



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0653/41

May/June 2023

1 hour 15 minutes

No additional materials are needed.

- 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.

- 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.

- 1 (a) Fig. 1.1 shows the circulatory system of frogs and the circulatory system of humans.

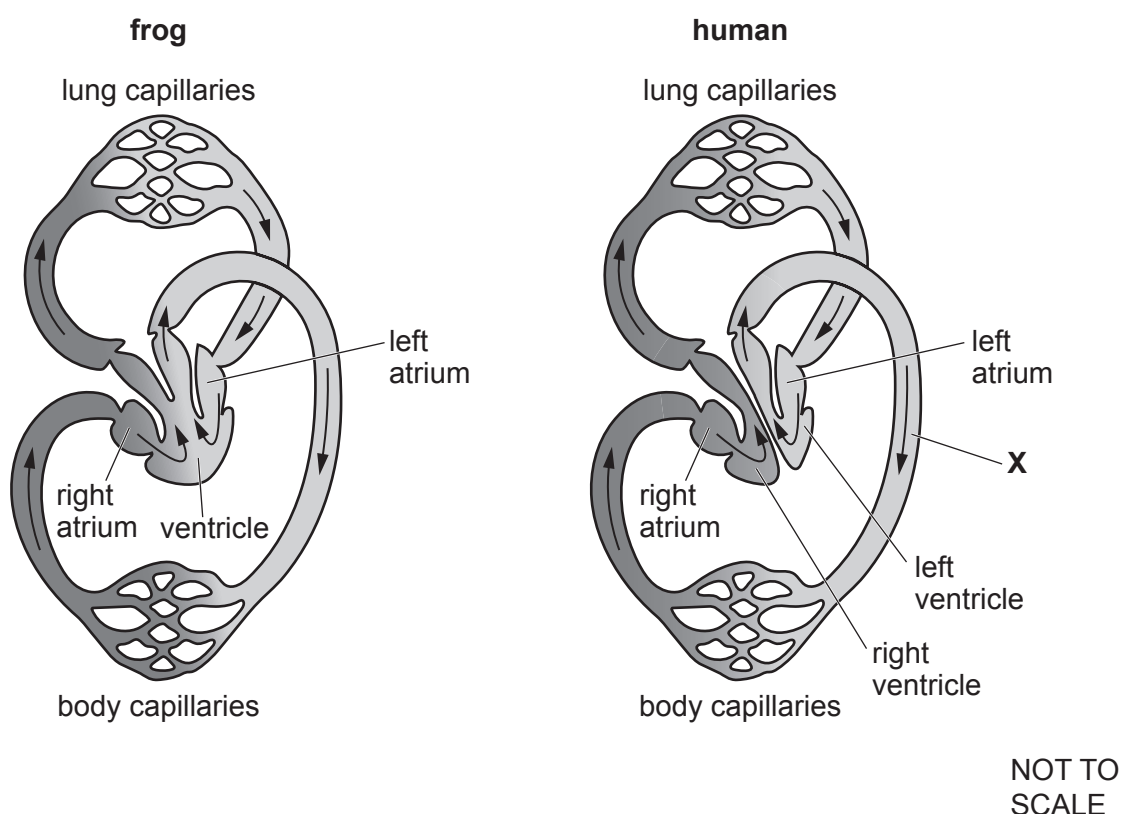


Fig. 1.1

- (i) Identify the **type** of blood vessel labelled **X** in Fig. 1.1.

..... [1]

- (ii) Describe **one** difference between the frog heart and the human heart shown in Fig. 1.1.

.....
 [1]

- (iii) Humans have a double circulatory system.

Explain the advantages of a double circulatory system.

.....

 [2]

- (b) A study investigates the risk factors for coronary heart disease (CHD).

A sample of people with CHD record the risk factors they have.

Some people in the study record more than one risk factor.

Table 1.1 shows the results.

Table 1.1

risk factor	percentage of people recording risk factor
current smoker	24
diet with few fruit and vegetables	64
high alcohol intake	42
lack of physical activity	70
overweight	54

- (i) Identify the risk factor recorded by the highest percentage of people.

..... [1]

- (ii) There are 350 people in the study.

Calculate the number of people that record being overweight.

number of people = ... [2]

- (iii) The risk factors in Table 1.1 are linked to lifestyle and can be changed.

State **one** risk factor for CHD that is **not** linked to lifestyle.

..... [1]

- (c) Eating more fruit and vegetables is one way to help reduce the risk of CHD.

Explain why eating more fruit and vegetables can also reduce the risk of scurvy and constipation.

scurvy

.....

constipation

.....

[2]

[Total: 10]

- 2 An electric current is passed through concentrated aqueous sodium chloride using inert electrodes, as shown in Fig. 2.1.

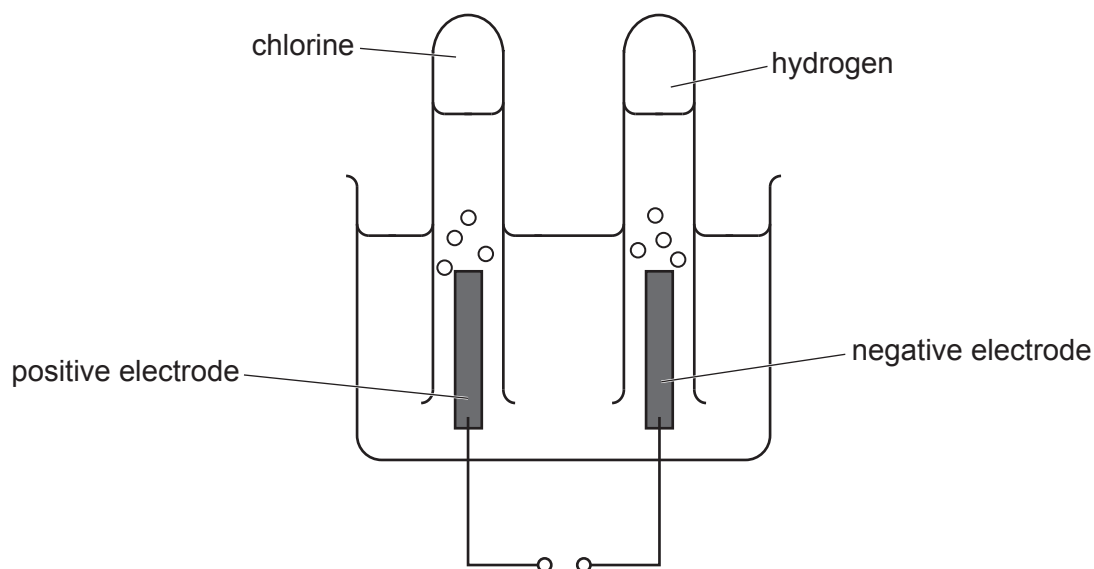


Fig. 2.1

- (a) Table 2.1 shows some of the names, formulae and sources of ions in concentrated aqueous sodium chloride.

- (i) Complete Table 2.1.

Table 2.1

name of ion	formula of ion	source of ion
chloride	Cl^-	sodium chloride
hydrogen		water
	OH^-	
sodium		

[3]

- (ii) State how the concentration of chloride ions changes during the electrolysis.

Explain your answer.

.....

 [1]

- (b) State the chemical test for hydrogen and the observation for a positive result.

test

observation

[1]

- (c) A solution of blue litmus indicator is added to the aqueous sodium chloride.

When the current is first turned on, the litmus indicator at the positive electrode turns red.

- (i) Explain why the litmus indicator turns red.

.....

..... [1]

- (ii) As the electrolysis progresses, the red litmus indicator changes colour.

State and explain this colour change.

colour change

explanation

.....

.....

[2]

[Total: 8]

- 3 Fig. 3.1 shows two people keeping warm by a campfire and one is playing a guitar.



Fig. 3.1

- (a) State the process by which the people are warmed by energy coming directly from the fire.

..... [1]

- (b) Hot air carries smoke from the fire high into the cold air.

Explain why the hot gases rise. Use ideas about molecules in your answer.

.....

 [3]

- (c) The person in Fig. 3.1 plays a guitar string which emits a musical note of frequency 256 Hz.

- (i) State how the musical note is produced by the guitar string when played.

..... [1]

- (ii) Calculate the wavelength of the musical note.

Speed of sound in air = 330 m/s.

wavelength = ... m [2]

- (iii) The sound is transmitted through the air as a succession of compressions and rarefactions.

Describe what is meant by a succession of compressions and rarefactions.

.....

.....

.....

