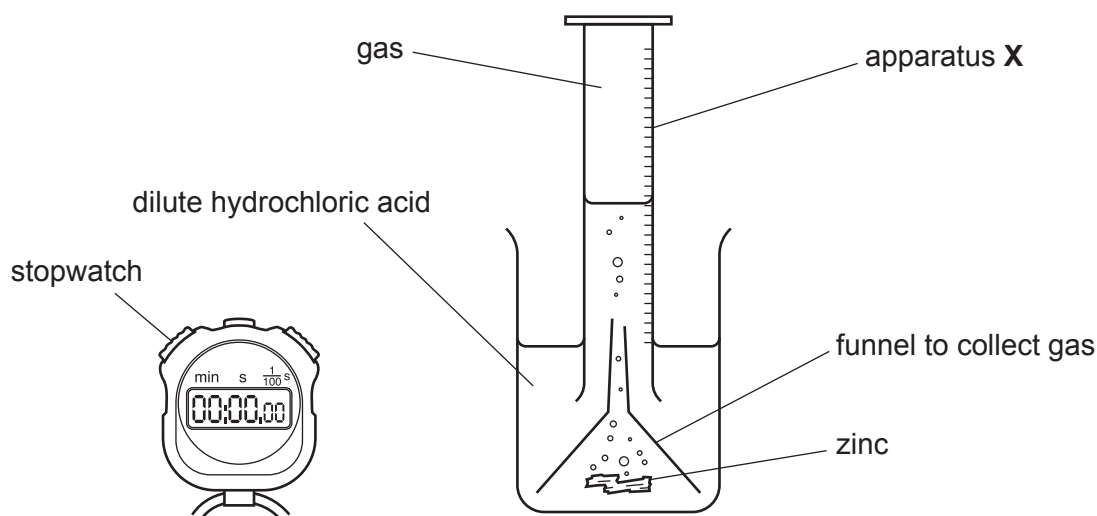
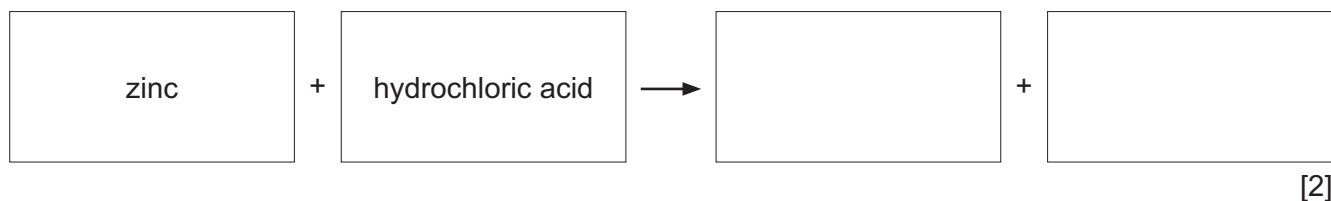


Fig. 5.1

The reaction forms a gas and a solution containing a zinc salt.

- (i) Complete the word equation for this reaction.



- (ii) Name apparatus X.

..... [1]

- (iii) Describe a chemical test to show that the solution contains zinc ions, Zn^{2+} .

test

result

..... [2]

- (iv) The student repeats the experiment under the same conditions, using 5.0g of magnesium instead of zinc.
State the change to the rate of the reaction, if any, that occurs when magnesium is used instead of zinc.

Explain your answer.

rate change

explanation

..... [1]

- (b) Zinc and other metals are obtained from their ores. They are also obtained by recycling.

Recycling metals costs less than obtaining metals from their ores.

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

..... [1]

- (c) Lithium, sodium and potassium are Group I metals.

Describe **one** chemical trend and **one** physical trend in the properties of these metals going down Group I from lithium to potassium.

chemical trend

.....

physical trend

.....

[2]

[Total: 9]

6 Fig. 6.1 shows a battery-powered electric bus.

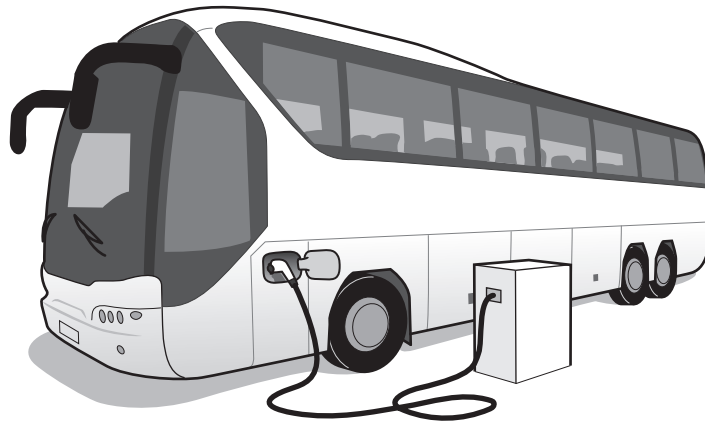


Fig. 6.1

The batteries are charged from the electricity supply through the cables. When the batteries are fully charged, the cable is unplugged and the bus is driven away.

