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CANDIDATE NAME

CENTRE NUMBER | | | | | |

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4260509187

COMBINED SCIENCE **0653/42**

Paper 4 Theory (Extended) **February/March 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 **20** pages.

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[Turn over

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1 **(a)** Fig. 1.1 shows an insect-pollinated flower cut open to show the internal structures.

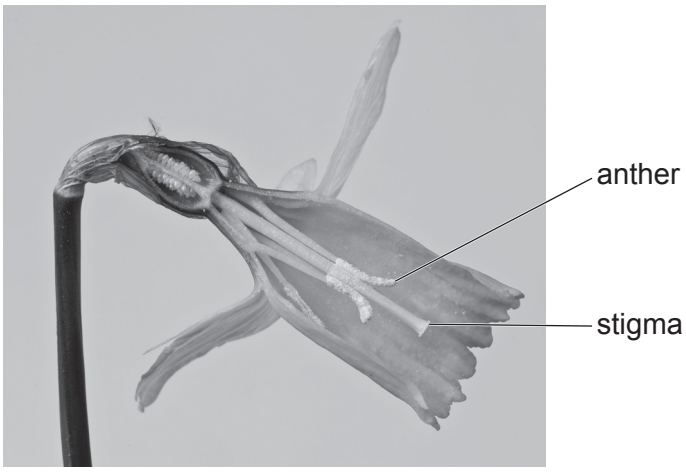


Fig. 1.1

(i) On Fig. 1.1, draw a label line and the letter **X** to identify the part that contains ovules. [1]

(ii) Describe **two** visible features that show the flower in Fig. 1.1 is adapted for insect pollination.

1 .....

.....

2 .....

.....

[2]

(b) Fig. 1.2 shows pollen grains from different plants as seen using a microscope.

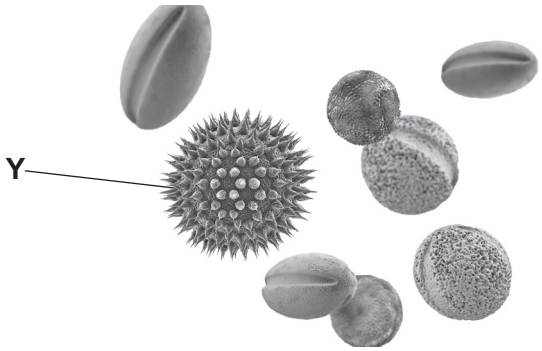


Fig. 1.2

Use evidence from Fig. 1.2 to describe how pollen grain **Y** is adapted for insect pollination.

.....

..... [1]

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(c) A student investigates phototropism in plants.

The student places a plant near a window. The plant is left for one week.

Fig. 1.3 shows the plant before the investigation starts and after one week by the window.

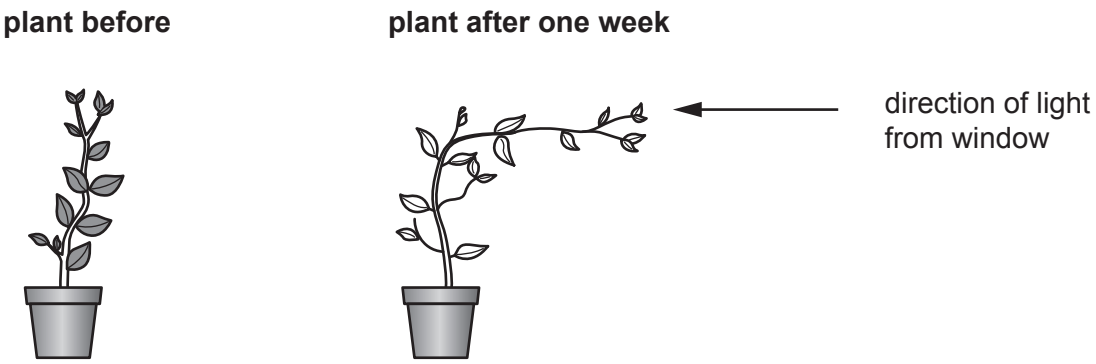


Fig. 1.3

Complete these sentences to explain the response of the plant to light.

Auxin spreads from the ..... to other parts of the plant.

There is unequal ..... of auxin in response to light.

The plant stem grows faster on the side with less light.

This is because auxin stimulates more cell ..... on this side.

[3]

(d) **(i)** Explain why plants are found at the first trophic level of a food chain.

