



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

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COMBINED SCIENCE

0653/21

Paper 2 (Core)

May/June 2012

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 24.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
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6	
7	
8	
9	
Total	

This document consists of **22** printed pages and **2** blank pages.



- 1 Sugar cane is a food crop grown in Australia. It is harvested and then transported on trains to the processing plant.

Fig. 1.1 shows one of the trains carrying sugar cane.

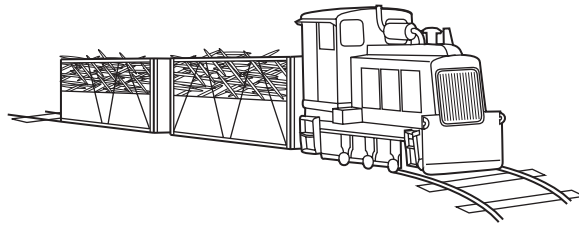


Fig. 1.1

- (a) The train travels a distance of 25 kilometres in 2 hours.

Calculate the average speed of the train.

State the formula that you use and show your working.

formula used

working

..... km/h [2]

- (b) The train engine is powered by oil. The oil is burned to change water into steam. The steam is used to make parts of the engine move.

- (i) What kind of energy is stored in the oil?

..... [1]

- (ii) The engine is 30% efficient in converting the energy stored in the oil into movement energy. The rest of the stored energy is lost in different ways.

State **one** of these ways.

..... [1]

- (c) The track for the train is composed of short lengths of steel rails with small gaps between them as shown in Fig. 1.2.

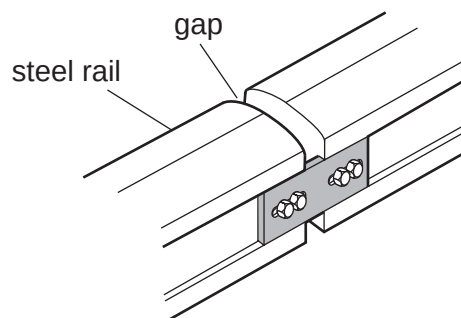


Fig. 1.2

Suggest a reason for leaving these small gaps.

.....

.....

..... [2]

- (d) Sugar can be fermented and turned into ethanol. Ethanol is now used as a fuel for cars.

Give **one** reason, other than cost, why people might use ethanol rather than petrol in their cars.

..... [1]

- (e) The farm on which the sugar cane is grown uses a wind turbine to produce electrical power. Table 1.1 shows the electrical power generated for different wind speeds.

Table 1.1

wind speed / km per hour	0	3	5	8	10	12	15	20
power generated / W	0	0	150	500	1000	1100	1200	1200

- (i) Suggest the lowest wind speed needed to generate power.

..... km/h [1]

- (ii) State the maximum power that this wind turbine can produce.

..... W [1]

- (iii) State **one** disadvantage of using only a wind turbine as the source of electrical power.

.....
 [1]

- 2 An element is a substance that is made of atoms which have the same proton number. Most atoms contain protons, neutrons and electrons.

The elements are shown in the Periodic Table.

- (a) The chemical symbol of an atom of the element chlorine is shown below.



The nucleon number of this atom is 35.

- (i) Name the part of an atom that contains the protons and neutrons.

..... [1]

- (ii) State the number of neutrons in this chlorine atom.

Explain your answer.

number of neutrons

explanation [2]

- (iii) Name the element whose atoms do **not** usually contain any neutrons.

..... [1]

- (b) Table 2.1 shows Period 2 of the Periodic Table.

Table 2.1

	I	II	III	IV	V	VI	VII	0
Period 2	X						Y	Z

The element represented by **X** is a solid at room temperature and the elements represented by **Y** and **Z** are gases.

- (i) Suggest **one** difference, other than physical state at room temperature, between the properties of elements **X** and **Y**.

..... [1]

- (ii) Suggest **one** difference between the chemical properties of elements **Y** and **Z**.

..... [1]

- (c) Fig. 2.1 shows a simple lime kiln which is used to produce lime (calcium oxide) from limestone (calcium carbonate).

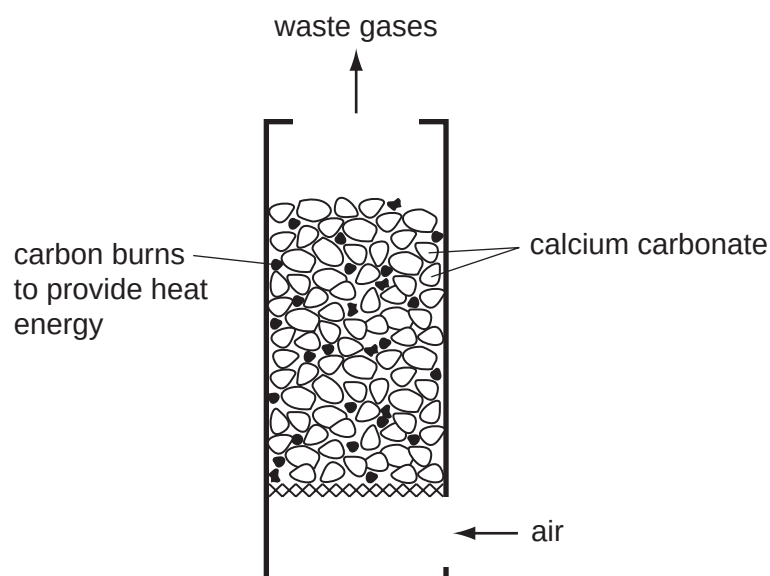


Fig. 2.1

In the lime kiln, the pieces of carbon are burnt to provide heat energy.

- (i) Explain why the burning of carbon is described as an oxidation reaction.

.....

 [2]

- (ii) Both calcium oxide and calcium carbonate are sometimes added to the soil by farmers.

Suggest and explain why this is done.

.....

 [2]

- 3 Marmots are herbivorous mammals. Fig. 3.1 shows a marmot.

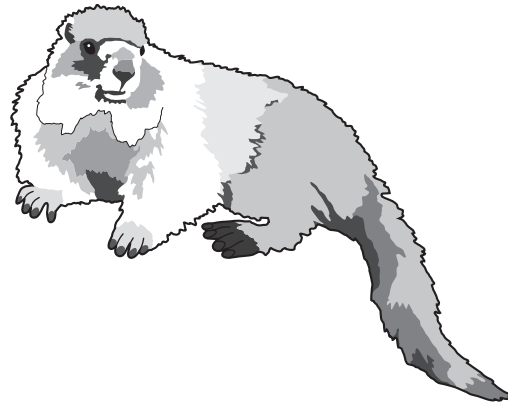


Fig. 3.1

- (a) Define the term *herbivore*.

.....
..... [2]

- (b) A study has been carried out on the marmots living in Colorado, USA.

The winters in this part of Colorado are very cold. The marmots hibernate (sleep) in burrows in winter. They do not eat while they are hibernating. They wake up in spring.

Before they hibernate, marmots build up large fat stores beneath their skin.

Suggest and explain what marmots must do in order to build up large fat stores in their bodies.

.....
.....
..... [2]

- (c) Fig. 3.2 shows the percentage of marmots with different body masses that survive through the winter.

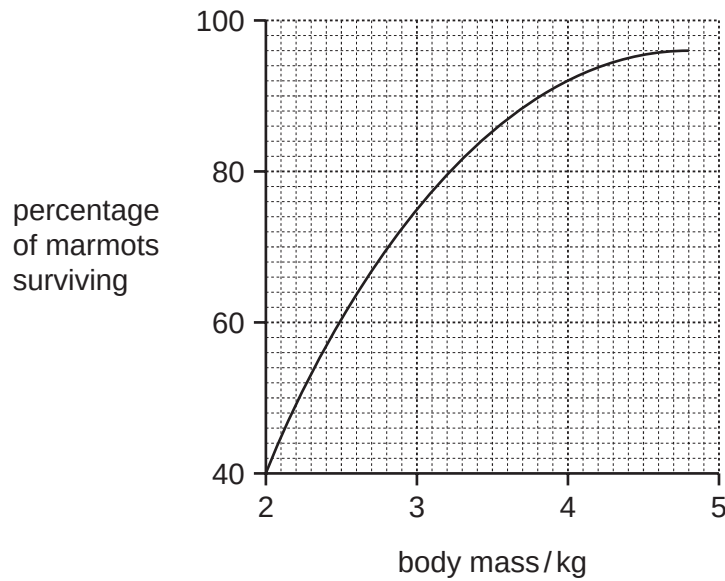


Fig. 3.2

- (i) Describe the relationship between a marmot's body mass and its chance of surviving the winter.

.....

 [2]

- (ii) Suggest how a layer of fat beneath the skin can help a marmot to keep warm during cold weather.

.....
 [1]

- (d) In the last twenty years, spring has been arriving earlier in the year in Colorado. This is a result of global warming.

Name **two** gases that contribute to global warming.

- 1
 2 [2]

- (e) Fig. 3.3 shows the mean body mass of the marmots on the first day of August (summer) between 1976 and 2006.