- (a) (i) Complete the useful energy change when the batteries are being charged.

electrical energy $\rightarrow$ energy [1]

- (ii) State the useful form of energy the bus has as it moves along the road.

..... [1]

- (b) The bus accelerates.

Describe how the driving force on the bus compares with the frictional forces acting on the bus as it accelerates.

.....
 [1]

- (c) The bus travels 15 km in 20 minutes.

Calculate the average speed of the bus in metres per second.

speed = ... m/s [3]

(d) Fig. 6.2 shows the electric circuit in the bus that:

- powers the electric motor
- lights the headlamps.

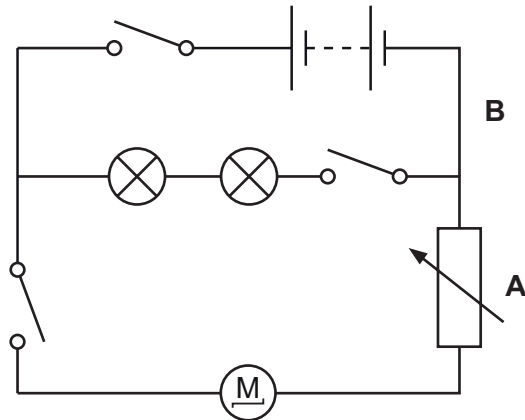


Fig. 6.2

—  — is the symbol for an electric motor

(i) Name the component at point **A**.

..... [1]

(ii) State the type of circuit connection for the two lamps.

..... [1]

(iii) Suggest why the component at point **A** is not connected at point **B** in the circuit. Include ideas about the motor and the lamps in your answer.

.....

 [2]

[Total: 10]

- 7 (a) Fig. 7.1 is a diagram of the human heart.

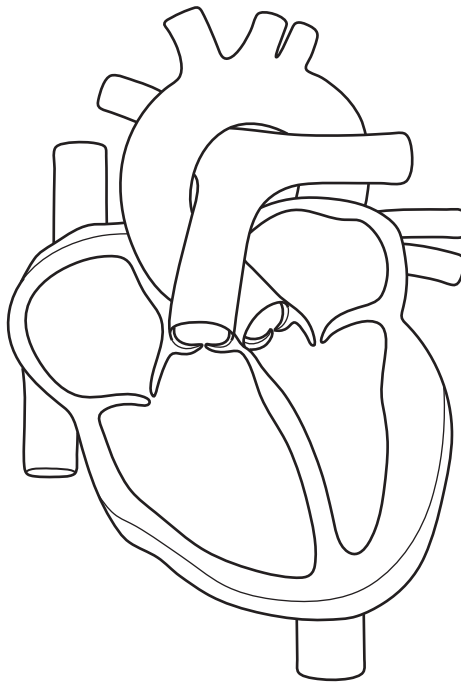


Fig. 7.1

- (i) Draw a label line and the letter **A** on Fig. 7.1 to show the position of the septum. [1]
- (ii) Circle the name of the blood vessel that brings blood to the right atria from the body.
aorta pulmonary artery pulmonary vein vena cava [1]
- (iii) The muscular wall pumps blood out of the right atria.
 State the type of structure that stops the blood returning to the right atria.
 [1]
- (iv) Arteries and veins are connected to the heart.
 State **two** differences between arteries and veins.
 1

 2
 [2]

(b) Vaccinations protect us from infection.

When given a vaccination our body produces antibodies.

(i) Name the part of the blood that produces antibodies.

..... [1]

(ii) Fig. 7.2 shows the number of antibodies in the blood after a vaccination for measles and after being infected by the measles virus.

