www.dynamicpapers.com

Cambridge Assessment International Education

# Cambridge IGCSE™

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CANDIDATE NAME | | | | | | | | | |
| CENTRE NUMBER | | | | | | CANDIDATE NUMBER | | | |

*0209974868*

**COMBINED SCIENCE** **0653/42**

Paper 4 Theory (Extended) **May/June 2021**

**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.


© UCLES 2021

www.dynamicpapers.com



**1** **(a)** Fig. 1.1 shows the flowers of a wind-pollinated plant.

**Fig. 1.1**

**(i)** Complete the sentence about wind pollination.

During wind pollination ..... from the anther of one flower is blown by the wind to the ..... of another flower.

[2]

**(ii)** Describe **one** way the anther of a wind-pollinated flower is different from the anther of an insect-pollinated flower.

.....

..... [1]

**(b)** After pollination and fertilisation a seed is formed.
Fig. 1.2 shows a bean seed just starting to grow.

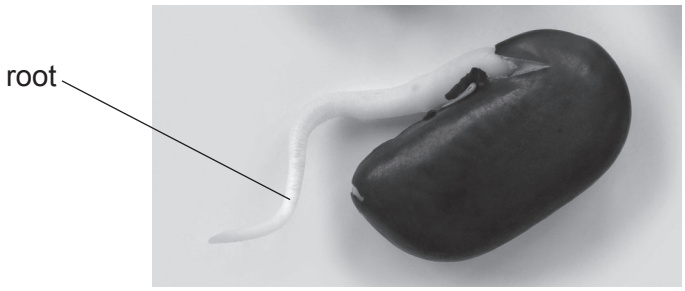



**Fig. 1.2**

**(i)** Circle the name of the process shown in Fig. 1.2.

**excretion** **germination** **nutrition** **respiration**

[1]

© UCLES 2021

www.dynamicpapers.com



**(ii)** The root of the seed is growing downwards away from the light.

Name this tropic response.

..... [1]

**(c)** Fig. 1.3 shows the plant growing from the bean seed a few days later.

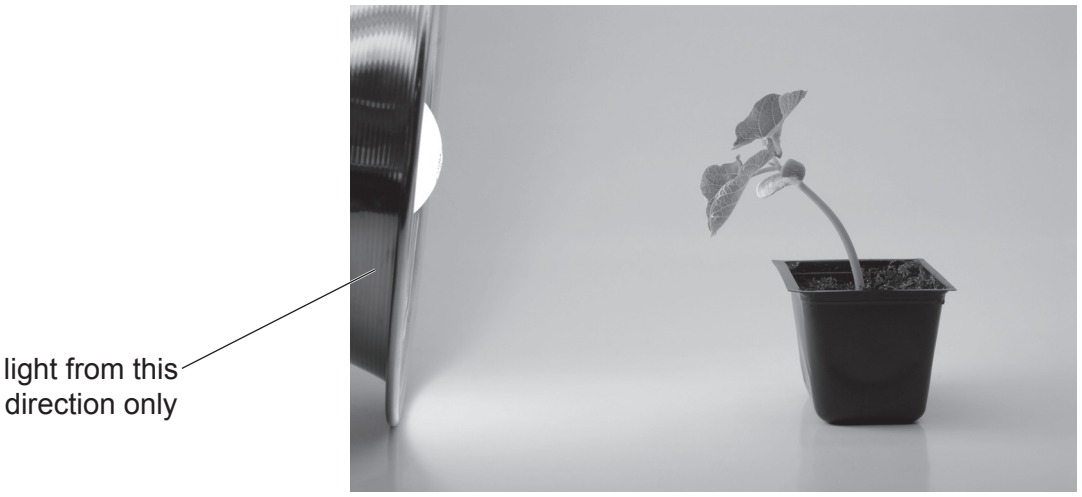



**Fig. 1.3**

Complete the sentences to explain the role of auxin in controlling the response of the shoot shown in Fig. 1.3.

Auxin is made in the shoot ..... and then spreads through the plant.

Auxin collects on the ..... side of the shoot.

Auxin stimulates cell ..... , which causes the shoot to bend.

