Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

3031698334

COMBINED SCIENCE **0653/32**

Paper 3 Theory (Core) **May/June 2023**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- 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.

INFORMATION

- 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.

[Turn over

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1 **(a)** Fig. 1.1 is a diagram of a human heart.

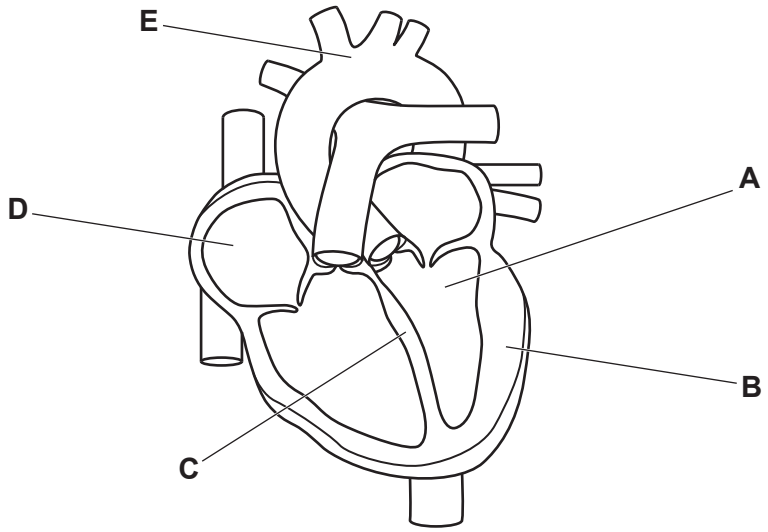

Fig. 1.1

(i) State the letter in Fig. 1.1 that identifies the:

right atrium .....

septum .....

[2]

(ii) Part **E** in Fig. 1.1 transports blood to the body.

Circle the name of part **E**.

aorta **coronary artery** **pulmonary artery** **vena cava**

[1]

(b) A student investigates how their pulse rate changes during different types of physical activity. The pulse rate is measured in beats per minute (bpm).

Fig. 1.2 is a bar chart showing the results.