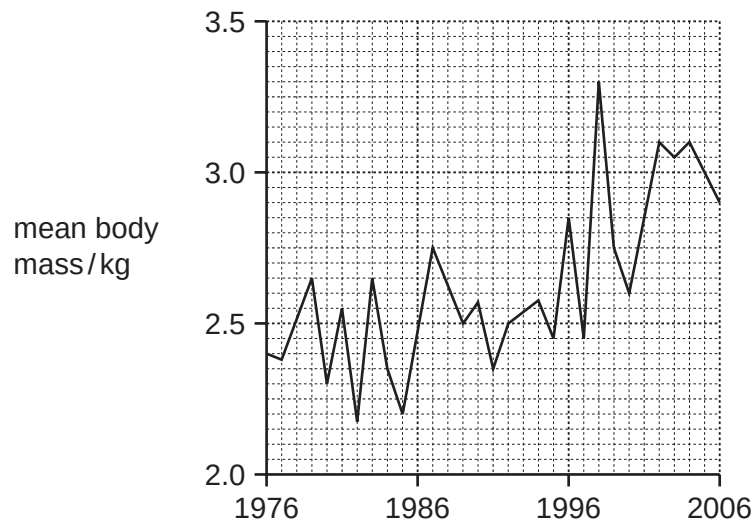


Fig. 3.3

- (i) Describe the general trend shown in Fig. 3.3.

.....
 [1]

- (ii) Suggest how the earlier arrival of spring could be responsible for this trend.

.....
 [1]

- 4 Fig. 4.1 shows some of the apparatus and substances a student used to investigate the rate of reaction between magnesium and dilute hydrochloric acid. In this reaction a gas is given off and bubbles up into the measuring cylinder.

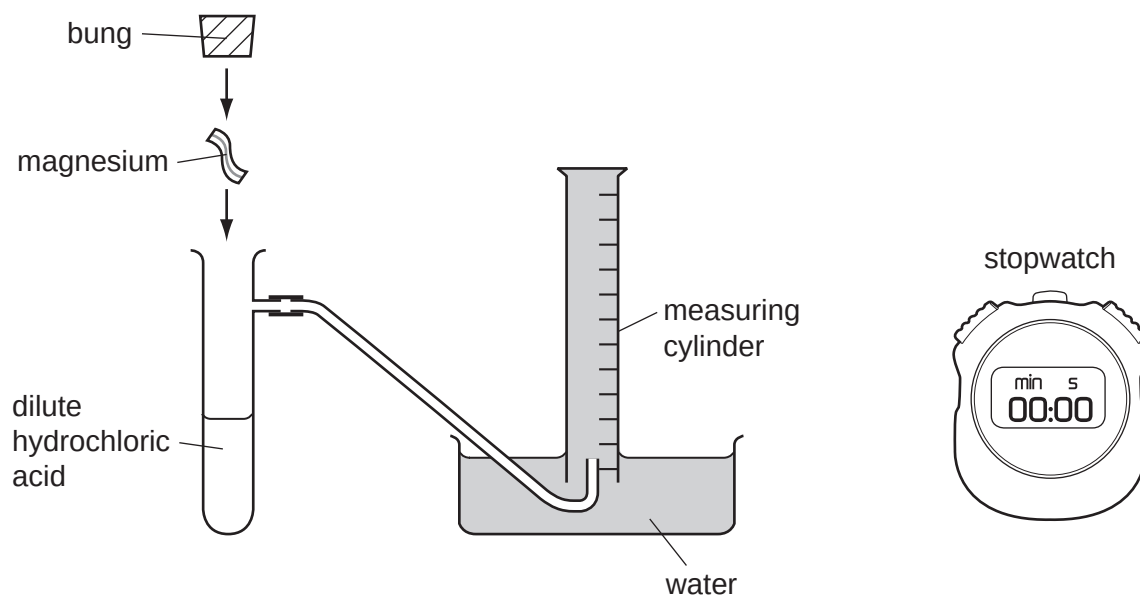


Fig. 4.1

- (a) Fig. 4.1 shows the apparatus just before the student started his experiment to measure the rate of reaction.

Describe briefly the method the student should use and the measurements he should make.

.....

.....

.....

..... [3]

- (b) The student carried out a second experiment using hydrochloric acid which **higher** concentration. All of the other variables which could affect the rate were the same as in the first experiment.

(i) State **one** of the other variables that the student kept constant.

..... [1]

(ii) Predict and explain briefly how the results the student obtained in the second experiment would be different from the first experiment.

.....

.....

..... [2]

- (c) The reaction between magnesium and dilute hydrochloric acid also produces the ionic compound magnesium chloride.

In crystals of this compound, **two** chloride ions combine with **one** magnesium ion.

(i) State **one** difference between a magnesium atom and a magnesium ion.

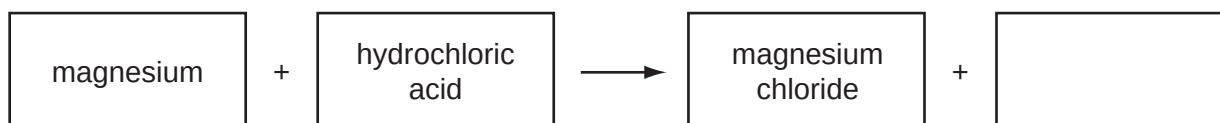
.....

..... [1]

(ii) State the chemical formula of magnesium chloride.

..... [1]

(iii) Complete the **word** chemical equation for the reaction between magnesium and hydrochloric acid.



[1]

- 5 (a) A bat produces a sound wave with a frequency of 212 kHz and a wavelength of 0.003 m.

- (i) This sound is outside the audible frequency range for humans.

State the approximate audible frequency range for humans.

..... Hz [1]

- (ii) State the meaning of the terms *frequency* and *wavelength*, when describing a wave. You may use a diagram if it helps your explanation.

frequency

.....
.....
.....

wavelength

.....
.....
.....

[2]

- (b) A girl shouts and waves to another girl in the school playground as shown in Fig.



Fig. 5.1

The sound energy and the light energy both travel from one girl to the other by wave motion.

- (i) Explain why sound waves will **not** travel through a vacuum.

..... [1]

- (ii) If the first girl now makes another sound with a smaller amplitude, what change would the second girl notice?

..... [1]

- (iii) The girls could have communicated with each other using their mobile phones (cell phones).

Name the type of electromagnetic wave used to communicate between mobile phones.

..... [1]

(c) Fig. 5.2 shows a ray of light passing through a rectangular glass block.

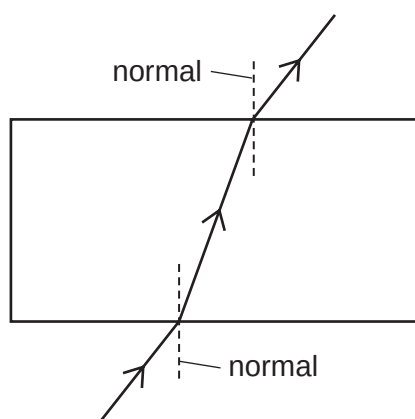


Fig. 5.2

On Fig. 5.2, label an angle of incidence, i , and an angle of refraction, r .

[2]

Please turn over for Question 6.

- 6 Fig. 6.1 shows part of a section across a root from a radish plant, photographed through a microscope.

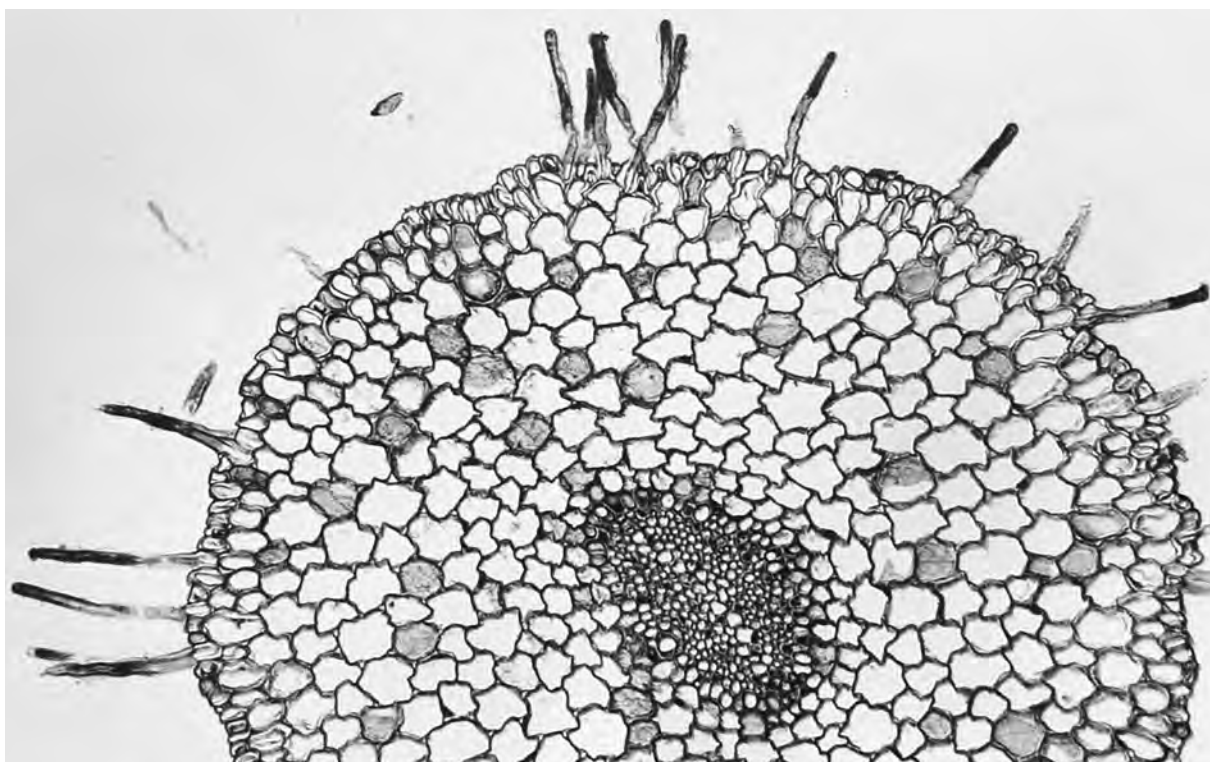


Fig. 6.1

- (a) On Fig. 6.1, use a label line to label a root hair cell. [1]

- (b) Root hair cells absorb substances from the soil.

