UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4837919311

CO-ORDINATED SCIENCES **0654/22**

Paper 2 (Core) **May/June 2012**

2 hours

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 28.

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	
10	
11	
12	
Total	

This document consists of **26** printed pages and **2** blank pages.

For Examiner's Use

1 **(a)** Most atoms of metallic elements found in the Earth's crust exist in compounds called 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.

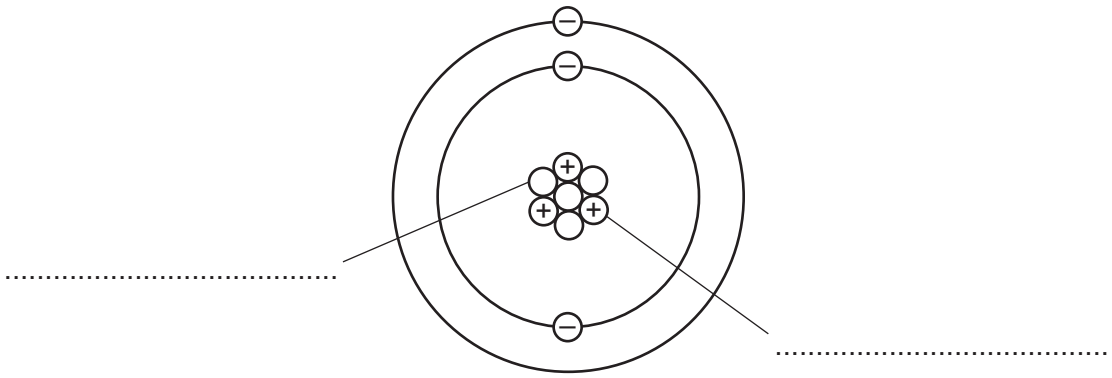
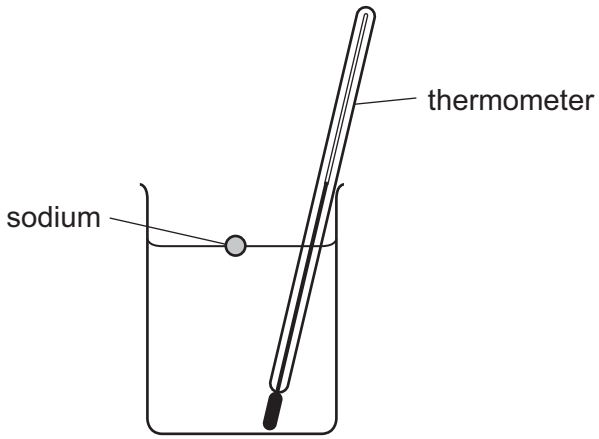


Fig. 1.1

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.

potassium	+	water	→		+	

[2]

For Examiner's Use

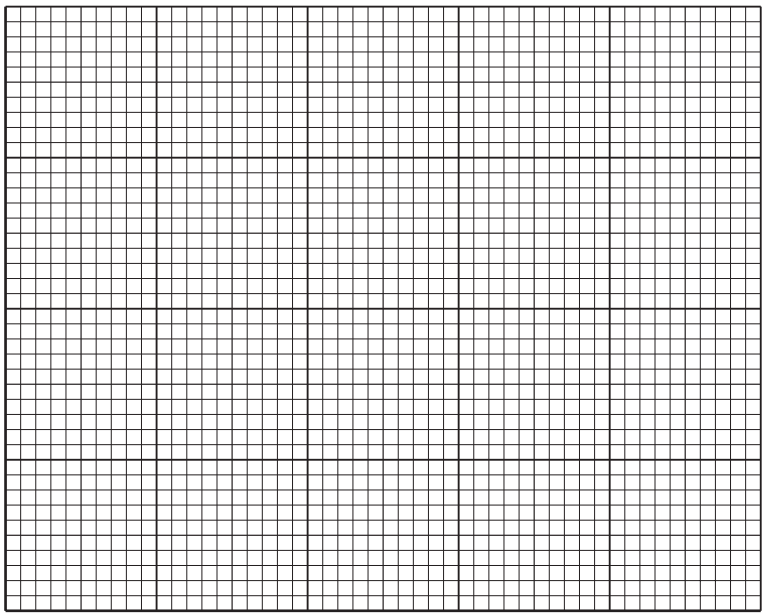
2 An athlete warms up by running along a race track.

