Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

9930966544

COMBINED SCIENCE **0653/31**

Paper 3 Theory (Core) **May/June 2024**

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

1 **(a)** Fig. 1.1 is a diagram of the alimentary canal and associated organs in humans.

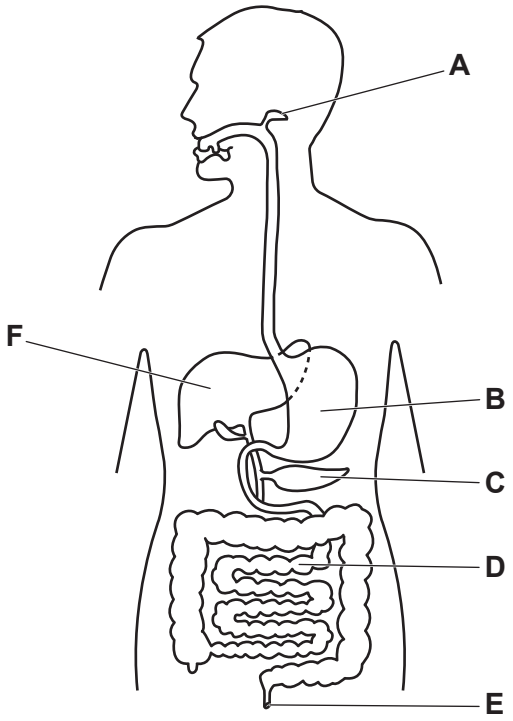

Fig. 1.1

(i) State the letter on Fig. 1.1 that identifies the position of:

a salivary gland .....

the liver. .....

[2]

(ii) Circle **one** function of the part labelled **D** in Fig. 1.1.

absorption **egestion** **ingestion** **synthesis**

[1]

(b) Enzymes digest food in the human alimentary canal.

Fig. 1.2 shows the effect of temperature on the activity of two different enzymes.

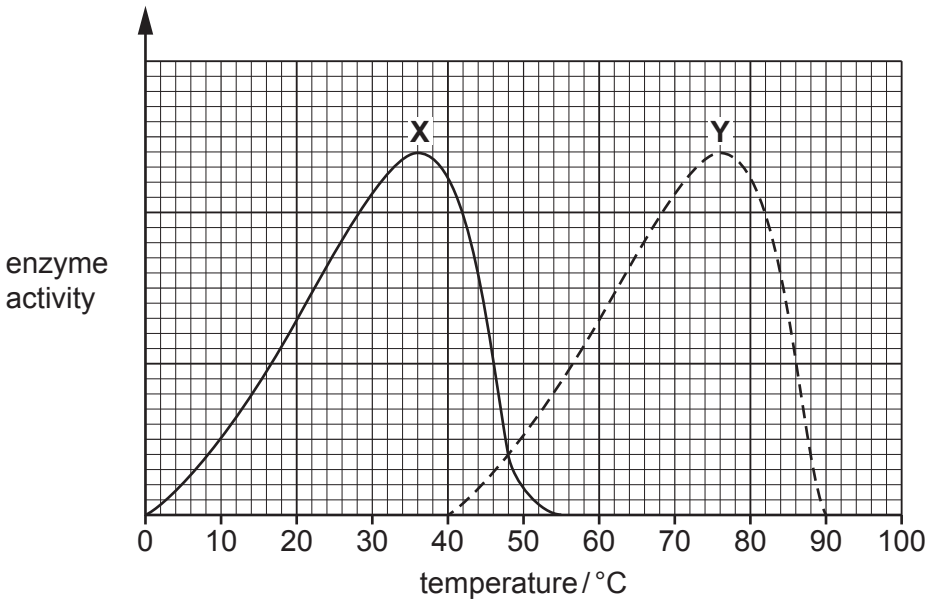

Fig. 1.2

(i) Identify the temperature where both enzyme **X** and enzyme **Y** have the same enzyme activity.

Tick (✓) the correct box.

15 °C	
40 °C	
48 °C	
55 °C	
90 °C	

[1]

(ii) The temperature of the human body is usually within the range 36.5 °C to 37.5 °C.