Name **two** substances that root hair cells absorb from the soil.

1

2 [2]

- (c) A complete radish plant was placed with the lower part of the root standing in water. A soluble red dye was added to the water. After a while, the veins in the leaves of the radish plant became red.

- (i) Name the tissue in the radish plant through which the coloured water was transported from the roots to the leaves.

..... [1]

- (ii) On Fig. 6.1, write the letter **A** to show the position of this tissue in the root. [1]

- (d) (i) The cells in the radish root are plant cells.

Complete Table 6.1 to show which structures are present in plant cells and which are present in animal cells.

Use a tick (✓) to show that the structure is present. Use a cross (✕) to show that the structure is not present.

You should place either a tick or a cross in every space in the table.

Table 6.1

structure	plant cells	animal cells
cell membrane		
cell wall		
nucleus		
vacuole containing sap		

[4]

- (ii) Would you expect the cells in the radish root to contain chloroplasts?

Explain your answer.

.....
 [1]

- 7 (a) A student investigated how the change in potential difference across a lamp affects the current flowing through it.

She used wires to connect the components shown in Fig. 7.1 to make a suitable circuit.

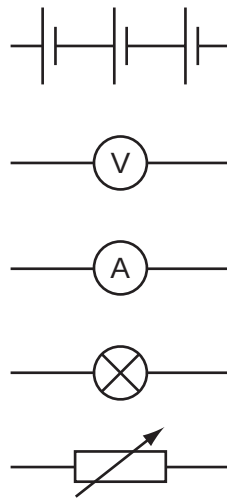


Fig. 7.1

- (i) Using the correct symbols from Fig. 7.1, draw a diagram to show the circuit she made.

[3]

- (ii) Explain why a variable resistor is used in this circuit.

.....
..... [1]

(b) A plastic rod is rubbed with a cloth. The rod becomes charged.

There are two types of electric charge.

(i) State the names of these types of charge.

1

2 [1]

(ii) Charged particles are transferred between the rod and cloth.

Name the charged particles transferred. [1]

(iii) Plastic is an example of an electrical insulator.

Name **one** material which is an electrical conductor.

..... [1]

- 8 The bar chart in Fig. 8.1 shows the approximate composition of unpolluted air.

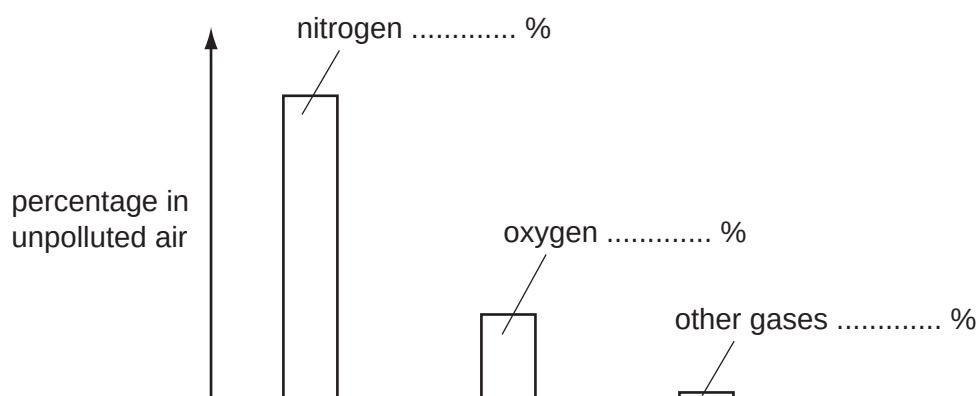


Fig. 8.1

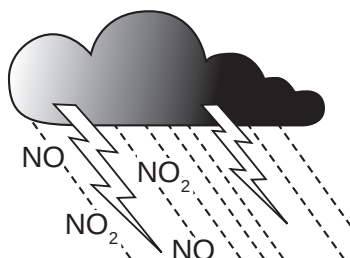
- (a) (i) Complete the bar chart in Fig. 8.1 by labelling the percentages of nitrogen, oxygen and other gases. [2]

- (ii) Name **one** of the **other gases** in Fig. 8.1 that exists in unpolluted air.

..... [1]

- (b) Nitrogen and oxygen exist in the air in the form of the diatomic molecules, N_2 and O_2 .

When lightning passes through the air, the gaseous compounds nitric oxide, NO , and nitrogen dioxide, NO_2 , are formed.



- (i) Explain why nitrogen and oxygen are described as chemical elements, but nitric oxide and nitrogen dioxide are described as compounds.

.....

.....

..... [2]

- (ii) Suggest the type of chemical bonding in nitric oxide and nitrogen dioxide.

Explain your answer briefly.

type of bonding

explanation

[2]

- (iii) Nitrogen dioxide dissolves and reacts with rainwater.

A student carried out an experiment to investigate what happened to the acidity of rainwater during a thunderstorm.

His results are shown in Table 8.1.

Table 8.1

description of sample	pH
pure water obtained in a science laboratory	7
rainwater collected when no thunderstorm was occurring	5
rainwater collected during a thunderstorm	4

What conclusions can the student make from these results?

.....

 [2]

- 9 (a) One of the characteristics of living organisms is sensitivity. This is the ability to respond to changes in the environment.

List **four** other characteristics of all living things.

- 1
- 2
- 3
- 4

[2]

- (b) Hormones help organisms to respond to changes in their environment.

(i) Name the hormone that is produced when a person is frightened.

..... [1]

(ii) State **two** effects of this hormone.

- 1
-
- 2
-

[2]

- (c) How are hormones transported around the body?

..... [1]

Copyright Acknowledgements:

Question 6 Photograph

© B23WP8 cross section of a radish root; Biodisc/Visuals Unlimited/Alamy.

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DATA SHEET
The Periodic Table of the Elements

Group																														
I	II																III	IV	V	VI	VII	0								
																	1 H Hydrogen 1												4 He Helium 2	
7 Li Lithium 3	9 Be Beryllium 4																11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10								
																	27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18								
23 Na Sodium 11	24 Mg Magnesium 12																65 Zn Zinc 30	64 Cu Copper 29	59 Ni Nickel 28	59 Co Cobalt 27	56 Fe Iron 26	55 Mn Manganese 25	52 Cr Chromium 24	51 V Vanadium 23	48 Ti Titanium 22	45 Sc Scandium 21	40 Ca Calcium 20			
																	112 Cd Cadmium 48	108 Ag Silver 47	106 Pd Palladium 46	103 Rh Rhodium 45	101 Ru Ruthenium 44	96 Mo Molybdenum 42	93 Nb Niobium 41	91 Zr Zirconium 40	89 Y Yttrium 39	88 Sr Strontium 38				
133 Cs Caesium 55	137 Ba Barium 56																201 Hg Mercury 80	197 Au Gold 79	195 Pt Platinum 78	192 Ir Iridium 77	190 Os Osmium 76	186 Re Rhenium 75	184 W Tungsten 74	181 Ta Tantalum 73	178 Hf Hafnium 72	139 La Lanthanum 57	137 Ba Barium 56			
																	227 Ac Actinium 89	226 Ra Radium 88	227 Fr Francium 87											
*58-71 Lanthanoid series †90-103 Actinoid series																														
a X b a = relative atomic mass X = atomic symbol b = proton (atomic) number																														
Key																														

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).



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COMBINED SCIENCE

0653/22

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This document consists of **18** printed pages and **2** blank pages.



- 1 (a) Most atoms of metallic elements found in the Earth's crust exist in compounds ores which are contained in rocks.

The chemical formulae of some metal compounds found in ores, together with the names of the ores, are shown below.

argentite	Ag_2S
chromite	FeCr_2O_4
galena	PbS
scheelite	CaWO_4

- (i) A binary compound is one that contains only two different elements.

State which of the compounds in the list above are binary compounds.

..... [1]

- (ii) State the ore from which the metallic element tungsten could be extracted.

..... [1]

- (b) Fig. 1.1 shows a diagram of an atom of the element lithium. This atom has a nucleon number (mass number) of seven.

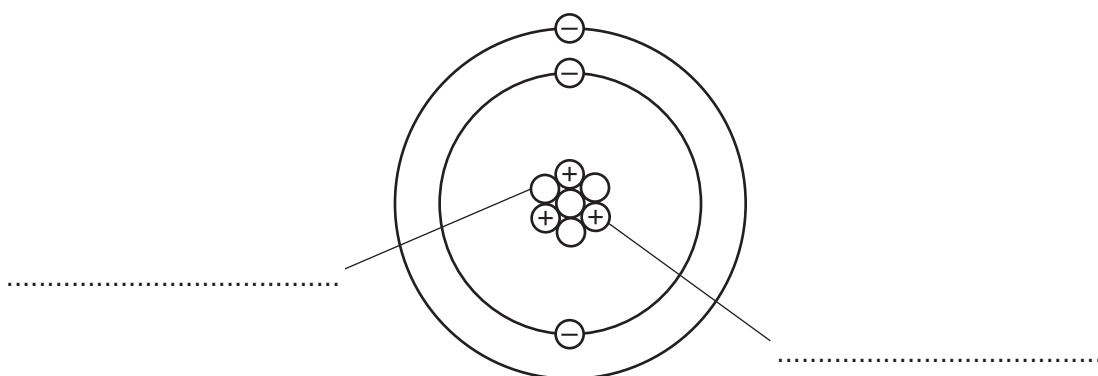
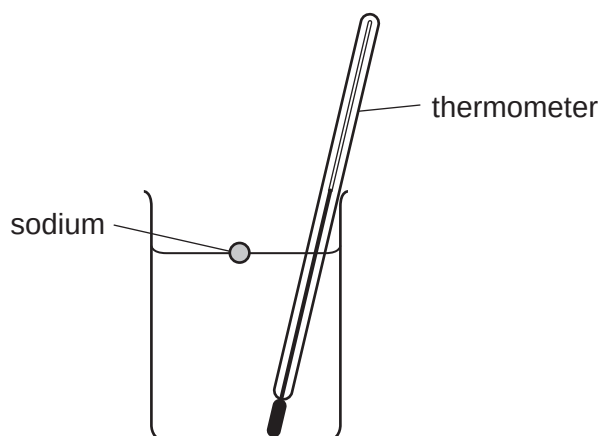


Fig. 1.1

Complete Fig. 1.1 by labelling the particles that exist in the nucleus.

