Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

COMBINED SCIENCE **0653/42**

Paper 4 Theory (Extended) **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

1 **(a)** Fig. 1.1 describes some feeding relationships in an ecosystem.

> • fruit flies eat mango fruit
> • thrushes eat fruit flies
> • eagles eat thrushes

Fig. 1.1

   (i) Draw a food chain using the information in Fig. 1.1.

     .... [2]

   (ii) Complete these sentences about the thrushes in Fig. 1.1.

     The thrushes are .... consumers.

     This means thrushes occupy trophic level ....

                                  [2]

(b) Mango fruit can be part of a balanced diet for humans.

   Table 1.1 shows some nutrient information about mango fruit.

Table 1.1

nutrient	mass per 100 g of mango fruit / g
carbohydrate	15.00
fat	0.38
protein	0.82

   (i) A person eats 85 g of mango fruit.

     Calculate the mass of protein they eat.

     Give your answer to **one** significant figure.

                      mass of protein = ... g [3]

(ii) Fat in the mango fruit is digested by enzymes in the small intestine.

State the name of the enzyme **and** the products of fat digestion.

enzyme ....

products ....

[2]

(iii) Suggest why eating mango fruit could help prevent constipation.

.... [1]

[Total: 10]

2 Concentrated aqueous sodium chloride is electrolysed using platinum electrodes, as shown in Fig. 2.1.
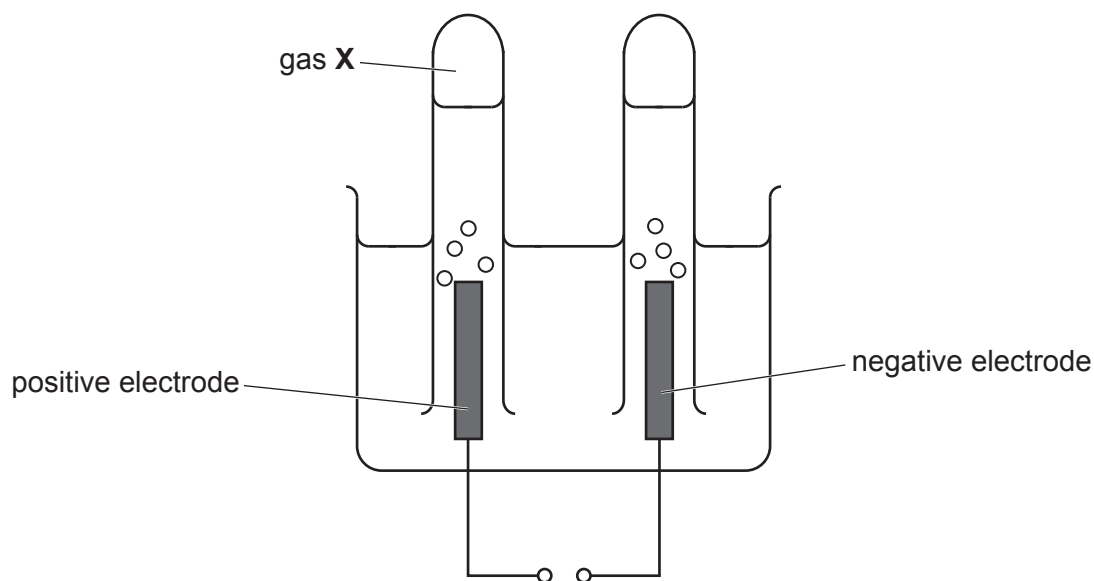

Fig. 2.1

(a) At the start of the electrolysis, the aqueous solution contains hydrogen ions.

(i) State the compound that provides these hydrogen ions.

.... [1]

(ii) Describe what happens to the hydrogen ions during this electrolysis.

Use ideas about ions, atoms and molecules in your answer.

....

....

....

....

.... [3]

(b) (i) State the name of gas **X** shown in Fig. 2.1.

.... [1]

(ii) Describe the test for gas **X** and state the observation for a positive result.

test ....

observation ....

....
[1]

(c) (i) State **two** properties of platinum that make it suitable for use as an electrode.

.... [1]

(ii) The atomic number of platinum is 78.

State the name of the collection of metals in the Periodic Table that includes platinum.

Use the Periodic Table to help you.

