



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

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COMBINED SCIENCE

0653/31

Paper 3 (Extended)

October/November 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	
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5	
6	
7	
8	
9	
Total	

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



- 1 (a) Complete Table 1.1 by choosing one of the words from the list to match statement.

ammeter ampere circuit electron
ohm volt voltmeter watt

Table 1.1

statement	word
a complete loop of conductors	
a particle with a negative electrical charge	
an instrument that measures potential difference	
the unit of power	

[2]

- (b) Fig. 1.1 shows two circuits, **A** and **B**. All the lamps and both cells are the same.

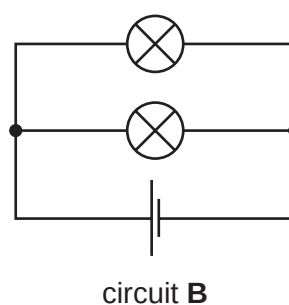
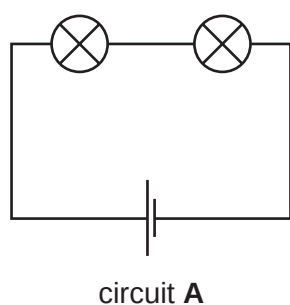


Fig. 1.1

- (i) One lamp is unscrewed from circuit **A**.

State what happens to the other lamp.

Explain your answer.

.....

 [1]

- (ii) Explain why lights in a house are connected as in circuit **B** and **not** as in circuit **A**.

.....

 [2]

- (iii) The resistance of each lamp is $1.2\ \Omega$.

Calculate the combined resistance of the two lamps in circuit **B**.

State the formula that you use and show your working.

formula used

working

..... [3]

- 2 (a) Fig. 2.1 shows part of the carbon cycle.

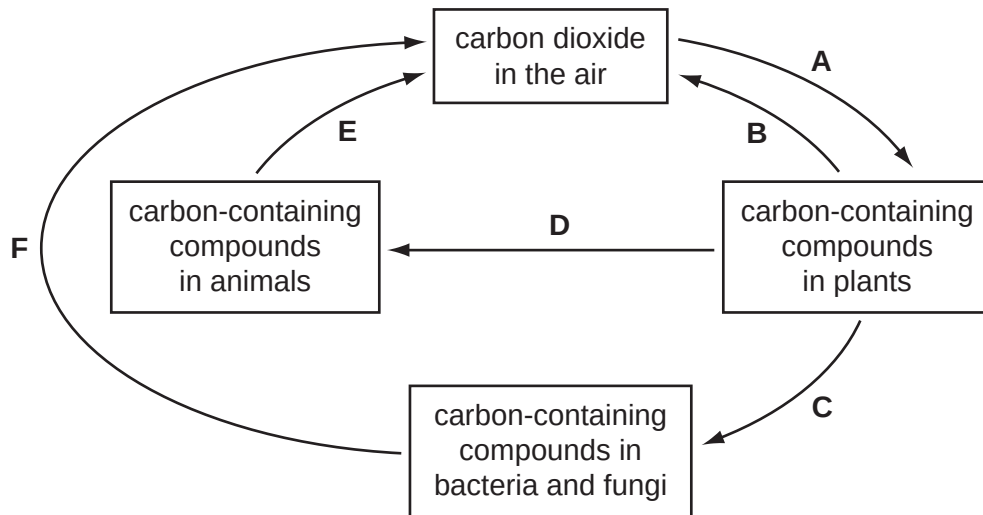


Fig. 2.1

- (i) State the letter or letters, **A**, **B**, **C**, **D**, **E** or **F**, that represent

photosynthesis, ...

respiration.

[2]

- (ii) Name **one** carbon-containing compound in plants.

..... [1]

- (b) Earthworms play an important part in the carbon cycle. They are decomposers.

Describe the role of decomposers in the carbon cycle.

.....

.....