[3]

**(d)** Oil is sometimes stored inside seeds.
Describe how you can test seeds to show that they contain oil.
Include the expected result in your answer.

method .....

.....

result .....

[2]

[Total: 10]

www.dynamicpapers.com



**2** Calcium chloride, $CaCl_2$, is an ionic compound.

**(a)** Fig. 2.1 is a dot-and-cross diagram which shows the arrangement of electrons in the ions in calcium chloride.

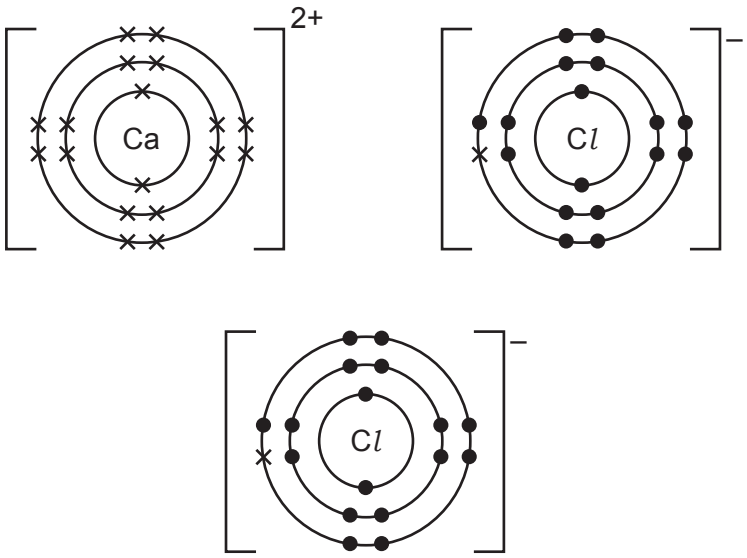



**Fig. 2.1**

**(i)** Describe how a calcium ion is formed from a calcium atom.

.....

..... [1]

**(ii)** Each chloride ion contains eight electrons in the outer shell.
These are represented by seven dots and one cross.
Explain why.

.....

.....

.....

..... [2]

**(iii)** Explain why there are two chloride ions for each calcium ion in calcium chloride.

.....

..... [1]

© UCLES 2021

www.dynamicpapers.com



**(b)** Sodium bromide is another ionic compound.
Fig. 2.2 represents the arrangement of ions in solid sodium bromide.

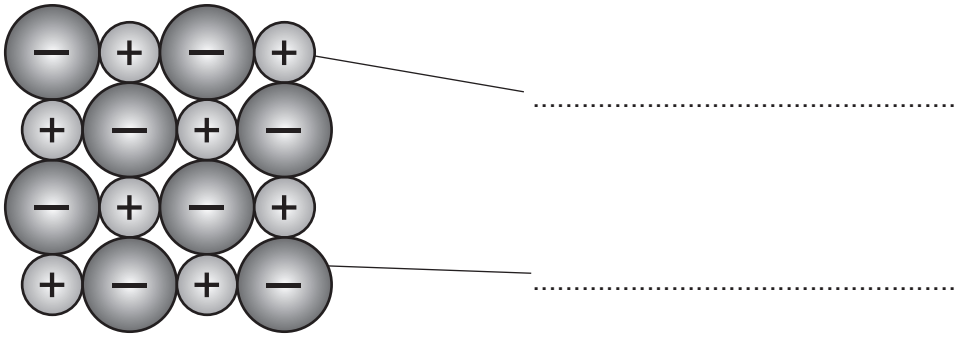



**Fig. 2.2**

**(i)** Complete Fig. 2.2 by labelling the ions in solid sodium bromide. [1]

**(ii)** State how Fig. 2.2 shows that sodium bromide is an ionic compound rather than a covalent compound.

.....

..... [1]

**(iii)** State **two** reasons why Fig. 2.2 **cannot** be used to represent the arrangement of ions in calcium chloride, $CaCl_2$.

1 .....

.....

2 .....