[2]

- (c) (i) A teacher dropped a small piece of sodium into a beaker containing cold water and a thermometer. She stirred the mixture until all of the sodium had reacted.



Predict **two** observations that could be made as the sodium reacts with the water.

- 1
- 2

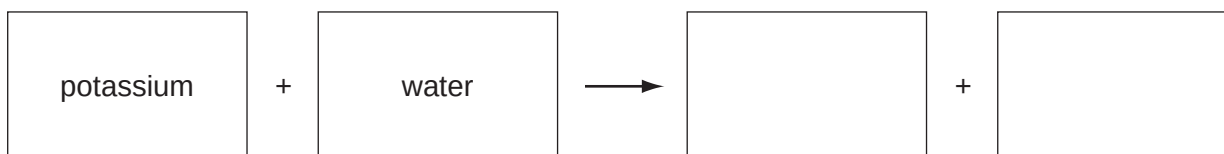
[2]

- (ii) Potassium is another element in the same group of the Periodic Table as sodium.

State **one** way in which the reaction of potassium with cold water would be different from that of sodium.

..... [1]

- (iii) Complete the **word** chemical equation for the reaction between potassium and water.



[2]

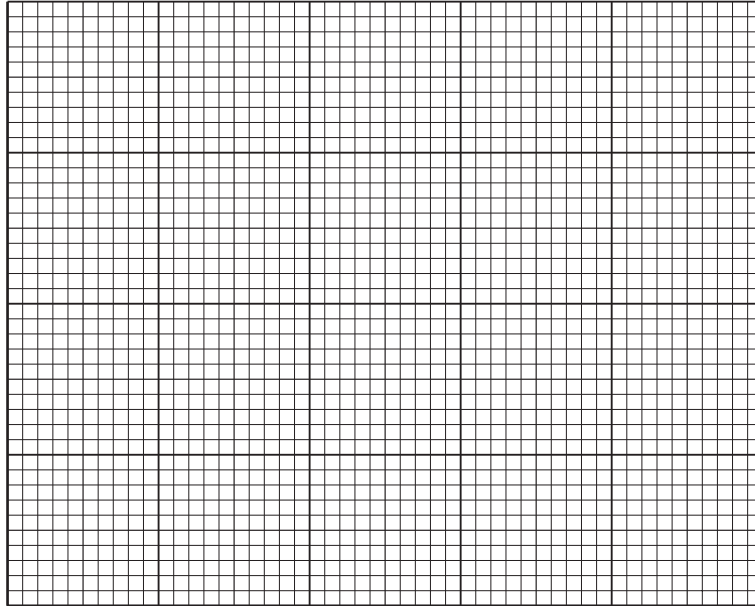
2 An athlete warms up by running along a race track.

(a) He accelerates from rest and after 10 seconds reaches a maximum speed of 7 m/s.

He continues at this speed for another 10 seconds.

During the next 5 seconds, he steadily slows down and stops.

Draw a speed-time graph to show the motion of the athlete.



[4]

(b) During a race the athlete cools down by sweating.

(i) Explain how evaporation cools down the athlete.

.....

 [2]

(ii) State **two** factors which would increase the rate of evaporation.

..... and [2]

- 3 (a) Define the term *respiration*.

.....

 [2]

- (b) Table 3.1 shows the percentages of three gases in inspired air and in expired air.

Write the name of each gas in Table 3.1.

Table 3.1

gas	percentage in inspired air	percentage in expired air
	21	17
	0.04	4
	78	78

[3]

- (c) Outline how oxygen is transported to a respiring cell in a muscle.

.....

 [2]

- (d) When adrenaline is secreted, oxygen is transported more quickly to the muscles.

- (i) How does adrenaline have this effect?

..... [1]

- (ii) State **one** situation in which adrenaline secretion increases.

..... [1]

- (iii) Name the body organ that destroys adrenaline after it has been secreted.

..... [1]

- 4 (a) Radio waves are electromagnetic waves. Sound waves are not.

State **one** other way in which radio waves differ from sound waves.

.....
..... [1]

- (b) Fig. 4.1 shows two lists. The first is a list of different types of electromagnetic wave. The second is a list of some of their uses.

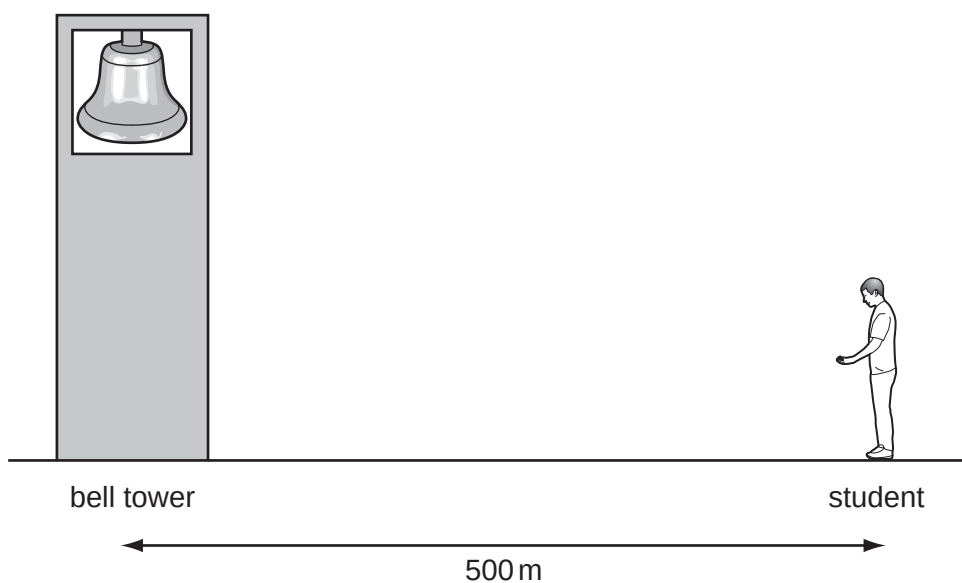
Draw lines to connect each type of radiation to its use. [3]

radiation	use
gamma	examining bones and teeth
microwave	remote controls for television sets
infra-red	satellite communications
X-rays	sterilising surgical instruments

Fig. 4.1

- (c) A student carried out an experiment to find the speed of sound in air by watching and listening to a bell being rung.

He stood 500 m from the bell.



The sound took 1.5 s to travel from the bell to the student.

- (i) Calculate the speed of sound.

State the formula that you use and show your working.

formula used

working

..... m/s [2]

- (ii) The sound wave produced by the bell had a frequency of 400 Hz.

State the approximate frequency range which humans can hear.

..... Hz to Hz [1]

- (iii) The mass of the bell is 10 000 kg and it has a volume of 1.1 m^3 .

Calculate the density of the bell.

State the formula that you use and show your working.

formula used

working

..... kg/m^3 [2]

- 5 Water supplies are often impure and have to be purified to make them safe for human drink.

(a) State **one** process that is used to make water safe for humans to drink.

Explain, for the process you have chosen, how this process purifies the water.

process

how it purifies

..... [2]

(b) Water is a compound which contains the elements hydrogen and oxygen.

Describe **one** difference, other than physical state, between the **compound** water and a **mixture** of the elements hydrogen and oxygen.

.....

.....

..... [2]

(c) Table 5.1 shows information about water and two compounds that can form mixtures with water.

Table 5.1

compound	melting point/°C	boiling point/°C	solubility in water
water	0	100	–
sodium chloride	801	1413	soluble
hexane	–95	69	insoluble

(i) Describe briefly how a sample of sodium chloride could be obtained from a solution of sodium chloride.

.....

.....

..... [2]

- (ii) Use the information in Table 5.1 to predict and explain whether or not a mixture of hexane and water could be separated at room temperature (20 °C) by the method of filtration.

.....

 [2]

- (d) A student burned a small piece of magnesium, using the apparatus shown in Fig. 5.1.

