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.

[Turn over

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.

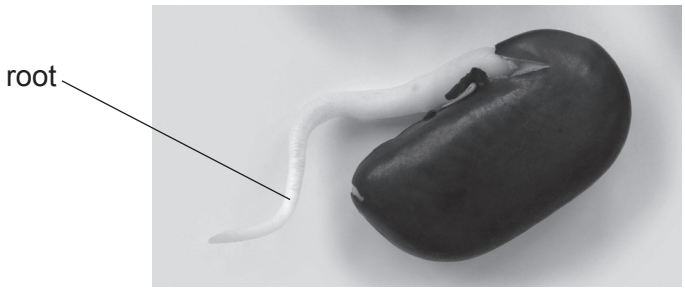

Fig. 1.2

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

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

[1]

(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.

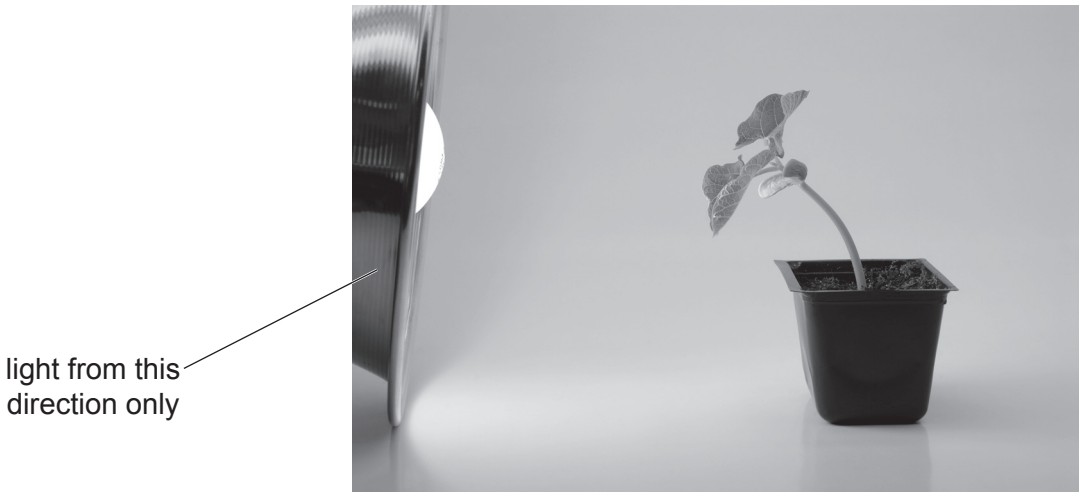

Fig. 1.3

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]

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.

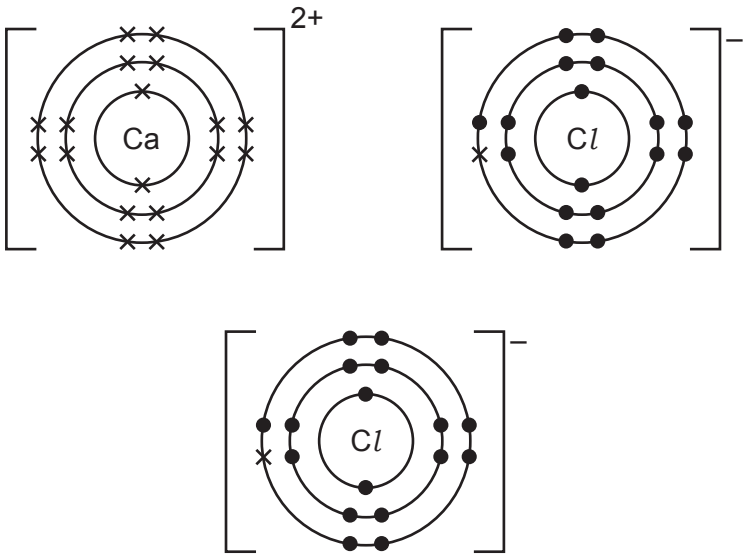

Fig. 2.1

(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]