.....
[2]

[Total: 8]

www.dynamicpapers.com



**3** Fig. 3.1 shows a battery-powered electric bus.

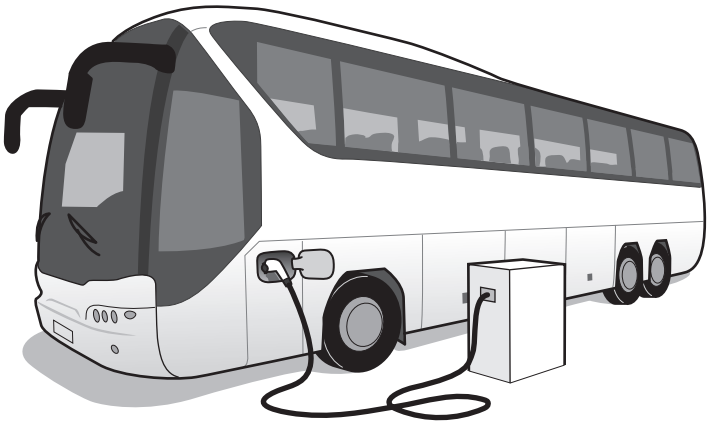


**Fig. 3.1**

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

**(a)** Electric buses are replacing buses that use fossil fuels because they cause less damage to the environment.

**(i)** Describe how electrical energy is obtained from wind energy.

.....

.....

.....

..... [2]

**(ii)** Wind energy is a renewable energy source.

Name another renewable energy source that can be used to generate the electrical energy to charge the batteries.

..... [1]