..... [2]

[Total: 9]

4 (a) Fig. 4.1 shows part of a food web.

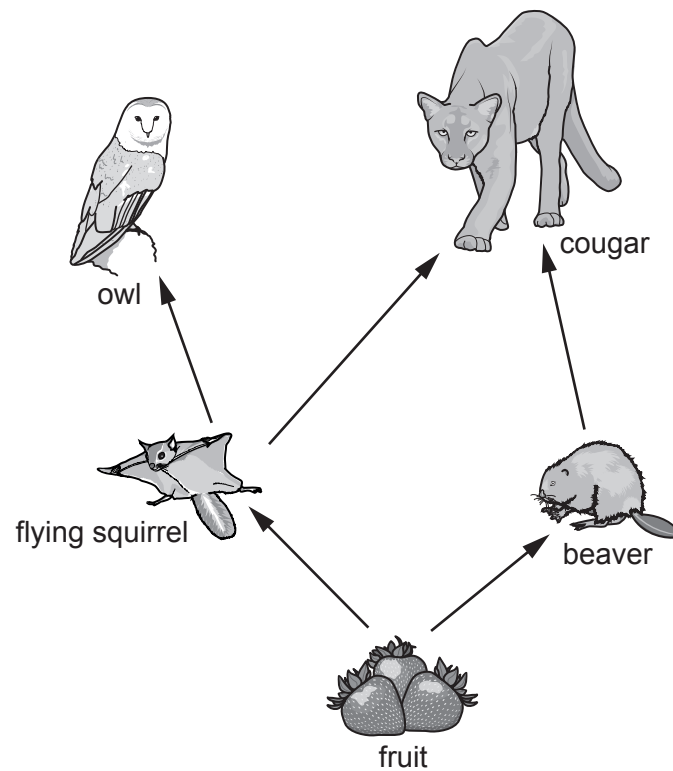


Fig. 4.1

(i) Table 4.1 shows some terms that can be used to describe the organisms in Fig. 4.1.

Complete Table 4.1 by placing ticks (✓) in the boxes to show the term used to describe each organism.

One column has been done for you.

Table 4.1

organism	producer	herbivore	secondary consumer
flying squirrel			
owl			
cougar			
beaver			
fruit	✓		

[2]

- (ii) Energy flows through the food web shown in Fig. 4.1. More energy is available at the trophic level occupied by the beaver than the cougar.

Explain why.

.....

.....

.....

.....

..... [3]

- (b) Most edible fruits are produced by insect-pollinated plants.

State **two** ways pollen is adapted for insect pollination.

1

2 [2]

[Total: 7]

5 Table 5.1 shows some information about alkanes and alkenes.

Table 5.1

number of carbon atoms per molecule	alkanes		alkenes	
	name	formula	name	formula
1	methane	CH ₄	does not exist	
2	ethane		ethene	C ₂ H ₄
3	propane	C ₃ H ₈	propene	C ₃ H ₆
4	butane	C ₄ H ₁₀	butene	C ₄ H ₈
8	octane	C ₈ H ₁₈	octene	

(a) The general formula of alkanes is C_nH_(2n+2).

Deduce the general formula of alkenes.

..... [1]

(b) Complete the table by filling in the formulae for ethane and for octene. [2]

(c) Fig. 5.1 shows the structures of ethene and propene.



Fig. 5.1

(i) Ethene and propene are unsaturated hydrocarbons.

State what is meant by unsaturated and hydrocarbons.

unsaturated

.....

hydrocarbons

.....

[2]

(ii) Explain why methene does not exist.

.....

.....

..... [2]

(d) Refinery gas, obtained from petroleum, contains both propane and butane.

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

..... [1]

(ii) Explain why propane and butane are in the same fraction.

..... [1]

[Total: 9]

- 6 Fig. 6.1 shows a moving conveyor belt carrying a box from the ground up to an aircraft.

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SCALE

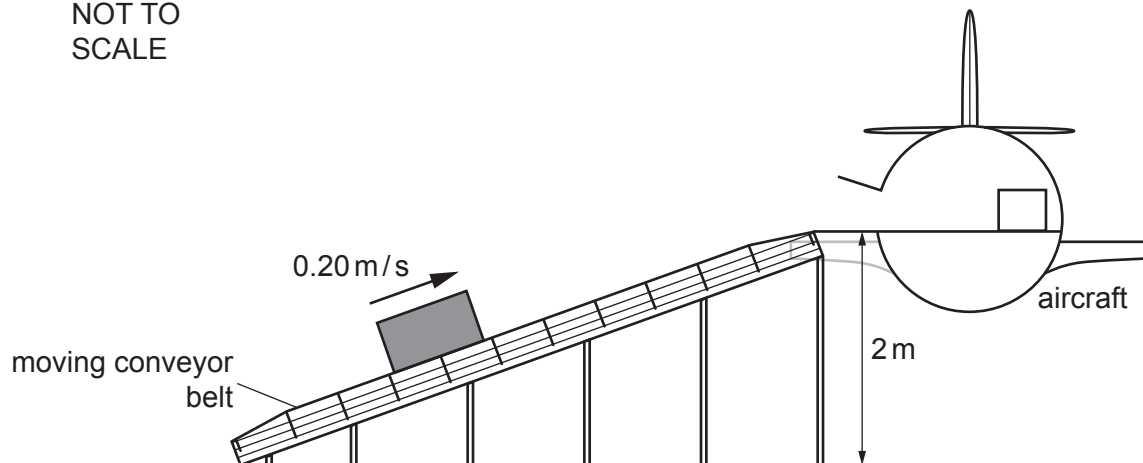


Fig. 6.1

- (a) (i) Complete the sentence.

The gravitational force acting on the box is called the of the box. [1]

- (ii) The conveyor belt carries the box upwards by the force of friction exerted by the belt on the box.

On Fig. 6.1, draw an arrow to show the direction of the force due to friction of the belt on the box. The arrow must be in contact with the box. [1]

- (b) The conveyor belt is 5.0 m long and moves the box at 0.2 m/s .

Calculate the time taken by the box to travel from the ground to the top of the conveyor belt.

time = ... s [2]

- (c) The box has a mass of 45 kg. The conveyor belt carries it to the aircraft, 2 m above the ground.
Gravitational force on unit mass is 10 N/kg.
- (i) Calculate the gain in gravitational potential energy of the box when it reaches the aircraft.

energy gained = ... J [2]

- (ii) When the box reaches the aircraft, it is placed on the floor inside.

The base of the box measures 60 cm × 50 cm.

Calculate the pressure exerted by the box on the floor of the aircraft.

Give the units of your answer.

pressure = ... units [4]

[Total: 10]

- 7 (a) Two young potted plants are left to grow in a room with **no** light.

Plant **A** is placed standing upright.

Plant **B** is placed on its side.

Fig. 7.1 shows the two plants after 10 days.

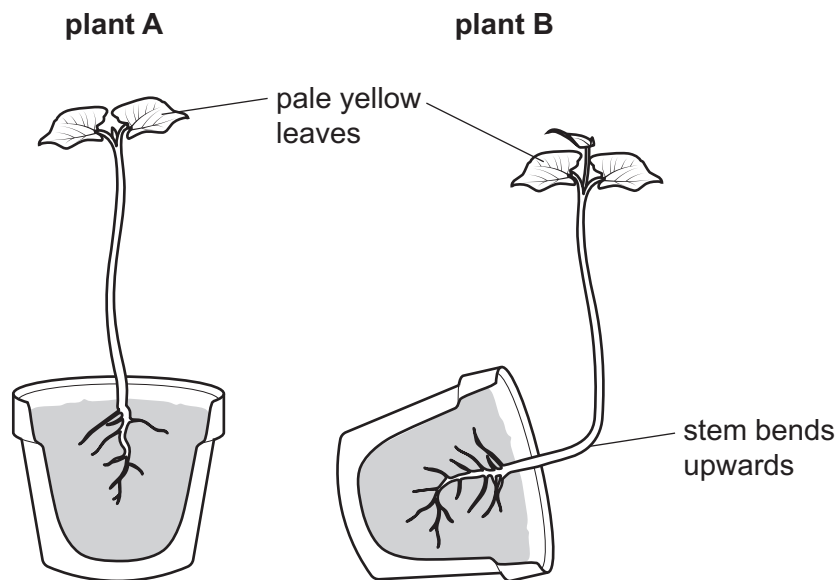


Fig. 7.1

- (i) Lack of light causes the leaves to turn yellow.

Complete the sentences.