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

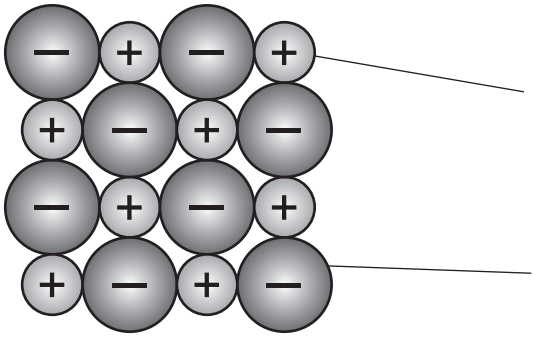

Fig. 2.2

(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]

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

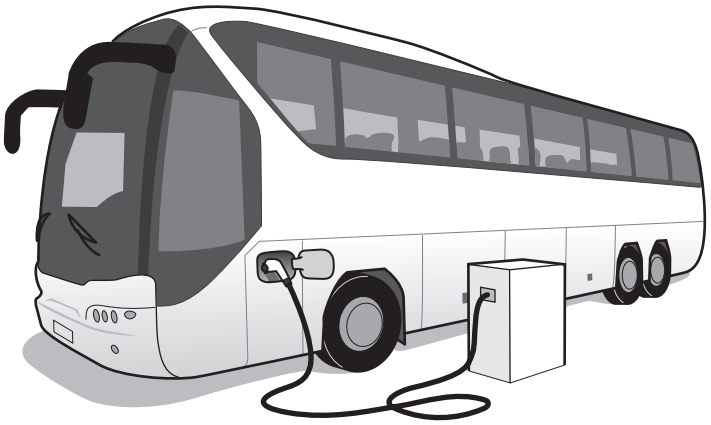

Fig. 3.1

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]