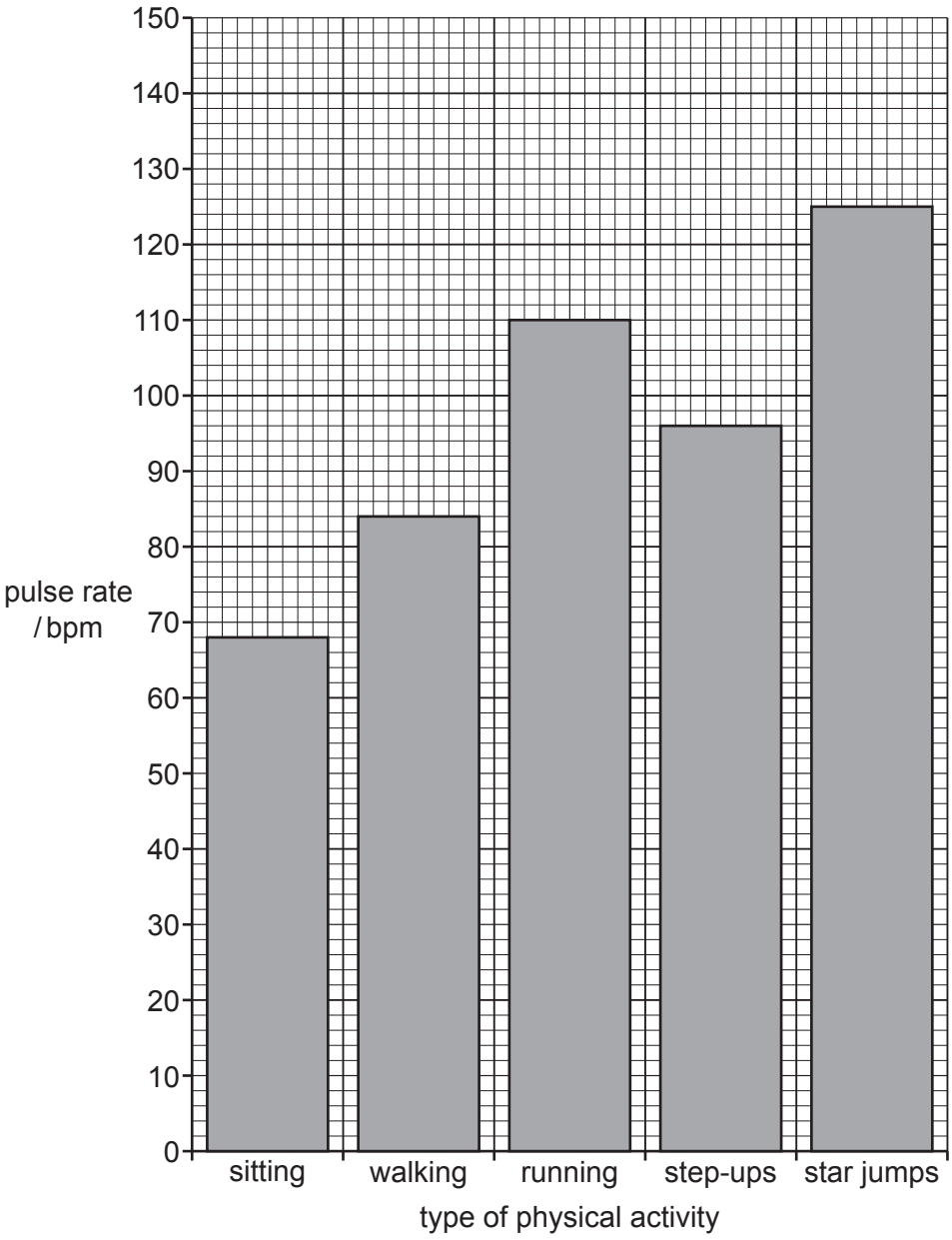

Fig. 1.2

(i) Identify the type of physical activity in Fig. 1.2 where the pulse rate is the highest.

..... [1]

(ii) Calculate the difference in pulse rate between running and step-ups.

pulse rate during running ..... bpm

pulse rate during step-ups ..... bpm

difference = ... bpm
[2]

(c) Fig. 1.3 shows a photomicrograph of blood.

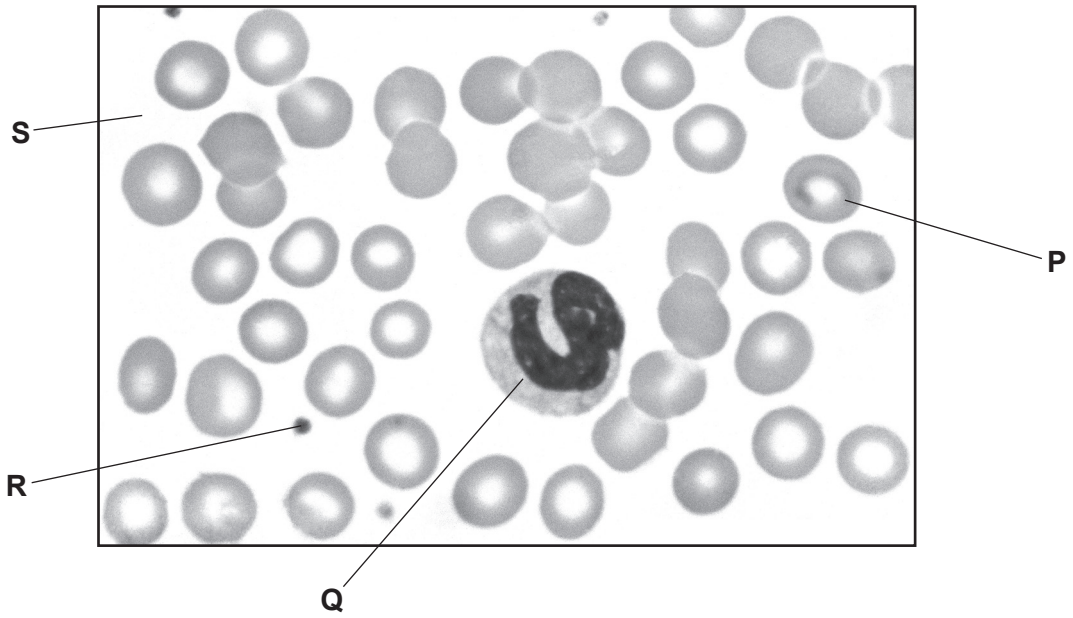

Fig. 1.3

Table 1.1 shows the names and functions of some parts of the blood labelled **P**, **Q**, **R** and **S** in Fig. 1.3.