State why enzyme **Y** is **not** found in the human alimentary canal.

.....

..... [1]

(c) (i) The boxes on the left show some types of biological molecules.

The boxes on the right show some tests used to identify biological molecules.

Draw **one** straight line from each biological molecule to its correct test.

biological molecule	test
starch	Benedict's solution
protein	biuret
	ethanol emulsion
	iodine solution

[2]

(ii) State the name of the smaller molecules that large protein molecules are made from.

..... [1]

(iii) Starch is a carbohydrate.

List **all** the chemical elements that make up carbohydrates.

..... [1]

[Total: 9]

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2 The elements chlorine, bromine and iodine are diatomic covalent molecules.

(a) State the meaning of diatomic.

..... [1]

(b) Complete the dot-and-cross diagram in Fig. 2.1 to show the outer-shell electrons in a molecule of chlorine, Cl_2.

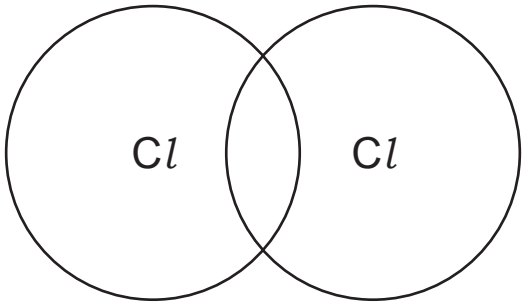

Fig. 2.1 [2]

(c) Chlorine reacts exothermically with sodium to form the ionic compound sodium chloride.

(i) State the meaning of exothermic.

.....

..... [1]

(ii) Describe what happens to a sodium atom and to a chlorine atom when they react to form the ionic compound sodium chloride.

Use ideas about electrons in your answer.

sodium atom .....

.....

chlorine atom .....

.....
[2]

(iii) Describe the difference in volatility between ionic compounds and covalent compounds.

.....

..... [1]

(d) Solid sodium carbonate reacts with dilute hydrochloric acid to form aqueous sodium chloride, carbon dioxide and one other product.

(i) Identify the solute and the solvent in aqueous sodium chloride.

solute .....

solvent .....
[2]

(ii) Complete the word equation for this reaction.

sodium carbonate	+	hydrochloric acid	→		+		+	

[1]

(iii) The structure of sodium carbonate is shown in Fig. 2.2.

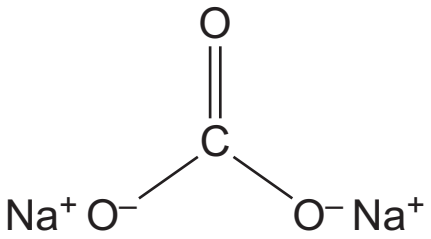

Fig. 2.2

Deduce the formula of sodium carbonate.

..... [1]

[Total: 11]

3 Fig. 3.1 shows an aluminium pan containing water, being heated on a hotplate of a cooker.

There is a glass lid on the pan and a thermometer dips into the water.

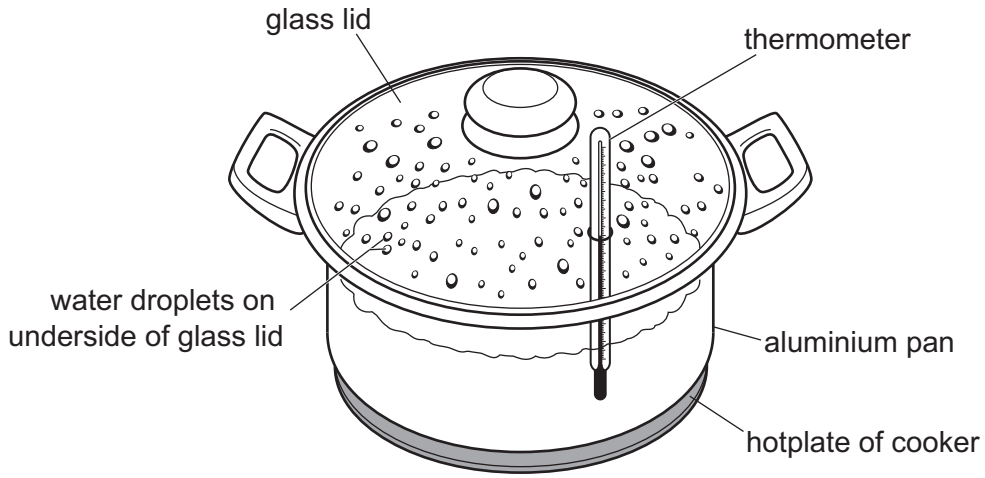

Fig. 3.1

(a) The thermometer reads 60 °C.