.....

.....

..... [2]

(ii) Explain why **not** all the energy in plants is transferred to the next trophic level.

.....

.....

..... [2]

[Total: 11]

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2 Lead(II) chloride is electrolysed using the apparatus shown in Fig. 2.1.
Lead(II) chloride melts at 501°C.

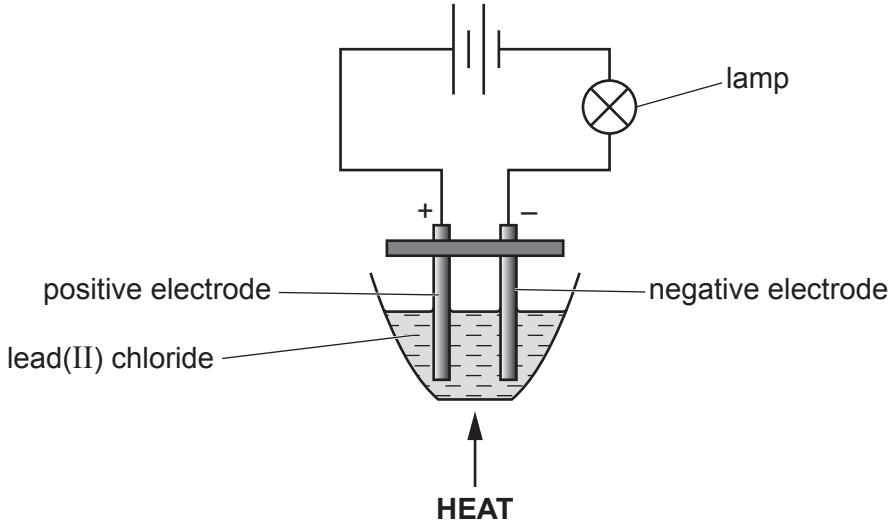


Fig. 2.1

(a) State the name of the positive electrode and the negative electrode.

positive electrode.....

negative electrode .....
[1]

(b) The lamp only lights up when the temperature of the lead(II) chloride is greater than 501 °C.

Explain why.

Use ideas about ions in your answer.

.....

.....

..... [2]

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(c) During the electrolysis, molten lead collects below the negative electrode and bubbles form around the positive electrode.

(i) Complete the symbol equation for the electrolysis reaction.

Include the state symbols.

$PbCl_2$ (.....) $\rightarrow$ ..... (.....) + ... (.....)

[2]

(ii) Describe how lead is formed from lead(II) chloride at the negative electrode.

Use ideas about electrons in your answer.

.....

.....

..... [2]

[Total: 7]