.... [1]

[Total: 8]

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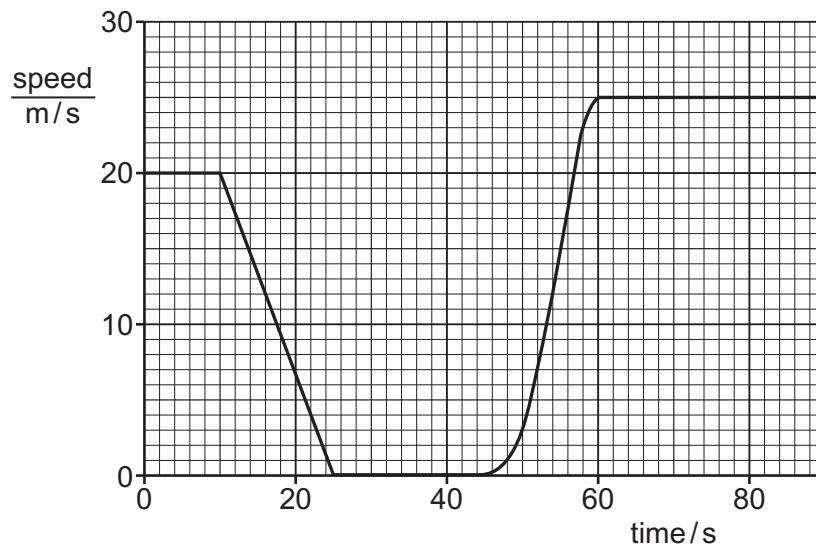
Fig. 3.1

(a) (i) Describe the motion of the car for the first 10 s of its journey.

....

.... [1]

(ii) On Fig 3.1, mark with an **X** a point at which acceleration is **not** constant. [1]

(b) There is a speed limit of 100 km/h on the road.

Use Fig. 3.1 to show that the car did **not** exceed the speed limit at any time on the journey. You will need to do a calculation.

.... [2]

(c) Use Fig. 3.1 to calculate the distance travelled between t = 0 and t = 25 s.

distance = ... m [3]

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(d) At t = 25 s the car stops at a red traffic light. The traffic light contains a lamp and a lens.

Fig. 3.2 shows the arrangement of the lamp and the lens and some rays from the traffic light to the driver's eye.

traffic light
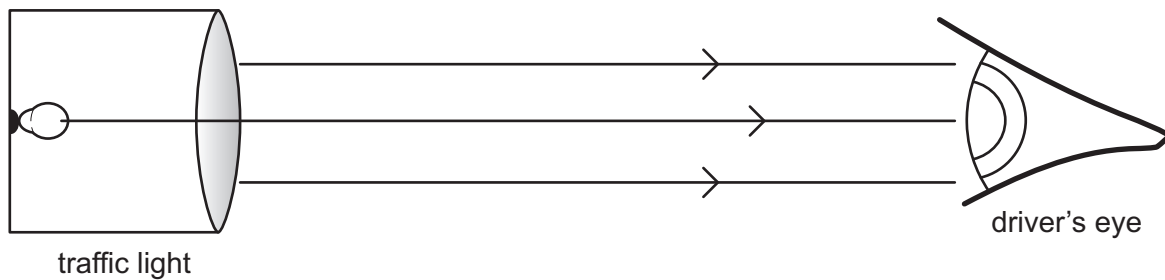
driver's eye

Fig. 3.2

(i) State the name of the distance from the lamp to the lens.

.... [1]

(ii) The car driver is 15 m away from the traffic light. The traffic light changes to green.

Calculate the time taken for the light from the green traffic light to reach the driver's eye.

The speed of electromagnetic waves is 3.0×10^8 m / s.

time = ... s [2]

[Total: 10]

