Cambridge Assessment International Education

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CANDIDATE NAME

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2632500799

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.

DC (LK/CT) 316983/2

[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.

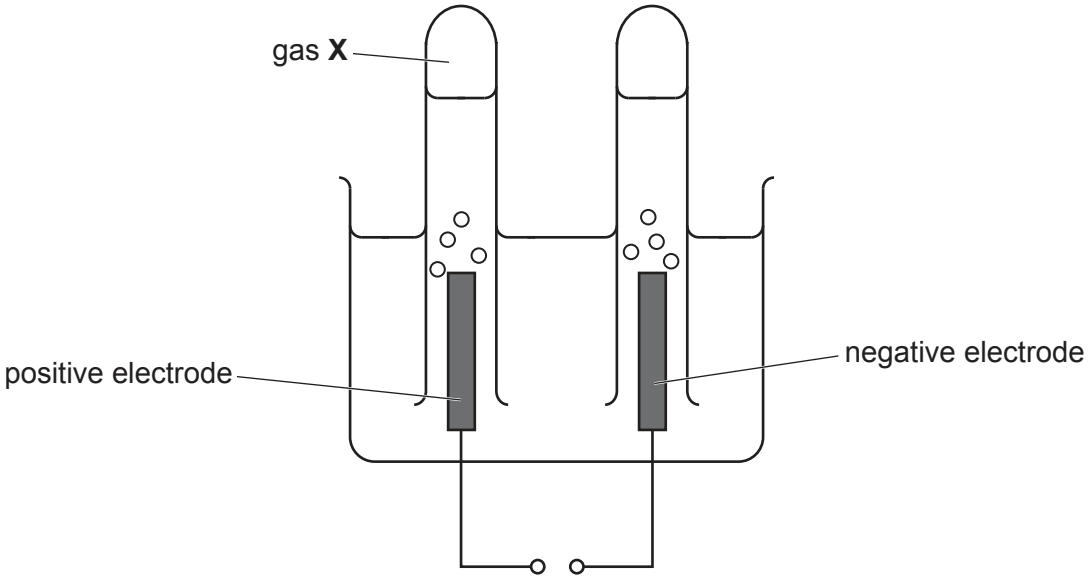

Fig. 2.1

(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.

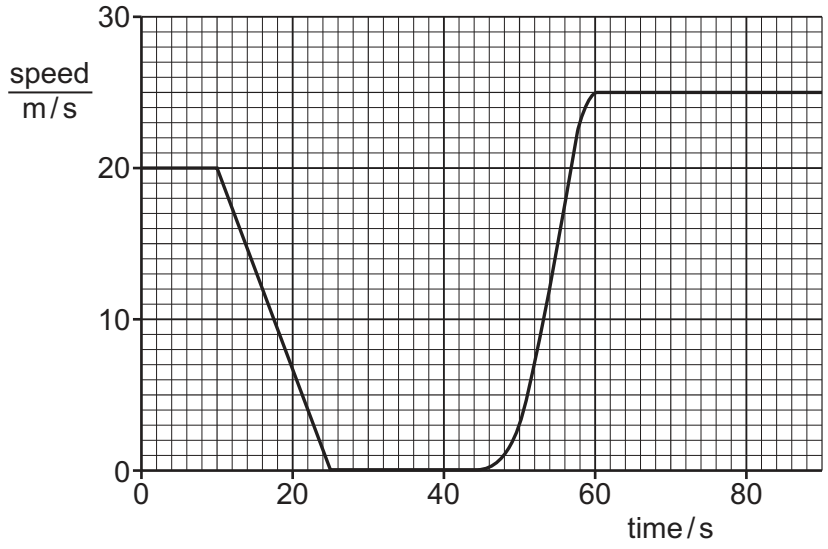

Fig. 3.1

(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]

(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.