3 Fig. 3.1 shows a speed–time graph for a student riding a bicycle.

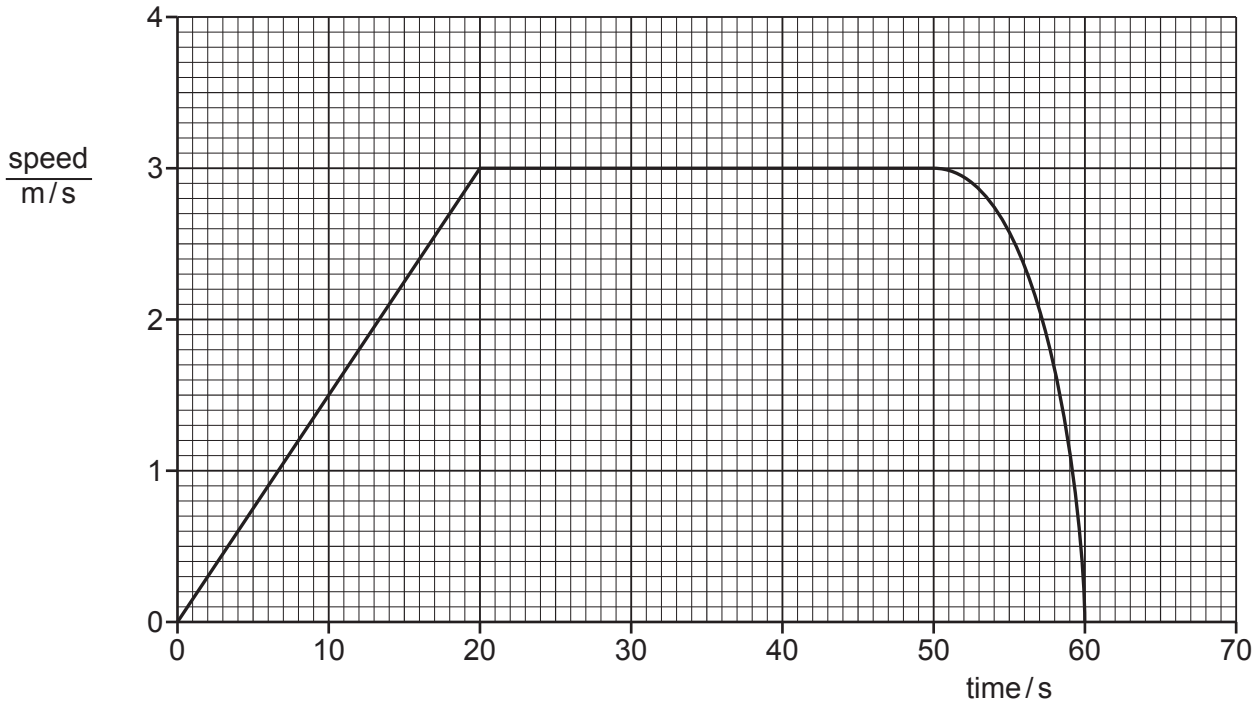


Fig. 3.1

(a) (i) On Fig. 3.1, write an **S** at a point where the student is slowing down. [1]

(ii) On Fig. 3.1, write an **X** at a point where the student's speed changes from accelerating to moving at constant speed. [1]

(iii) The student applies the brakes to slow down and stop.

Use Fig. 3.1 to find how long the student takes to stop after applying the brakes.

time = ... s [1]

(b) The student lifts the bicycle off the ground.

Explain why the total energy transferred by the student is more than the useful work done on the bicycle.

.....

.....

..... [1]

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(c) The weight of the bicycle is 150 N. The student has a mass of 60 kg.

Calculate the kinetic energy of the bicycle and student, when riding at a speed of 3.0 m / s.

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

kinetic energy = ... J
[4]

[Total: 8]

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4 **(a)** Enzymes are found in living organisms.

Complete the definition of enzymes.

Enzymes are proteins that function as biological ..... . [1]

(b) Fig. 4.1 shows the effect of temperature on the activity of four different enzymes, **A**, **B**, **C** and **D**.

The enzymes are from organisms that live in different habitats.

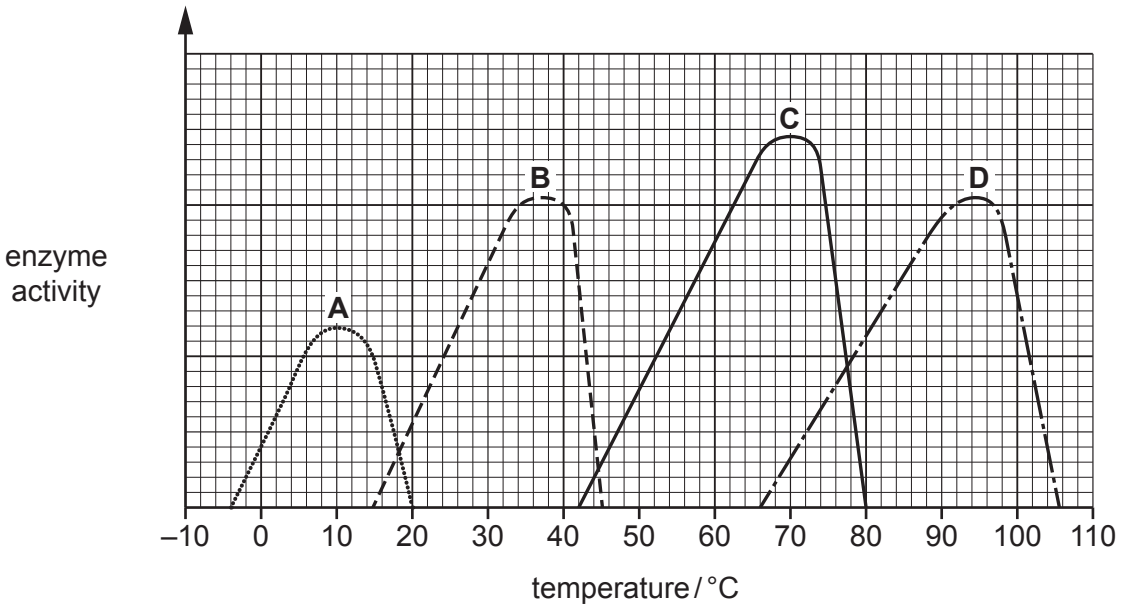


Fig. 4.1

(i) The Arctic Ocean has a temperature of approximately –1.8 °C.