4 **(a)** Fig. 4.1 shows a student's diagram of a cross-section through a leaf.
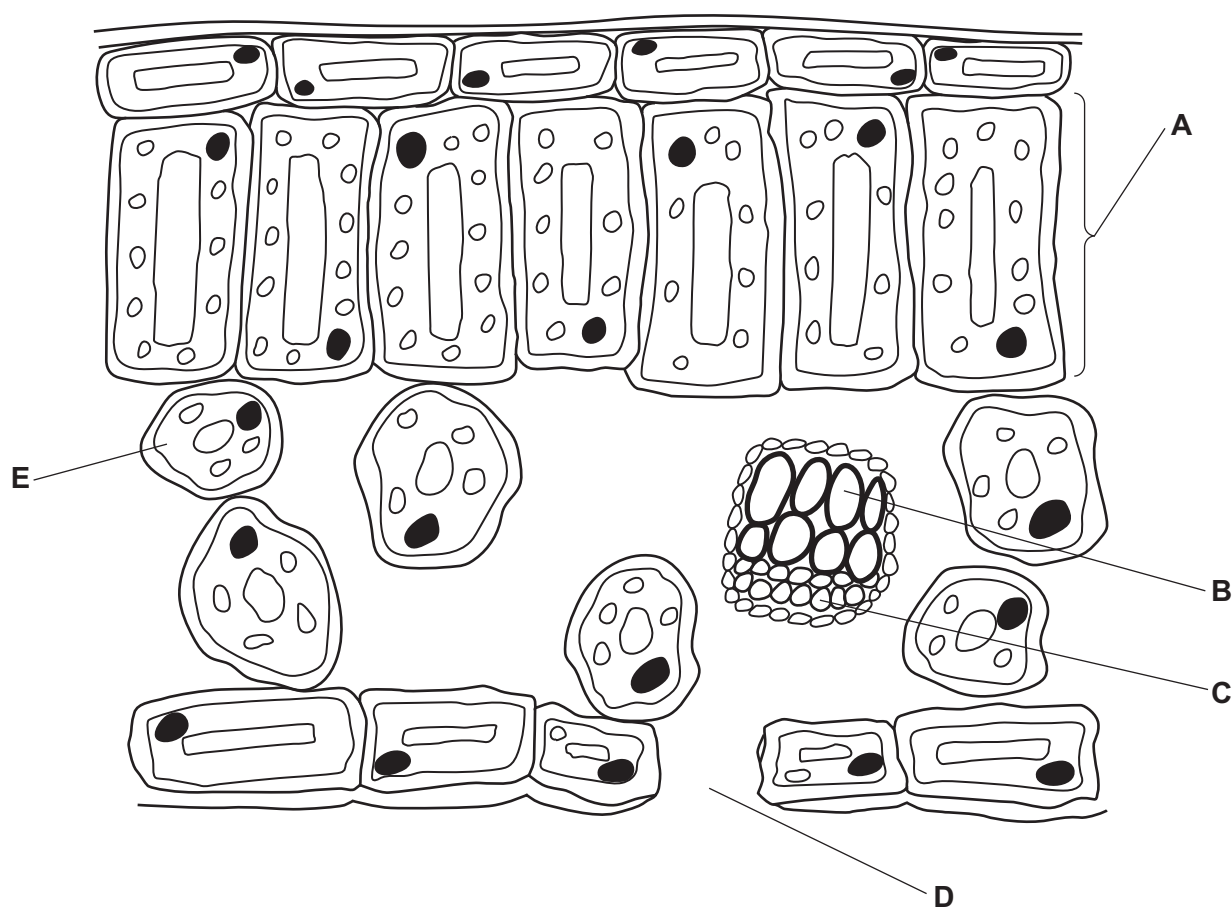
Fig. 4.1

The student uses Table 4.1 to show the functions of some of the leaf parts labelled in Fig. 4.1.

Complete Table 4.1.

Table 4.1

letter	name of part	function
A		photosynthesis
D		
	phloem cell	

[3]

(b) Plants use light energy in photosynthesis.

(i) Complete the balanced equation for photosynthesis.

.... H_2O + ... CO_2 ⟶ .... + ... [2]