© UCLES 2021

www.dynamicpapers.com



**(b)** Fig. 3.2 shows a graph of a journey made by the bus along a road between two bus stops.

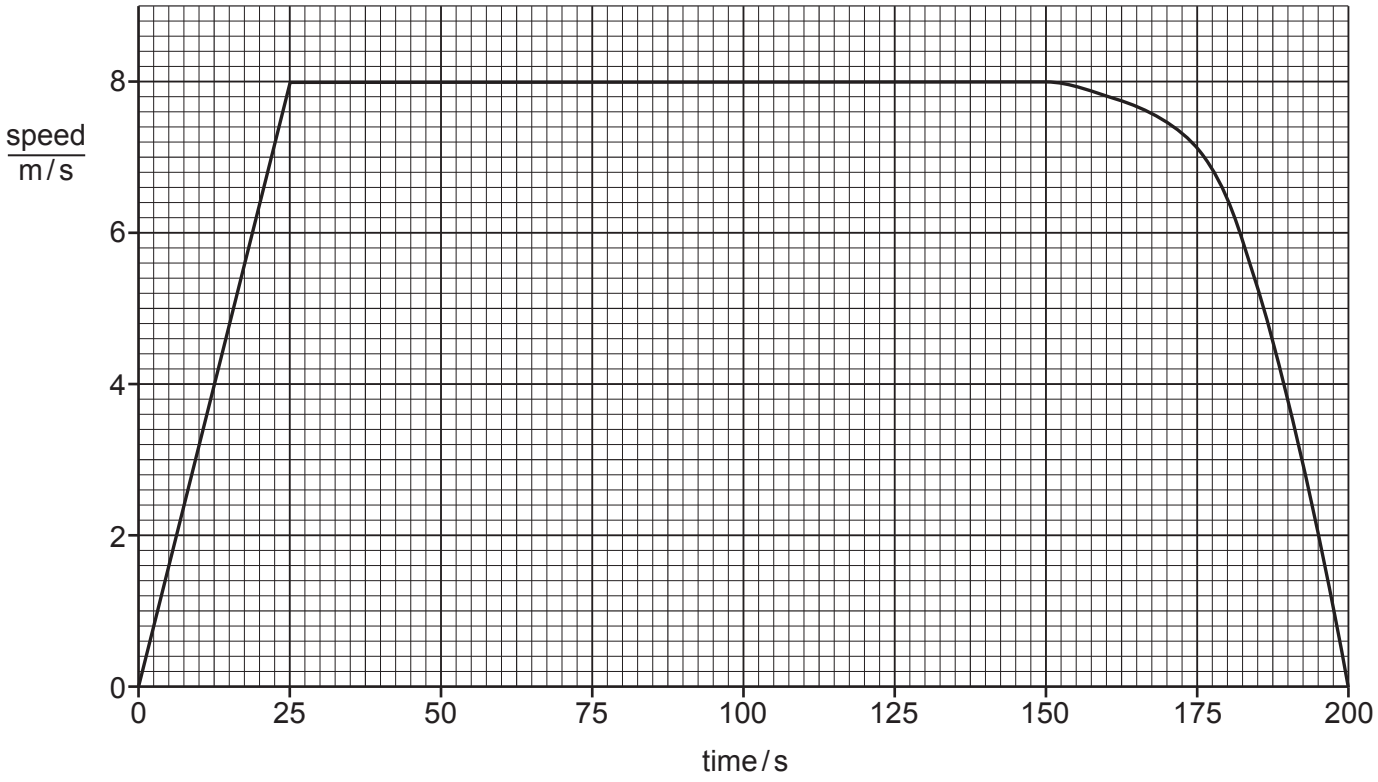



**Fig. 3.2**

**(i)** At one time in the journey, the driver starts to apply the brakes.

State the time the driver starts to apply the brakes. ..... s [1]

**(ii)** Use Fig. 3.2 to calculate the distance travelled by the bus between 0 s and 100 s.

distance travelled = ..... m [3]

**(iii)** The speed limit on the road for this journey is 30 km / h.

Show that the bus does **not** break the speed limit during this journey.
Use Fig. 3.2 to help you.

[2]

[Total: 9]

© UCLES 2021



**[Turn over**

www.dynamicpapers.com



**4** **(a)** Fig. 4.1 is a graph showing the effect of temperature on the activity of an enzyme.

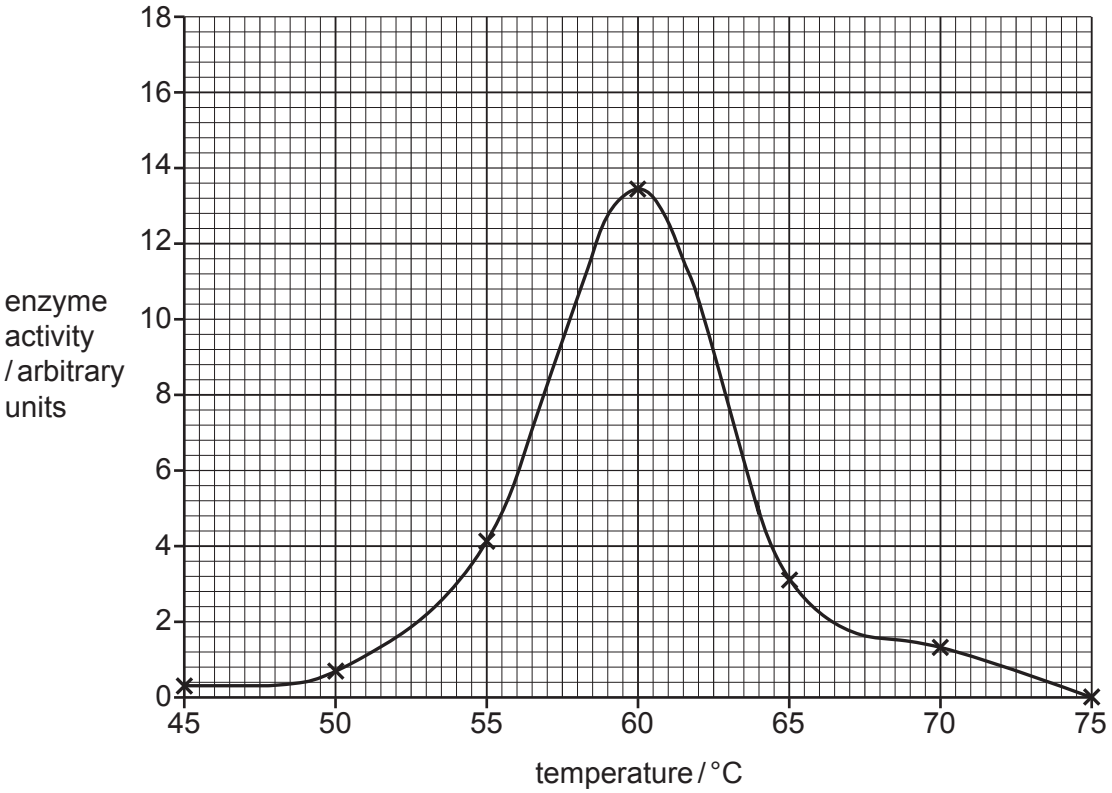



**Fig. 4.1**

**(i)** Identify the temperature when this enzyme is most active.

..... °C [1]

**(ii)** Explain why enzyme activity increases between 45 °C and 55 °C in Fig. 4.1.

.....