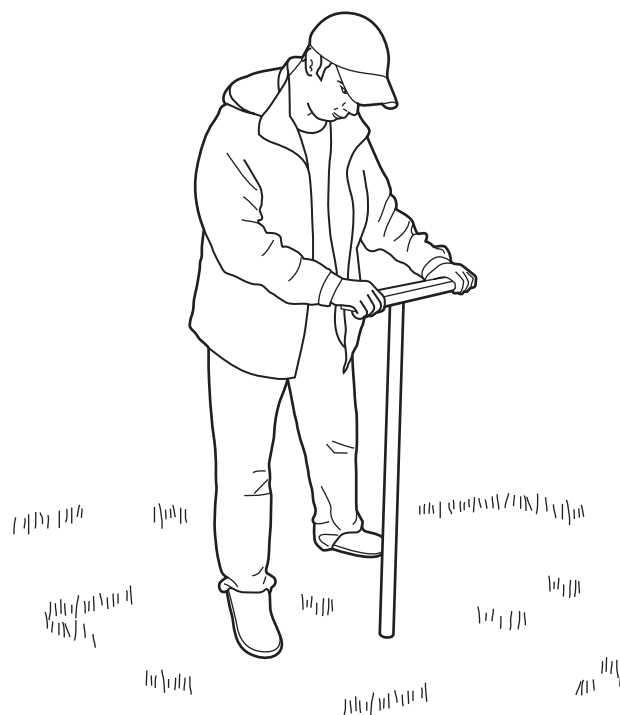
.....

..... [2]

(c) In Florida, USA, some people collect earthworms by vibrating the soil.

A wooden post is pushed into the ground, and then a heavy object is pulled across the top of the post to make it vibrate. The vibrations travel through the soil.

Earthworms respond to the vibrations by crawling out of their burrows onto the soil surface, where they can be caught.



A student investigated the effect of different frequencies of vibrations on the numbers of earthworms that emerged from the soil. Fig. 2.2 shows his results.

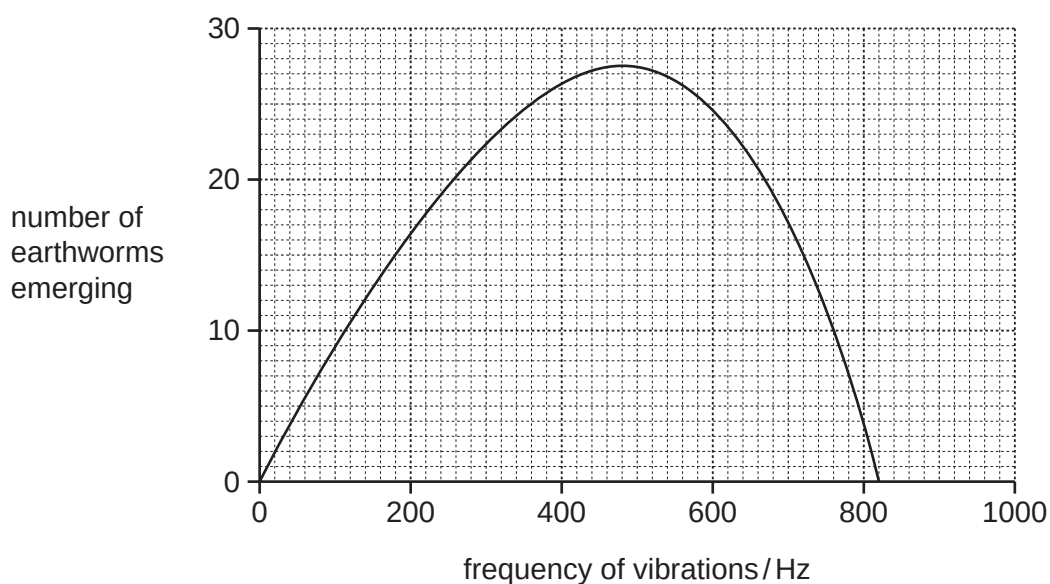


Fig. 2.2

- (i) Describe the effect of different frequencies of vibrations on the number of earthworms emerging.

.....

.....

.....

..... [2]

- (ii) Moles are predators that live underground and eat earthworms. When moles burrow through the ground, they produce vibrations of around 500 Hz.

Suggest how the response of earthworms helps them to survive.