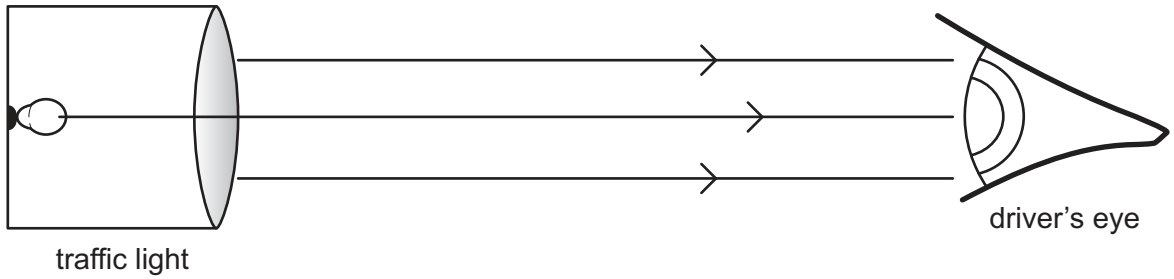

Fig. 3.2

(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.

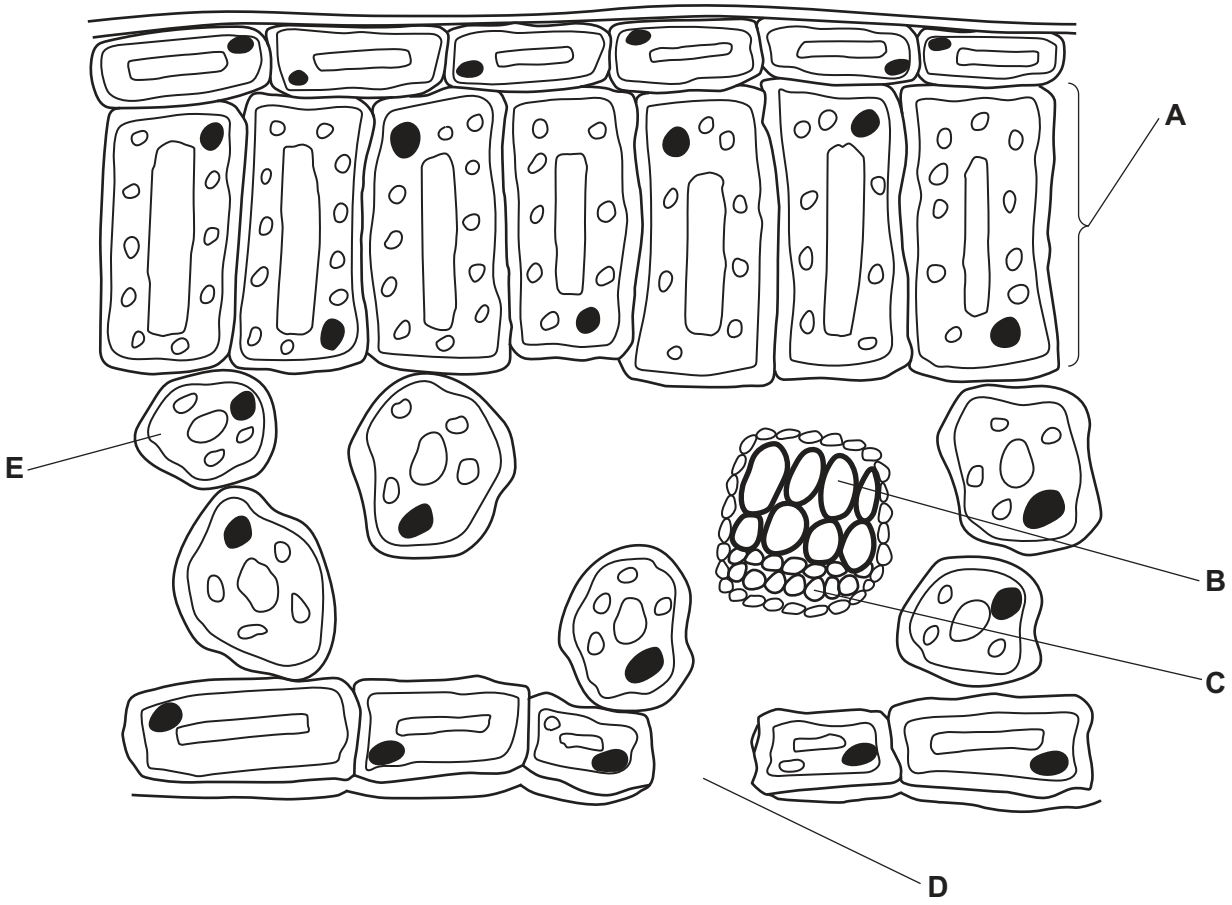

Fig. 4.1

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.