.....

.....

..... [2]

© UCLES 2021

www.dynamicpapers.com



**(b)** Protease enzymes are found in the stomach of humans.

**(i)** State the role of protease enzymes in the stomach.

.....

.....

..... [2]

**(ii)** Fig. 4.2 shows how changing pH affects the activity of three enzymes, **A**, **B** and **C**.

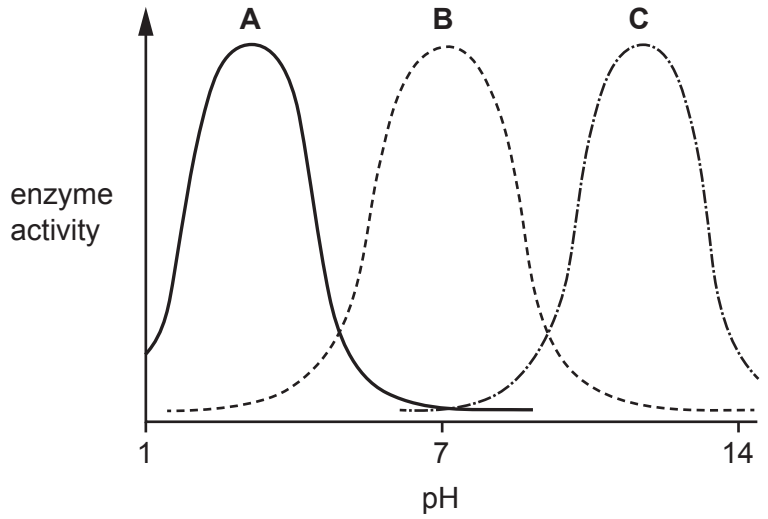



**Fig. 4.2**

Describe the evidence from Fig. 4.2 that shows that enzyme **A** is the protease enzyme from the stomach.

.....

.....

..... [2]

**(c)** The process of photosynthesis occurs in plants.

Complete the balanced equation for photosynthesis.

$$\text{..... } CO_2 + \text{..... .....} \xrightarrow[\text{chlorophyll}]{\text{light}} \text{.....} + \text{..... } O_2$$

[2]

[Total: 9]

www.dynamicpapers.com



**5** A student investigates the rate of reaction between solid calcium carbonate and dilute hydrochloric acid.

**(a)** The student:

- uses Universal Indicator paper to measure the pH of the acid before the reaction
- then adds excess calcium carbonate to the acid
- measures the pH of the mixture after the reaction is complete.

**(i)** Describe how to use Universal Indicator paper to measure pH.

.....

.....

..... [2]

**(ii)** Suggest a value for the pH of the dilute hydrochloric acid before the reaction and a value for the pH of the mixture after the reaction is complete.

acid .....

mixture .....

[2]

www.dynamicpapers.com



**(b)** The student repeats the experiment.
The student uses the same mass of calcium carbonate and the same temperature of acid each time.
The student uses different concentrations of acid and different sized pieces of calcium carbonate, as shown in Table 5.1.

**Table 5.1**

| experiment | concentration of hydrochloric acid / mol/dm$^3$ | calcium carbonate pieces |
|---|---|---|
| 1 | 0.5 | large |
| 2 | 0.5 | small |
| 3 | 1.0 | large |
| 4 | 1.0 | small |

State which experiment has the **highest** rate of reaction and which has the **lowest** rate of reaction.
Use ideas about colliding particles to explain your answer.

highest .....

lowest .....

explanation .....

.....

.....

.....

.....

[4]

[Total: 8]

© UCLES 2021



**[Turn over**

www.dynamicpapers.com



**6** Fig. 6.1 shows thermal energy being transferred to a beaker of water. A thermometer measures the temperature of the water.