The yellow colour of the leaves in Fig. 7.1 is due to a decrease in the green pigment called

Less light energy is converted to energy in the chloroplasts.

This results in reduced synthesis of

[3]

- (ii) Explain why the stem of plant **B** bends upwards.

.....

 [3]

(b) Fig. 7.2 shows part of a plant root.

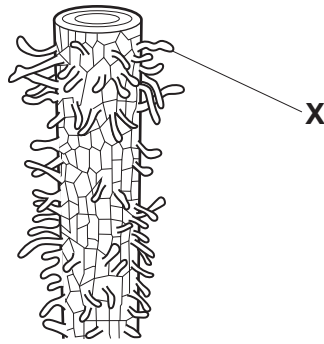


Fig. 7.2

Describe how the cell labelled **X** is adapted for its function.

.....

.....

..... [2]

(c) During eutrophication aquatic plants die. This decreases the concentration of dissolved oxygen in lakes.

One reason for this is a reduction in photosynthesis.

Explain one **other** way the death of aquatic plants reduces the concentration of dissolved oxygen in lakes.

.....

.....

.....

..... [2]

[Total: 10]

- 8 An iron nail is placed in a test-tube, as shown in Fig. 8.1.

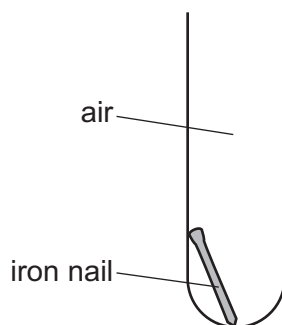


Fig. 8.1

- (a) After one week, a layer of rust has formed on the nail.

The equation for the reaction that forms rust is shown.



- (i) Balance the equation. [1]

- (ii) The symbol for an oxide ion is O^{2-} .

Deduce the symbol for the iron ion in Fe_2O_3 .

..... [1]

- (b) Rusting can be prevented by using a barrier method.

- (i) Describe how a barrier method prevents rusting.

.....

..... [2]

- (ii) State an example of a barrier method used to prevent rusting.

..... [1]

- (c) The arrangement of bonds in a molecule of oxygen is shown in Fig. 8.2.



Fig. 8.2

State the number of electrons which are shared between the oxygen atoms in this molecule.

Give a reason for your answer.

number of electrons

reason

..... [2]

- (d) At room temperature, iron oxide is a solid and oxygen is a gas.

Explain why iron oxide and oxygen have different physical states.

Use ideas about bonding and forces in your answer.

.....

.....

..... [2]

[Total: 9]

- 9 Fig. 9.1 shows a student using a laptop computer. There is a lamp beside the student.



Fig. 9.1

- (a) Fig. 9.2 is a diagram of the student, lamp and computer from the same viewpoint as Fig. 9.1. The ray in Fig. 9.2 shows how the student sees the light from the lamp reflected in the laptop computer screen.

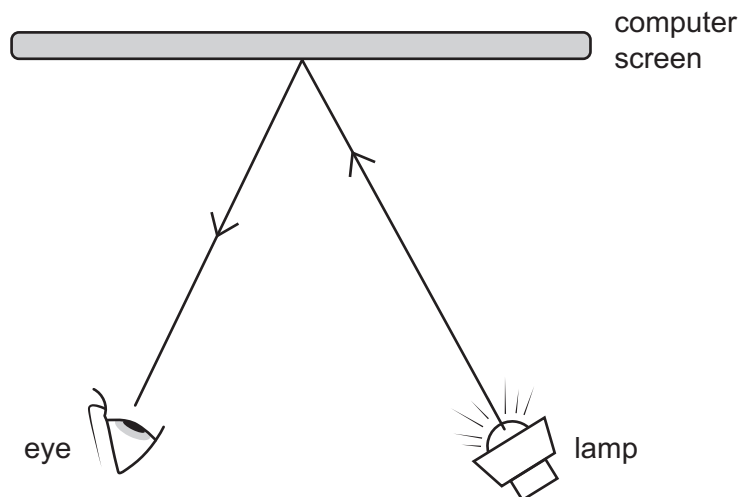


Fig. 9.2

State the law of reflection of light.

Your answer should include the word **normal**.

.....

.....

..... [1]

- (b) The lamp is connected to the laptop computer by a cable to supply power at 5.0 V. The current in the lamp is 0.020 A.

(i) Calculate the resistance of the lamp.

resistance = ... Ω [2]

(ii) Calculate the power rating of the lamp.

power = ... W [2]

- (iii) The lamp contains two identical components called LEDs (light-emitting diodes) connected in parallel.

A switch and resistor are connected in series with the LEDs.

The symbol for an LED is shown in Fig. 9.3.

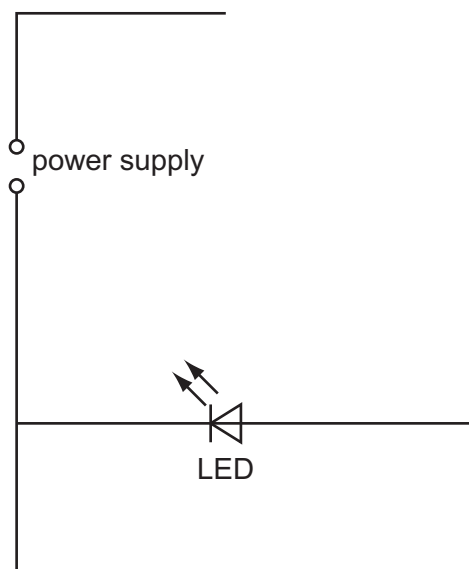


Fig. 9.3

On Fig. 9.3, complete the circuit diagram for the lamp circuit using the correct circuit symbols.

[3]

[Total: 8]

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The Periodic Table of Elements

Group																		
I	II	Key										III	IV	V	VI	VII	VIII	
		atomic number atomic symbol name relative atomic mass																
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		2 He helium 4
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 —			

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.).



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0653/42

May/June 2023

1 hour 15 minutes

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- Answer **all** questions.
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- The total mark for this paper is 80.
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- The Periodic Table is printed in the question paper.

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[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 85g 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.

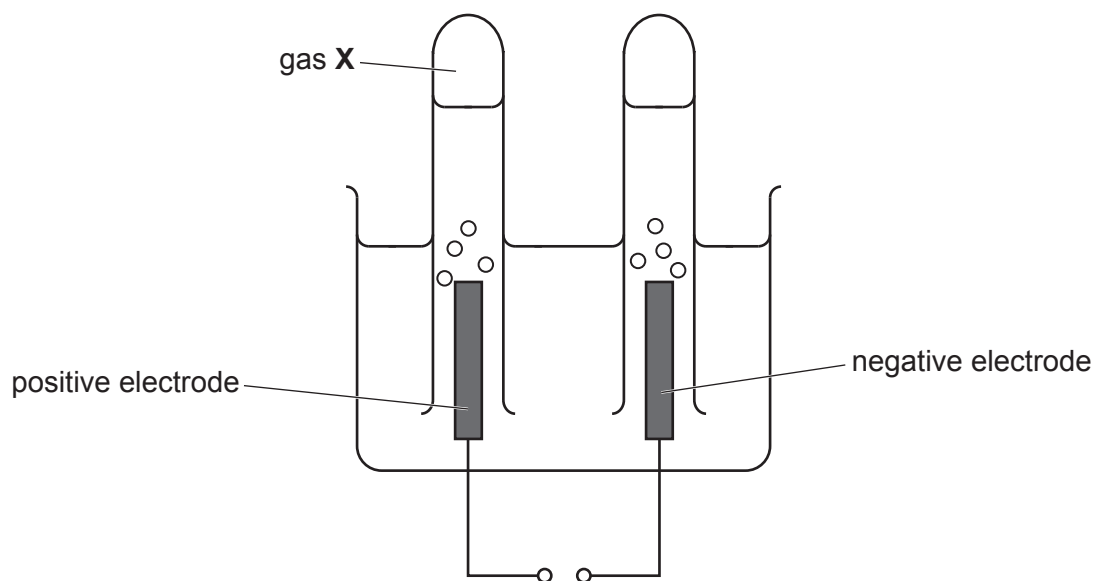


Fig. 2.1

- (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.