Water droplets can be seen condensing on the underside of the glass lid.

(i) State the process that forms water vapour at 60 °C.

..... [1]

(ii) State the process that happens when the temperature of the water reaches 100 °C.

..... [1]

(b) (i) State the process that transfers thermal energy from the cooker to the water through the aluminium pan.

..... [1]

(ii) Another pan on the cooker has the same shape but is made of glass.

The pan contains the same volume of water as the aluminium pan, has a lid and is heated on an identical hotplate.

Explain why the water in the glass pan takes a longer time to reach 100 °C.

.....

..... [1]

(c) A thermometer is placed in another pan of water.

Fig. 3.2 shows what an observer sees when viewing the pan from the side.

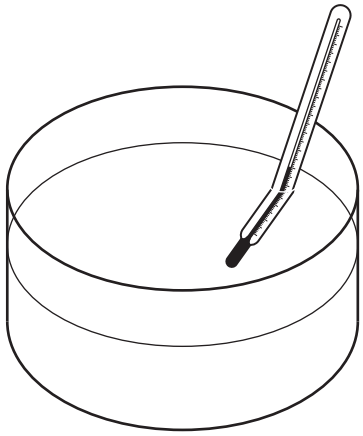

Fig. 3.2

State the property of light that makes the thermometer appear bent.

..... [1]

(d) A person reads the thermometer when it is reflected in a plane mirror.

Fig. 3.3 shows a ray of light from the thermometer reading to the mirror.
The normal at the mirror is also shown.

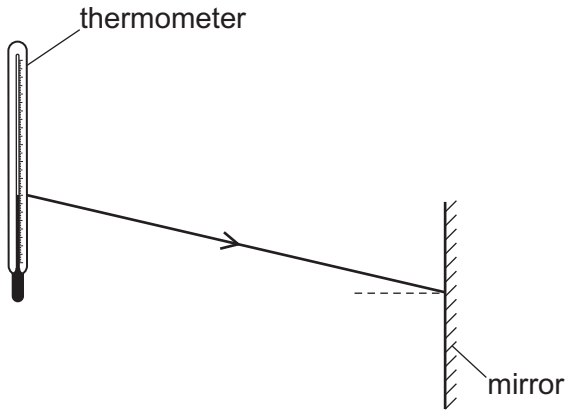

Fig. 3.3

(i) On Fig. 3.3, complete the ray diagram to show the ray of light reflected by the mirror.

Draw an **X** in a correct place for an eye to see the reflection of the thermometer reading. [2]

(ii) The thermometer reading on the scale is 30 °C as shown in Fig. 3.4.

Complete the right-hand box in Fig. 3.4 to show the image of the reading as seen reflected in the mirror.

Fig. 3.4

[1]

(e) Visible light is part of the electromagnetic spectrum.

State **one** part of the electromagnetic spectrum with a higher frequency than visible light.

..... [1]

(f) Microwaves are part of the electromagnetic spectrum.

State **one** use of microwaves.

..... [1]

[Total: 10]

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4 **(a)** Fig. 4.1 shows the pathway taken by water through a plant root.