Identify which enzyme shown in Fig. 4.1 is most likely from an organism that can live in the Arctic Ocean.

enzyme ..... [1]

(ii) Explain the effect of a temperature of 80 °C on the activity of enzyme **C** as in Fig. 4.1.

.....

.....

.....

.....

..... [3]

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(c) Table 4.1 shows some of the names and functions of enzymes in the alimentary canal of humans.

Complete Table 4.1.

Table 4.1

enzyme	function
.....	breaks down starch into simple sugars
protease	breaks down ..... into .....
.....	breaks down fats into fatty acids and glycerol

[3]

(d) Plants convert glucose into starch.

State the use of starch in plants.

..... [1]

[Total: 9]

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[Turn over

5 Solid magnesium sulfate, $MgSO_4$, dissolves to form aqueous magnesium sulfate.

(a) Name the solute and the solvent in aqueous magnesium sulfate.

solute .....

solvent .....
[2]

(b) An energy level diagram for dissolving magnesium sulfate is shown in Fig. 5.1.

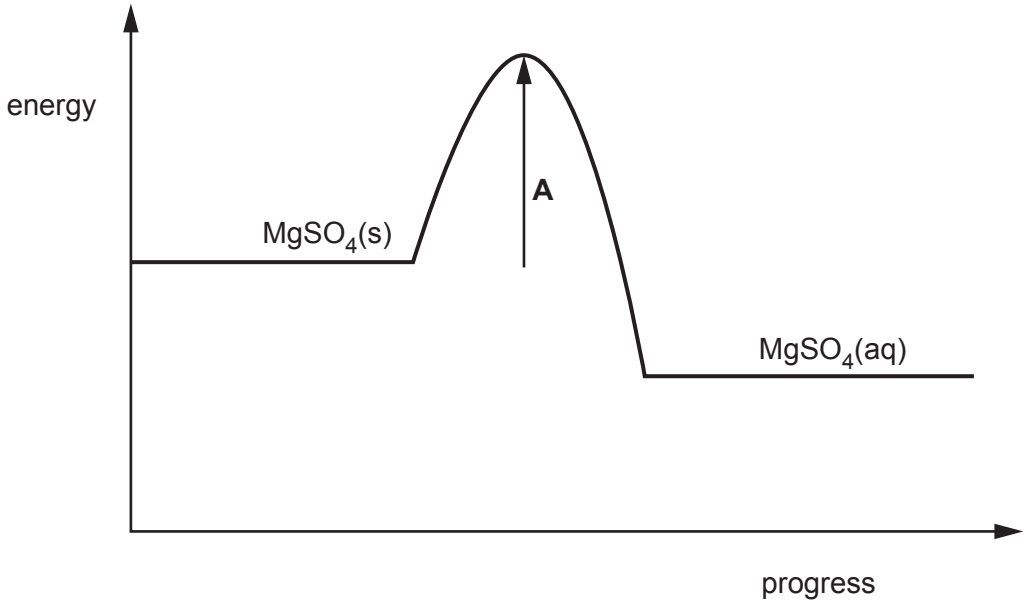


Fig. 5.1

(i) Describe the overall energy change that occurs when magnesium sulfate dissolves.

Explain your answer.

.....

.....

..... [2]

(ii) State the name of the energy change represented by arrow **A**.

..... [1]

(iii) Describe what happens during the energy change represented by arrow **A**.

Use ideas about bonds in your answer.

.....

..... [1]

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(c) Magnesium sulfate is made in reactions between solid magnesium or solid magnesium compounds and dilute acid.

Complete Table 5.1 to show the substances used and the products formed in these reactions.

Table 5.1

substances used		products formed
solid	dilute acid	
magnesium	.....	magnesium sulfate + ...
magnesium oxide	.....	magnesium sulfate + ...
.....	.....	magnesium sulfate + water + carbon dioxide

[4]

[Total: 10]

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6 Fig. 6.1 shows a house in the Himalayan mountain range. The roof of the house is covered in snow in the winter.