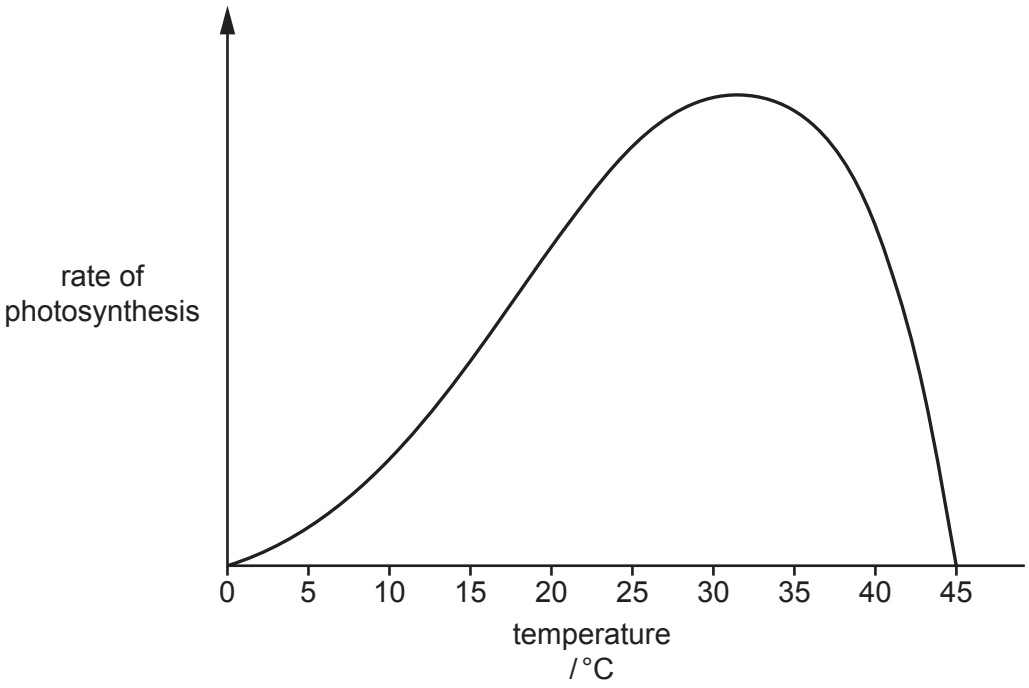

Fig. 4.2

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.

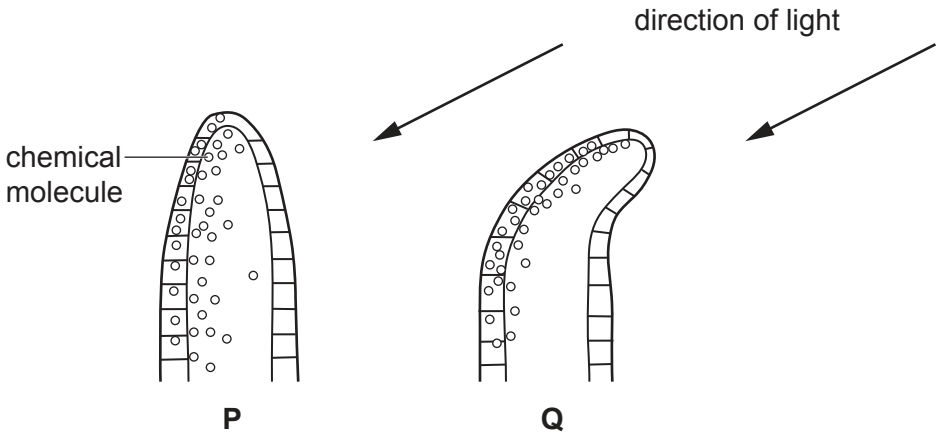

Fig. 4.3

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.