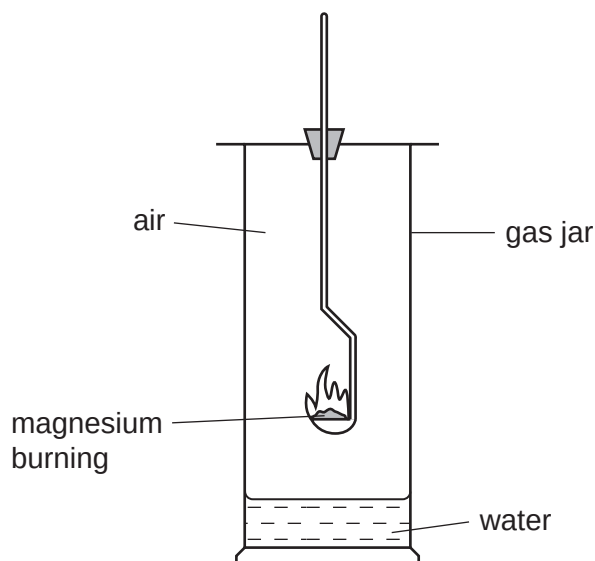


Fig. 5.1

When the reaction finished, the magnesium oxide was mixed with the water in the bottom of the gas jar.

- (i) Magnesium oxide is made of positive ions and negative ions.

Describe briefly what happens to an atom when it is converted into a negative ion.

.....
 [1]

- (ii) The student added a few drops of full range indicator solution (Universal Indicator) to the mixture of water and magnesium oxide.

The indicator changed from green to blue.

Explain why this happens.

.....

 [2]

6 A car is travelling along a road.

(a) Many forces act on the car.

(i) State **two** effects that forces can have on an object.

1

2

[2]

(ii) State the unit used to measure force. [1]

(b) Fig. 6.1 shows a car travelling in a straight line. The car is decelerating (slowing down).

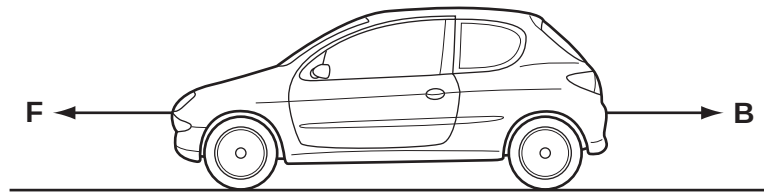


Fig. 6.1

The total forward force on the car is **F** and the total backward force is **B**.

Which force is greater, **F** or **B**?

Explain your answer.

.....

..... [1]

- (c) Using some of the words below, complete the sentences to explain the energy changes which take place in a car when petrol (gasoline) is used to power the car.

boiled

burned

cooled

chemical

heat

kinetic

nuclear

sound

Petrol (gasoline) contains energy. The petrol is in the engine to produce heat energy. The heat energy is changed into energy which moves the car. This process is not very efficient and much energy is wasted as energy and energy. [5]

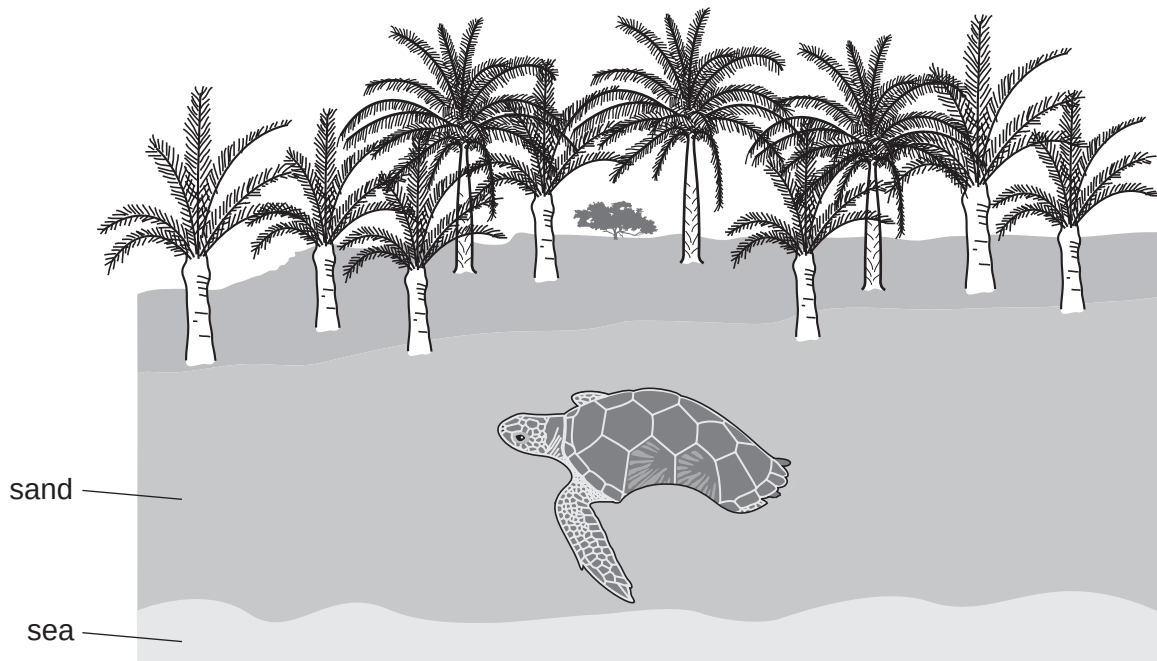
- (d) Petrol (gasoline) is a mixture of hydrocarbons.

Explain why the mixture of waste gases (exhaust gases) from a car contains carbon dioxide and water vapour.

.....

 [2]

- 7 Hawksbill turtles are an endangered species. They lay their eggs in nests in the sand on the beach.



The sex of hawksbill turtles is determined by the temperature of the sand in which the eggs develop.

- At 29°C , equal numbers of males and females develop.
- Higher temperatures produce more females.
- Lower temperatures produce more males.

- (a) Researchers measured the temperature, at a depth of 30 cm, in two different parts of a beach, on Antigua, where hawksbill turtles lay their eggs. The results are shown in Fig. 7.1. The tops of the bars represent the mean temperature.

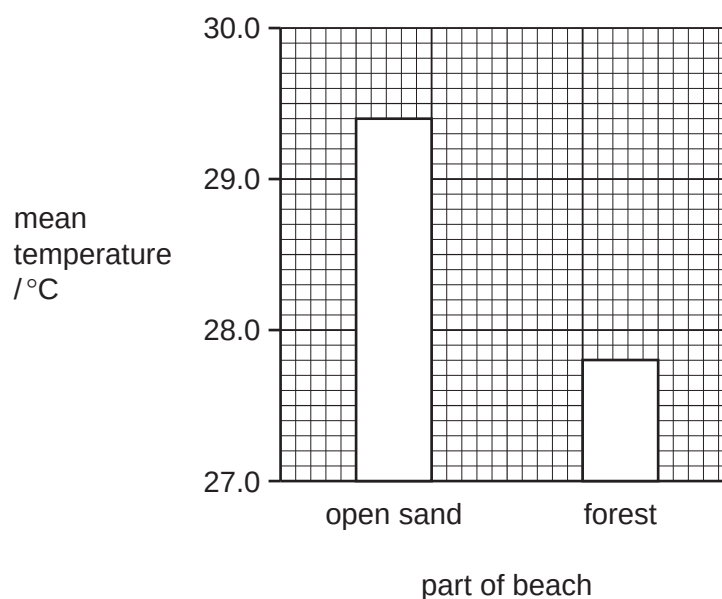


Fig. 7.1

With reference to Fig. 7.1, describe the effect of the forest on the temperature of the

.....

 [2]

- (b) The researchers counted the proportion of male and female turtles hatching from nests in the two different parts of the beach. The results are shown in Table 7.1.

Table 7.1

part of beach	nests producing more males than females	nests producing more females than males	nests producing equal numbers of females and males
open sand	0	16	0
in forest	36	0	0

Use the information in Fig. 7.1 to explain the results for nests in open sand and in forest, shown in Table 7.1.

.....

 [2]

- (c) Suggest why hawksbill turtles might become extinct if all the forest by the beaches is cut down.

.....

 [2]

- (d) State **two** harmful effects to the environment, other than extinction of species, that can result from deforestation.

1

 2

[2]

- 8 Fig. 8.1 shows apparatus a student used to investigate temperature changes that occur during chemical reactions.

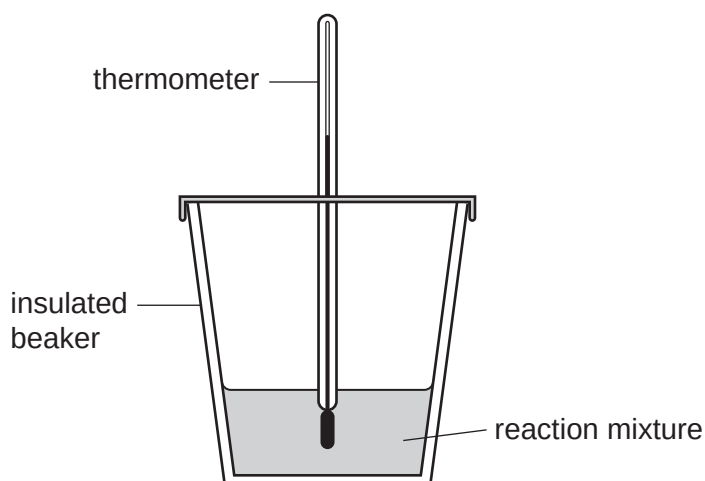


Fig. 8.1

The student added reactants to the insulated beaker and stirred the mixture. She recorded the final temperature of each mixture.

At the start of each experiment, the temperature of the reactants was 22 °C.

Table 8.1 contains the results the student obtained.

Table 8.1

experiment	reactant A	reactant B	final temperature / °C
1	dilute hydrochloric acid	sodium hydrogencarbonate	16
2	dilute hydrochloric acid	potassium hydroxide solution	26
3	magnesium	copper sulfate solution	43
4	copper	magnesium sulfate solution	22

- (a) (i) Explain which experiment, **1**, **2**, **3** or **4**, was a neutralisation reaction between an acid and an alkali.

experiment

explanation

..... [1]

- (ii) State and explain which experiment, **1**, **2**, **3** or **4**, was an endothermic reaction.

experiment

explanation

[1]

- (iii) Suggest why the temperature did **not** change when copper was added to magnesium sulfate solution.