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.

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



[4]

(b) He then competes in a 200 m race. He completes the race in 25 seconds.

Calculate his average speed.

State the formula that you use and show your working.

formula used

working

..... m / s [2]

For Examiner's Use

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

(i) Describe and explain, in terms of the movement of water molecules, how evaporation cools down the athlete.

.....

.....

.....

.....

..... [3]

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

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

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

.....

.....

..... [2]

(b) Fig. 3.1 shows the effect of pH on the activity of an enzyme.

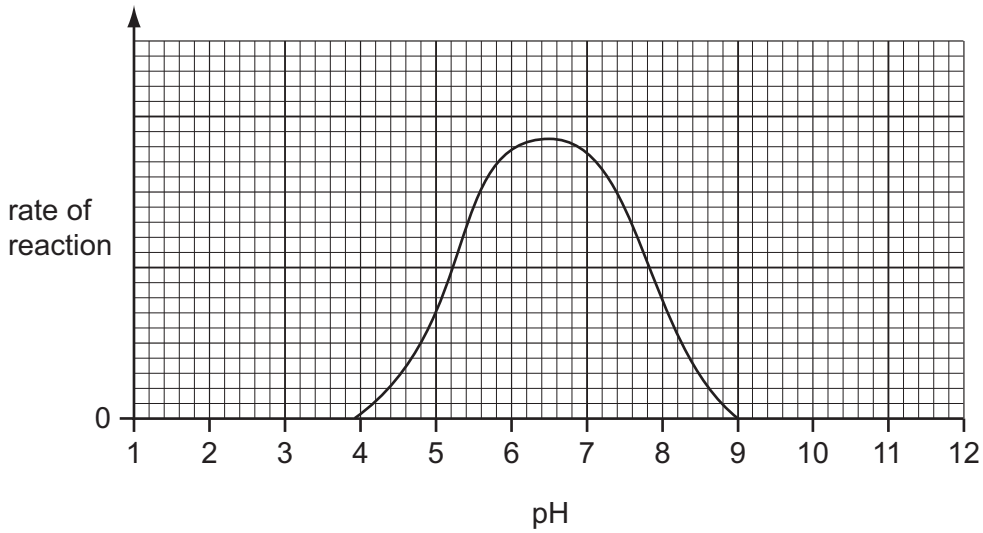


Fig. 3.1

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

.....

.....

..... [2]

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

(i) **On Fig. 3.1**, sketch a curve to show how pH affects the activity of this protease 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 protease enzyme stops working when it enters the duodenum.

.....

.....

..... [2]

For Examiner's Use

(iii) Name the substrate and product of a protease enzyme.

substrate .....

product ..... [2]

(iv) Explain how the activity of this enzyme makes it possible for body cells to obtain nutrients from the food inside the digestive system.

.....

.....

..... [2]

For Examiner's Use

4 **(a)** A car tyre is inflated with air.

Explain how the air molecules in the tyre exert a pressure on the wall of the tyre.

.....

.....

..... [2]

(b) Many forces act on a car tyre during a car journey.

State **three** effects that forces can have on an object.

1 .....

2 .....

3 .....

[2]

(c) Fig. 4.1 shows a car travelling in a straight line. The car is decelerating (slowing down).

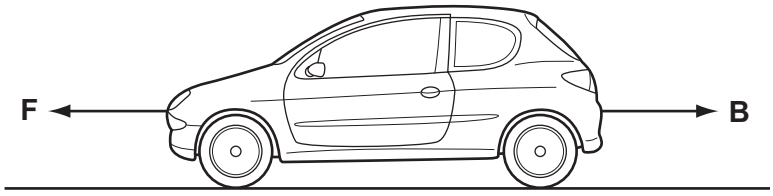


Fig. 4.1

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]

For Examiner's Use

(d) 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]

(e) Car brake lights (stop lights) light up when the driver presses on the footbrake pedal. The pedal acts as a switch.