.....

.....

.....

..... [2]

- 3 (a) Fig. 3.1 shows how a digital pH meter is used to measure the pH of some liquids.

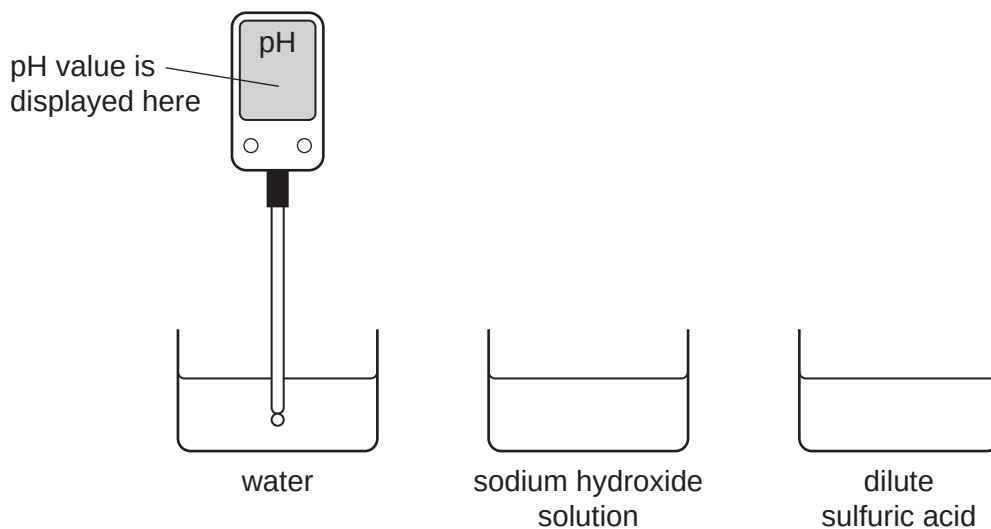


Fig. 3.1

- (i) Complete Table 3.1 by suggesting suitable pH values for the different liquids.

Table 3.1

liquid	pH
water	
sodium hydroxide solution	
dilute sulfuric acid	

[2]

- (ii) Suggest **one** advantage of using a digital pH meter rather than a piece of litmus paper to assess the acidity of an aqueous solution.

.....

..... [1]

- (iii) Dilute acids are aqueous solutions that contain dissolved ions.

Table 3.2 shows the names of the ions in two common acids.

Table 3.2

name of dilute acid	names of dissolved ions
hydrochloric acid	hydrogen ions and chloride ions
sulfuric acid	hydrogen ions and sulfate ions

A student is given an unlabelled beaker which is known to contain either dilute hydrochloric acid or dilute sulfuric acid.

Describe a chemical test that a student could use to find out whether or not the beaker contains hydrochloric acid.

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

- (b) Fig. 3.2 shows three experiments that a teacher set up to compare the reactivity of magnesium, copper and an unknown metal **G**.

In each experiment she heated a mixture of one metal and the oxide of a different metal. In each case there was an exothermic chemical reaction.