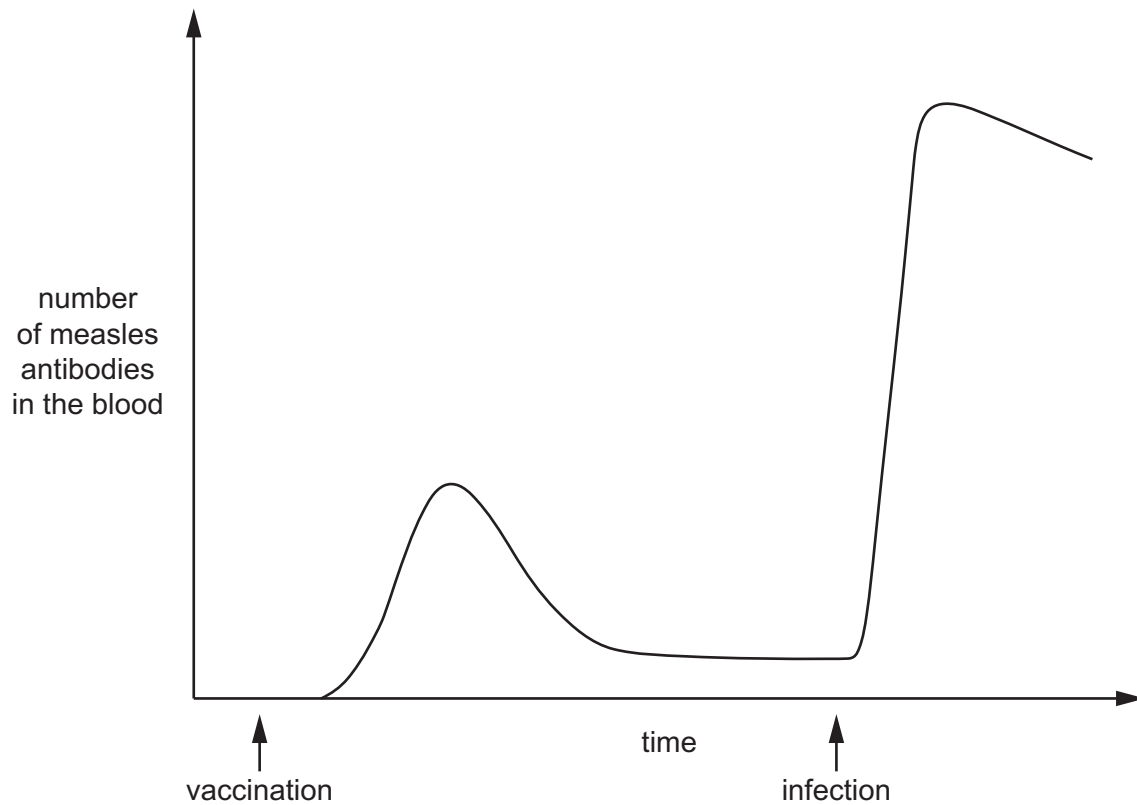


Fig. 7.2

Describe **two** differences between the antibody production after the vaccination and after the infection shown in Fig. 7.2.

1

.....

2

.....

[2]

[Total: 8]

- 8 The structures of ethane and of ethene are shown in Fig. 8.1.

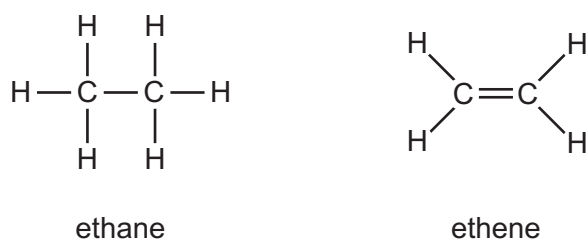


Fig. 8.1

- (a) Ethane is an alkane.
Ethene is an alkene.

Describe one similarity and one difference between the chemical bonds in alkane molecules and in alkene molecules.

similarity

.....

difference

.....

[2]

- (b) During the complete combustion of ethane, water and one other substance form.

- (i) Identify this other substance.

..... [1]

- (ii) Describe **one** chemical test for water and state the observation for a positive result.

test

observation

[2]

- (iii) Explain why the combustion of ethane is described as an oxidation reaction.

.....

..... [1]

- (c) Fractional distillation of petroleum produces naphtha.
Cracking naphtha produces ethene.
Addition polymerisation of ethene produces polymer Y.

Name polymer Y.

..... [1]

[Total: 7]

- 9 Fig. 9.1 shows thermal energy being transferred to a beaker full of water.

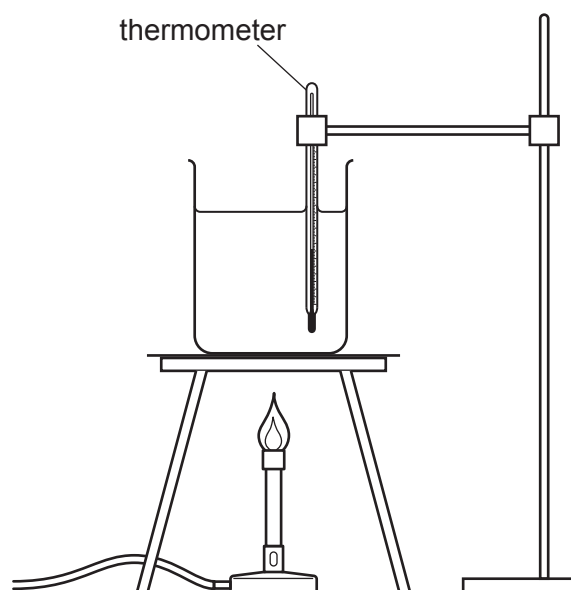


Fig. 9.1

- (a) A student measures the temperature of the water every five minutes.

Explain why the level of the liquid **in the thermometer** changes as the temperature increases.

.....
 [1]

- (b) Table 9.1 shows the results.

Table 9.1

time/min	temperature/°C
0	20
5	40
10	60
15	80
20	100
25	100

- (i) Name the process taking place as the water is heated between 20 and 25 minutes.

..... [1]

- (ii) Describe the changes in the separation and motion of the water molecules between 5 minutes and 10 minutes.

separation

motion

[2]

- (c) The student puts the thermometer in a cup of water. When the student looks down into the cup, the thermometer appears to bend as it goes into the water.

Fig. 9.2 shows what the student can see.



Fig. 9.2

Name the property of light demonstrated by this observation.