[1]

- (b) The student used the apparatus in Fig. 8.1 to carry out two further experiments, **5** and **6**, to investigate the exothermic reaction between zinc and copper sulfate solution.

In experiment **5** the student used zinc powder and in experiment **6** she used a single piece of zinc.

The mass of zinc in both experiments was the same.

Suggest and explain briefly in which experiment, **5** or **6**, the temperature increased more quickly.

experiment

explanation

[2]

- 9 (a) Explain what is meant by the term *enzyme*.

.....

.....

..... [2]

- (b) Fig. 9.1 shows the effect of pH on the activity of an enzyme.

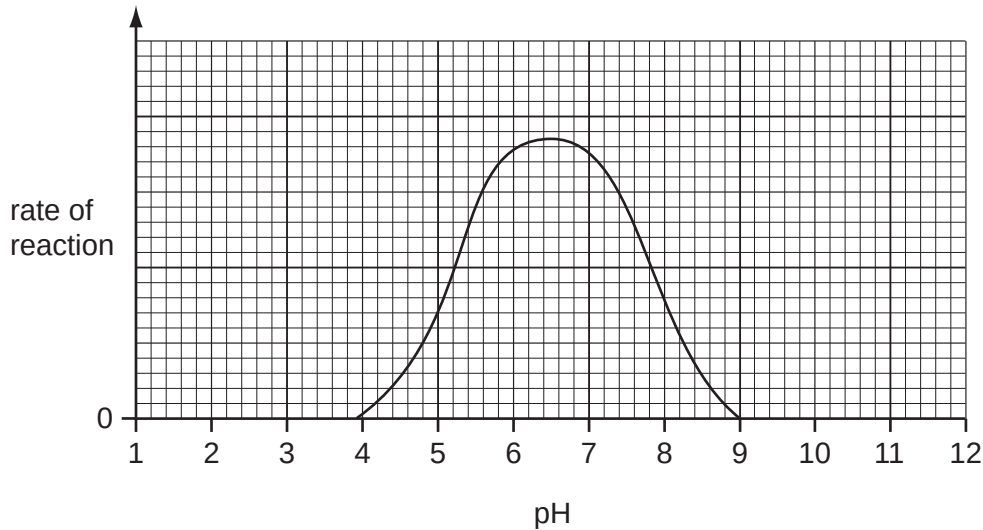


Fig. 9.1

Describe the effect of pH on the activity of this enzyme.

.....

.....

..... [2]

- (c) An enzyme works in the human stomach, where hydrochloric acid is secreted. This enzyme is adapted to work best in these conditions.

(i) On Fig. 9.1, sketch a curve to show how pH affects the activity of this stomach enzyme. [1]

- (ii) After the food has been in the stomach for a while, it passes into the duodenum. Pancreatic juice, which contains sodium hydrogencarbonate, is mixed with the food in the duodenum.

Explain why the stomach enzyme stops working when it enters the duodenum.

.....

.....

..... [2]

- (d) Enzymes in the human digestive system help to break down large food molecules into smaller molecules.

Explain why this is important.

.....

.....

..... [2]

Group

Key

a	X
---	----------

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

*58-71 Lanthanoid series
†90-103 Actinoid series



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COMBINED SCIENCE

0653/23

Paper 2 (Core)

May/June 2012

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 24.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **22** printed pages and **2** blank pages.



- 1 Sugar cane is a food crop grown in Australia. It is harvested and then transported on trains to the processing plant.

Fig. 1.1 shows one of the trains carrying sugar cane.

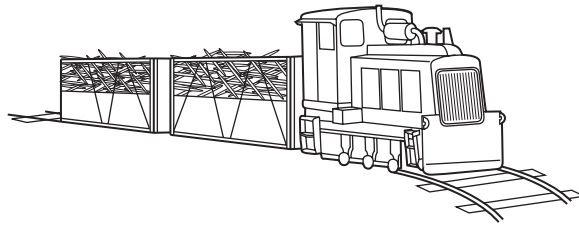


Fig. 1.1

- (a) The train travels a distance of 25 kilometres in 2 hours.

Calculate the average speed of the train.

State the formula that you use and show your working.

formula used

working

..... km/h [2]

- (b) The train engine is powered by oil. The oil is burned to change water into steam. The steam is used to make parts of the engine move.

- (i) What kind of energy is stored in the oil?

..... [1]

- (ii) The engine is 30% efficient in converting the energy stored in the oil into movement energy. The rest of the stored energy is lost in different ways.

State **one** of these ways.

..... [1]

- (c) The track for the train is composed of short lengths of steel rails with small gaps between them as shown in Fig. 1.2.

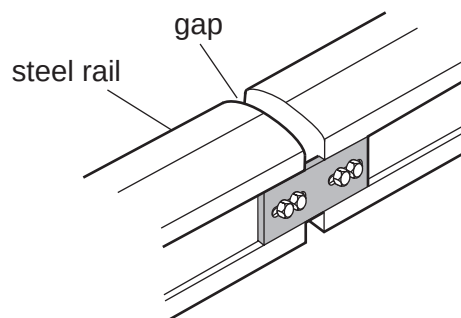


Fig. 1.2

Suggest a reason for leaving these small gaps.

.....

.....

..... [2]

- (d) Sugar can be fermented and turned into ethanol. Ethanol is now used as a fuel for cars.

Give **one** reason, other than cost, why people might use ethanol rather than petrol in their cars.

..... [1]

- (e) The farm on which the sugar cane is grown uses a wind turbine to produce electrical power. Table 1.1 shows the electrical power generated for different wind speeds.

Table 1.1

wind speed / km per hour	0	3	5	8	10	12	15	20
power generated / W	0	0	150	500	1000	1100	1200	1200

- (i) Suggest the lowest wind speed needed to generate power.

..... km/h [1]

- (ii) State the maximum power that this wind turbine can produce.

..... W [1]

- (iii) State **one** disadvantage of using only a wind turbine as the source of electrical power.

.....
 [1]

- 2 An element is a substance that is made of atoms which have the same proton number. Most atoms contain protons, neutrons and electrons.

The elements are shown in the Periodic Table.

- (a) The chemical symbol of an atom of the element chlorine is shown below.



The nucleon number of this atom is 35.

- (i) Name the part of an atom that contains the protons and neutrons.

..... [1]

- (ii) State the number of neutrons in this chlorine atom.

Explain your answer.

number of neutrons

explanation [2]

- (iii) Name the element whose atoms do **not** usually contain any neutrons.

..... [1]

- (b) Table 2.1 shows Period 2 of the Periodic Table.

Table 2.1

	I	II	III	IV	V	VI	VII	0
Period 2	X						Y	Z

The element represented by **X** is a solid at room temperature and the elements represented by **Y** and **Z** are gases.

- (i) Suggest **one** difference, other than physical state at room temperature, between the properties of elements **X** and **Y**.

..... [1]

- (ii) Suggest **one** difference between the chemical properties of elements **Y** and **Z**.

..... [1]

- (c) Fig. 2.1 shows a simple lime kiln which is used to produce lime (calcium oxide) from limestone (calcium carbonate).

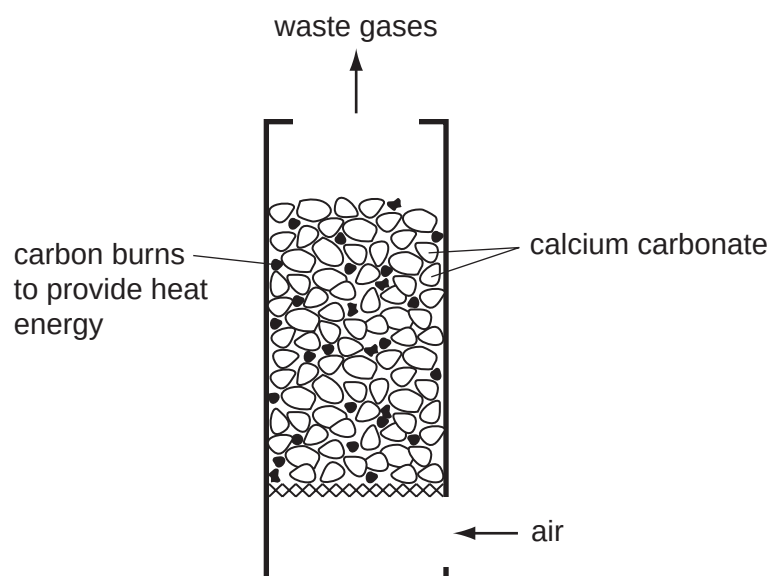


Fig. 2.1

In the lime kiln, the pieces of carbon are burnt to provide heat energy.

- (i) Explain why the burning of carbon is described as an oxidation reaction.

.....

 [2]

- (ii) Both calcium oxide and calcium carbonate are sometimes added to the soil by farmers.

Suggest and explain why this is done.

.....

 [2]

- 3 Marmots are herbivorous mammals. Fig. 3.1 shows a marmot.