Complete Table 1.1.

Table 1.1

name of part	letter in Fig. 1.3	function
red blood cell		transport of oxygen
	S	transport of hormones
white blood cell		

[3]

[Total: 9]

2 A student investigates sodium chloride, NaC*l*.

(a) The student uses solid sodium chloride to make a concentrated aqueous solution of sodium chloride. The student then uses the apparatus shown in Fig. 2.1 to electrolyse this solution.

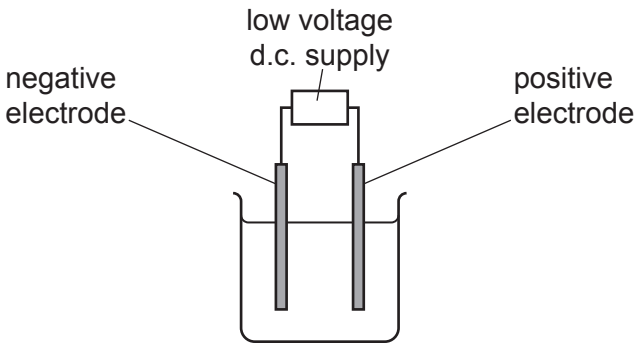

Fig. 2.1

(i) State what is meant by concentrated and aqueous.

concentrated .....

.....

aqueous .....

.....
[2]

(ii) State the name of the product formed at the positive electrode.

..... [1]

(iii) State the name of the type of chemical bonding found in compounds that can be electrolysed.

..... [1]

(b) The student adds aqueous silver nitrate to aqueous sodium chloride under acidic conditions.

State the observation when these two solutions are mixed.

..... [1]

(c) Aqueous sodium chloride is made when dilute hydrochloric acid is neutralised by aqueous solution **X**, as shown in Fig. 2.2.

The reading on the thermometer increases during the reaction.

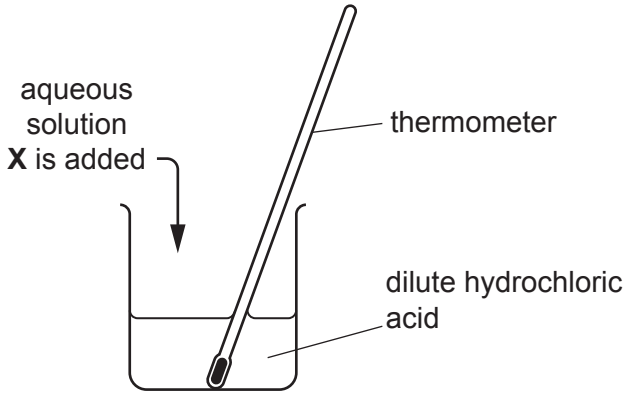

Fig. 2.2

(i) Suggest the identity of **X**.

..... [1]

(ii) State what happens to the pH of the mixture when **X** is added.

..... [1]

(iii) State the type of chemical reaction that causes the reading on the thermometer to increase.

..... [1]

(d) An atom of sodium is represented as shown.

$$^{23}_{11}Na$$

Deduce the number of electrons and neutrons in this atom.

number of electrons = ...

number of neutrons = ...

[2]

[Total: 10]