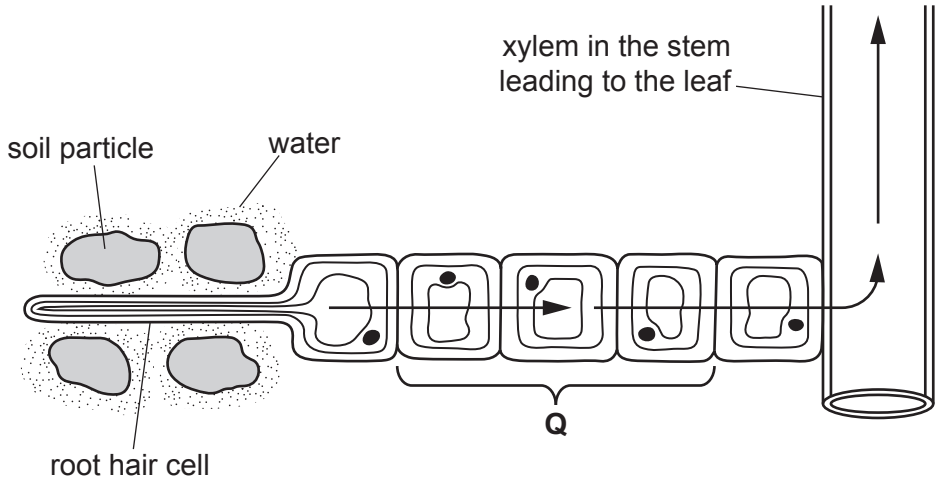

Fig. 4.1

(i) State the name of the type of cells labelled **Q** in Fig. 4.1.

..... [1]

(ii) On Fig. 4.1, draw a label line and the letter **V** to identify **one** vacuole. [1]

(iii) Complete the sentences to describe the pathway taken by water through the leaf.

Choose words from the list.
Each word may be used only once.

diffusion **evaporation** **osmosis**

transmission **transpiration**

Water moves from the xylem to the air spaces in the leaf by

…… from the surface of mesophyll cells.

The water vapour then passes out of the stomata by the process of

…… .

This loss of water vapour from the leaves is called

…… .

[3]

(b) Fig. 4.2 shows a plant reproducing asexually.

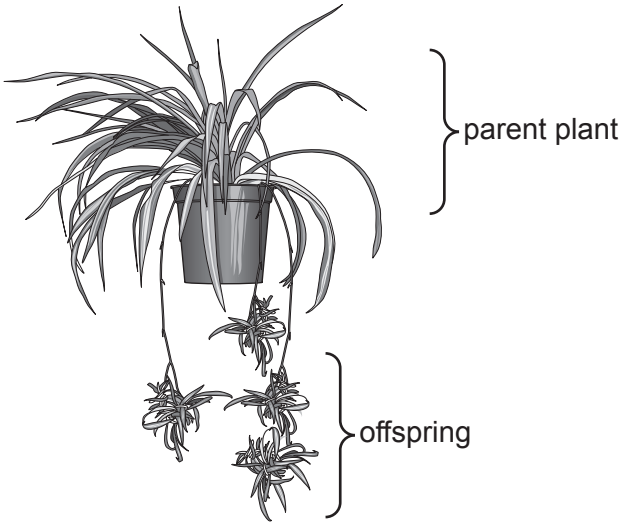

Fig. 4.2

Tick (✓) **two** correct statements about the plants shown in Fig. 4.2.

The offspring are genetically identical to the parent plant.	
The offspring developed from germinating seeds.	
The parent plant needed flowers to produce the offspring.	
Fertilisation did **not** take place to produce the offspring.	
The parent plant has been pollinated to produce the offspring.	

[2]

(c) **(i)** Explain why plants are classified as producers in a food chain.

.....

.....

..... [2]

(ii) Fig. 4.3 shows a food chain.

Circle the primary consumer in Fig. 4.3.

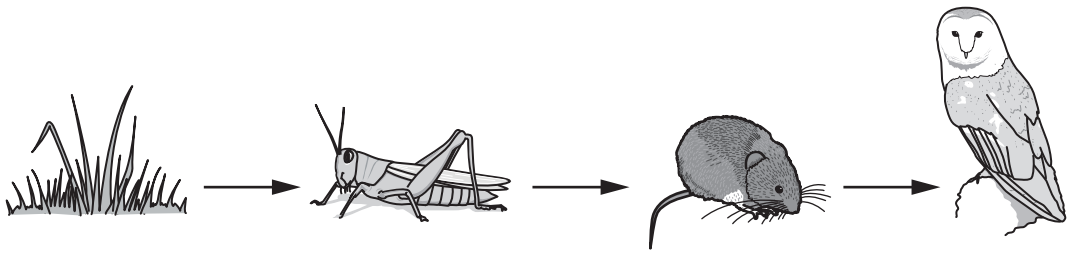

Fig. 4.3

[1]

[Total: 10]

5 Petroleum is a mixture of hydrocarbons.

Fig. 5.1 shows the process that separates petroleum into hydrocarbons and another process, process **B**.