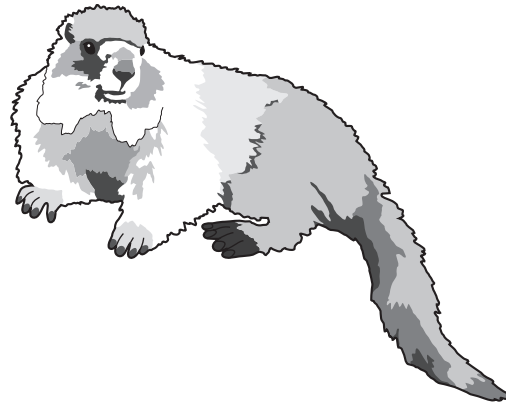


Fig. 3.1

- (a) Define the term *herbivore*.

.....
..... [2]

- (b) A study has been carried out on the marmots living in Colorado, USA.

The winters in this part of Colorado are very cold. The marmots hibernate (sleep) in burrows in winter. They do not eat while they are hibernating. They wake up in spring.

Before they hibernate, marmots build up large fat stores beneath their skin.

Suggest and explain what marmots must do in order to build up large fat stores in their bodies.

.....
.....
..... [2]

- (c) Fig. 3.2 shows the percentage of marmots with different body masses that survive through the winter.

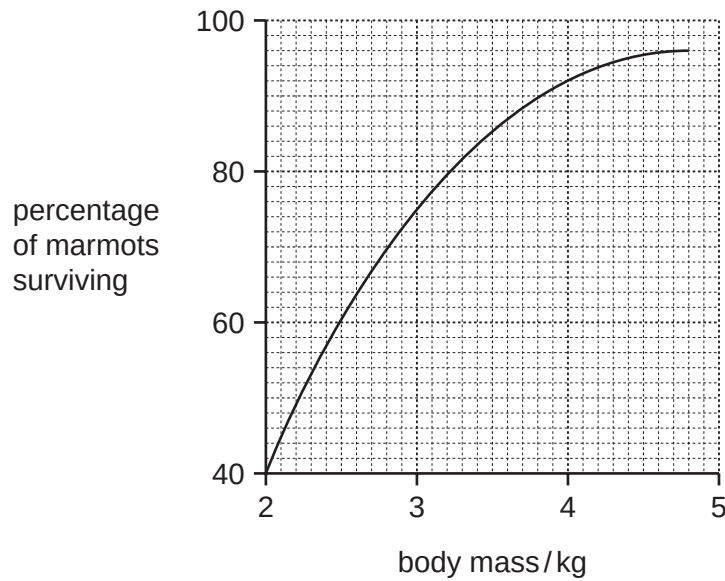


Fig. 3.2

- (i) Describe the relationship between a marmot's body mass and its chance of surviving the winter.

.....

 [2]

- (ii) Suggest how a layer of fat beneath the skin can help a marmot to keep warm during cold weather.

.....
 [1]

- (d) In the last twenty years, spring has been arriving earlier in the year in Colorado. This is a result of global warming.

Name **two** gases that contribute to global warming.

- 1
 2 [2]

- (e) Fig. 3.3 shows the mean body mass of the marmots on the first day of August (summer) between 1976 and 2006.

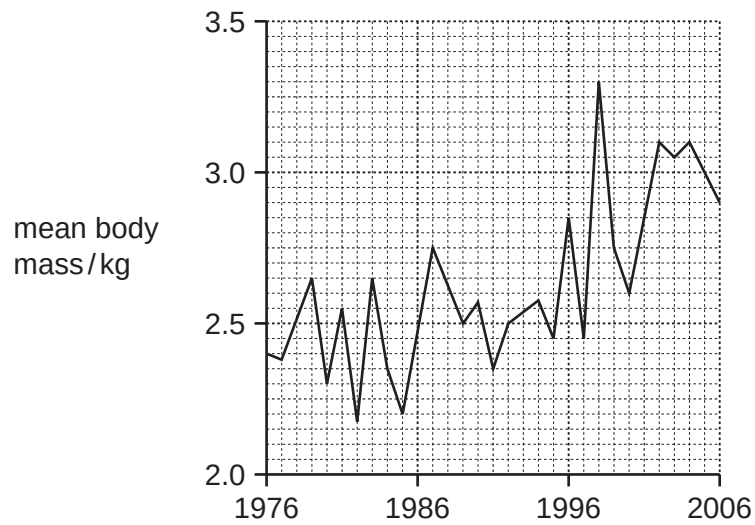


Fig. 3.3

- (i) Describe the general trend shown in Fig. 3.3.

.....
 [1]

- (ii) Suggest how the earlier arrival of spring could be responsible for this trend.

.....
 [1]

- 4 Fig. 4.1 shows some of the apparatus and substances a student used to investigate the rate of reaction between magnesium and dilute hydrochloric acid. In this reaction a gas is given off and bubbles up into the measuring cylinder.

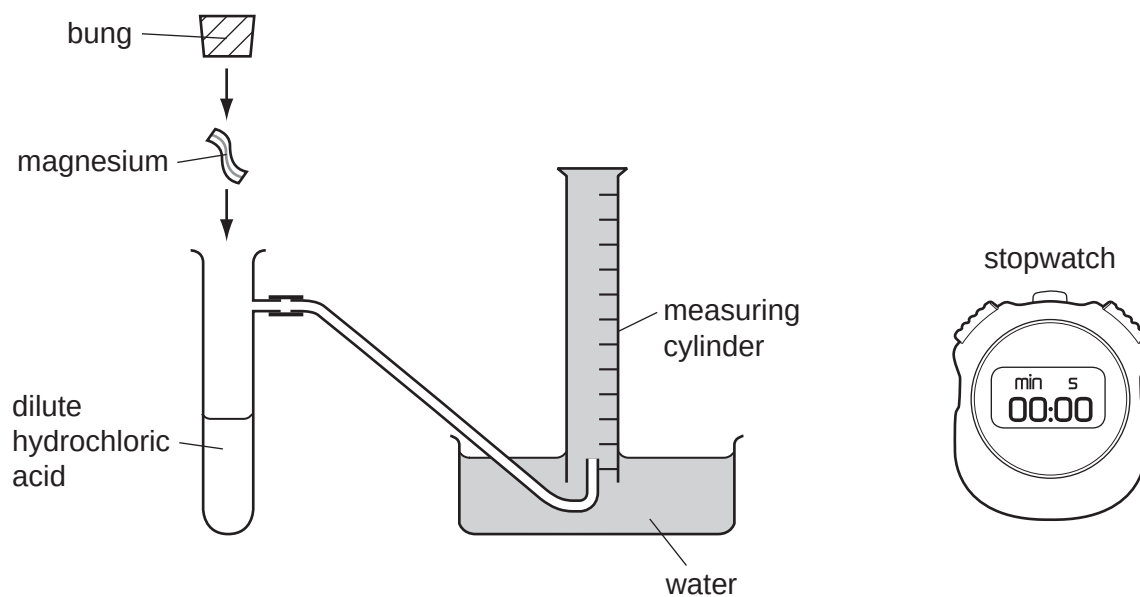


Fig. 4.1

- (a) Fig. 4.1 shows the apparatus just before the student started his experiment to measure the rate of reaction.

Describe briefly the method the student should use and the measurements he should make.

.....

.....

.....

..... [3]

- (b) The student carried out a second experiment using hydrochloric acid which **higher** concentration. All of the other variables which could affect the rate were the same as in the first experiment.

(i) State **one** of the other variables that the student kept constant.

..... [1]

(ii) Predict and explain briefly how the results the student obtained in the second experiment would be different from the first experiment.

.....

.....

..... [2]

- (c) The reaction between magnesium and dilute hydrochloric acid also produces the ionic compound magnesium chloride.

In crystals of this compound, **two** chloride ions combine with **one** magnesium ion.

(i) State **one** difference between a magnesium atom and a magnesium ion.

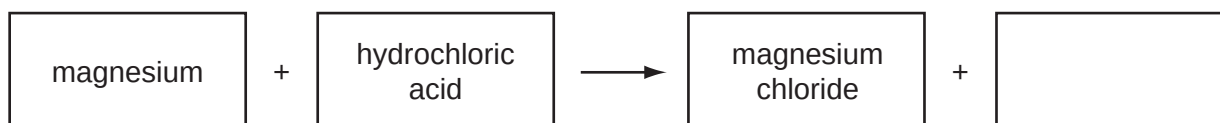
.....

..... [1]

(ii) State the chemical formula of magnesium chloride.

..... [1]

(iii) Complete the **word** chemical equation for the reaction between magnesium and hydrochloric acid.



[1]

- 5 (a) A bat produces a sound wave with a frequency of 212 kHz and a wavelength of 0.003 m.

- (i) This sound is outside the audible frequency range for humans.

State the approximate audible frequency range for humans.

..... Hz [1]

- (ii) State the meaning of the terms *frequency* and *wavelength*, when describing a wave. You may use a diagram if it helps your explanation.

frequency

.....
.....
.....

wavelength

.....
.....
.....

[2]

- (b) A girl shouts and waves to another girl in the school playground as shown in Fig.



Fig. 5.1

The sound energy and the light energy both travel from one girl to the other by wave motion.

- (i) Explain why sound waves will **not** travel through a vacuum.

..... [1]

- (ii) If the first girl now makes another sound with a smaller amplitude, what change would the second girl notice?

..... [1]

- (iii) The girls could have communicated with each other using their mobile phones (cell phones).

Name the type of electromagnetic wave used to communicate between mobile phones.

..... [1]

(c) Fig. 5.2 shows a ray of light passing through a rectangular glass block.