Draw a circuit diagram including a battery to show how this works.

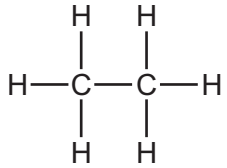
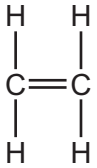
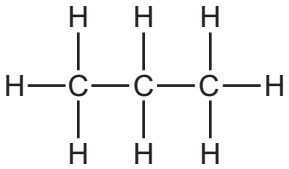
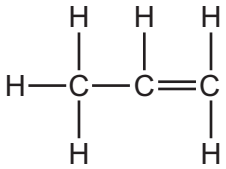
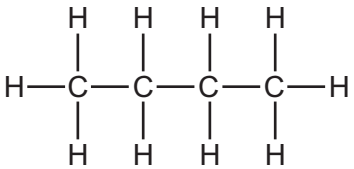
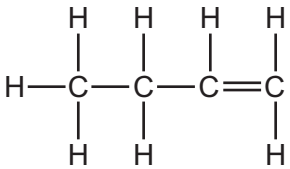
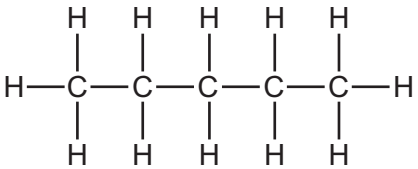
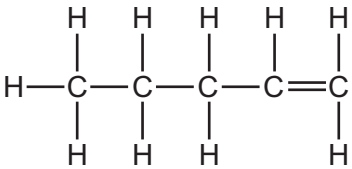
Design your circuit so that if one brake light fails, the other still lights up.

[4]

5 In hydrocarbons, carbon atoms are joined in chains of various lengths.

Table 5.1 shows information about some hydrocarbons.

Table 5.1

alkanes		alkenes
molecular structure	**boiling point / °C**	**molecular structure**
	–87	
	–42	
	0	
	36	

(a) Table 5.1 contains examples of both saturated and unsaturated hydrocarbons.

(i) Fig. 5.1 shows a simplified diagram of the industrial process used to produce unsaturated hydrocarbons.

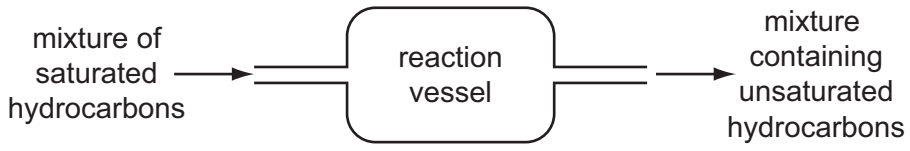


Fig. 5.1

State the name of this process. ..... [1]

For Examiner's Use

(ii) The reaction in **(i)** requires a catalyst.

State the meaning of the term *catalyst*.

.....

.....

..... [2]

(iii) Describe a chemical test that is used to show whether a hydrocarbon is saturated or unsaturated.

.....

.....

..... [2]

(b) The alkanes in Table 5.1 occur naturally in deposits of petroleum (crude oil) and natural gas.

Petroleum is separated into simpler mixtures by fractional distillation at an oil refinery.

(i) Fractional distillation relies on differences in the boiling points of hydrocarbons.

Describe the trend in boiling point shown by the alkanes in Table 5.1.

.....

..... [1]

(ii) Refinery gas is a useful fraction obtained from petroleum.

State **one** use for refinery gas.

..... [1]

(iii) Gasoline is a mixture of hydrocarbons that is used as car fuel.

When gasoline is burned in car engines one of the waste gases (exhaust gases) is carbon monoxide.

Describe briefly how carbon monoxide is formed in a car engine and explain why this gas is considered to be a serious air pollutant.

.....

.....