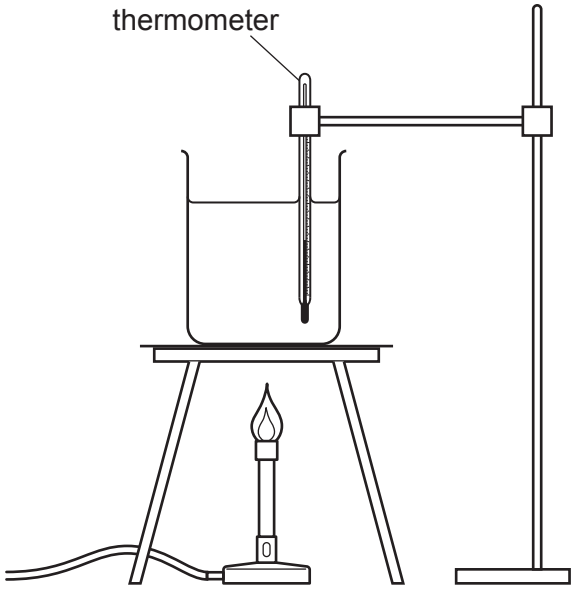



**Fig. 6.1**

**(a)** Name the processes by which thermal energy is transferred:

**(i)** through the beaker to the water ..... [1]

**(ii)** through the water to the thermometer. ..... [1]

**(b)** In the experiment shown in Fig. 6.1 there is thermal expansion of liquids and gases.

**(i)** Identify **one** useful application of thermal expansion taking place in this apparatus.

.....

..... [1]

**(ii)** For each degree of temperature rise, gases expand more than liquids at constant pressure.

Use your understanding of the forces and distances between molecules to explain this observation.

.....

.....

.....

..... [2]

www.dynamicpapers.com



**(c)** A student reads the thermometer scale using a magnifying glass.

Fig. 6.2 shows a ray diagram of the way the student tries to use the magnifying glass.

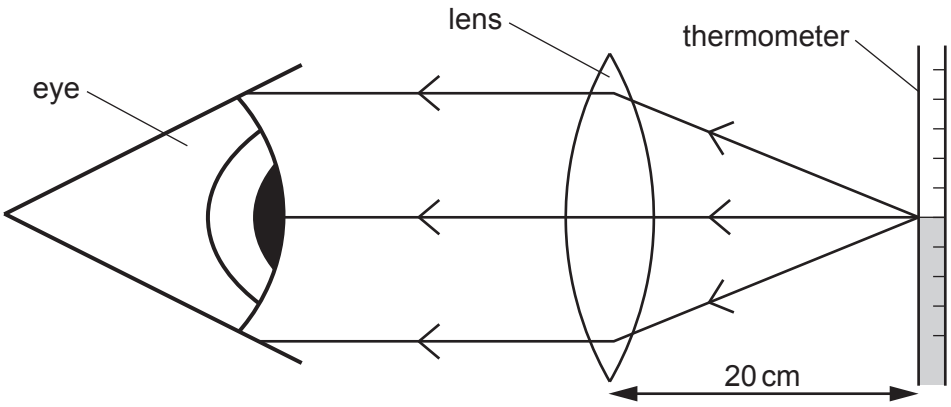



**Fig. 6.2**

**(i)** Name the type of lens used as a magnifying glass.

..... [1]

**(ii)** Name the property of light shown when the light travels through the glass lens.

..... [1]

**(iii)** The student **cannot** see a magnified image of the thermometer scale through the lens in Fig. 6.2.

Describe how the student should move the lens and his eye so he can see a magnified image of the thermometer scale.

.....

.....

.....

..... [2]

[Total: 9]

© UCLES 2021



**[Turn over**

www.dynamicpapers.com



**7** **(a)** Define the term ecosystem.

.....

.....

.....