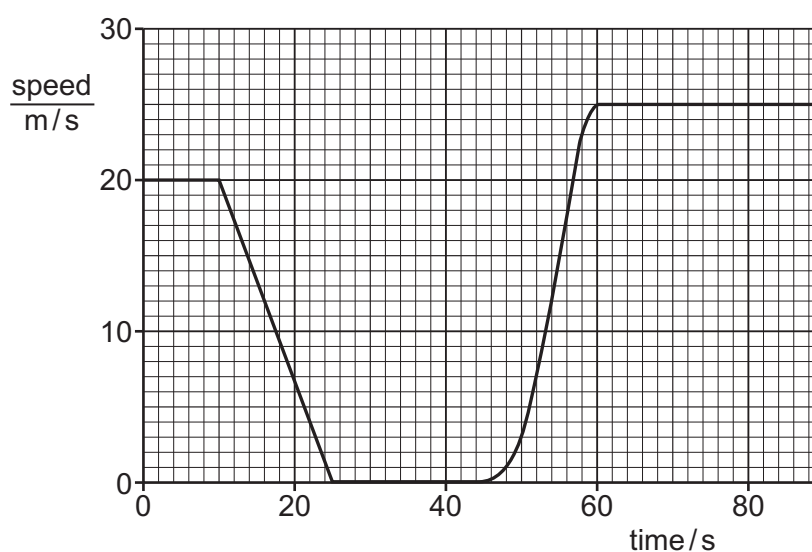


Fig. 3.1

- (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 $t = 25\text{ s}$ 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.

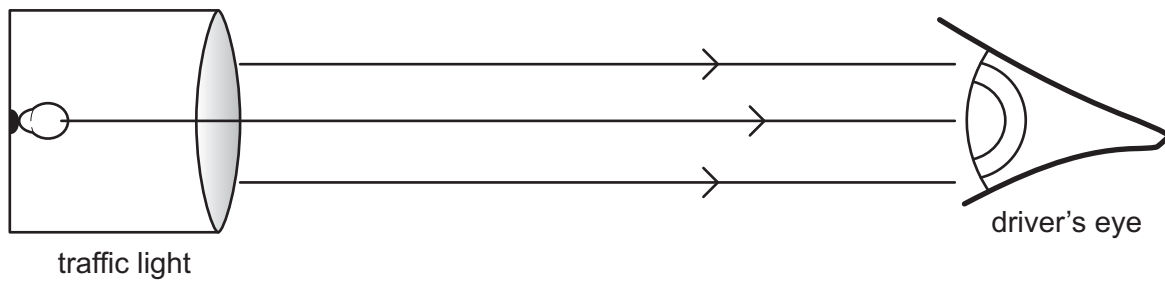


Fig. 3.2

- (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 $3.0 \times 10^8\text{ m/s}$.

time = ... s [2]

[Total: 10]

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

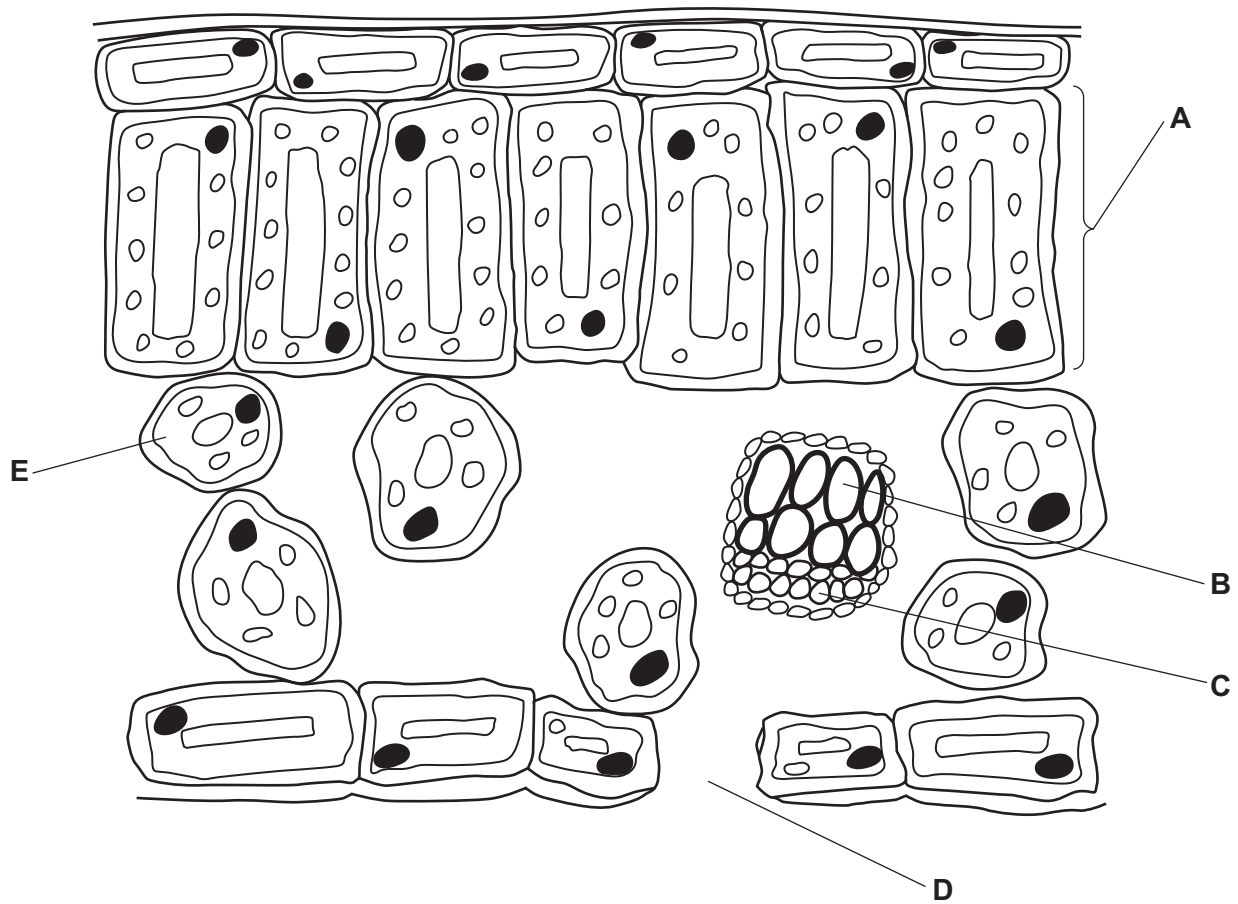


Fig. 4.1

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.



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

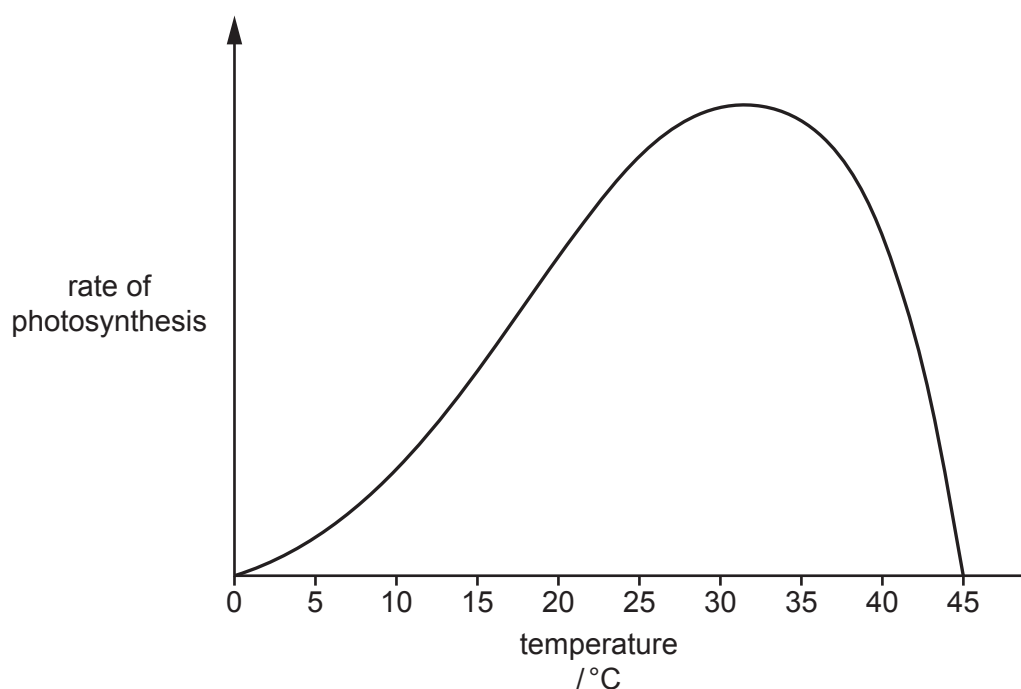


Fig. 4.2

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.