..... [1]

(d) The student sends a message containing the results of the experiment by mobile phone (cell phone) to a friend.

(i) State the type of electromagnetic waves used by the mobile phone to send the message.

..... [1]

(ii) Fig. 9.3 shows an incomplete electromagnetic spectrum.

	X-rays		visible light	infrared		
--	--------	--	------------------	----------	--	--

Fig. 9.3

On Fig. 9.3 write your answer to (d)(i) in the correct position in the electromagnetic spectrum. [1]

[Total: 7]

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.

The Periodic Table of Elements

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

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

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



CANDIDATE
NAME

--

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--

0653/33

May/June 2021

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

This document has **24** pages. Any blank pages are indicated.

- 1 (a) Nutrition is one of the characteristics of living organisms.

Identify the characteristics of living organisms defined as
the chemical reactions in cells that break down nutrient molecules and release energy

.....

the ability to detect and respond to changes in the environment.

.....

[2]

- (b) Fig. 1.1 shows part of the alimentary canal and associated organs.

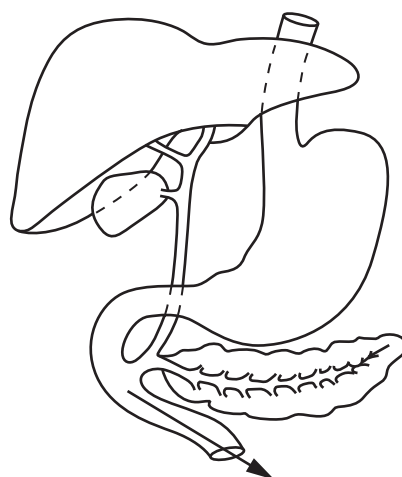


Fig. 1.1

- (i) Draw the letter **X** on Fig. 1.1 to identify the position of the liver. [1]
- (ii) The arrow shows the direction the food moves as it passes into the small intestine.

Complete these sentences about what happens in the small intestine.

Large insoluble molecules are broken down by the process of

Small food molecules are then moved into the blood by the process of

[2]

- (c) A student investigates nutrition in plants. Sugar is stored as starch in a leaf.

The student puts black paper around a green leaf still attached to the plant. After two days she takes the leaf from the plant and removes the black paper. She then tests the leaf for starch using iodine solution.

Fig. 1.2 shows the results.

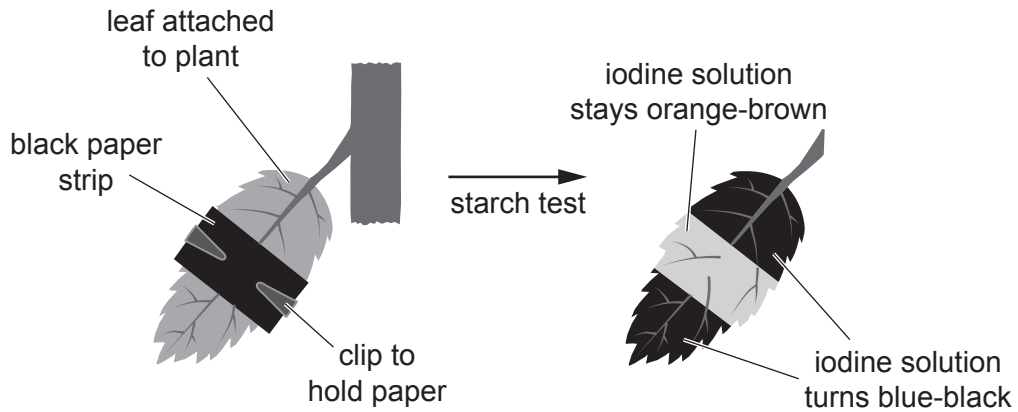


Fig. 1.2

Explain the results seen in Fig. 1.2 for the area that was covered by black paper.

.....

.....

..... [2]

- (d) Different plant tissues in the stem have different functions.

Name the tissue that transports sugars in the stem.

..... [1]

- (e) Starch and sugar are carbohydrates.

Table 1.1 shows the mass of carbohydrates in some different food types.

Table 1.1

food type	mass of carbohydrate in 100 g of food /g
bread	40
cake	59
cheese	2
lentils	18
rice	25
tomato	3

- (i) Identify the food type that contains the most carbohydrate.

..... [1]

- (ii) A man eats 200g of bread and 50g of cheese.

Calculate the mass of carbohydrate he eats.

mass of carbohydrate = ...g [2]

[Total: 11]

BLANK PAGE

- 2 (a) Fig. 2.1 shows a process used to separate substances in a fossil fuel.

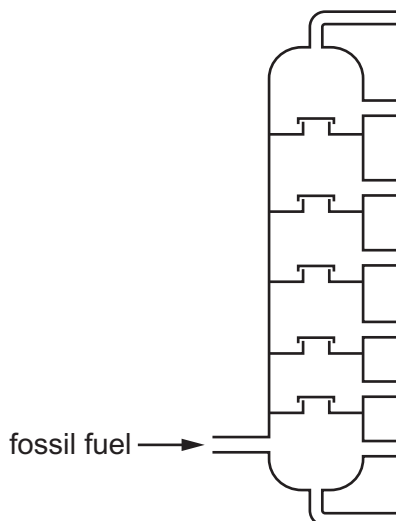


Fig. 2.1

- (i) Name this process.