..... [2]

**(b)** Fig. 7.1 shows some of the living organisms found in a pond ecosystem.

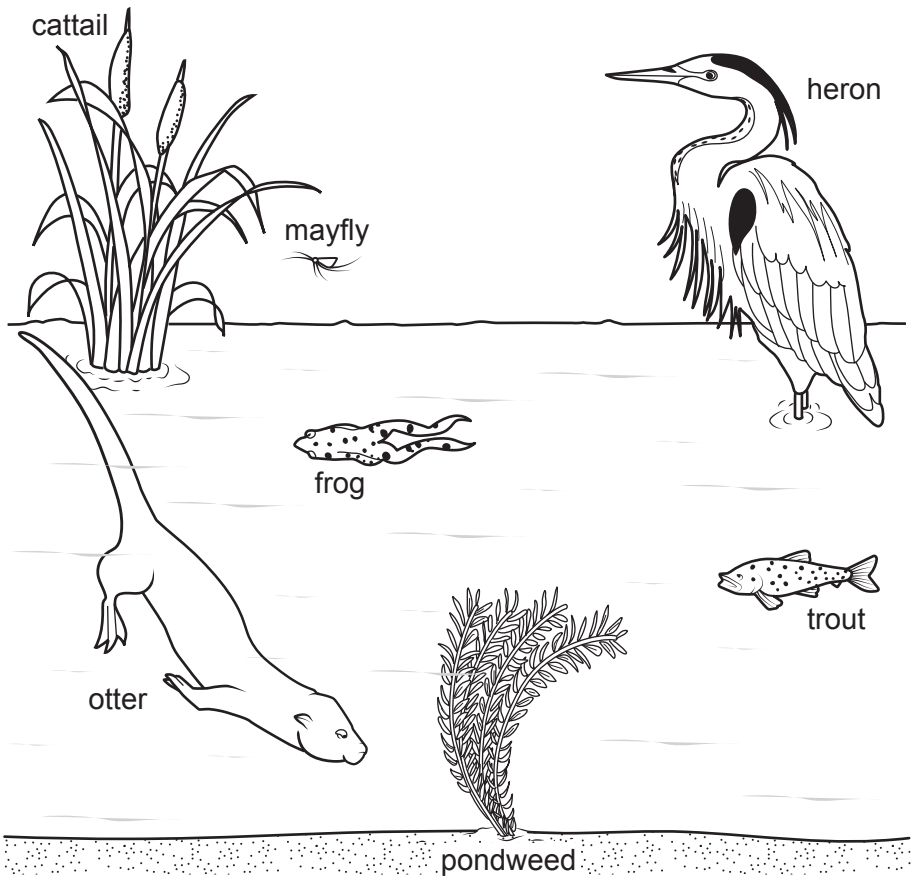



**Fig. 7.1**

Mayflies eat pondweed. Trout eat mayflies. Herons eat trout.

Construct a food chain using this information.

..... [2]

www.dynamicpapers.com



**(c)** Fertilisers high in nitrates pollute the pond in Fig. 7.1 causing algae to grow on the surface of the water.

**(i)** Explain why producers under the surface of the water die.

.....

..... [1]

**(ii)** Explain why the death of producers causes a lack of oxygen in the water.

.....

..... [1]

**(iii)** Explain why a lack of oxygen in the water causes a reduction in the population of herons.

.....

.....

.....

..... [2]

[Total: 8]

www.dynamicpapers.com



**8** The alkanes and the alkenes are both homologous series.

Table 8.1 shows the formulae of some alkanes and alkenes.

**Table 8.1**

| number of carbon atoms | formula of alkane | formula of alkene |
|---|---|---|
| 2 | $C_2H_6$ | $C_2H_4$ |
| 3 | $C_3H_8$ | $C_3H_6$ |
| 4 | $C_4H_{10}$ | |
| 10 | $C_{10}H_{22}$ | $C_{10}H_{20}$ |
| 15 | | |

**(a) (i)** Complete Table 8.1 by filling in the missing formulae. [2]

**(ii)** All alkanes are hydrocarbons.
State two **other** similarities between all alkanes.

1 .....

.....

2 .....

.....
[2]

**(b)** State the colour change seen when aqueous bromine is added to an alkene.

from .....