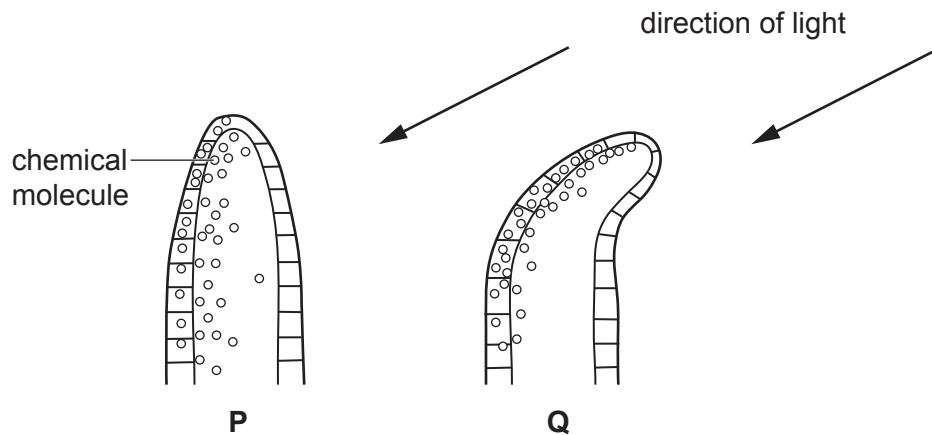


Fig. 4.3

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.

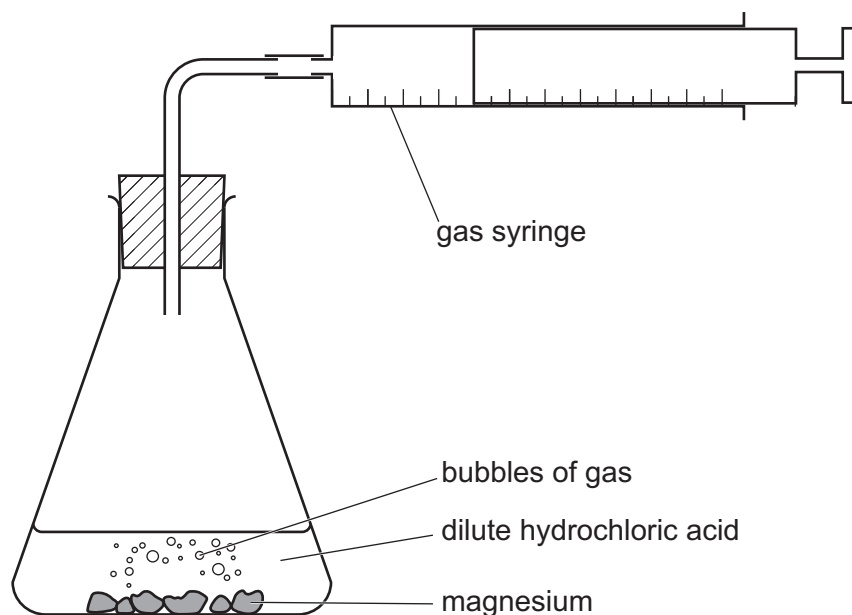


Fig. 5.1

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 / $^{\circ}\text{C}$	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.

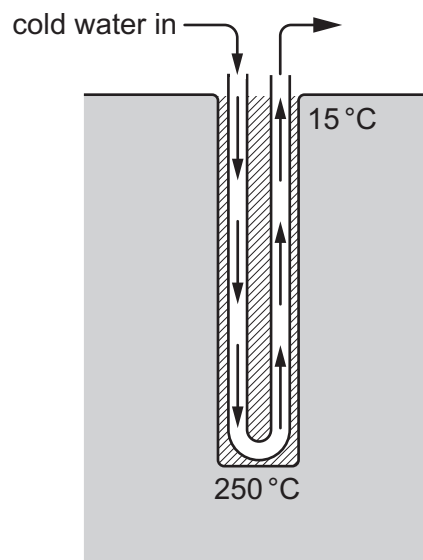


Fig. 6.1

(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 $6 \times 10^6 \text{ Pa}$.

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.

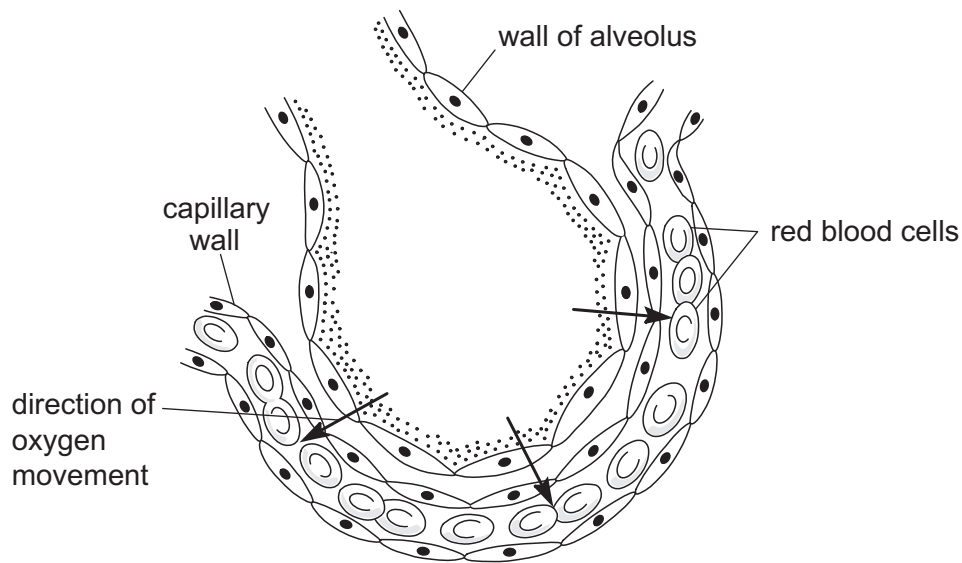


Fig. 7.1

- (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.

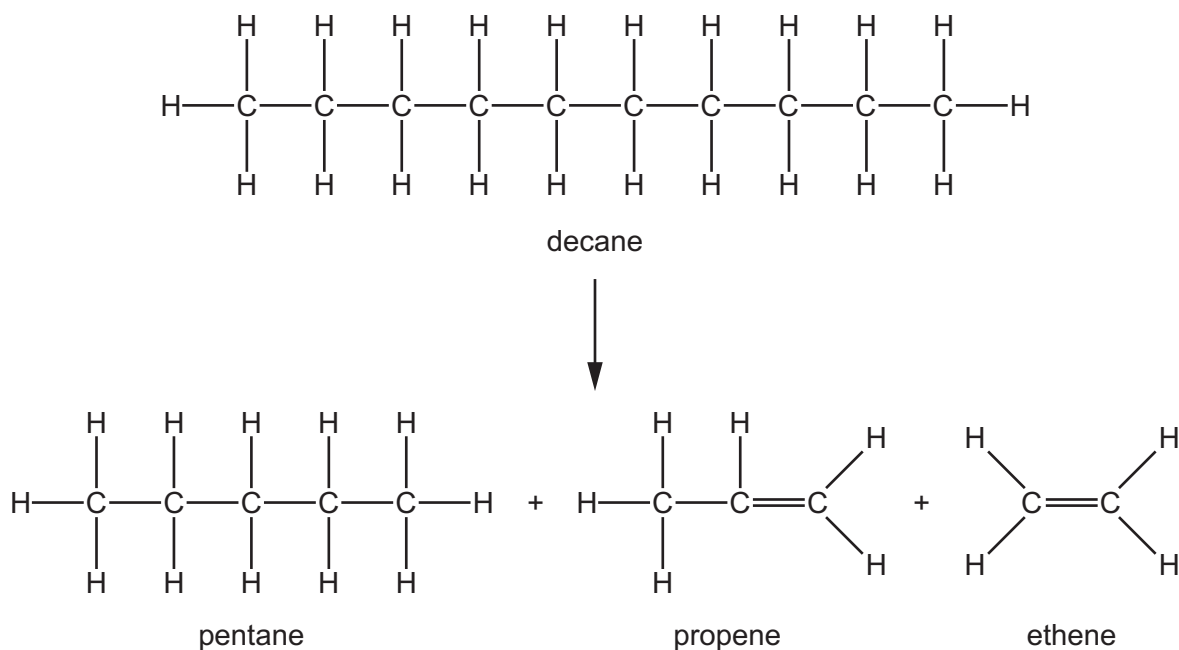


Fig. 8.1

- (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.