..... [2]

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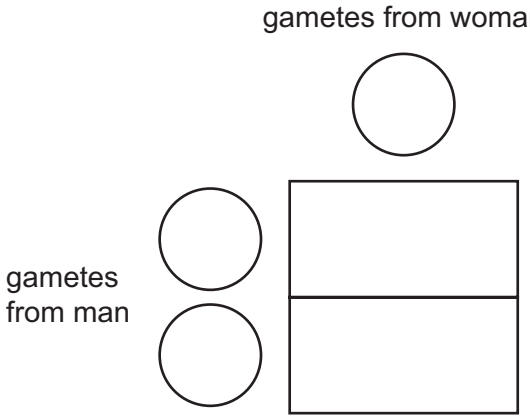
For Examiner's Use

6 **(a)** Each time a human child is born, there is an equal chance that it will be a boy or a girl.

Complete the genetic diagram to explain why.

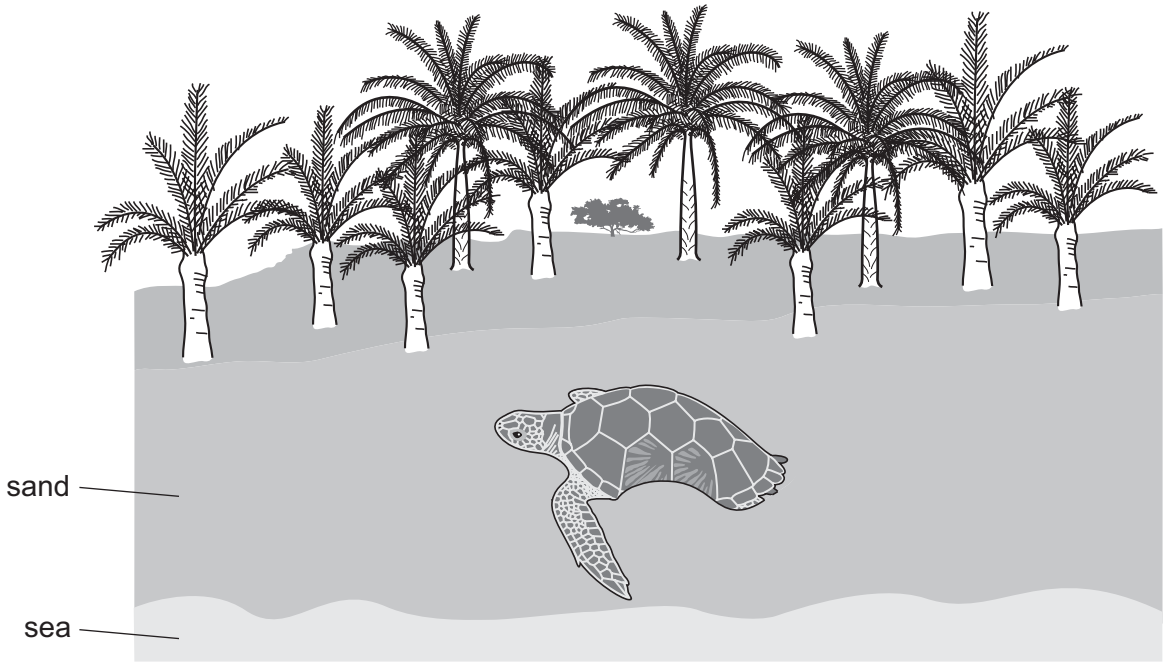
sex of parents	female	male
genotype of parents	XX	.....
gametes	○	○ and ○



[3]

For Examiner's Use

(b) Hawksbill turtles are an endangered species. They lay their eggs in nests in the sand on a 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.

(i) 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. 6.1. The tops of the bars represent the mean temperature.