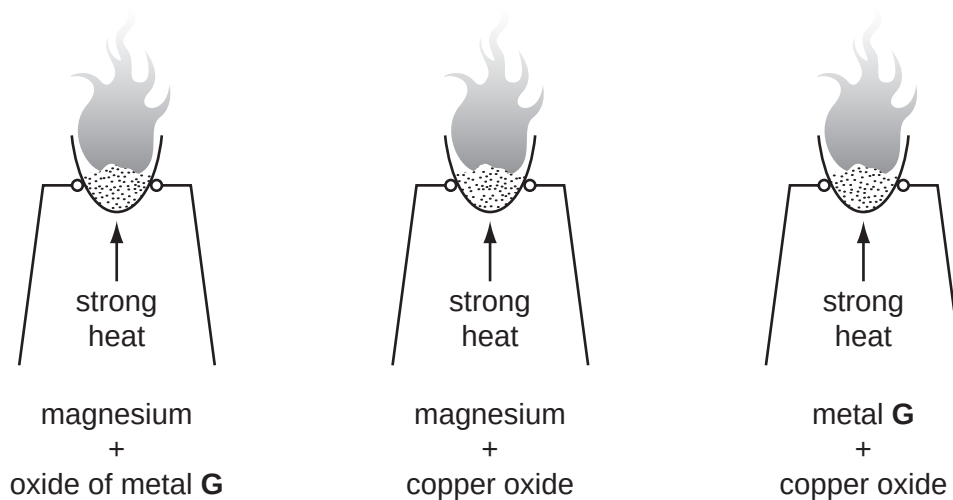


Fig. 3.2

- (i) Write a **word** chemical equation for the reaction between magnesium and copper oxide.

..... [1]

- (ii) Use the information in Fig. 3.2 to predict whether or not copper would react with the oxide of metal **G**.

Explain your answer.

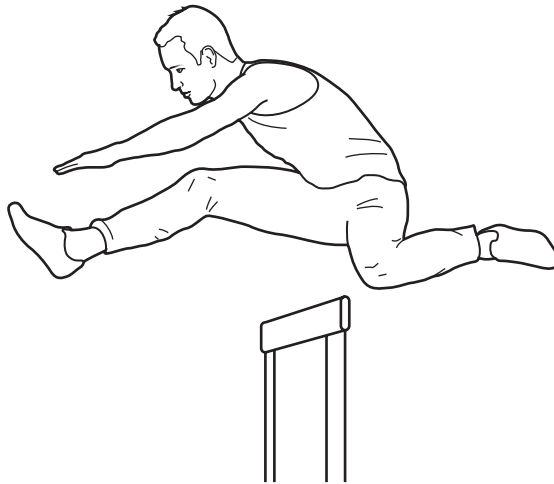
prediction

explanation

.....

..... [2]

- 4 (a) An athlete of mass 60 kg jumps 1.3 metres vertically.



Calculate the work done by the athlete to achieve this height.

State the formula that you use and show your working. The gravitational field strength of the Earth is 10 N/kg .

formula used

working

..... [3]

- (b) Using your answer to (a), state the gain in potential energy of the athlete when he jumps 1.3 metres.

..... [1]

- (c) The work done in jumping vertically was completed in 0.5 s.

Calculate the power developed.

State the formula that you use and show your working.

formula used

working

..... [2]

- 5 Fig. 5.1 shows apparatus that can be used to measure the rate of respiration of germinating seeds.

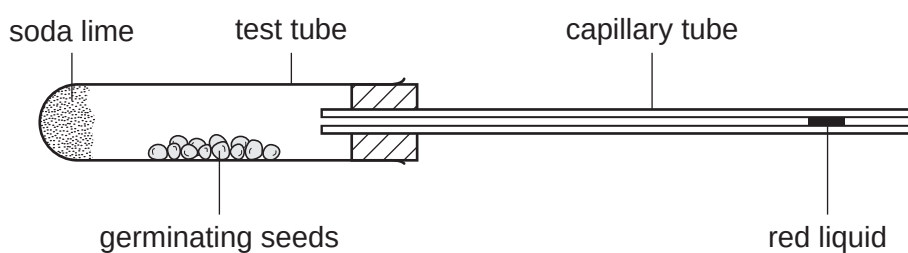


Fig. 5.1

The soda lime absorbs carbon dioxide from the air inside the apparatus.

- (a) As the seeds respire, they use oxygen. This reduces the volume of gas inside the apparatus. The faster they respire, the faster the red liquid moves towards the left.

- (i) Write the balanced equation for aerobic respiration.

..... [2]

- (ii) Use the equation to explain why the liquid would **not** move if there was **no** soda lime in the apparatus.

.....

 [2]

- (b) An experiment was carried out to investigate the effect of temperature on the respiration of the germinating seeds.

Four sets of the apparatus shown in Fig. 5.1 were set up and labelled **A**, **B**, **C** and **D**. Each set of apparatus contained either germinating or dead seeds.

The distance moved by the red liquid in five minutes was measured for each set.

The results are shown in Table 5.1.