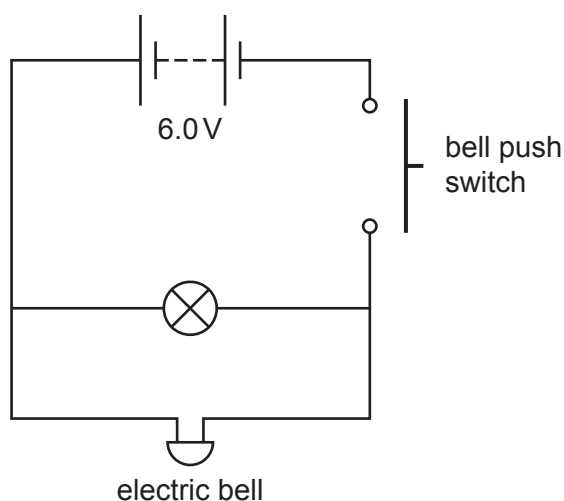


Fig. 9.1

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 1.0m to 100m.

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

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

.....

.....

..... [2]

[Total: 6]

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The Periodic Table of Elements

Group																		
I	II	Key										III	IV	V	VI	VII	VIII	
		atomic number atomic symbol name relative atomic mass																
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		2 He helium 4
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 —			

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.).



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0653/43

May/June 2023

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

- 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.

- 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.

- 1 (a) Fig. 1.1 is a diagram of the male reproductive system in humans.

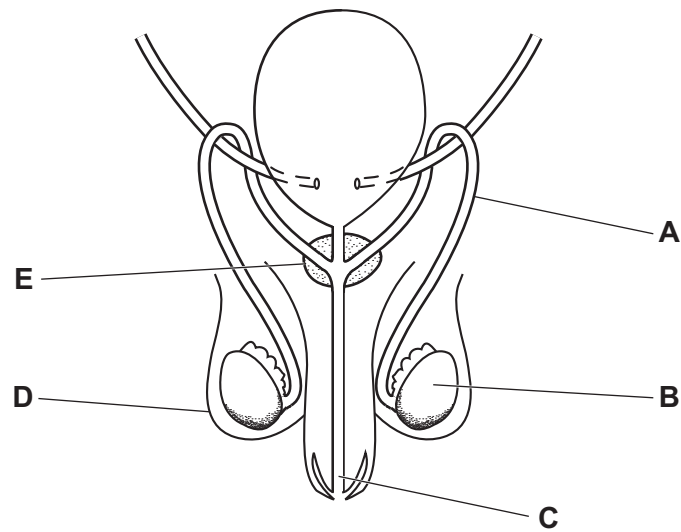


Fig. 1.1

The letters **A – E**, in Fig. 1.1 indicate parts of the male reproductive system.

Complete Table 1.1 to show the letter, name and function of some of these parts.

Table 1.1

letter	name of part	function
	scrotum	
B		
		carries urine and semen out of the body

[3]

- (b) The female reproductive system in humans produces egg cells.

Complete the sentences about egg cells.

Egg cells are specialised cells. Each cell has an energy store and a coating which changes after fertilisation.

Fertilisation is the fusion of the from a sperm and an egg cell.

[2]

- (c) During pregnancy a placenta develops.

Describe **two** different functions of the placenta.

1

.....

2

.....

[2]

[Total: 7]

- 2 Dilute sulfuric acid is electrolysed, as shown in Fig. 2.1.

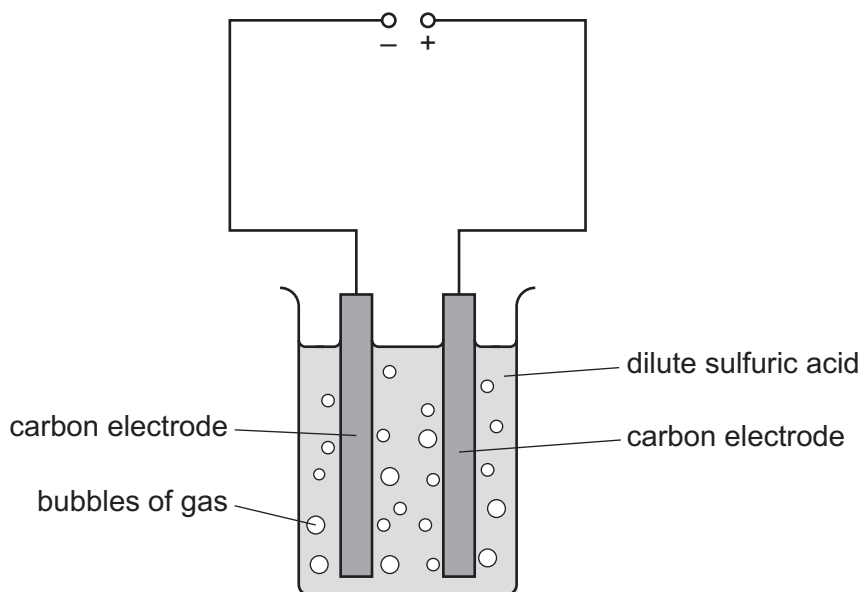
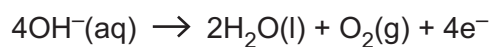


Fig. 2.1

Bubbles of gas form at both electrodes during the electrolysis.

- (a) The ionic equation for the reaction at the positive electrode is shown.



- (i) Describe **in words** the reaction at the positive electrode.

.....

.....

.....

..... [3]

- (ii) Complete the ionic equation for the reaction at the negative electrode.



- (b) Dilute sulfuric acid is the electrolyte in this electrolysis.

State the meaning of electrolyte.

.....

.....

..... [2]

- (c) A different aqueous solution is electrolysed.

The products of this electrolysis are hydrogen and chlorine.

Suggest the identity of this aqueous solution.

..... [1]

[Total: 8]

- 3 Fig. 3.1 shows a football player kicking a football. The ball travels straight up in the air before falling to the ground and stopping.



Fig. 3.1

- (a) Fig. 3.2 shows the speed–time graph of the ball after leaving the player's foot until it hits the ground.

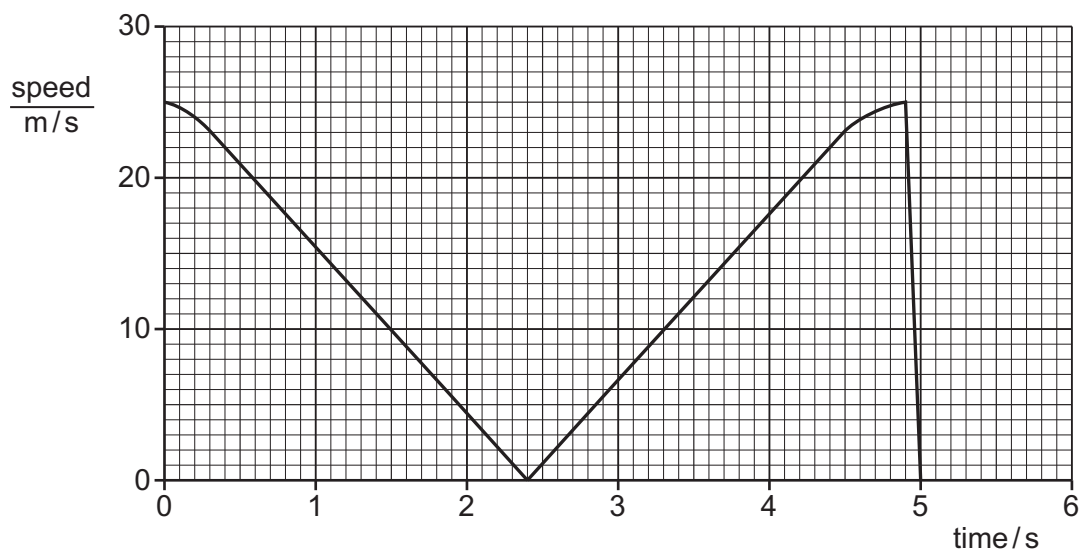


Fig. 3.2

- (i) State the speed of the ball as it leaves the player's foot.

speed = ... m/s [1]

- (ii) On Fig. 3.2, mark with an **X** a time when the ball has non-constant deceleration. [1]

- (iii) Give **two** reasons why the ball decreases in speed after leaving the player's foot but before it hits the ground.

1

2 [2]

- (b) Fig. 3.3 shows the player holding the football on his hand without the ball moving.