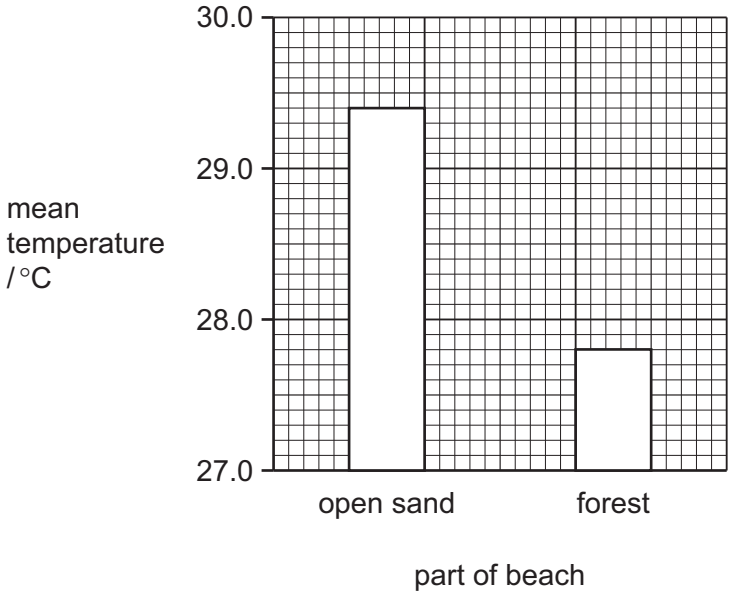


Fig. 6.1

With reference to Fig. 6.1, describe the effect of the presence of trees on the temperature of the sand.

.....

.....

..... [2]

(ii) 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 6.1.

Table 6.1

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. 6.1 to explain the results for nests in open sand and in forest, shown in Table 6.1.

.....

.....

..... [2]

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

.....

.....

..... [2]

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

1 .....

.....

2 .....

.....

[2]

For Examiner's Use

7 **(a)** The three types of nuclear radiation are alpha, beta and gamma. They can be identified by their different penetrating powers. Alpha radiation cannot penetrate paper.

Explain how you could identify beta and gamma radiations by their penetrating powers.

beta radiation .....

.....

gamma radiation .....

..... [2]

(b) Gamma radiation is an electromagnetic wave with a short wavelength.

Explain the meaning of the term *wavelength*. You may draw a diagram if it helps your answer.

.....

..... [2]

(c) Radon is a gas that emits alpha radiation.

Explain why alpha radiation is dangerous to human beings.

.....

.....

..... [2]

For Examiner's Use

8 Water supplies are often impure and have to be purified to make them safe for humans to 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 helps to purify 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]

For Examiner's Use

(c) Table 8.1 shows information about water and two compounds that can form mixtures with water.

Table 8.1

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 8.1 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 was given some small pieces of two solid elements. One of these elements was a metal and the other was a non-metal.

The student burned the samples in air, using the apparatus shown in Fig. 8.1. The oxide of each element was produced.

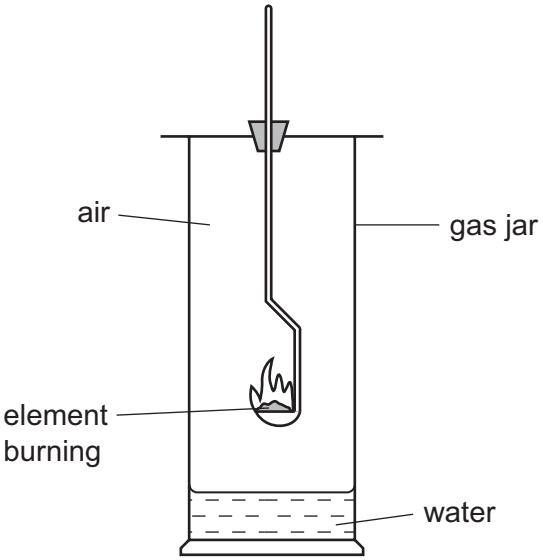


Fig. 8.1

(i) One of the oxides was a solid at room temperature and the other was a gas.

State and explain, in terms of the type of chemical bonding involved, which oxide was a solid.

type of element whose oxide was solid .....

explanation .....

.....

..... [2]

(ii) The student also found that both of the oxides dissolved and reacted with the water in the bottom of the gas jar.

State and explain the colour of full range indicator (Universal Indicator) when a few drops are added to the solution formed by the oxide of the metal.

colour .....