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

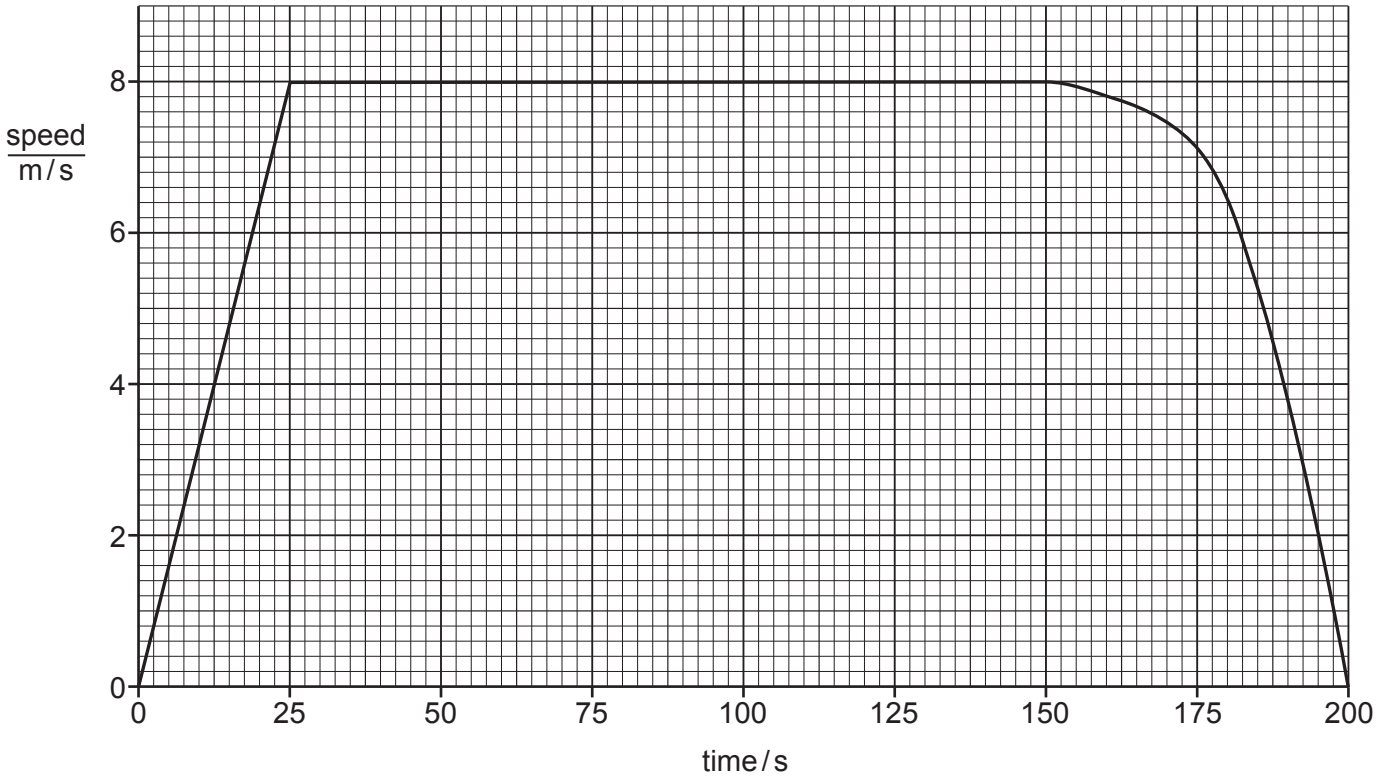

Fig. 3.2

(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]