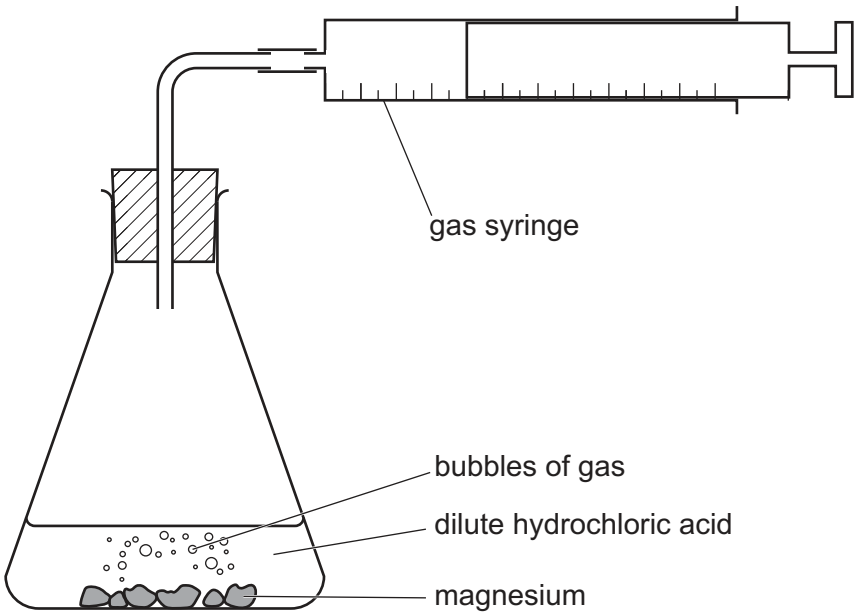

Fig. 5.1

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]

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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.

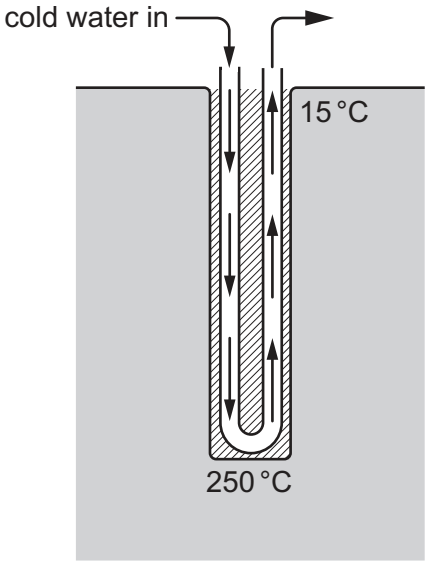

Fig. 6.1

(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]

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

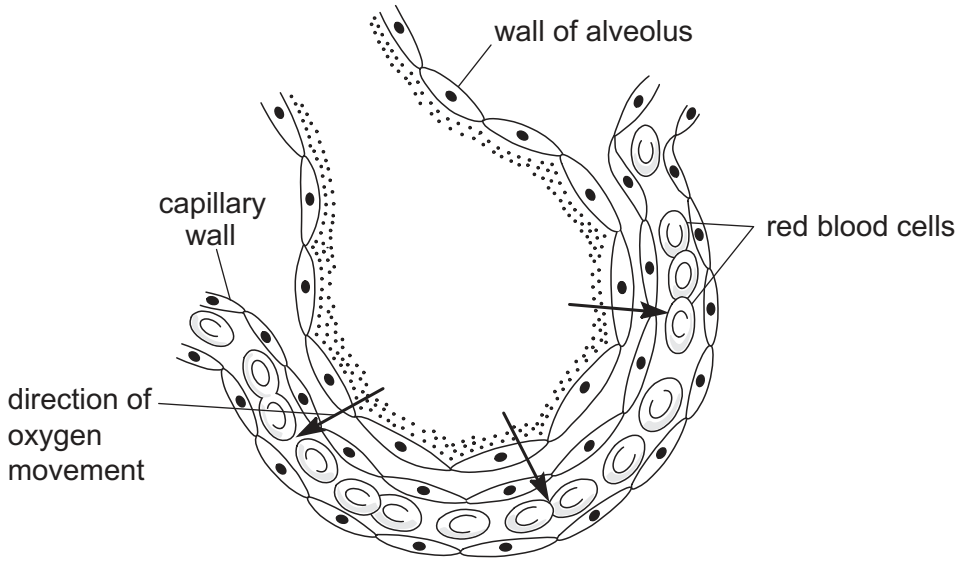

Fig. 7.1

(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]