3 Fig. 3.1 shows a speed–time graph for a car on part of a journey along a road.

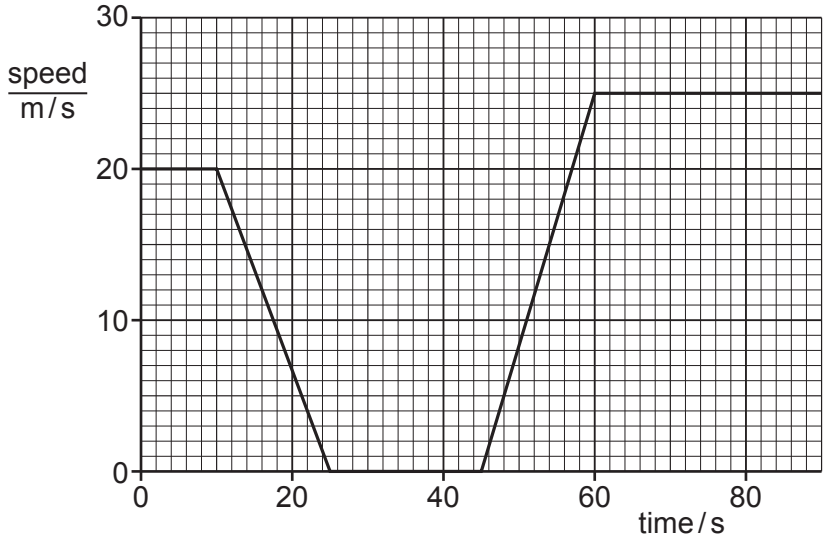

Fig. 3.1

(a) (i) Deduce the time interval for which the car is moving at a constant speed of 20 m/s.

time interval = ... s [1]

(ii) During the journey the car stops at traffic lights.

Deduce the time interval for which the car stops at the traffic lights.

time interval = ... s [1]

(iii) On Fig. 3.1, mark with an **X** a point at which the car is decelerating. [1]

(b) For part of the journey the car is travelling at 25 m/s.

Calculate the speed of the car in km/h.

speed = ... km/h [1]

(c) In another part of the journey the car travels at a constant speed of 30 m/s for 65 s.

Calculate the distance the car travels in this time interval.

distance = ... m [2]

(d) At the traffic lights the driver sees a red light. The light contains a lamp and lens.

Fig. 3.2 shows the arrangement of the lamp and the lens. The lamp is at the principal focus of the lens.

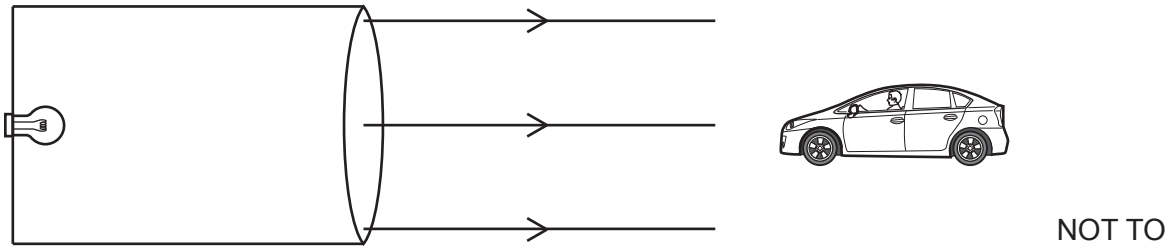

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Fig. 3.2

(i) Complete the sentence.

When light waves pass from air into glass, they can undergo ..... due to a change in the ..... of the waves.

[2]

(ii) On Fig. 3.2, complete the **three** rays emitted by the traffic light to show how they reach the lens from the lamp. [1]

[Total: 9]

4 **(a)** A student investigates photosynthesis.

The student:

- adds an indicator solution to three test-tubes, **A**, **B** and **C**
- puts one leaf into test-tube **B** and one leaf into test-tube **C**
- puts a bung into the top of each test-tube
- wraps test-tube **C** with dark card
- places the test-tubes in a warm room with plenty of light for 24 hours.

Fig. 4.1 is a diagram of the test-tubes after 24 hours.

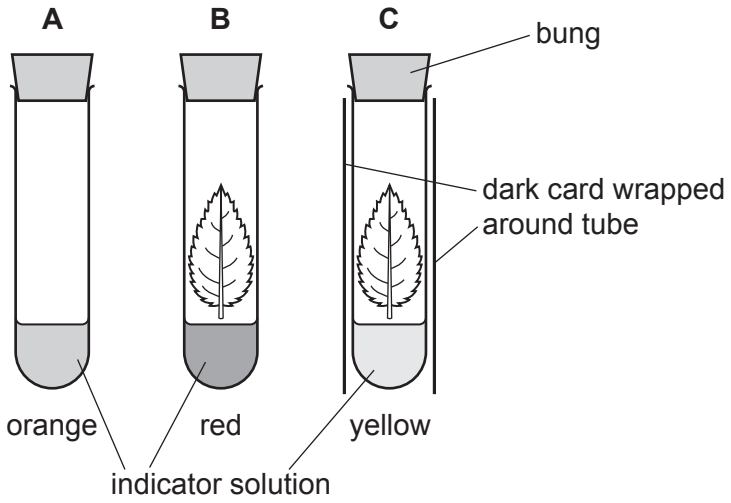

Fig. 4.1

The colour of the indicator solution shows the concentration of carbon dioxide in the test-tube.