Table 5.1

set	contents	temperature / °C	distance moved by red liquid in 5 minutes / mm
A	germinating seeds	0	3
B	germinating seeds	10	6
C	germinating seeds	20	12
D	dead seeds	20	0

- (i) Explain why it was important to include set **D** in the experiment.

.....

 [1]

- (ii) With reference to Table 5.1, describe the effect of temperature on the rate of respiration of germinating seeds.

.....

 [2]

- (iii) Predict and explain the results you would expect if the apparatus was set up with germinating seeds at a temperature of 60 °C.

predicted results
 explanation

 [2]

- 6 Some types of firework are made by filling a cardboard tube with firework mixture. The mixture is made from several solid substances which have been powdered and mixed together.

Fig. 6.1 shows a typical firework.

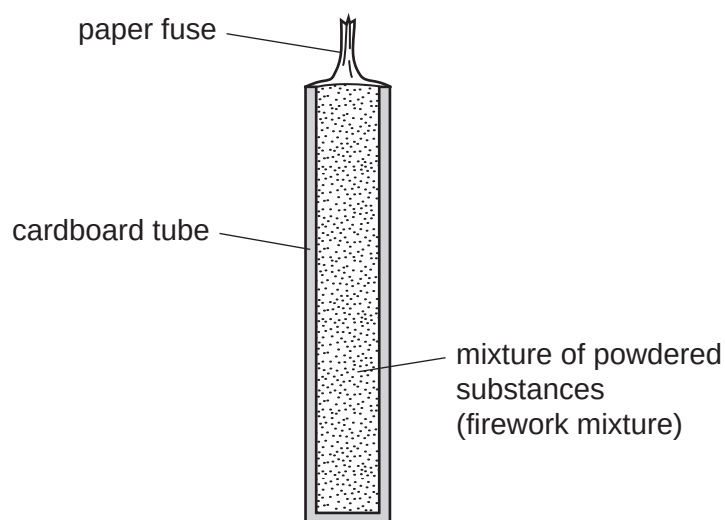


Fig. 6.1

When the paper fuse is lit, exothermic chemical reactions occur inside the firework.

- (a) Explain, in terms of rate of reaction, why firework mixture is a powder.

.....

.....

..... [2]

- (b) Some firework mixtures contain aluminium which is oxidised to produce the compound, aluminium oxide.

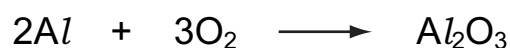
- (i) The electron configuration of an aluminium **atom** is **2,8,3** and of an oxygen **atom** is **2,6**.

Explain how aluminium and oxygen atoms become strongly bonded when they react to form aluminium oxide. You may draw some diagrams to help your explanation.

.....

 [4]

- (ii) A student suggested the symbolic equation below for the formation of aluminium oxide.



State and explain whether or not this equation is balanced.

.....

 [2]

- (c) The firework mixture contained in the firework in Fig. 6.1 contains the compound potassium perchlorate, $KClO_4$.

When potassium perchlorate is heated, a colourless gas is given off which re-lights a glowing splint.

Suggest why the firework mixture needs to contain potassium perchlorate.