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

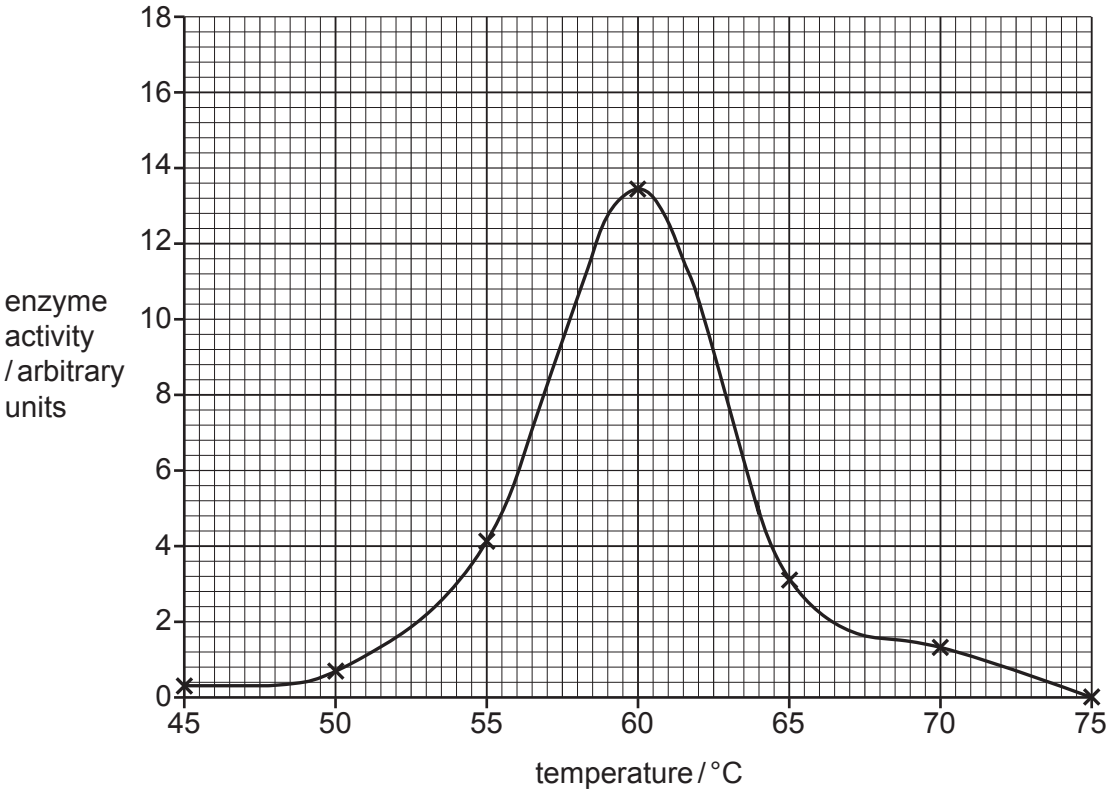

Fig. 4.1

(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]

(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**.

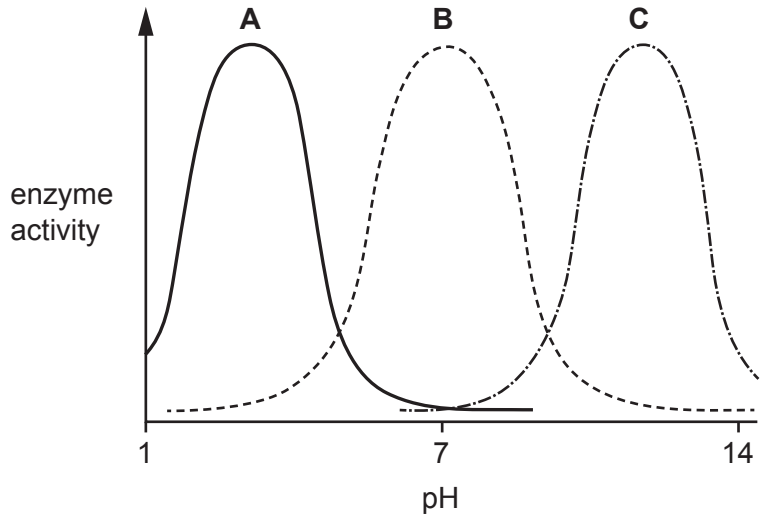

Fig. 4.2

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]

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]

(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]

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

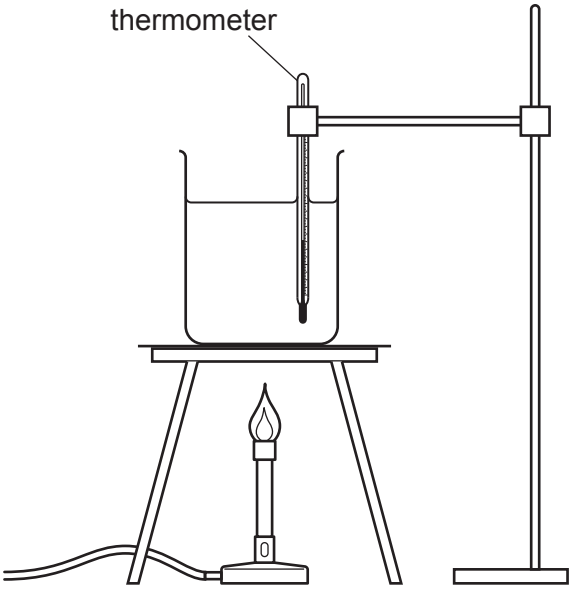

Fig. 6.1

(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]

(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.