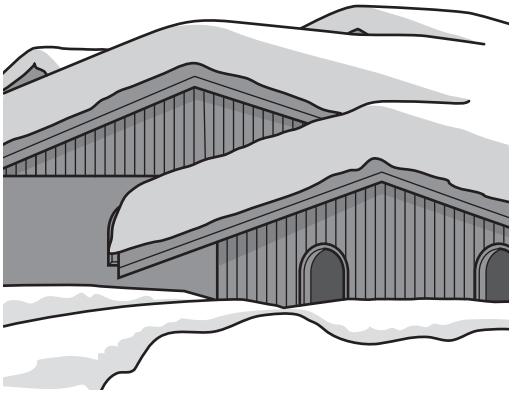


Fig. 6.1

(a) As the Sun shines on the roof, the snow warms up and the temperature of the roof rises from –10 °C to +5 °C.

(i) Describe the change in physical state of the snow on the roof as it warms up.

..... [1]

(ii) State the temperature at which this change happens.

..... °C [1]

(b) Electromagnetic radiation from the Sun is more intense on top of high mountains. This can be damaging to skin.

Fig. 6.2 shows part of an electromagnetic spectrum.

← increasing frequency						
gamma radiation	x-ray		visible light	infrared		

Fig. 6.2

Write in the correct space on Fig. 6.2, a type of radiation from the Sun that causes damage to the skin. [1]

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(c) There is ice on a lake near the house.

Fig. 6.3 shows a ray of light from the Sun being refracted as it moves into the ice.

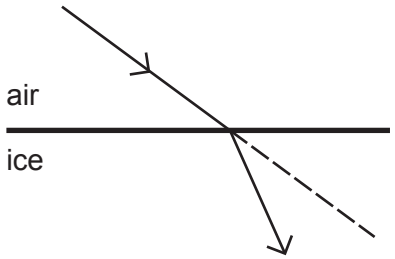


Fig. 6.3

Explain why the ray of light changes direction on entering the ice.

.....

..... [2]

(d) In the summer there is no ice on the lake.

Two students are watching waves on the surface of the lake.

One student counts 40 waves moving past in 25 s.

The other student measures the wavelength as 2.0 m.

Calculate the speed of the waves.

speed = ... m/s
[4]

[Total: 9]

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[Turn over

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7 **(a)** Fig. 7.1 is a diagram of a heart.

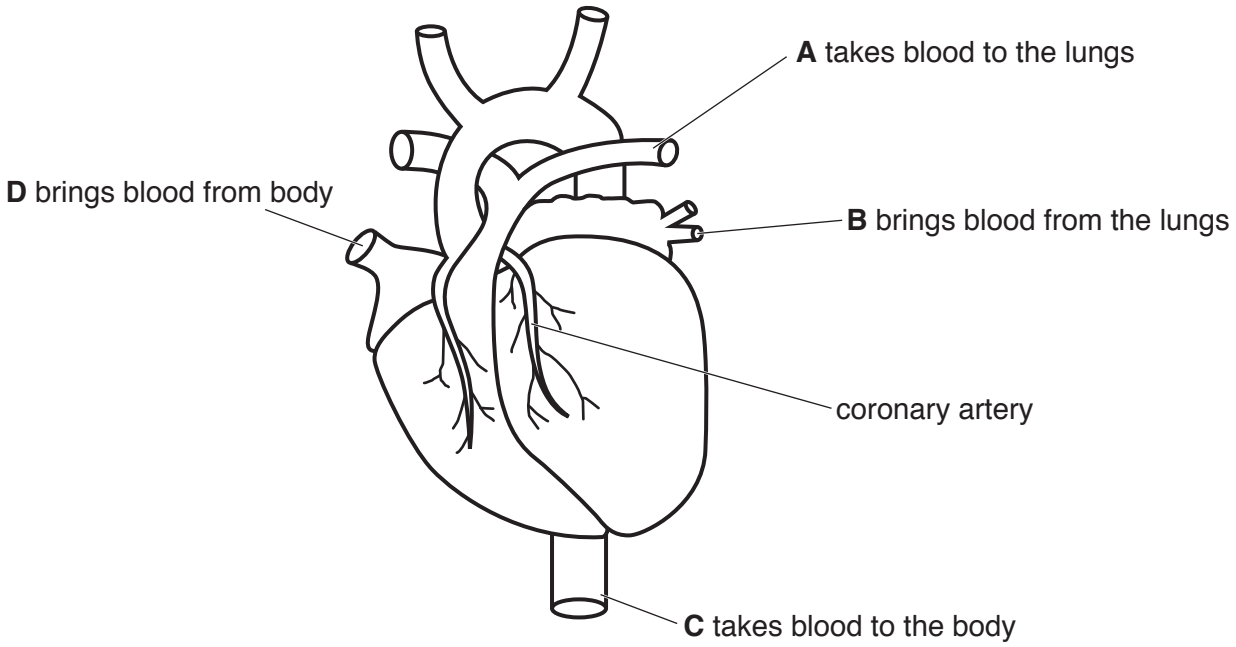


Fig. 7.1

(i) State the letter in Fig. 7.1 that identifies the pulmonary artery.