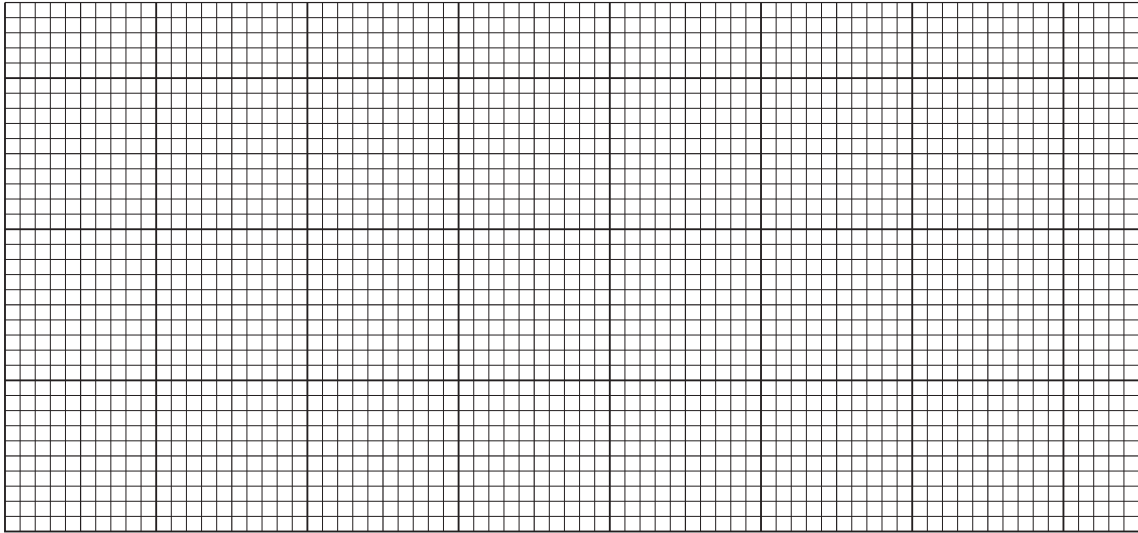
.....

.....

..... [2]

- 7 (a) On the grid below, draw a wave with an amplitude of 2 cm and a wavelength of 4 cm.

On your diagram, clearly label the amplitude and the wavelength.



[3]

- (b) (i) Two sound waves, **A** and **B**, have the same frequency. **A** has a greater amplitude than **B**.

What difference would you hear?

..... [1]

- (ii) Two sound waves, **X** and **Y**, have the same amplitude. **X** has a greater frequency than **Y**.

What difference would you hear?

..... [1]

- (iii) The speed of sound was calculated for sound passing through a solid, a liquid, a gas and a vacuum.

The values recorded were

0 m/s 330 m/s
1500 m/s 5000 m/s.

Write the values in the correct boxes in Table 7.1.

Table 7.1

	<u>speed of sound</u> m/s
vacuum	
solid	
liquid	
gas	

[2]

- (iv) Sound travels through the air by a series of compressions and rarefactions.

Explain what is meant by *compressions* and *rarefactions*. You may use a diagram to help your explanation.

.....

.....

..... [2]

- (c) Energy travels to the Earth from the Sun.

State whether this transfer of energy is by conduction, convection or radiation.

Explain your answer.

.....

.....

..... [2]

- (d) Light is able to travel down optical fibres by total internal reflection.

Complete the diagram to show how the ray of light passes down the optical fibre.



[2]

- 8 Fig. 8.1 shows the male reproductive system.

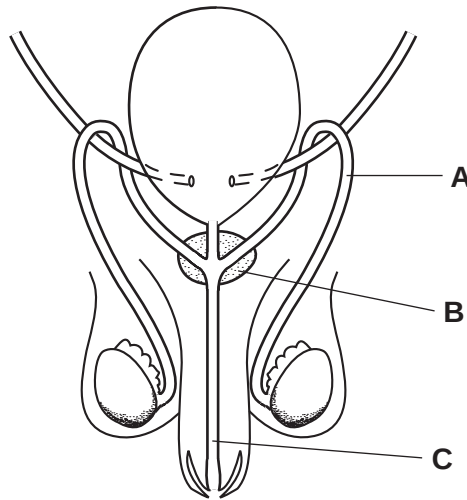


Fig. 8.1

- (a) (i) State the functions of parts **A**, **B** and **C**.

A

B

C [3]

- (ii) On Fig. 8.1, use a label line and the letter **S** to indicate where male gametes are made. [1]

- (b) Describe **two** ways in which human male gametes differ from human female gametes.

1

2 [2]

- (c) HIV is the virus that causes AIDS. HIV can be passed from one person to another during sexual intercourse.

Outline how HIV affects the immune system of a person with HIV/AIDS.

.....

.....

.....

..... [2]

- 9 (a) (i) Methane and ethane are hydrocarbons found in fossil fuels.

Complete the structures of molecules of methane and ethane that have been started below.

methane	ethane
H—C	H—C

[2]

- (ii) Methane and ethane are found in refinery gas, which is an important product obtained from petroleum (crude oil).