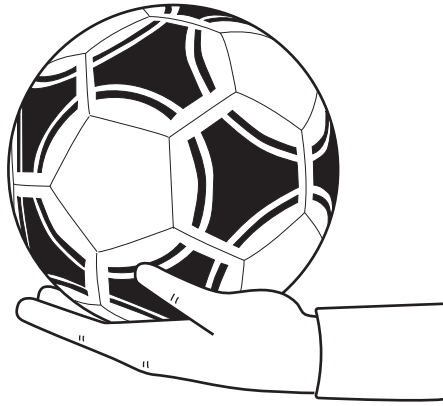


Fig. 3.3

The mass of the ball is 0.40 kg.

- (i) Calculate the upward force used by the player to hold the ball without it moving.

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

force = ... N [2]

- (ii) Explain why you need to know that the ball is not moving to calculate your answer to (b)(i).

.....
 [1]

- (c) Fig. 3.4 shows a rugby ball.

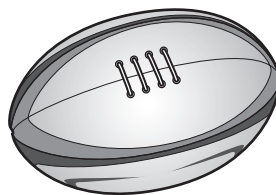


Fig. 3.4

The mass of the ball is 450 g. The ball has a volume of 4100 cm³.

Calculate the average density of the ball in kg/m³.

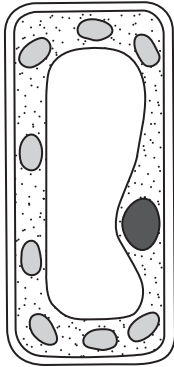
density = ... kg/m³ [3]

[Total: 10]

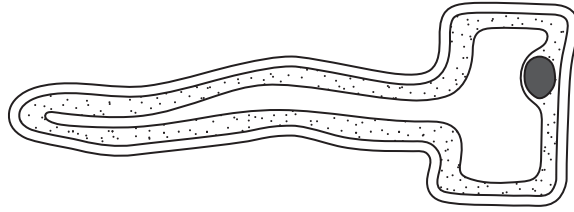
[Turn over]

- 4 (a) Fig. 4.1 is a diagram of a palisade cell and a root hair cell.

palisade cell



root hair cell



NOT TO
SCALE

Fig. 4.1

- (i) State the name of two structures visible in **both** the palisade cell and the root hair cell in Fig. 4.1.

..... and [1]

- (ii) Explain how the root hair cell is adapted for its function.

.....

 [2]

- (iii) Palisade cells are involved in the synthesis of carbohydrates by photosynthesis.

Explain the role of palisade cells in photosynthesis.

.....

 [3]

(b) Plants lose water by transpiration.

A scientist measures the surface area of a plant and the mass of water it loses at different times of the day.

The scientist also takes regular measurements of the temperature and humidity of the plant's environment.

Table 4.1 shows the results.

Table 4.1

time of day / hours	temperature / °C	percentage humidity	rate of transpiration / g per m ² per hour
08:00	12	87	54
10:00	18	86	81
12:00	26	78	170
14:00	29	62	182
16:00	27	68	126
18:00	16	78	76

- (i)** Calculate the percentage increase in the rate of transpiration between **08:00** and **12:00** hours.

Give your answer to the nearest whole number.

percentage increase = ... % [3]

- (ii)** Table 4.1 shows that between **14:00** and **18:00** hours the temperature and humidity of the environment changes.

Explain how each of these changes can affect the rate of transpiration.

Change in temperature

.....

Change in humidity

.....

[3]

[Total: 12]

5 Solid ammonium nitrate, NH_4NO_3 , dissolves to form aqueous ammonium nitrate.

(a) Name the solute and the solvent in aqueous ammonium nitrate.

solute

solvent

[2]

(b) The energy level diagram for dissolving ammonium nitrate is shown in Fig. 5.1.

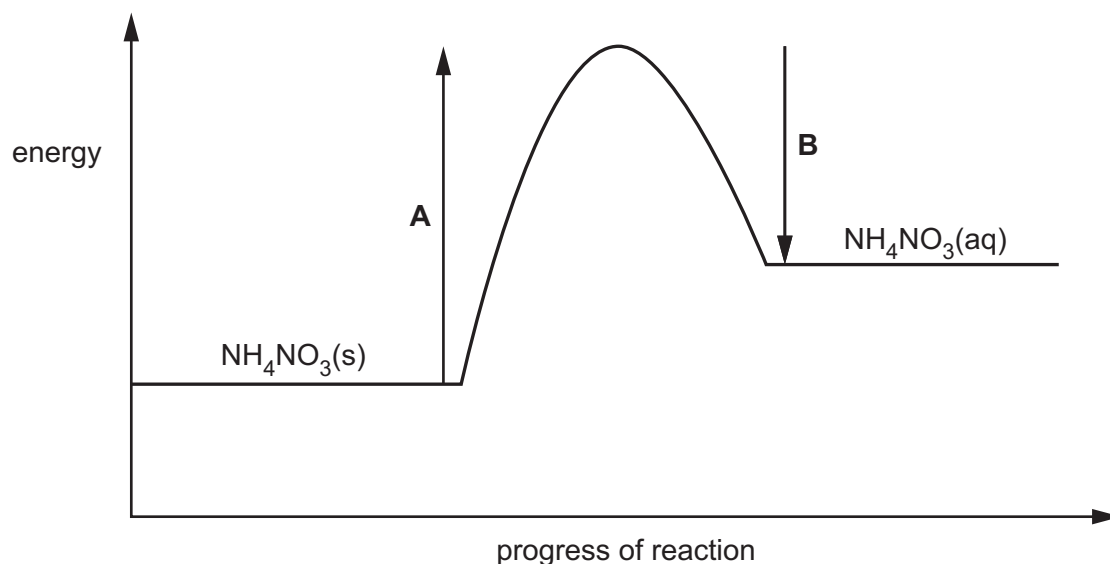


Fig. 5.1

(i) Describe the overall energy change that occurs when ammonium nitrate dissolves.

Explain your answer.

.....

 [2]

(ii) Describe the changes that are represented by arrow **A** and arrow **B**.

Use ideas about energy and bonds in your answer.

arrow **A**

 arrow **B**

[3]

(c) Complete Table 5.1 about the elements in ammonium nitrate, NH_4NO_3 .

Table 5.1

element	symbol	metal or non-metal	number of atoms in one molecule of ammonium nitrate
nitrogen	N		
hydrogen	H		
oxygen	O		

[2]

[Total: 9]

- 6 Fig. 6.1 shows an electric fan and a lighting unit with two lamps, connected to a car battery.

The fan blades rotate and blow cool air when the fan is switched on.

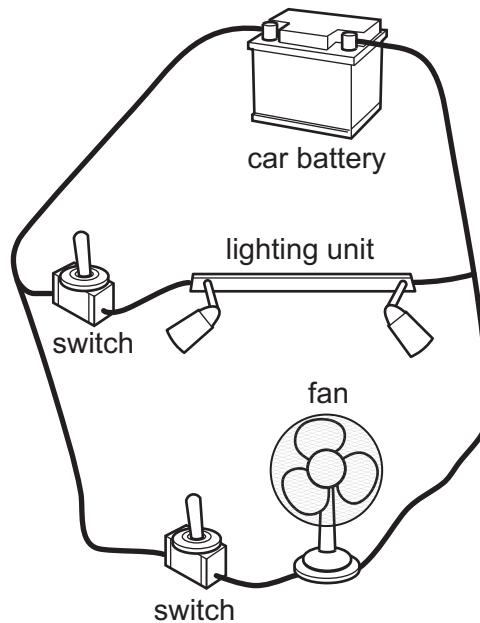


Fig. 6.1

- (a) State the type of circuit connection for the fan and lighting unit.

..... [1]

- (b) State the form of useful energy output by the working fan.

..... [1]

- (c) The battery supplies a voltage of 12.0 V. The current from the battery is 8.0 A.

The power rating of the lighting unit is 11 W.

- (i) Show that the current in the lighting unit is 0.92 A.

[1]

- (ii) Calculate the power rating of the fan.

power W [2]

- (d) The circuit should also contain a fuse to protect the components.

A fuse rated at 10 A is added into the main circuit.

Explain why this fuse:

- will give protection to the fan
- will **not** give protection to the lighting unit.

.....

.....

..... [1]

- (e) Fig. 6.2 shows an incomplete circuit diagram for the circuit in Fig. 6.1.

The light fitting contains two lamps in series. The fan contains an electric motor.

The complete circuit needs two fuses.