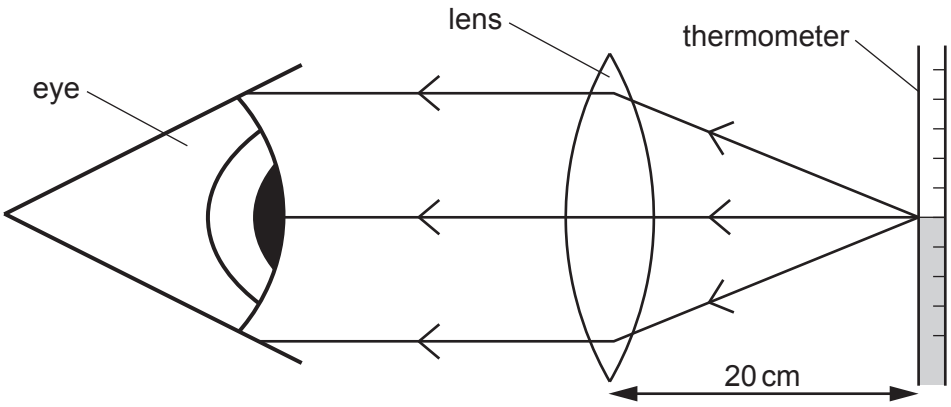

Fig. 6.2

(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]

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

.....

.....

.....

..... [2]

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

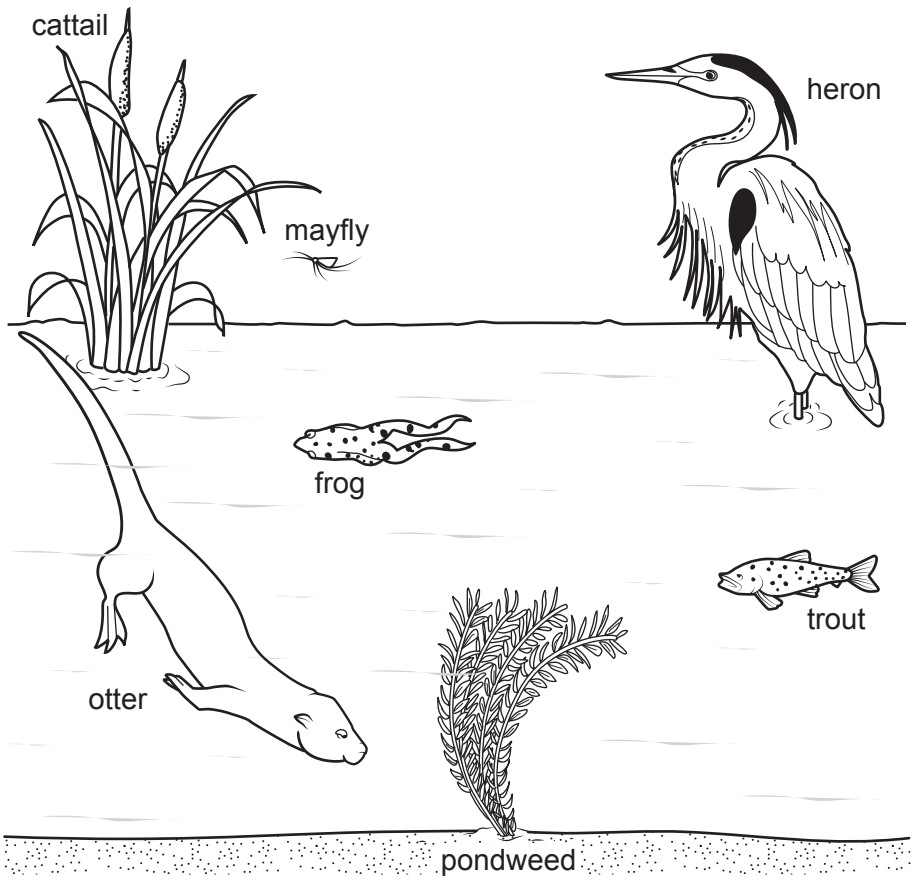

Fig. 7.1

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

Construct a food chain using this information.

..... [2]

(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]

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]

(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.