..... [1]

- (ii) Name the fossil fuel that is separated by this process.

..... [1]

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

- (i) Name this fossil fuel.

..... [1]

- (ii) Complete Fig. 2.2 to show the dot-and-cross diagram of one molecule of methane, CH_4 .

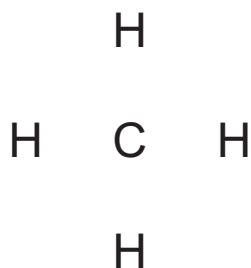


Fig. 2.2

[2]

(iii) Identify a greenhouse gas that is formed by the complete combustion of methane.

..... [1]

- (c) Carbon has atomic number 6 and mass number 12.
Hydrogen has atomic number 1 and mass number 1.

Complete Table 2.1 to show the number of protons and the number of neutrons in one atom of carbon and in one atom of hydrogen.

Table 2.1

atom	number of protons	number of neutrons
carbon		
hydrogen		

[2]

[Total: 8]

- 3 (a) Fig. 3.1 shows a man lying down on a sandy beach on a sunny day.



Fig. 3.1

Visible light is one type of electromagnetic radiation emitted by the Sun.
The man is also affected by ultraviolet and infrared radiation from the Sun.

Fig. 3.2 shows the electromagnetic spectrum.

	X-rays	X	visible light		micro- waves	
--	--------	----------	------------------	--	-----------------	--

Fig. 3.2

Identify **X** in Fig. 3.2 and state **one** effect it will have on the man.

X is

effect

.....

[2]

- (b) The man stands up. There is a mark in the sand to show where he was lying.
When he stands up, his feet make deeper marks in the sand.

Explain why the marks are deeper in the sand when he is standing.

.....

.....

.....

..... [2]

(c) Fig. 3.3 shows the man holding a beach ball.



Fig. 3.3

- (i) The ball has a mass of 0.25 kg.
The ball exerts a downward force on the man's hand of 2.45 N.
Calculate the gravitational field strength, g .

$g = \dots\dots\dots$ N/kg [2]

- (ii) The man throws the ball vertically upwards in the air. He catches it as it falls down.
Complete the sentences about energy below.

The ball gains $\dots\dots\dots$ energy as it moves upwards.

The ball gains $\dots\dots\dots$ energy as it falls down.

[2]

- (d) The man throws the ball to a friend.
The friend catches the ball 4.2 s later.
The distance travelled by the ball is 15 m.
Show that the average speed of the ball is 3.6 m/s.

[1]

[Total: 9]

- 4 (a) (i) The boxes on the left show different components of blood.
The boxes on the right show functions of the components.

Draw one straight line from each component of the blood to its function.

component of blood	function
plasma	transport oxygen
platelets	transport hormones
red blood cells	clotting the blood

[2]

- (ii) Fig. 4.1 shows both red and white blood cells as seen using a light microscope.

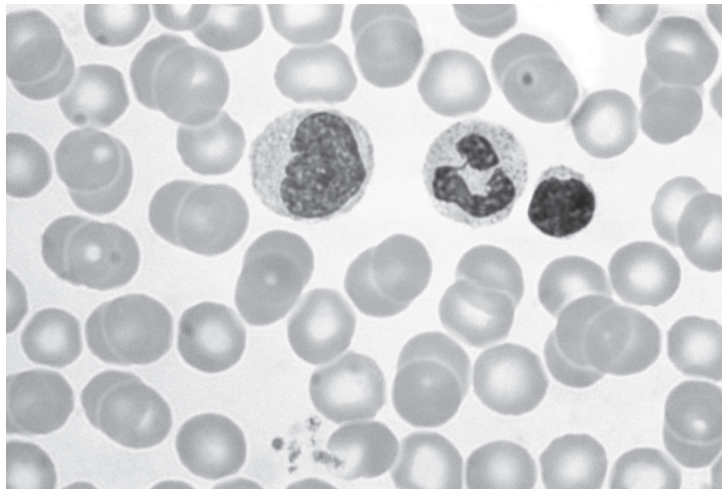


Fig. 4.1

Identify **one** structure found in white blood cells that is **not** found in red blood cells.
Use Fig. 4.1 to help you.

..... [1]

- (b) Cancer can affect the components of the blood.
There are different types of cancer that affect the blood.

Fig. 4.2 shows the percentage of people that survived four different blood cancers, **A**, **B**, **C** and **D** in 1992 and 2008.