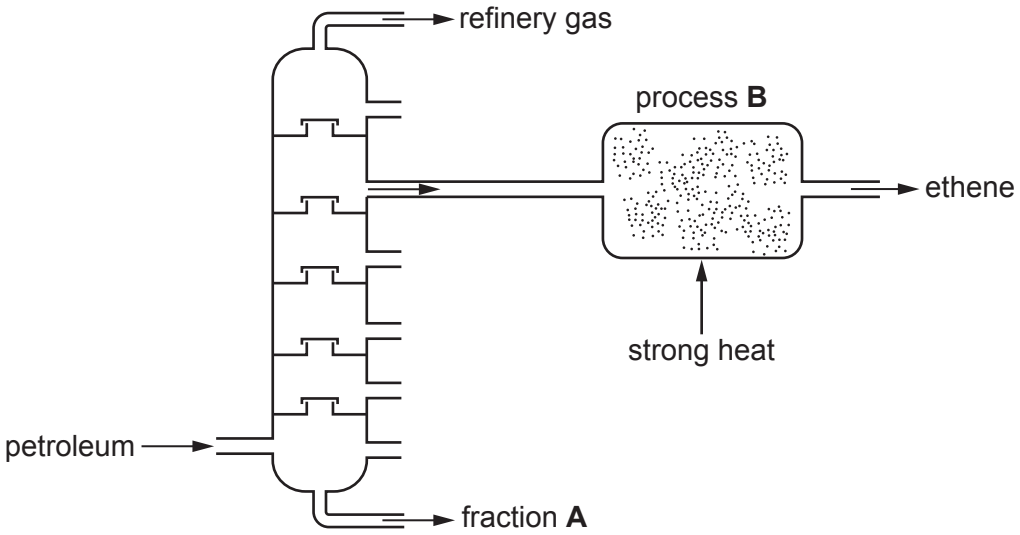

Fig. 5.1

(a) (i) Circle the name of the process that separates petroleum into hydrocarbons.

chromatography **crystallisation** **filtration** **fractional distillation**

[1]

(ii) State **one** use for refinery gas.

..... [1]

(iii) State **one** use for fraction **A**.

..... [1]

(b) Process **B** produces the unsaturated hydrocarbon ethene.

(i) State the name of process **B**.

..... [1]

(ii) Explain why ethene is described as unsaturated and as a hydrocarbon.

unsaturated .....

.....

hydrocarbon .....

.....

[2]

(iii) Describe a chemical test for unsaturated hydrocarbons.

State the observation for a positive result.

test .....

observation .....

.....
[2]

(iv) State the type of chemical reaction that converts ethene monomer units to poly(ethene).

..... [1]

(c) Petroleum is one example of a fossil fuel.

Another fossil fuel has a greenhouse gas as its main constituent.

State the name of this other fossil fuel.

..... [1]

[Total: 10]