State **one** use for refinery gas.

[1]

- (b) Draw **three** straight lines to connect each process or reaction in the left hand column with its meaning in the right hand column.

term	meaning
catalytic cracking	exothermic oxidation of hydrocarbons
fractional distillation	reaction that produces alkenes
combustion	process that simplifies a complex mixture

[2]

- (c) Decane is a colourless liquid compound which has the chemical formula, $C_{10}H_{22}$.

Fig. 9.1 shows apparatus that a teacher used to show what happens when decane vapour is passed over a hot catalyst.

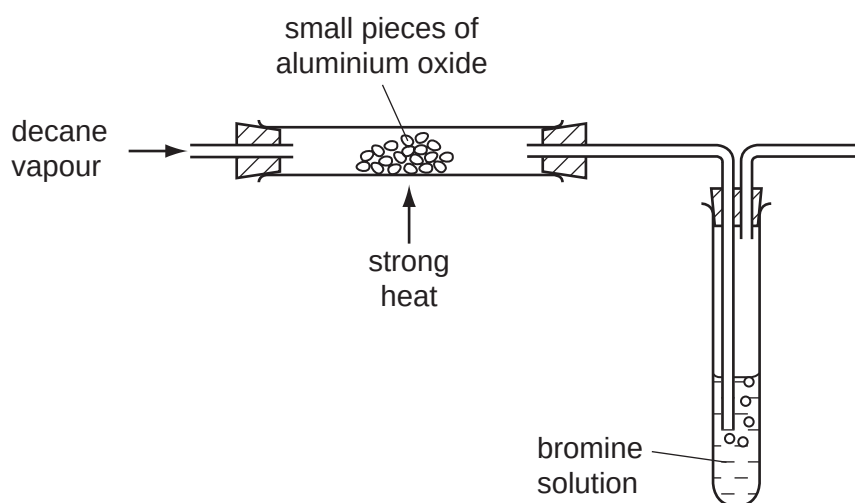


Fig. 9.1

When the teacher started to pass the decane vapour through the apparatus, the solution of bromine rapidly changed colour from orange to colourless.

- (i) Suggest and explain why the bromine solution changed from orange to colourless.

.....

.....

.....

.....

..... [3]

- (ii) Suggest why the catalyst was heated.

.....

..... [1]

DATA SHEET
The Periodic Table of the Elements

Group																			
I	II								III	IV	V	VI	VII	0					
1 H Hydrogen															4 He Helium				
															2				
7 Li Lithium	9 Be Beryllium											11 B Boron	12 C Carbon	14 N Nitrogen	16 O Oxygen	19 F Fluorine	20 Ne Neon		
23 Na Sodium	24 Mg Magnesium											27 Al Aluminium	28 Si Silicon	31 P Phosphorus	32 S Sulfur	35.5 Cl Chlorine	40 Ar Argon		
39 K Potassium	40 Ca Calcium	45 Sc Scandium	48 Ti Titanium	51 V Vanadium	52 Cr Chromium	55 Mn Manganese	56 Fe Iron	59 Co Cobalt	59 Ni Nickel	64 Cu Copper	65 Zn Zinc	70 Ga Gallium	73 Ge Germanium	75 As Arsenic	79 Se Selenium	84 Kr Krypton			
85 Rb Rubidium	88 Sr Strontium	89 Y Yttrium	91 Zr Zirconium	93 Nb Niobium	96 Mo Molybdenum	101 Ru Ruthenium	101 Rh Rhodium	103 Pd Palladium	106 Ag Silver	108 Cd Cadmium	112 In Indium	115 Sn Tin	119 Sb Antimony	122 Te Tellurium	127 I Iodine	131 Xe Xenon			
133 Cs Caesium	137 Ba Barium	139 La Lanthanum	178 Hf Hafnium	181 Ta Tantalum	184 W Tungsten	186 Re Rhenium	190 Os Osmium	192 Ir Iridium	195 Pt Platinum	197 Au Gold	201 Hg Mercury	204 Tl Thallium	207 Pb Lead	209 Bi Bismuth	85 At Astatine	86 Rn Radon			
Fr Francium	Ra Radium	226 Ac Actinium																	
58-71 Lanthanoid series																	175 Lu Lutetium		
90-103 Actinoid series																	169 Tm Thulium	173 Yb Ytterbium	103 Lr Lawrencium
Key	X	a	a = relative atomic mass														102 No Nobelium		
		b	X = atomic symbol b = proton (atomic) number														101 Md Mendelevium		

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



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COMBINED SCIENCE

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



- 1 Fig. 1.1 shows a red blood cell and a root hair cell.