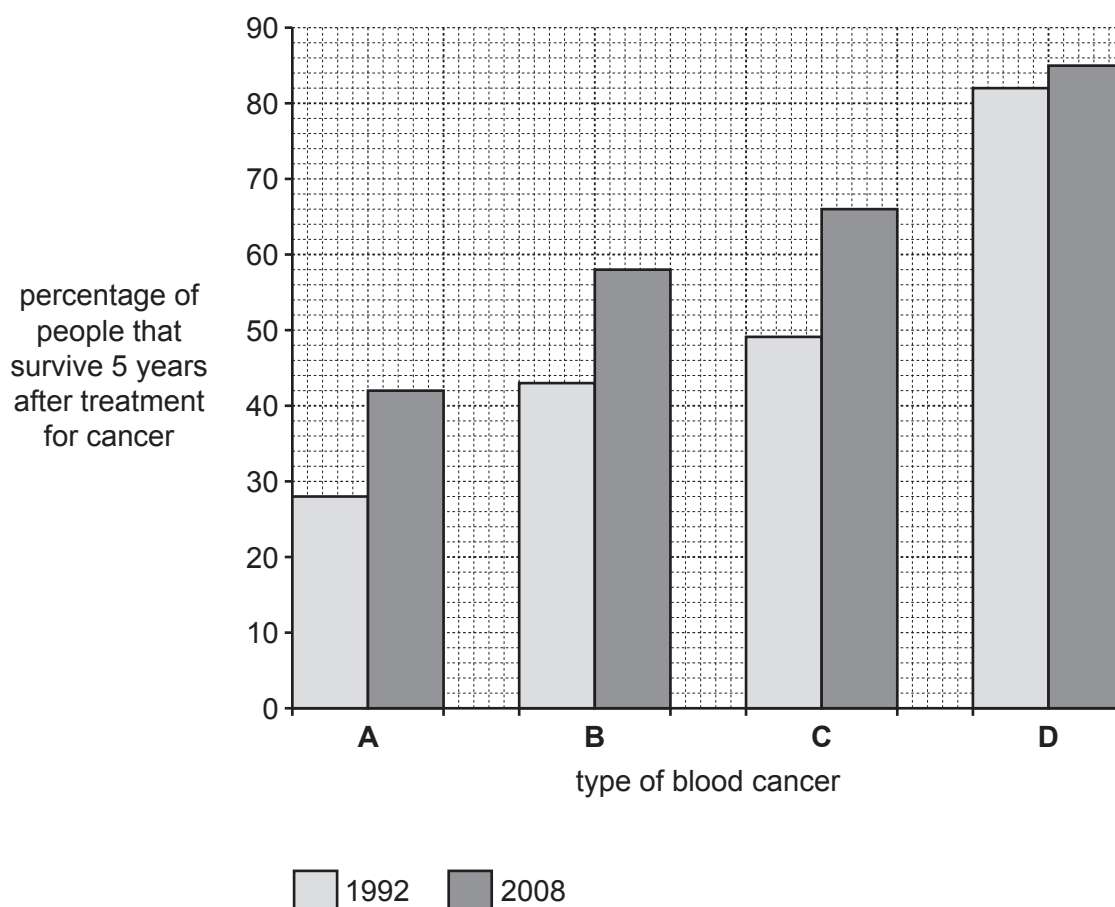


Fig. 4.2

- (i) Identify the blood cancer with the best survival rate in both 1992 and 2008. [1]
- (ii) Blood cancer **B** can stop white blood cells functioning correctly.

Explain why someone with blood cancer **B** finds it more difficult to fight infections.

.....

.....

.....

..... [2]

(c) Hepatitis is a sexually transmitted infection that can be passed on through body fluids and infected blood.

- (i) One way to prevent the spread of hepatitis is using sterilised needles.
State **two other** ways to prevent the spread of hepatitis.

1

2

[2]

- (ii) Name **one other** sexually transmitted infection.

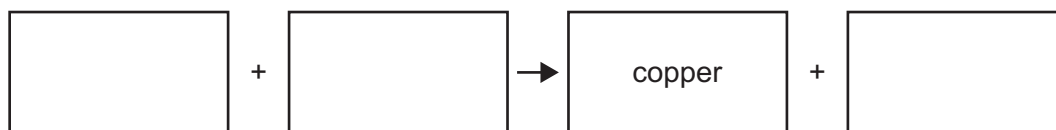
..... [1]

[Total: 9]

BLANK PAGE

- 5 (a) Copper is extracted from copper(II) oxide by heating with carbon.

(i) Complete the word equation for this reaction.



[2]

- (ii) Copper(II) oxide is reduced to copper in this reaction.
Explain what is meant by the term reduced.

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

- (b) Brass is a mixture of copper and zinc.

(i) State the name of this type of mixture.

..... [1]

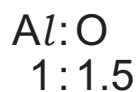
- (ii) Door keys are sometimes made from brass.

Suggest why brass, rather than pure copper, is used to make door keys.

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

(c) Aluminium is extracted from aluminium oxide.

(i) The ratio of aluminium atoms to oxygen atoms in aluminium oxide is shown.



Deduce the formula of aluminium oxide.

..... [1]

(ii) State the method used to extract aluminium from aluminium oxide.

..... [1]

(iii) Suggest why carbon **cannot** be used to extract aluminium from aluminium oxide.
Use ideas about reactivity in your answer.