6 Fig. 6.1 shows a mechanical crane using force **P** to lift a box from the ground to the top of a building.

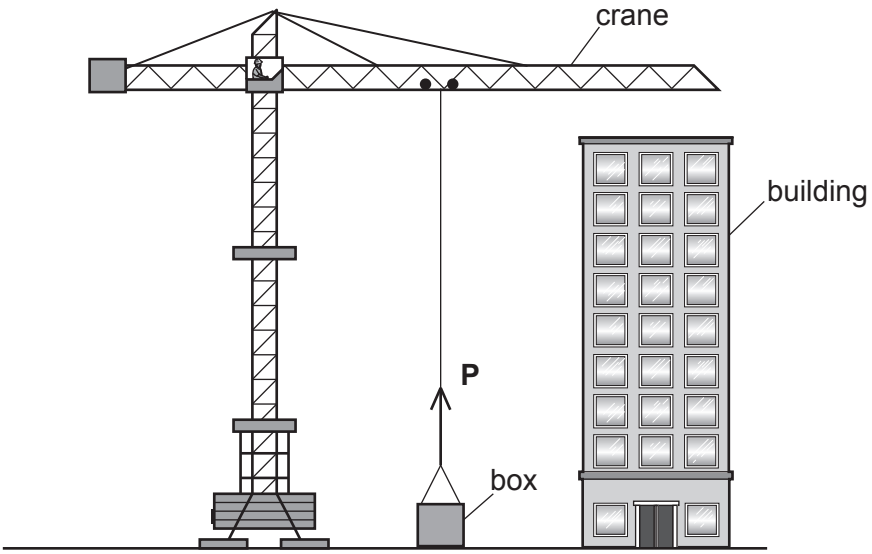

Fig. 6.1

(a) (i) The box weighs 15000 N.

Calculate the mass of the box.

The gravitational force on unit mass is 10 N / kg.

mass = ... kg [2]

(ii) The box has a volume of 2.0 m^3.

Use your answer to **(a)(i)** to calculate the density of the box.

density = ... kg/m^3 [2]

(b) When the box is on the ground, the crane applies force **P** of 16 000 N to the box.

Describe what happens to the box when this force is applied.

Use ideas about motion in your answer.

.....

.....

..... [2]

(c) The building is 56 m tall. The crane lifts the box at an average speed of 0.28 m / s.

(i) Calculate the time taken to lift the box from the ground to the top of the building.

time = ... s [2]

(ii) The box gains 825 000 J of gravitational potential energy (GPE) when it is lifted to the top of the building.

The crane lifts a second box of the same weight to the top of the building at an average speed of 0.50 m / s.

State whether the second box gains more, less or the same gravitational potential energy (GPE) as the first box.

Explain your answer.

.....

.....

..... [2]

[Total: 10]

7 **(a)** Fig. 7.1 shows part of the human circulatory system.

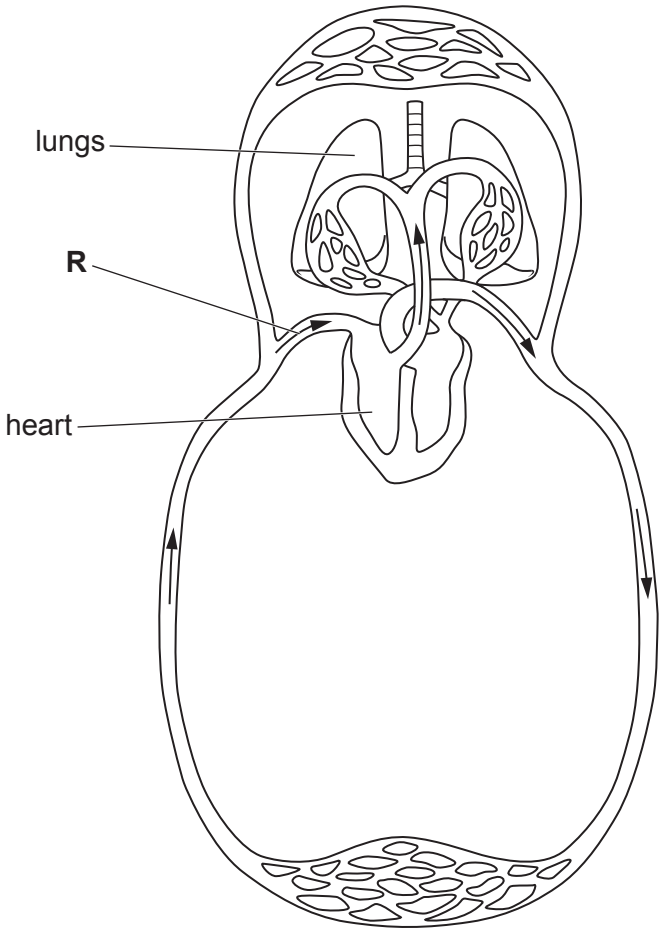

Fig. 7.1

(i) The arrows show the direction of blood flow in the circulatory system.