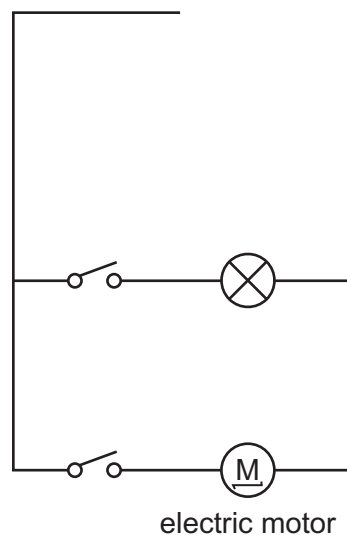


Fig. 6.2

On Fig. 6.2, complete the circuit diagram to include:

- the second lamp
- one fuse to protect the fan
- one fuse to protect the lamps
- the battery and all connecting wires.

[3]

[Total: 9]

- 7 (a) Fig. 7.1 shows the structure of the human heart.

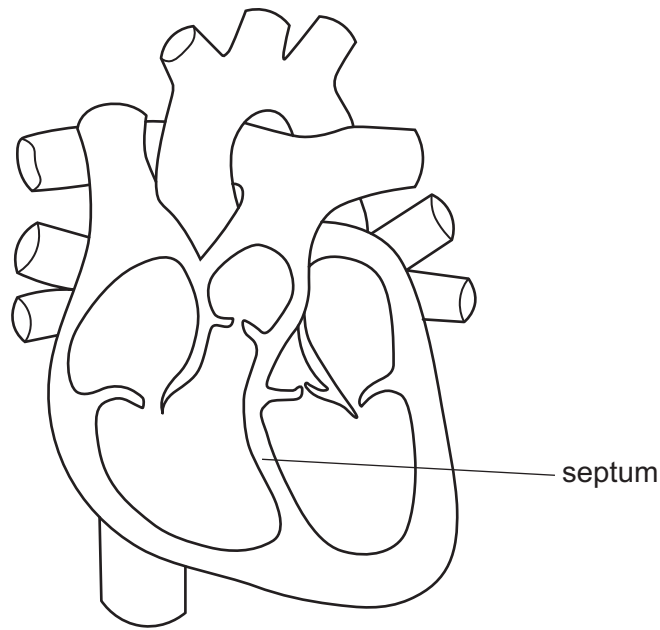


Fig. 7.1

- (i) Draw a label line and the letter **X** on Fig. 7.1 to show **one** atrium. [1]
- (ii) Some babies are born with a hole in the septum. This affects the double circulation system of their blood.

Explain how this can affect the blood circulating in the body.

.....

.....

.....

..... [2]

- (b) An unhealthy diet is one risk factor for coronary heart disease.

- (i) Describe what is meant by coronary heart disease.

.....

..... [1]

- (ii) State **two** other risk factors for coronary heart disease.

1

2 [2]

- (c) Glucose is transported in the blood.

Glucose is needed for aerobic respiration.

Define aerobic respiration.

.....

.....

..... [2]

[Total: 8]

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

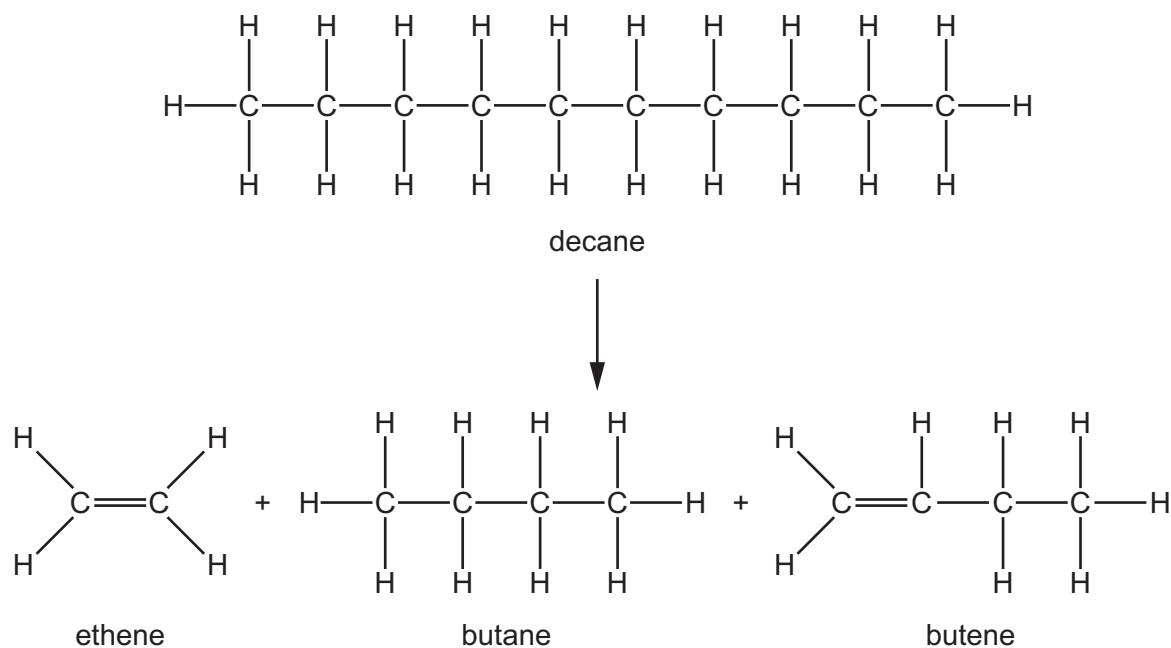


Fig. 8.1

- (a) State the **two** compounds shown in Fig. 8.1 that turn aqueous bromine colourless.

Give a reason for your answer.

compounds and

reason

[2]

- (b) State the name and formula of the **two** products formed in the complete combustion of decane.

name formula

name formula

[2]

- (c) Name the homologous series that contains butane and decane.

..... [1]

- (d) State **two** reasons why cracking is described as a chemical change and not a physical change.

1

2

[2]

- (e) The boiling points of butane and decane are shown in Table 8.1.

Table 8.1

compound	boiling point /°C
butane	−1
decane	174

- (i) Explain why the boiling point of butane is lower than the boiling point of decane.

Use ideas about forces in your answer.

.....

..... [1]

- (ii) Suggest **one** reason why propane and butane are in the same fraction obtained by fractional distillation of petroleum.

..... [1]

[Total: 9]

- 9 (a) Fig. 9.1 represents a sound wave travelling through air between two people.

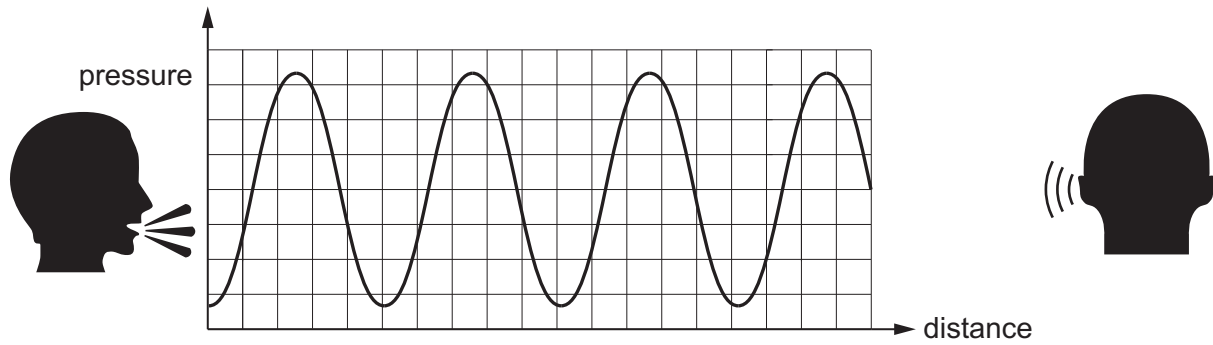


Fig. 9.1

- (i) Describe in terms of particle separation what the peaks and troughs on the graph represent for a sound wave in air.

.....

.....

..... [2]

- (ii) Fig. 9.2 shows a person wearing ear defenders to protect their hearing from loud noise.



Fig. 9.2

Sound waves are absorbed by material in the ear defenders.

Suggest what happens to the sound energy absorbed.

.....

..... [1]

- (b) Light waves travel much faster than sound waves.

State **two** other ways in which light waves differ from sound waves.

1

2 [2]

- (c) Mobile phones use microwaves of wavelength 0.030 m. The speed of microwaves in air is $3 \times 10^8 \text{ m/s}$.

Calculate the frequency of the microwaves used by mobile phones.

Give the unit of your answer.

frequency = ... unit [3]

[Total: 8]

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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	
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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 —				116 Lv livermorium —			

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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.).