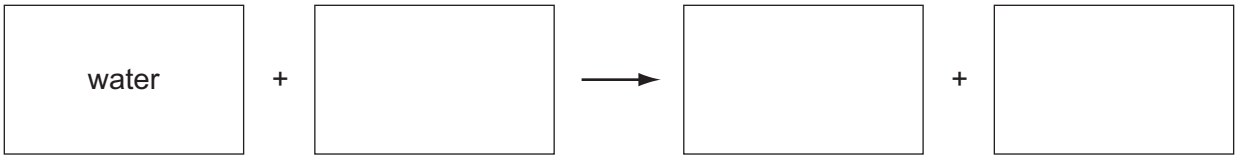
explanation .....

.....

..... [2]

[Turn over

9 **(a)** Complete the word equation for photosynthesis.



[2]

(b) Fig. 9.1 is a photograph of a cross-section of a leaf, taken through a microscope.

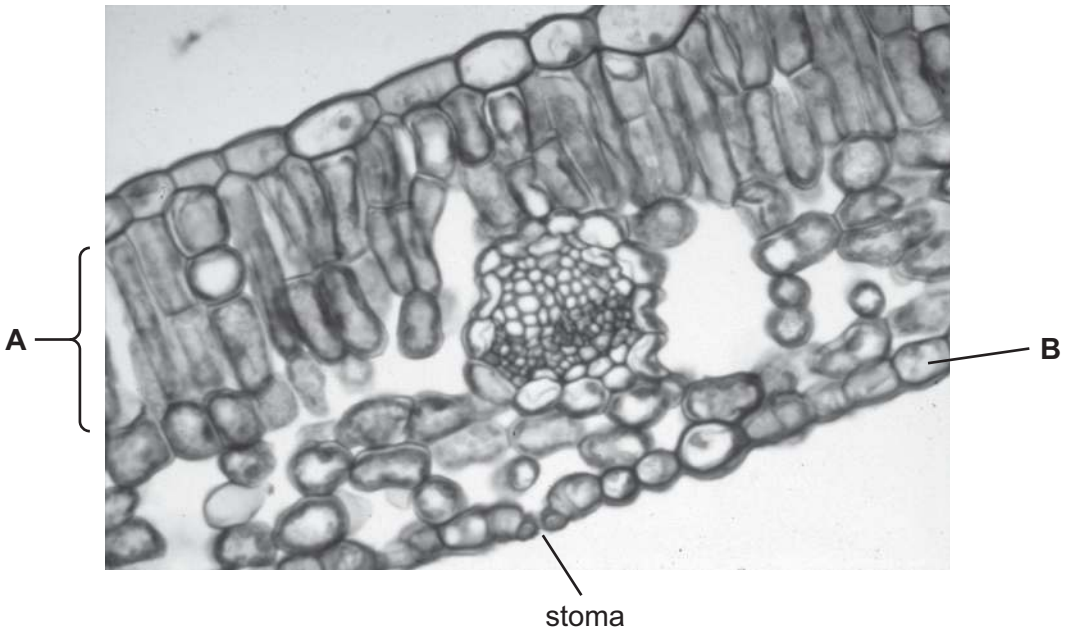


Fig. 9.1

Name the parts of the leaf labelled **A** and **B**.

A .....

B ..... [2]

(c) There are small gaps in the lower surface of the leaf, called stomata.

Explain the role of stomata in photosynthesis.

.....

.....

..... [2]

(d) Stomata allow water vapour to diffuse out of the leaf.

State the correct term for the loss of water vapour from a leaf.

..... [1]

(e) Plants that live in hot, dry deserts often have fewer stomata than plants that live in places where there is plenty of water.

Suggest how this helps the desert plants to survive.

.....

..... [1]

(f) Most leaves have stomata on their lower surfaces.

Plants that live in water, with leaves that float on the water, often have stomata on the upper surface of their leaves.

Suggest how this helps the water plants to survive.

.....

.....

..... [2]

(g) Plants must have a good supply of magnesium ions, in order to grow well.

State why they need magnesium ions.

.....

..... [1]

[Turn over

For Examiner's Use

10 (a) Radio waves are electromagnetic waves. Sound waves are not.

State **three** other ways in which radio waves differ from sound waves.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(b) Draw lines to connect each type of radiation to its use.

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

[3]

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

For Examiner's Use

He stood 500 m from the bell.