(ii) Fig. 4.2 shows the effect of temperature on the rate of photosynthesis in a species of plant.
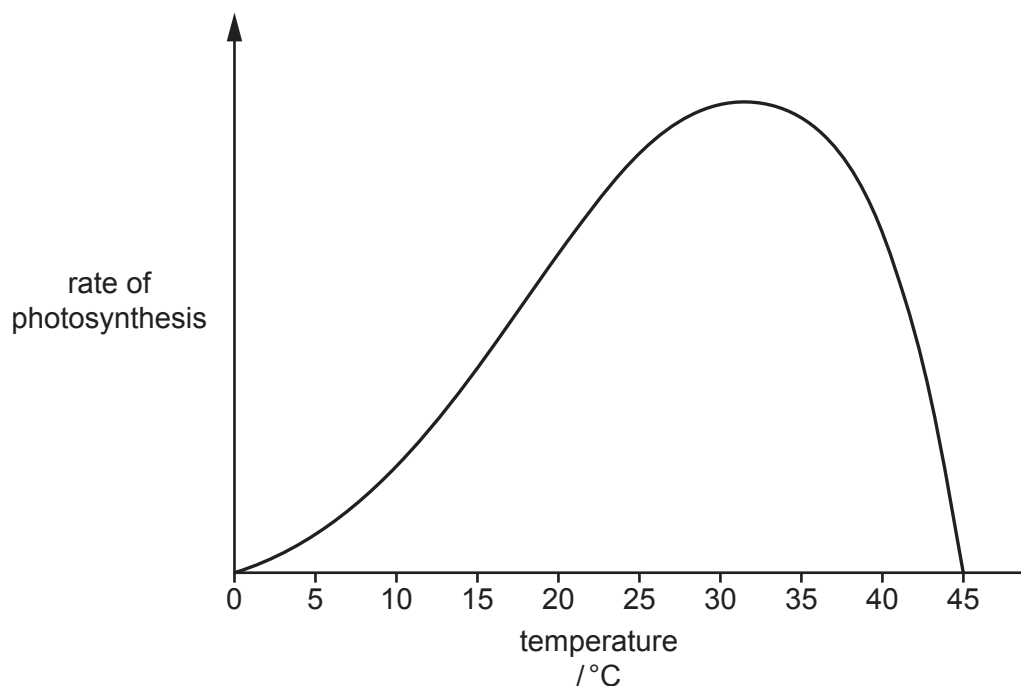
Fig. 4.2

Photosynthesis is an enzyme-controlled reaction.

Explain the effect of a temperature of 45 °C on the rate of photosynthesis in Fig. 4.2.

....

....

....

....

.... [3]

(c) Fig. 4.3 shows some of the cells and molecules at the tip of a plant shoot. The plant shoot is placed in a position where the direction of light is constantly from the side as shown in Fig. 4.3.
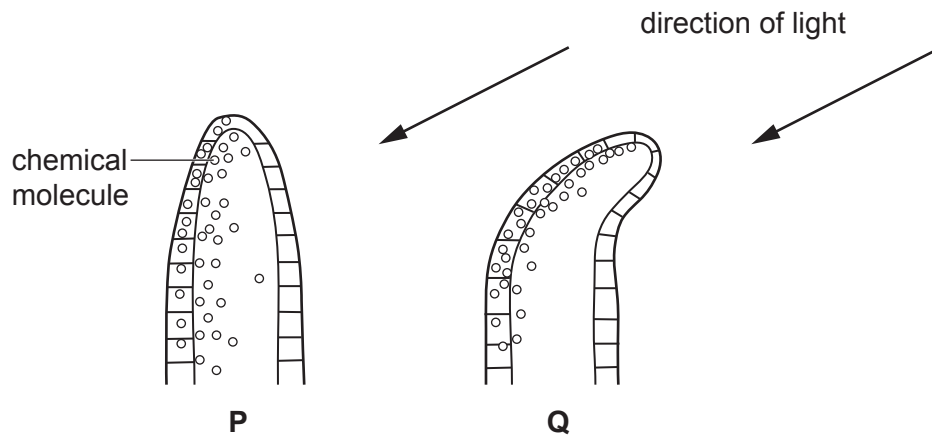
Fig. 4.3

P shows the plant shoot at the start.

Q shows the plant shoot after 2 days.

Complete these sentences about the response of the plant shoot to light.

The plant shoot is responding to light, this is called ....

The response is caused by a chemical made in the shoot tip called ....

The chemical stimulates growth by causing greater cell .... on the shaded side of the shoot.

[3]

[Total: 11]

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5 A student does five experiments to investigate the reaction between magnesium and dilute hydrochloric acid.

In each experiment, the student measures the volume of gas given off during the first 10 seconds of the reaction, as shown in Fig. 5.1.