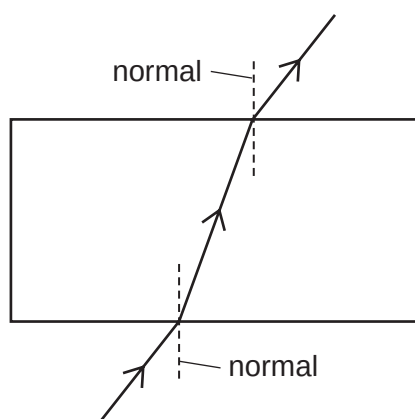


Fig. 5.2

On Fig. 5.2, label an angle of incidence, i , and an angle of refraction, r .

[2]

Please turn over for Question 6.

- 6 Fig. 6.1 shows part of a section across a root from a radish plant, photographed through a microscope.

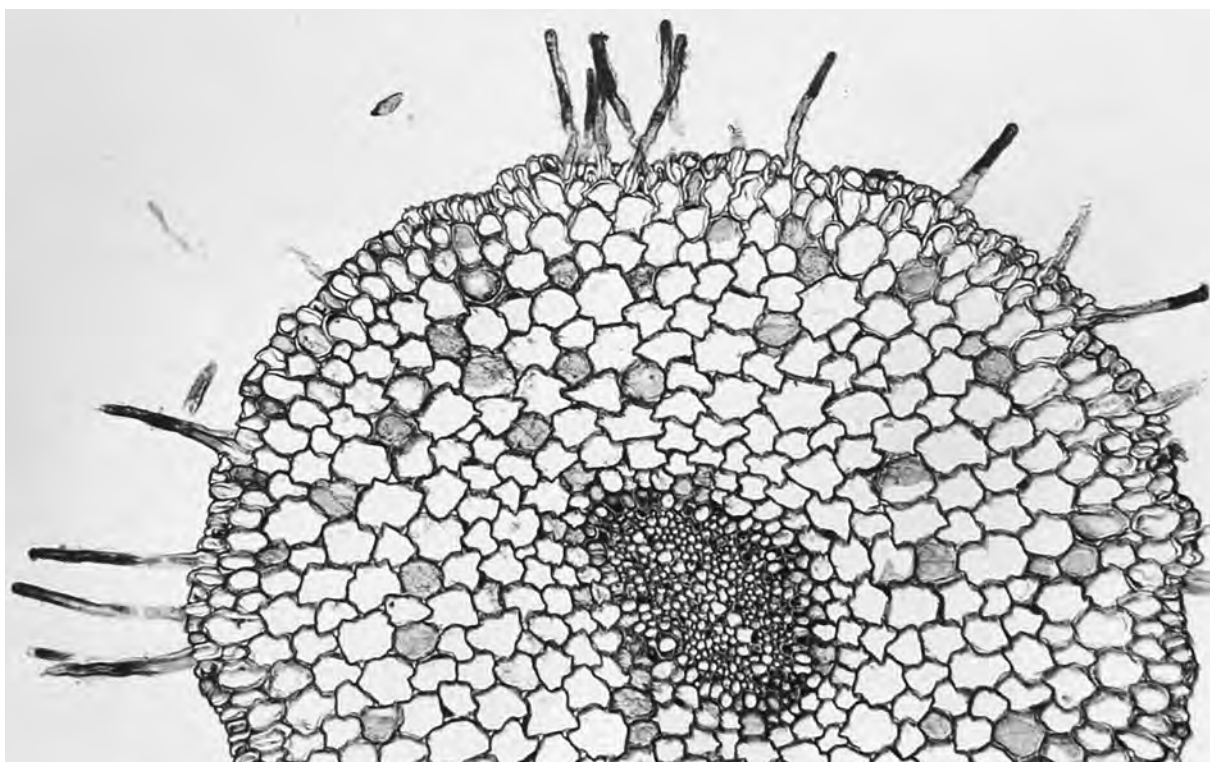


Fig. 6.1

- (a) On Fig. 6.1, use a label line to label a root hair cell. [1]

- (b) Root hair cells absorb substances from the soil.

Name **two** substances that root hair cells absorb from the soil.

1

2 [2]

- (c) A complete radish plant was placed with the lower part of the root standing in water. A soluble red dye was added to the water. After a while, the veins in the leaves of the radish plant became red.

- (i) Name the tissue in the radish plant through which the coloured water was transported from the roots to the leaves.

..... [1]

- (ii) On Fig. 6.1, write the letter **A** to show the position of this tissue in the root. [1]

- (d) (i) The cells in the radish root are plant cells.

Complete Table 6.1 to show which structures are present in plant cells and which are present in animal cells.

Use a tick (✓) to show that the structure is present. Use a cross (✕) to show that the structure is not present.

You should place either a tick or a cross in every space in the table.

Table 6.1

structure	plant cells	animal cells
cell membrane		
cell wall		
nucleus		
vacuole containing sap		

[4]

- (ii) Would you expect the cells in the radish root to contain chloroplasts?

Explain your answer.

.....

..... [1]

- 7 (a) A student investigated how the change in potential difference across a lamp affects the current flowing through it.

She used wires to connect the components shown in Fig. 7.1 to make a suitable circuit.

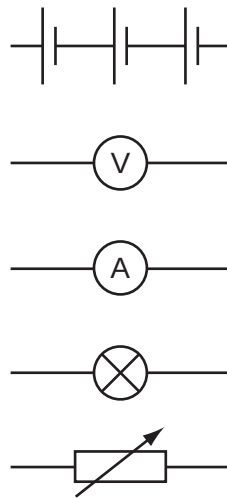


Fig. 7.1

- (i) Using the correct symbols from Fig. 7.1, draw a diagram to show the circuit she made.

[3]

- (ii) Explain why a variable resistor is used in this circuit.

.....
..... [1]

(b) A plastic rod is rubbed with a cloth. The rod becomes charged.

There are two types of electric charge.

(i) State the names of these types of charge.

1

2

[1]

(ii) Charged particles are transferred between the rod and cloth.

Name the charged particles transferred. [1]

(iii) Plastic is an example of an electrical insulator.

Name **one** material which is an electrical conductor.

..... [1]

- 8 The bar chart in Fig. 8.1 shows the approximate composition of unpolluted air.

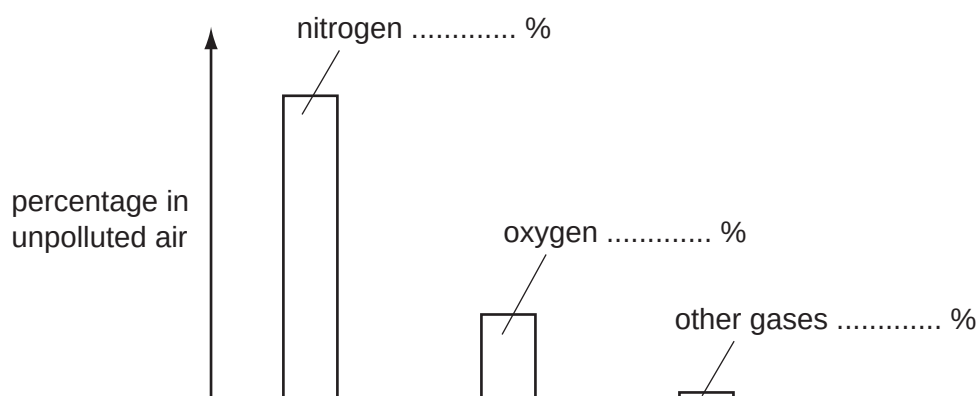


Fig. 8.1

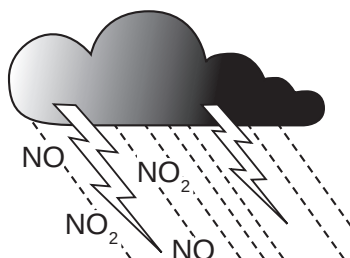
- (a) (i) Complete the bar chart in Fig. 8.1 by labelling the percentages of nitrogen, oxygen and other gases. [2]

- (ii) Name **one** of the **other gases** in Fig. 8.1 that exists in unpolluted air.

..... [1]

- (b) Nitrogen and oxygen exist in the air in the form of the diatomic molecules, N_2 and O_2 .

When lightning passes through the air, the gaseous compounds nitric oxide, NO , and nitrogen dioxide, NO_2 , are formed.



- (i) Explain why nitrogen and oxygen are described as chemical elements, but nitric oxide and nitrogen dioxide are described as compounds.

.....

.....

..... [2]

- (ii) Suggest the type of chemical bonding in nitric oxide and nitrogen dioxide.

Explain your answer briefly.

type of bonding

explanation

[2]

- (iii) Nitrogen dioxide dissolves and reacts with rainwater.

A student carried out an experiment to investigate what happened to the acidity of rainwater during a thunderstorm.

His results are shown in Table 8.1.

Table 8.1

description of sample	pH
pure water obtained in a science laboratory	7
rainwater collected when no thunderstorm was occurring	5
rainwater collected during a thunderstorm	4

What conclusions can the student make from these results?

.....

 [2]

- 9 (a) One of the characteristics of living organisms is sensitivity. This is the ability to respond to changes in the environment.

List **four** other characteristics of all living things.

- 1
- 2
- 3
- 4

[2]

- (b) Hormones help organisms to respond to changes in their environment.

(i) Name the hormone that is produced when a person is frightened.

..... [1]

(ii) State **two** effects of this hormone.

- 1
-
- 2
-

[2]

- (c) How are hormones transported around the body?

..... [1]

Copyright Acknowledgements:

Question 6 Photograph

© B23WP8 cross section of a radish root; Biodisc/Visuals Unlimited/Alamy.

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	0	
1 H Hydrogen 1																	
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	209 Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

*58-71 Lanthanoid series
†90-103 Actinoid series

a

X

b

a = relative atomic mass

X = atomic symbol

b = proton (atomic) number

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	144 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	232 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).