Identify the blood vessel labelled **R** in Fig. 7.1.

Circle the correct answer.

aorta **pulmonary artery** **pulmonary vein** **vena cava**

[1]

(ii) State the function of valves in the circulatory system.

..... [1]

(b) The pulse rate of a student is measured at rest and during different types of physical activity.

Table 7.1 shows the results.

Table 7.1

physical activity	pulse rate / beats per minute
rest	70
slow walking	112
fast walking	126
running	135

(i) Calculate the percentage increase in pulse rate between rest and slow walking.

percentage increase …….. [2]

(ii) Exercise requires increased muscle contraction.

Explain why muscles need more oxygen during exercise.

.....

.....

.....

..... [2]

(c) Humans also have a reproductive system.

State the name of the part of the human reproductive system that produces sperm and the part that produces eggs.

sperm .....

eggs .....
[2]

[Total: 8]

8 **(a)** Solid zinc and dilute sulfuric acid react to form zinc sulfate and hydrogen gas.

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$$

(i) A student measures and controls the temperature, the volume and the concentration of the acid.

State **two other** measurements that the student needs to make to investigate the rate of this reaction.

1 .....

2 .....

[2]

(ii) Describe what happens to the pH number of the reaction mixture during the reaction.

..... [1]

(b) Dilute sulfuric acid is electrolysed using the apparatus shown in Fig. 8.1.

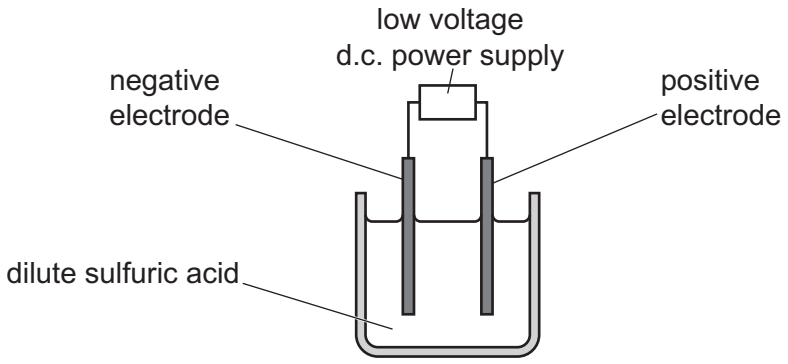

Fig. 8.1

(i) State the name of the negative electrode.

..... [1]

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

..... [1]

[Total: 5]

9 Fig. 9.1 shows an electrical circuit with components labelled **E**, **F**, **G**, **H** and **J**.

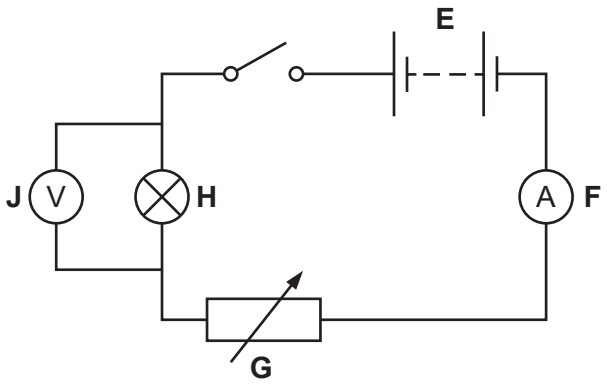

Fig. 9.1

(a) State the letter of the component that:

(i) is the energy source for the circuit. ..... [1]

(ii) is connected in parallel with another component. ..... [1]

(iii) measures the current in the circuit. ..... [1]

(iv) can be used to vary the current in the circuit. ..... [1]

(b) The potential difference across the battery is 3.0 V. The current in the circuit is 0.6 A.

Calculate the total resistance in the circuit.

Give the unit of your answer.

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

[Total: 7]

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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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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.).