- red = low carbon dioxide concentration
- orange = medium carbon dioxide concentration
- yellow = high carbon dioxide concentration

Explain the results for test-tubes **B** and **C**.

Use the words photosynthesis and respiration in your answer.

test-tube **B** .....

.....

.....

test-tube **C** .....

.....

.....

.....

[3]

(b) Fig. 4.2 shows a photomicrograph of cells in the lower epidermis of a leaf.

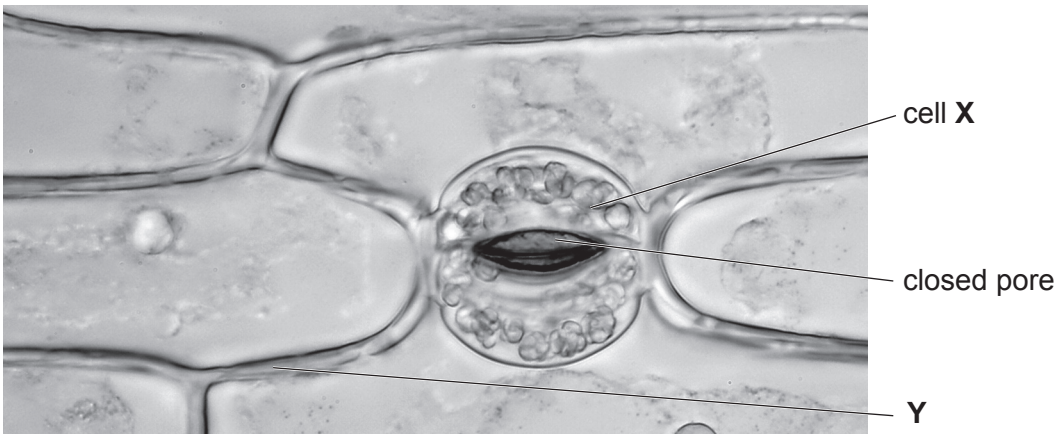

Fig. 4.2

(i) State the function of the structure labelled **Y** in Fig. 4.2.

..... [1]

(ii) Complete the sentences about Fig. 4.2.

Use words from the list.

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

air	**guard**	**mesophyll**	**liquid**
minerals	**palisade**	**stomata**	**water**

Cell **X** is called a ..... cell.

Cell **X** changes shape to control the size of the pore.

The pores in leaves are called ..... .

The pores open to allow ..... to diffuse out during transpiration. [3]

(iii) State one change to the environmental conditions that would **increase** the rate of transpiration.

..... [1]

(iv) State the name of the vessels that transport water from the roots to the leaf.

..... [1]

[Total: 9]

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5 Copper is a transition element.

(a) (i) State **one** physical property and **one** chemical property of copper.

physical property .....

chemical property .....

[2]

(ii) Suggest why some coins are made of copper alloy rather than pure copper.

.....

..... [1]

(b) Copper is extracted from copper oxide by heating with carbon.

Aluminium is extracted from aluminium oxide by electrolysis.

Argon, a noble gas, does not react with copper or aluminium.

(i) Complete the balanced equation for the extraction of copper.

$$.....CuO + ...C \rightarrow .....CO_2 + ...Cu$$

[1]

(ii) State whether carbon is oxidised or reduced during the extraction of copper.

Give a reason for your answer.

carbon is .....

reason .....

.....

[1]

(iii) State why aluminium cannot be extracted from aluminium oxide by heating with carbon.

.....

..... [1]

(iv) Explain why argon and other noble gases do **not** react with either copper or aluminium.

Use ideas about noble gas electronic structures in your answer.

.....

.....

..... [2]

[Total: 8]

6 **(a)** Moving water has kinetic energy.

State **two** energy resources which supply useful energy from moving water.

1 .....

2 .....
[2]

(b) Fig. 6.1 shows a borehole drilled into the Earth to obtain energy. This energy is then used to generate electricity.

The temperature of the rock at the top of the borehole and at the bottom of the borehole is shown.