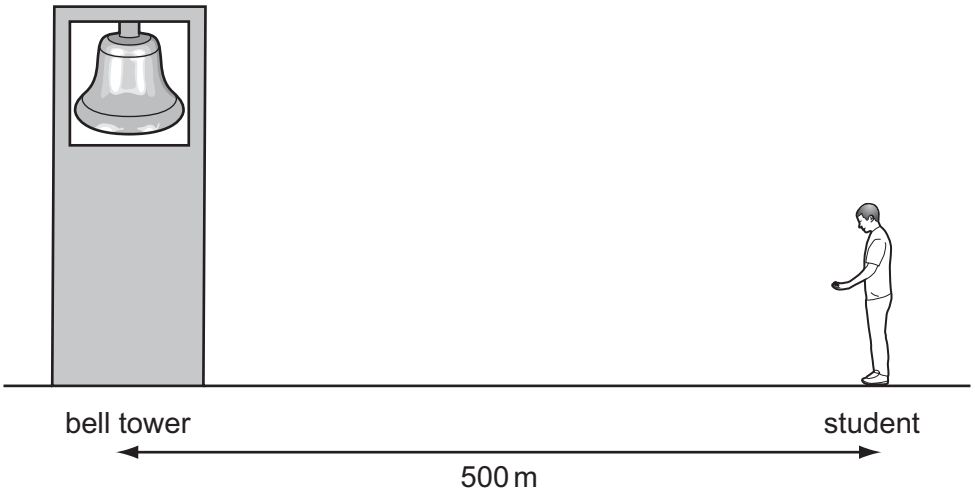


Fig. 10.1

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

Calculate the speed of sound.

State the formula that you use and show your working.

formula used

working

..... m / s [2]

(d) 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]

11 Fig. 11.1 shows apparatus a student used to investigate temperature changes that occurred during chemical reactions.

For Examiner's Use

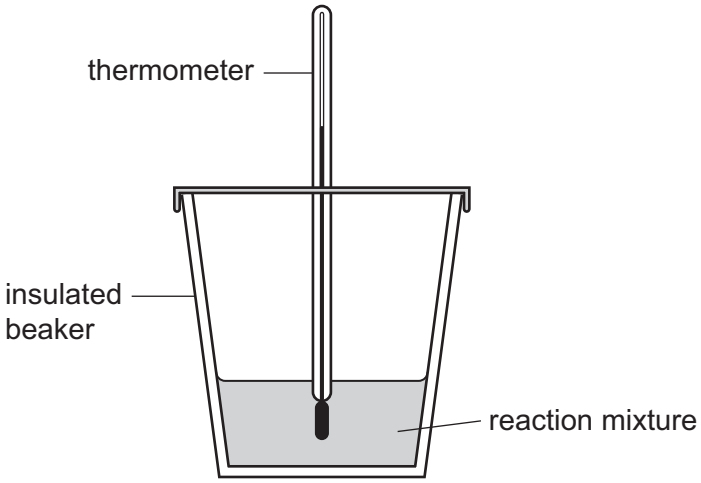


Fig. 11.1

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 11.1 contains the results the student obtained.

Table 11.1

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]

For Examiner's Use

(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. 11.1 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]

(c) When reactive metals are added to dilute acid, the metal reacts and dissolves and a gas is given off. Unreactive metals do **not** dissolve in acid.

(i) Name the gas that is given off, and describe how you would test for this gas.

gas .....

test .....

..... [2]

(ii) A student has a mixture of powdered zinc and powdered copper.

Suggest and explain how the student could use some dilute hydrochloric acid and usual laboratory apparatus to obtain some copper from this mixture.

.....

.....

.....

.....

..... [3]

12 (a) Define the term *respiration*.

.....

.....

..... [2]

(b) Complete Table 12.1 to show the approximate percentages of oxygen, carbon dioxide and nitrogen in inspired and expired air.

Table 12.1

gas	percentage in inspired air	percentage in expired air
oxygen	21	
carbon dioxide		4
nitrogen		

[3]

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

.....

.....

..... [2]

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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
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	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**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	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

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

Key

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).