gas syringe

bubbles of gas

dilute hydrochloric acid
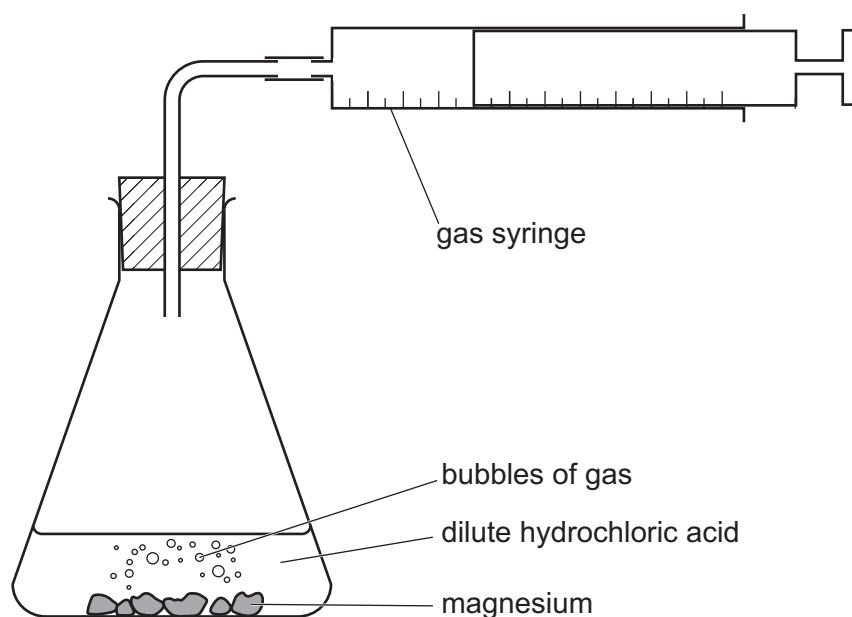
magnesium

Fig. 5.1

The student:

- uses the same mass of magnesium and the same volume of dilute hydrochloric acid in each experiment
- uses different temperatures and different concentrations of dilute hydrochloric acid.

Table 5.1 shows some of the results.

Table 5.1

experiment	temperature /°C	concentration of acid g/dm^3	volume of gas /cm^3
1	20	1.0	25
2	30	1.0	42
3	20	1.5	36
4		1.0	9
5	20		14

(a) Complete Table 5.1 by suggesting the two missing values.

[2]

(b) Explain why the rate of reaction is higher for experiment 2 than for experiment 1.

Use ideas about particles and energy in your answer.

....

....

....

....

.... [3]

(c) Deduce which of the five experiments listed in Table 5.1 has the most closely packed acid particles.

Give a reason for your answer.

experiment ....

reason ....

....
[2]

(d) Experiment 1 is repeated using different metals.

Table 5.2 shows the results.

Table 5.2

metal	volume of gas in 10 seconds / cm^3
magnesium	25
calcium	90
copper	0

(i) Suggest a reason for the result for copper.

....

.... [1]

(ii) Suggest the name of a metal **not** listed in Table 5.2 that could produce a greater volume of gas in 10 seconds.

Give a reason for your answer.

metal ....

reason ....

....

[1]

[Total: 9]

15

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6 (a) The Sun is the source of energy for most of our energy resources.

(i) State the source of the Sun's energy.

.... [1]

(ii) One of our energy resources that does **not** come from the Sun is geothermal.

State one **other** energy resource that does **not** come from the Sun's energy.

.... [1]

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

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

cold water in

15 °C

250 °C
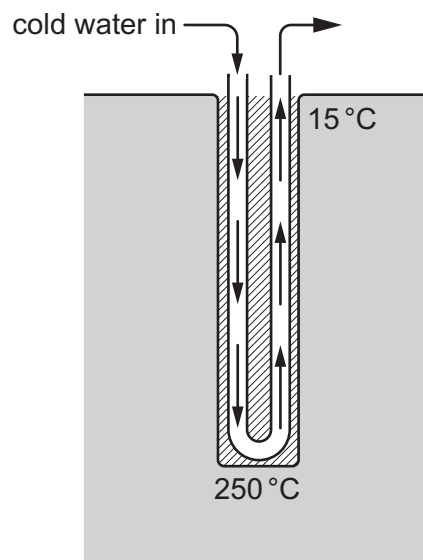
Fig. 6.1

(i) Describe what happens to the water pumped down the borehole.

Give a reason for your answer.

....

....

.... [2]

(ii) Water is pumped down the borehole at a pressure of 6×10^6 Pa.

The borehole is circular and has a radius of 0.12 m.

Calculate the force applied by the pump to the water going into the hole.

Give the unit of your answer.

force = ... unit .... [4]

(c) A type of hydroelectric scheme called pumped storage uses spare electrical energy to pump water from below the power station to a lake above the station.

The water is later released to drive turbines and generate electricity when needed.

(i) State the form of useful energy stored by the water in the lake above the power station.