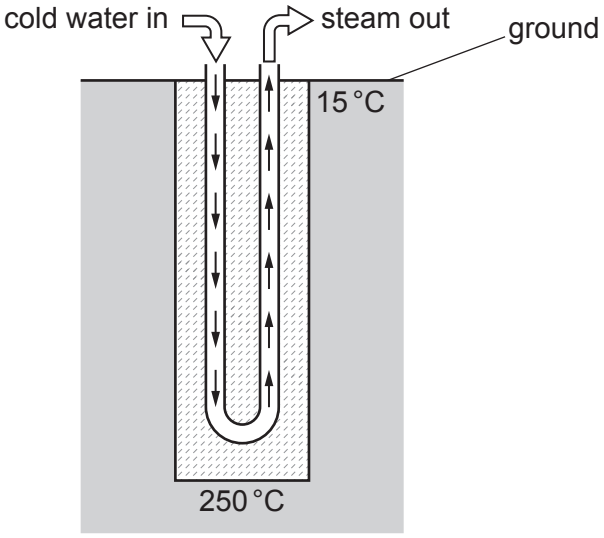


Fig. 6.1

(i) Calculate the temperature difference between the top and the bottom of the borehole.

temperature difference = ... °C [1]

(ii) This is an energy resource that uses energy stored in hot rocks below the ground.

State the name of this type of energy resource.

..... [1]

(iii) Use Fig. 6.1 to describe how the energy is extracted from the borehole and used to generate electrical energy.

.....

.....

.....

.....

..... [3]

(c) Energy is stored in batteries.

(i) State the form of energy stored in a battery.

..... [1]

(ii) Two electric motors do work using energy from batteries.

One of the electric motors does work by lifting a load to a high shelf.
The second electric motor has a lower power output but does the same task.

Complete the sentences.

As the load moves upwards, it has kinetic energy and gains ..... energy.

The second motor takes ..... to complete the same task.

[2]

[Total: 10]

7 **(a)** Fig. 7.1 shows an incomplete food web.

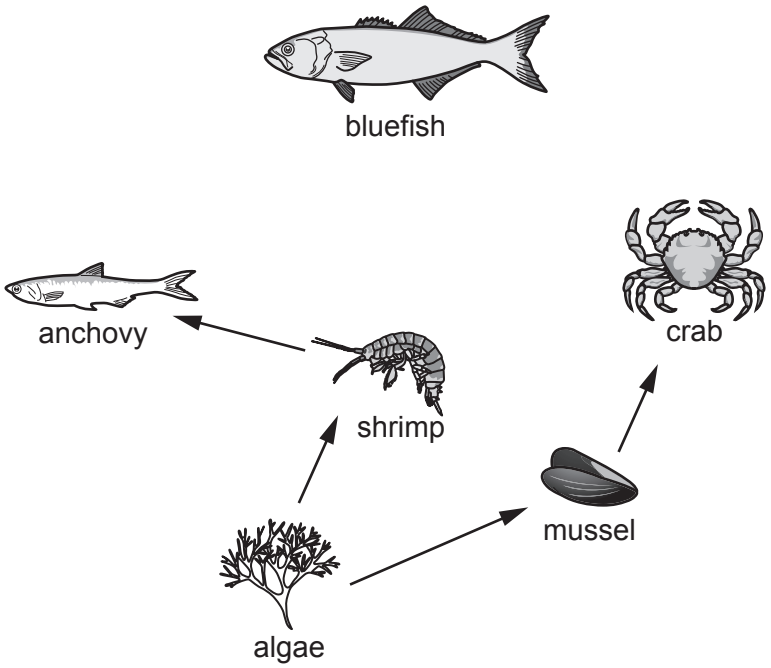


Fig. 7.1

(i) The bluefish eats the anchovy **and** the shrimp.

Draw **two** arrows on Fig. 7.1 to show these feeding relationships. [1]

(ii) Identify **one** primary consumer shown in Fig. 7.1.

..... [1]

(iii) State the principal source of energy in all food webs.

..... [1]

(b) Algae reproduce both sexually and asexually.

State **two** ways asexual reproduction is different from sexual reproduction.

1 .....

.....

2 .....

.....

[2]

(c) Bluefish are eaten by humans. They are a source of fats.

(i) State the dietary importance of fats in humans.

..... [1]

(ii) Circle the name of the chemical used in the test for the presence of fats in food.

Benedict's solution **biuret solution** **ethanol** **iodine solution**

[1]

(iii) Fats are digested in the alimentary canal.