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

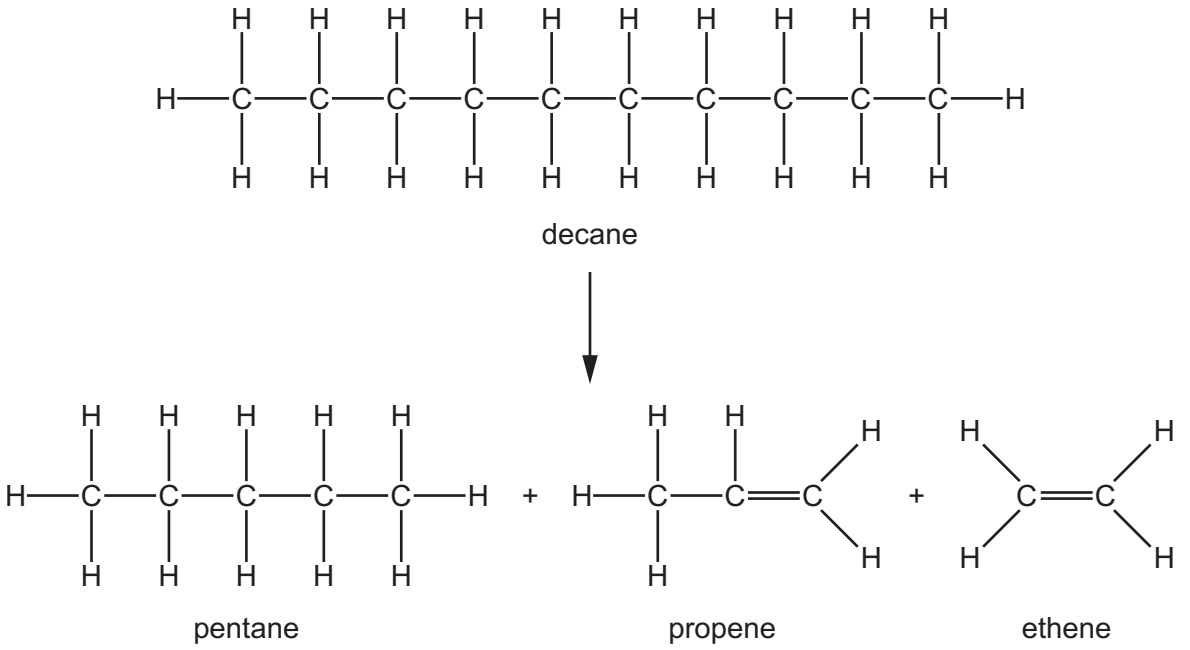

Fig. 8.1

(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]

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

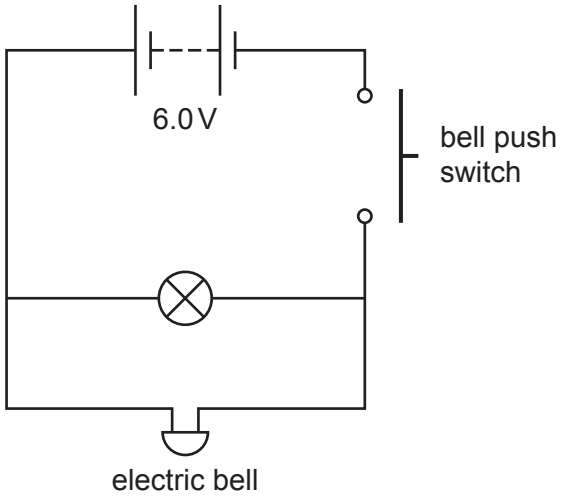

Fig. 9.1

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 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.).