.... [1]

(ii) Calculate the energy stored in 1000 kg of water when it is pumped a vertical height of 200 m, to the lake above the power station.

Gravitational force on unit mass = 10 N/kg.

energy = ... J [2]

[Total: 11]

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7 (a) Fig. 7.1 shows the gas exchange surface in humans.

wall of alveolus

capillary wall

red blood cells

direction of oxygen movement
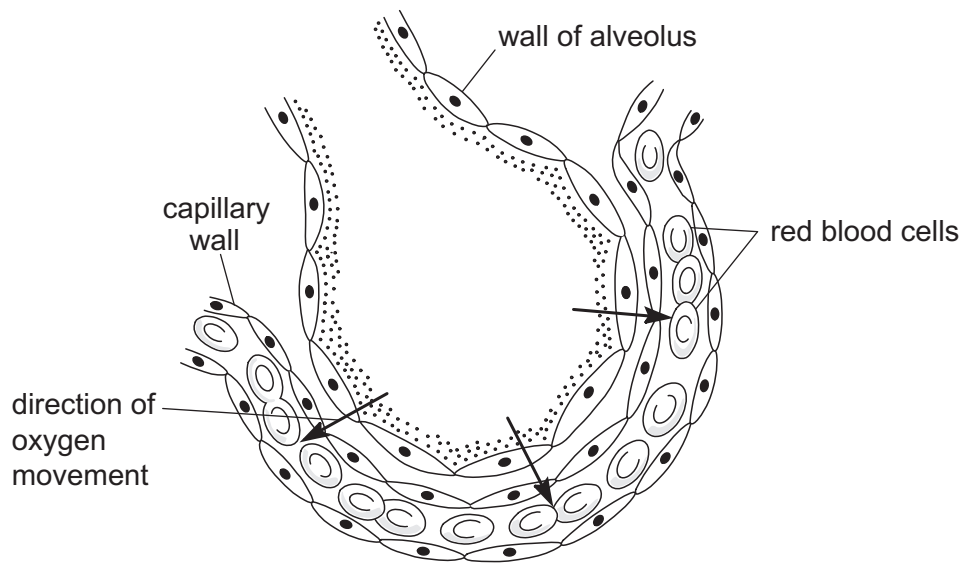
Fig. 7.1

(i) State the name of the process by which oxygen moves into the red blood cells.

.... [1]

(ii) A good blood supply is one feature of a gas exchange surface.

State **two** other features of a gas exchange surface.

1 ....

2 ....
[2]

(b) Describe how goblet cells protect the gas exchange system from particles in the air.

....

....

.... [2]

(c) Tobacco smoking can cause lung cancer.

State the name of one **other** disease of the lungs that can be caused by smoking tobacco.

.... [1]

[Total: 6]

19

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8 Cracking decane, $C_{10}H_{22}$, forms three compounds, as shown in Fig. 8.1.