Complete the sentences to describe the process of digestion.

Digestion is the breakdown of ..... insoluble food molecules into ..... soluble molecules using mechanical and chemical processes.

Chemical digestion uses a type of protein that functions as a biological catalyst.

These proteins are called ..... .

[2]

[Total: 9]

8 **(a)** Methane, CH_4, is the main constituent of natural gas.

(i) Complete the word equation for the complete combustion of methane.

methane	+		→		+	water

[1]

(ii) Complete the dot-and-cross diagram in Fig. 8.1 to show the arrangement of electrons in a molecule of water.

Show only the outer shell electrons.

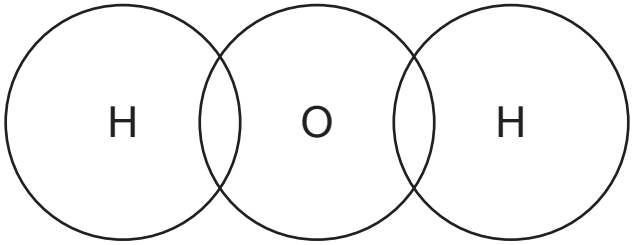


Fig. 8.1

[2]

(b) Ethene is an unsaturated hydrocarbon.

Aqueous **Y** is an orange solution that is decolourised by ethene. It is used as a test for ethene.

(i) State what is meant by unsaturated.

.....

..... [1]

(ii) Identify **Y**.

..... [1]

(iii) State the type of polymerisation that produces poly(ethene) from ethene.

..... [1]

(c) At –120 °C methane is a gas and ethene is a liquid.

Describe **two** differences between the particles in a gas and a liquid.

1 .....

.....

2 .....

.....

[2]

[Total: 8]

9 Fig. 9.1 shows an electrical circuit.

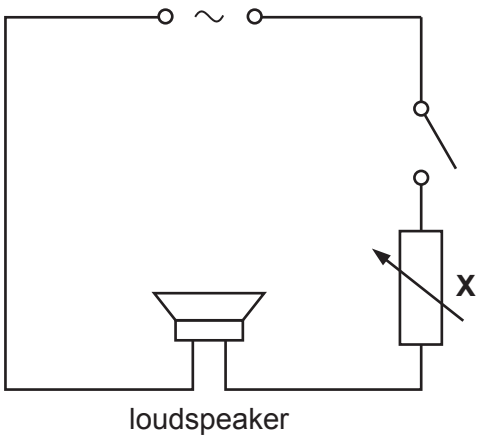


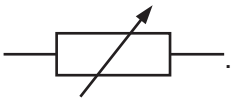
Fig. 9.1

(a) The potential difference across the loudspeaker is 9 V.
The current in the loudspeaker is 1.5 A.

Calculate the resistance of the loudspeaker.

Give the unit of your answer.

resistance = ... unit ..... [3]

(b) (i) State the name of component **X** with the symbol  .

..... [1]

(ii) Increasing the current in the loudspeaker increases the loudness.

Explain why increasing the resistance of component **X** decreases the loudness of the sound emitted.

.....

..... [1]

(iii) The loudness of the sound emitted decreases.

State the property of the sound waves that changes.

..... [1]

(c) A lamp is added to the circuit in parallel with the loudspeaker to show when the loudspeaker is switched on.

The lamp is connected so that it is not affected by altering the resistance of component **X**.

On Fig. 9.2, add the lamp to the circuit diagram, using the circuit symbol for a lamp.

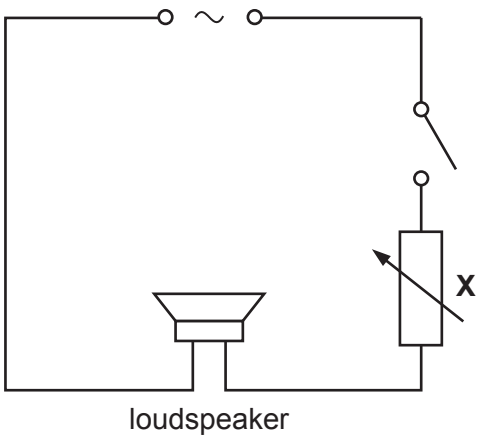


Fig. 9.2

[2]

[Total: 8]

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

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

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