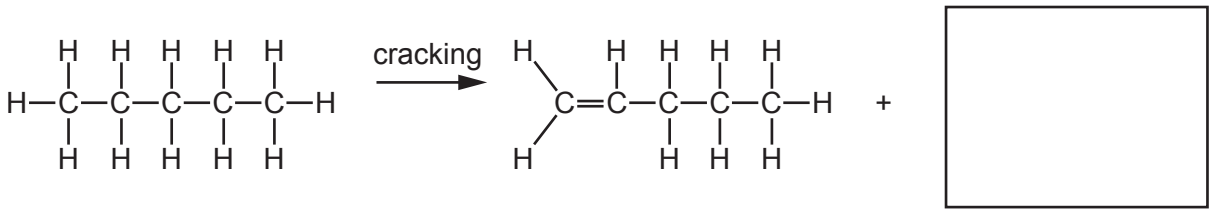
to .....
[1]

© UCLES 2021

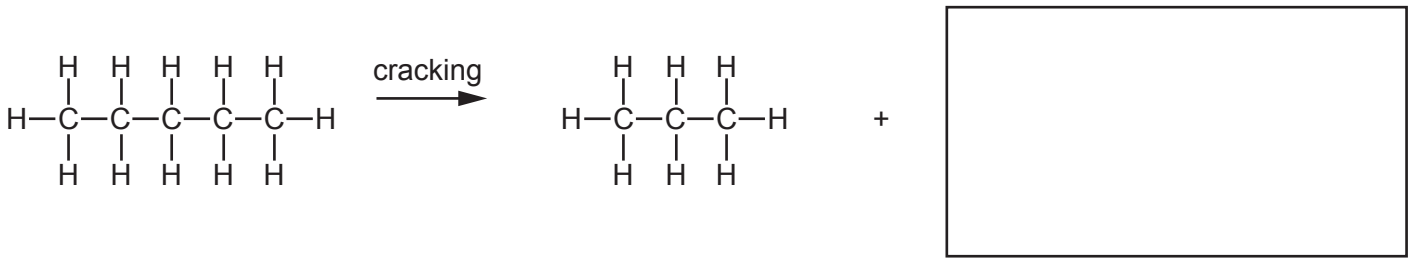
www.dynamicpapers.com



**(c)** Pentane, $C_5H_{12}$, can be cracked to form smaller molecules.
Fig. 8.1 shows the structures and the formulae of pentane and some products of cracking pentane.




$C_5H_{12}$ ⟶ $C_5H_{10}$ + .....




$C_5H_{12}$ ⟶ $C_3H_8$ + .....

**Fig. 8.1**

**(i)** Complete Fig. 8.1 to show the structures and the formulae of the missing products. [3]

**(ii)** State **two** conditions needed for cracking.

1 .....

2 .....
[2]

[Total: 10]

www.dynamicpapers.com



**9** Fig. 9.1 shows a car powered by a battery. The battery supplies electrical energy to two identical electric motors, one for each front wheel.

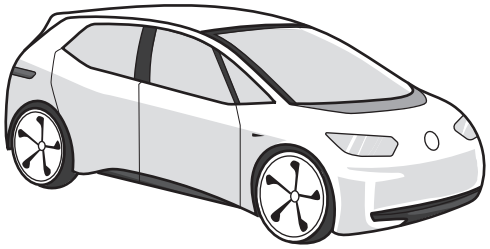


**Fig. 9.1**

The two motors are connected in parallel.

Both motors are controlled by the same variable resistor.

**(a)** On Fig. 9.2 complete the circuit diagram with two motors, one switch and one variable resistor.

Use as the symbol for an electric motor.

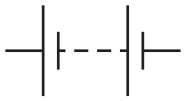


**Fig. 9.2**

[3]

© UCLES 2021

www.dynamicpapers.com



**(b)** The potential difference (p.d.) across each motor when used at maximum power is 96 V.

The maximum power supplied to one motor is 24 kW.

**(i)** Calculate the current through the motor when at maximum power.

current = .....A [2]

**(ii)** Show that the current supplied by the battery when both motors are at maximum power is 500 A.

[1]

**(c)** The car battery is recharged from an electricity supply with a current of 30 A. It takes 4 hours (14 400 seconds) to recharge the battery.

Calculate the total electric charge required to recharge the battery.

State the unit of your answer.

charge = ..... unit ..... [3]

[Total: 9]

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.

© UCLES 2021

© UCLES 2021



## 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.).



www.dynamicpapers.com