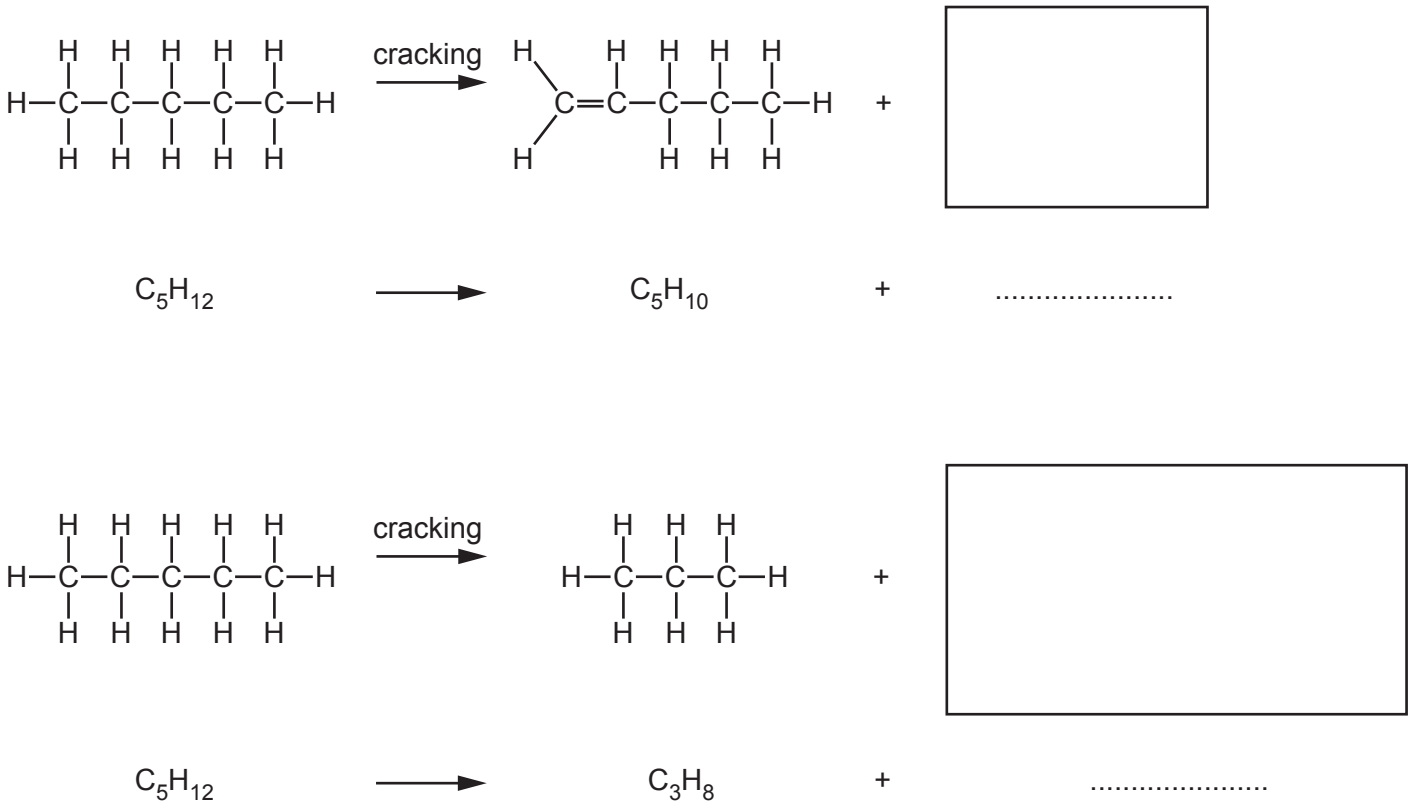

Fig. 8.1

(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]

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.

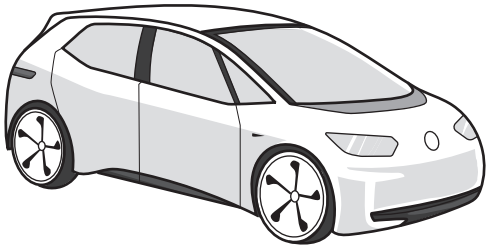

Fig. 9.1

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.

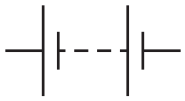

Fig. 9.2

[3]

(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]

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.).