..... [1]

(ii) State **one** letter in Fig. 7.1 that identifies a blood vessel with valves along its length.

Give a reason for your answer.

letter .....

reason .....
[1]

(iii) Describe how blood is pumped through the heart from blood vessel **D** to blood vessel **A**.

.....

.....

..... [2]

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(b) Fig. 7.2 shows an unblocked coronary artery and a blocked coronary artery.

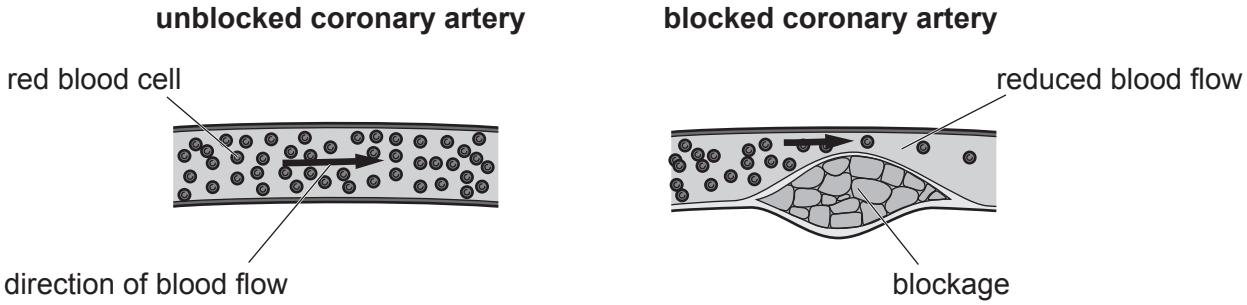


Fig. 7.2

The coronary artery transports oxygen to the wall of the heart.

Explain how the blockage could affect the function of the heart.

Use Fig. 7.2 and ideas about aerobic respiration in your answer.

.....

.....

.....

.....

..... [3]

[Total: 7]

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8 The structures of the hydrocarbons propane and ethene are shown in Fig. 8.1.

propane **ethene**

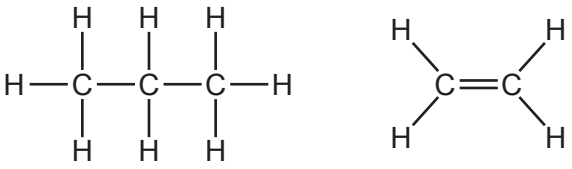


Fig. 8.1

(a) Name the homologous series which contains propane.

..... [1]

(b) Describe how Fig. 8.1 shows that propane is saturated and that ethene is unsaturated.

propane .....

.....

ethene .....

..... [2]

(c) Ethene, C_2H_4, is used to make ethanol, C_2H_5OH.

(i) Deduce the formula of the compound that reacts with ethene to make ethanol.

..... [1]

(ii) Explain why ethanol is **not** considered to be a hydrocarbon.

.....

..... [1]

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(d) Complete the dot-and-cross diagram in Fig. 8.2 to show the bonding in a molecule of ethene.

Show only the outer shell electrons.

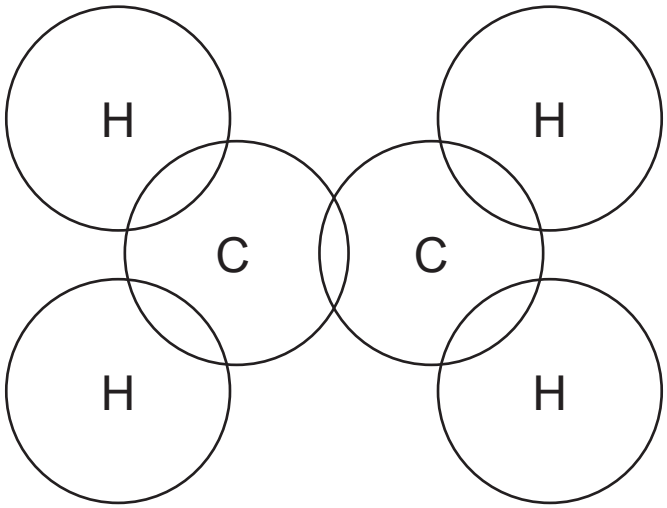


Fig. 8.2

[2]

(e) Suggest a chemical test that can be used to distinguish between propane and ethene.