.....

..... [1]

(d) Copper is a transition element.
Aluminium is not a transition element.

(i) Suggest **one** property of copper that is **not** shown by aluminium.

..... [1]

(ii) Suggest one **physical** property that is shown by **both** copper and aluminium.

..... [1]

[Total: 10]

- 6 (a) Table 6.1 shows the melting points and boiling points of six substances.

Table 6.1

substance	melting point /°C	boiling point /°C
ammonia	−78	−33
benzene	6	80
bromine	−7	59
lactic acid	17	122
mercury	−39	357
sulfur	115	445

- (i) Identify **two** substances that are liquid at 65 °C.

..... and [1]

- (ii) Identify **two** substances whose molecules are far apart at 60 °C.

..... and [1]

- (b) A student has a liquid-in-glass thermometer without a scale. The student wants to mark a scale on the thermometer.

The student puts the thermometer into melting ice, waits for the level of the liquid in the thermometer to stop changing, and marks this liquid level as 0 °C.

- (i) Suggest what the student does in order to decide where to put a mark for 100 °C.

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

- (ii) Measuring temperature uses a property of the liquid in the thermometer that changes with temperature.

State the property that is used.

..... [1]

- (c) Fig. 6.1 shows the student using a mirror to observe a digital thermometer.

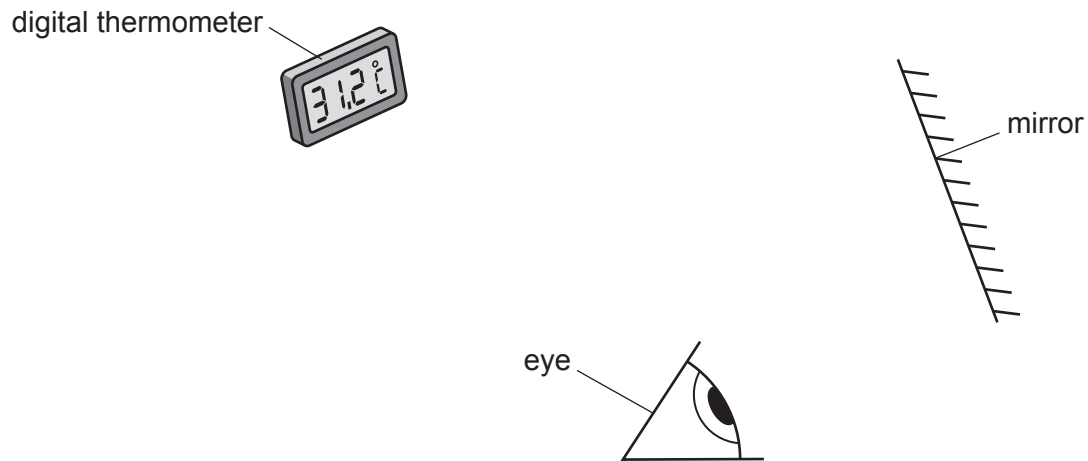


Fig. 6.1

- (i) On Fig. 6.1 draw a ray to show how the student is able to use the mirror to read the scale on the thermometer.

Include in your drawing:

- the normal
- the angles of incidence (i) and reflection (r).

[3]

- (ii) Fig. 6.2 shows the image seen by the student in the mirror.

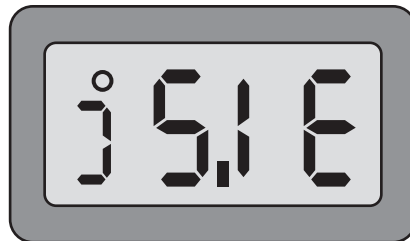


Fig. 6.2

Describe the characteristic of an image in a plane mirror, as shown in Fig. 6.2.

..... [1]

[Total: 8]

7 (a) Fig. 7.1 shows a food web.