decane

pentane + propene + ethene
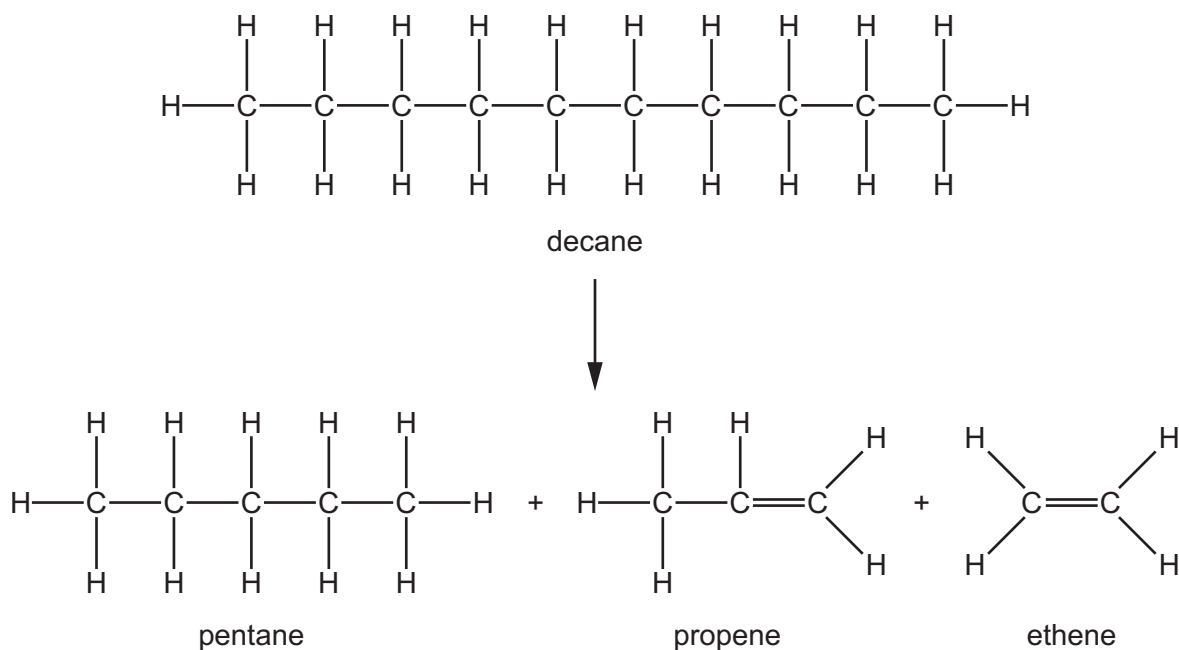
Fig. 8.1

(a) State which **two** compounds in Fig. 8.1 are alkanes.

Give a reason for your answer.

compounds .... and ....

reason ....

....
[2]

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

1 ....

2 ....
[2]

(c) Describe what happens to the carbon-carbon bonds during cracking.

....

....

.... [2]

(d) Refinery gas and naphtha are two fractions obtained from petroleum.

Refinery gas contains some pentane.

Naphtha contains some decane.

Explain why pentane and decane are in different fractions.

....

.... [1]

(e) Refinery gas and naphtha have different uses.

(i) State **one** use of refinery gas.

.... [1]

(ii) Naphtha is used as a chemical feedstock.

State the meaning of feedstock.

....

.... [1]

[Total: 9]

 [Turn over

9 Fig. 9.1 shows a circuit diagram for an electric doorbell.

6.0 V

bell push switch

electric bell
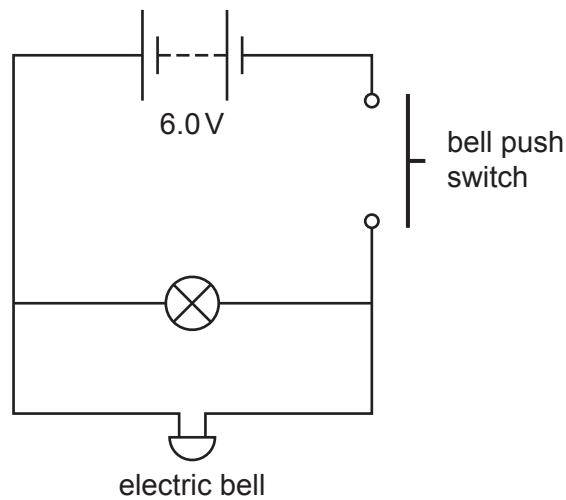
Fig. 9.1

A potential difference of at least 6.0 V is needed to make the bell ring and the lamp light.

The wires connecting the bell to the rest of the circuit are 1.0 m long.

A battery is included in the circuit giving a voltage of 6.0 V.

The current in the bell is 0.75 A when it rings.

(a) (i) Calculate the resistance of the bell.

resistance = ... Ω [2]

(ii) The voltage provided by the battery is checked using a voltmeter.

The voltmeter is connected so that the bell push does not affect the reading.

On Fig. 9.1, add a voltmeter symbol to show how the voltmeter is connected. [2]

(b) The length of wire connecting the bell to the rest of the circuit is increased from 1.0 m to 100 m.

The lamp lights but the bell does **not** work.

Suggest why the bell no longer works, but the lamp still works.

....

....

.... [2]

[Total: 6]

The Periodic Table of Elements

Group

Key

atomic number
atomic symbol
name
relative atomic mass

I	II	III	IV	V	VI	VII	VIII
							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 **A*l*** aluminium 27	14 **Si** silicon 28	15 **P** phosphorus 31	16 **S** sulfur 32	17 **C*l*** chlorine 35.5	18 **Ar** argon 40
19 **K** potassium 39	20 **Ca** calcium 40	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	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	81 **T*l*** 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 –				116 **Lv** livermorium –		

Transition elements:

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
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
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
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 –

1
H
hydrogen
1

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 dm³ at room temperature and pressure (r.t.p.).