State the observations for each.

test .....

observations with propane .....

observations with ethene .....

[2]

[Total: 9]

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9 Fig. 9.1 shows some components making an electrical circuit.

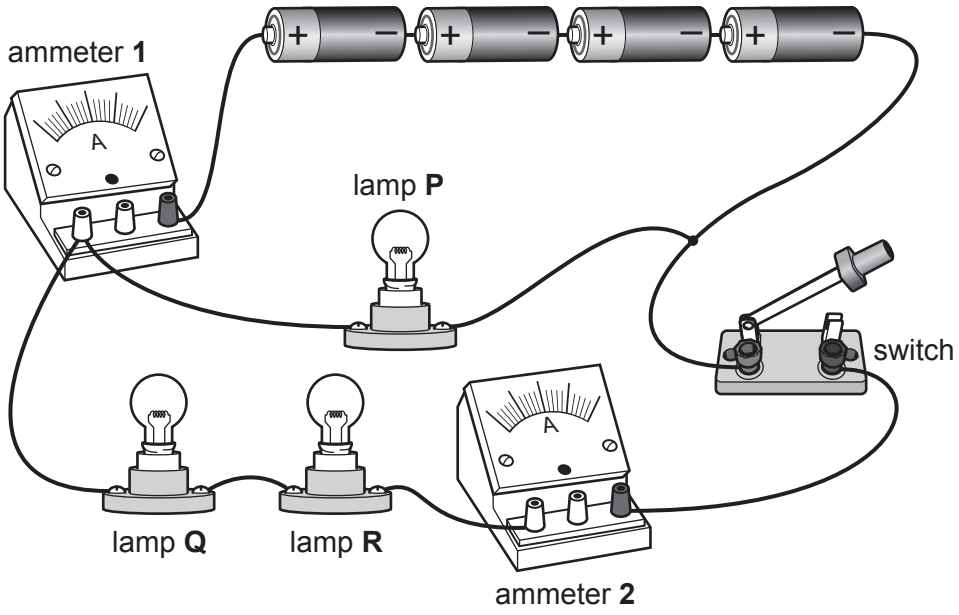


Fig. 9.1

(a) State the type of circuit arrangement for the lamps **Q** and **R** in Fig. 9.1.

..... [1]

(b) The three lamps are identical.

The battery applies a voltage of 6.4 V across the circuit.

When all three lamps are lit, ammeter **1** reads 1.28 A.

(i) Calculate the total resistance of the circuit.
State the unit of your answer.

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

(ii) Show that the current reading on ammeter **2** is 0.43 A.

[3]

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(c) The circuit in Fig. 9.1 is changed.

- Ammeter **2** is removed.
- Lamp **Q** is replaced by a variable resistor.
- A voltmeter is added to measure the potential difference (p.d.) across lamp **R**.

On Fig. 9.2, complete the circuit diagram for this changed circuit.

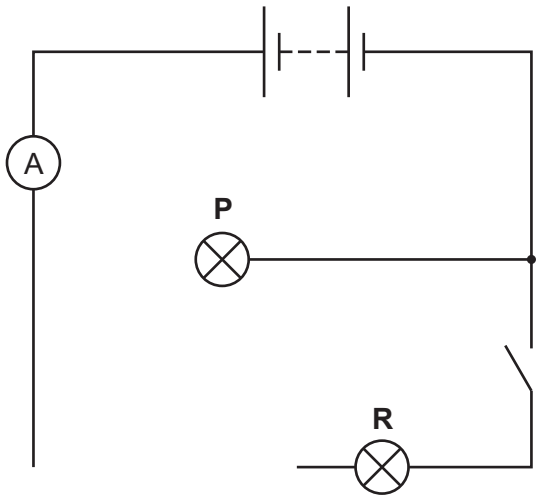


Fig. 9.2

[3]

[Total: 10]

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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.).

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