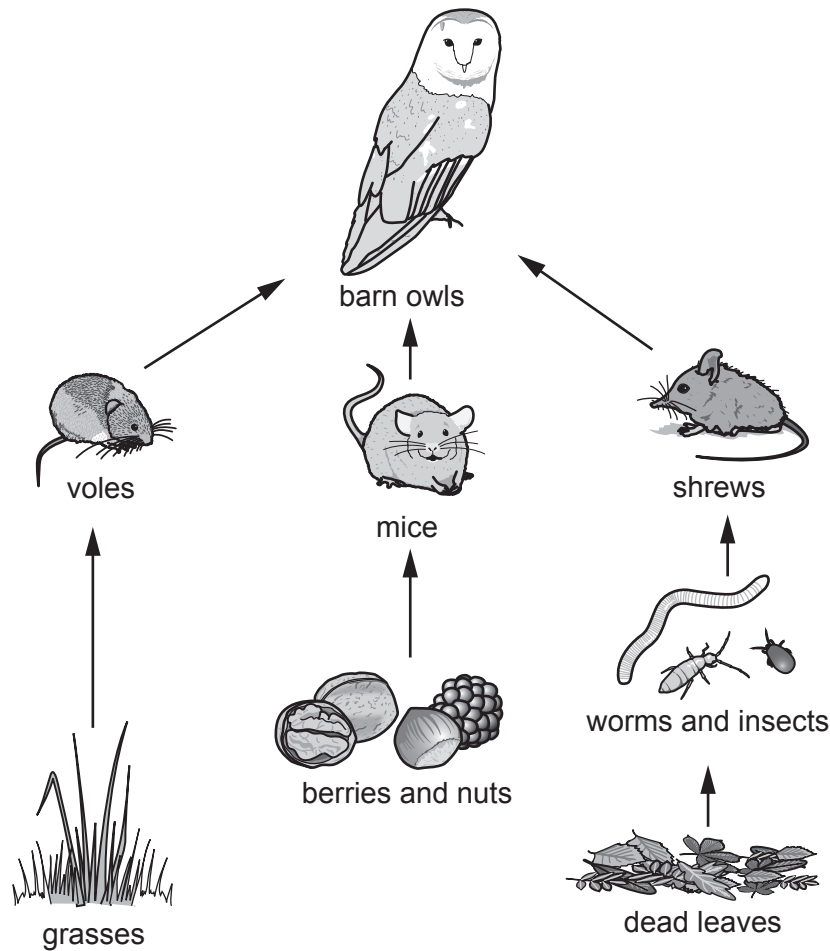


Fig. 7.1

(i) State the principal source of energy for a food web.

..... [1]

(ii) The owl is the top carnivore in this food web.

Define the term carnivore.

.....
 [1]

(iii) Complete the sentence to explain why shrews are classed as secondary consumers in this food web.

Shrews are secondary consumers because they eat ,
 which are consumers.

[2]

(b) Grass roots take in mineral ions from the soil to make amino acids.

(i) State the name of the mineral ions needed to make amino acids.

..... [1]

(ii) Grasses take in water from the soil through the root hair cells.

Describe how water moves into root hair cells.

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

[Total: 7]

- 8 (a) Chlorine and bromine are diatomic non-metals in Group VII of the Periodic Table. Chlorine is above bromine in Group VII.

(i) Explain what is meant by diatomic.

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

(ii) State the trend in the colour and the boiling point of the elements going down Group VII.

colour

boiling point [1]

(iii) State why chlorine is used in the treatment of the water supply.

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

(iv) Describe a chemical test for chlorine and give the observation for a positive result.

test

observation [2]

- (b) Chlorine reacts with sodium in an exothermic reaction.
Argon, a Group VIII element, is next to chlorine in the Periodic Table. Argon does **not** react with sodium.

(i) State what is meant by exothermic.

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

(ii) Explain why argon does **not** react with sodium.
Use ideas about electrons in your answer.

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

[Total: 8]

BLANK PAGE

- 9 Fig. 9.1 shows three ammeters, **L**, **M** and **N**, measuring the current in different parts of a circuit containing two cells and three identical lamps, **X**, **Y** and **Z**.

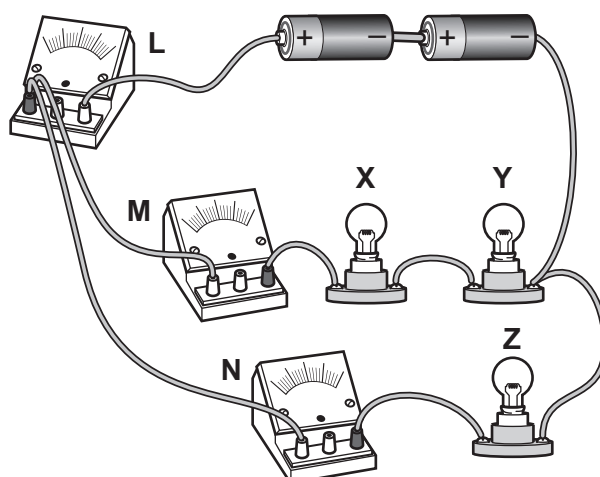


Fig. 9.1

- (a) On Fig. 9.2 complete the circuit diagram for the circuit in Fig. 9.1.



Fig. 9.2

[3]

- (b) (i) The resistance of each lamp when lit is $11\ \Omega$.
Calculate the combined resistance of lamps **X** and **Y**.

resistance = ... Ω [1]

- (ii) State which ammeters will show the largest current and the smallest current.
Give reasons for your answers.

largest current

reason

.....

smallest current

reason

.....

[3]

- (c) Ammeter **N** shows a current of 0.31 A.
The resistance of lamp **Z** when lit is $11\ \Omega$.
Calculate the potential difference across lamp **Z**.

Give the unit of your answer.

p.d. = ... unit [3]

[Total: 10]

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.

The Periodic Table of Elements

Group																		
I	II	Key										III	IV	V	VI	VII	VIII	
		atomic number atomic symbol name relative atomic mass																
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19		2 He helium 4
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5		18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84	
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium —	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131	
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —	
87 Fr francium —	88 Ra radium —	89–103 actinoids	104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —		114 Fl flerovium —		116 Lv livermorium —			

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

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