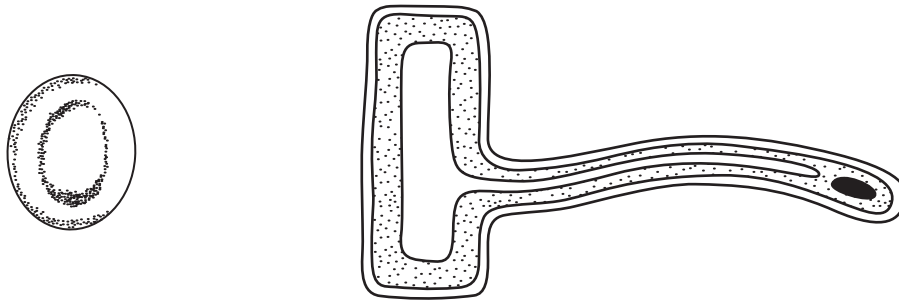


Fig. 1.1

- (a) Name the red protein found in the cytoplasm of the red blood cell.

..... [1]

- (b) (i) State the function of a root hair cell.

..... [1]

- (ii) Explain how the root hair cell is adapted to carry out this function.

.....

 [2]

- (c) Fig. 1.2 shows a plant with its roots in a beaker of water containing a blue dye.

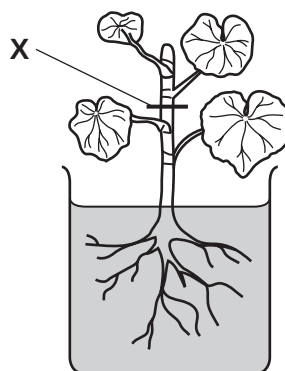


Fig. 1.2

After 10 minutes, the stem of the plant was cut across at **X**. Fig. 1.3 shows the appearance of the cut stem seen through a microscope.

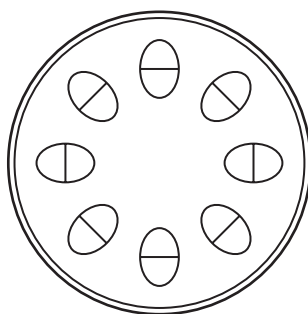


Fig. 1.3

(i) On Fig. 1.3, use a pencil to shade all of the parts that would look blue. [1]

(ii) The blue dye eventually reached the leaves of the plant. The following parts of the plant all became blue.

- A** leaf mesophyll cells
- B** xylem cells
- C** root hair cells

List the letters in order, to show the sequence in which the cells would become blue.

first to become blue

.....

last to become blue [1]

(iii) Describe how water is lost from the leaves of plants.

.....

.....

.....

..... [3]

- 2 (a) In 2002 some research scientists claimed that they had produced a tiny amount of a new element that had a proton number of 118.

The scientists predicted that this element should be placed in Period 7 and Group 0 of the Periodic Table.

State the total number of electrons and the number of electron shells (energy levels) in one atom of this element.

total number of electrons

number of electron shells

[2]

- (b) The halogens are reactive elements found in Group 7 of the Periodic Table.

Halogens combine vigorously with the alkali metals from Group 1 to form colourless ionic compounds. The halogens and alkali metals from Periods 2 to 5 are shown in Fig. 2.1.

Li	F
Na	Cl
K	Br
Rb	I

Fig. 2.1

- (i) A student has a colourless solution which he knows is either potassium bromide or potassium iodide.

The student adds chlorine solution as shown in Fig. 2.2.

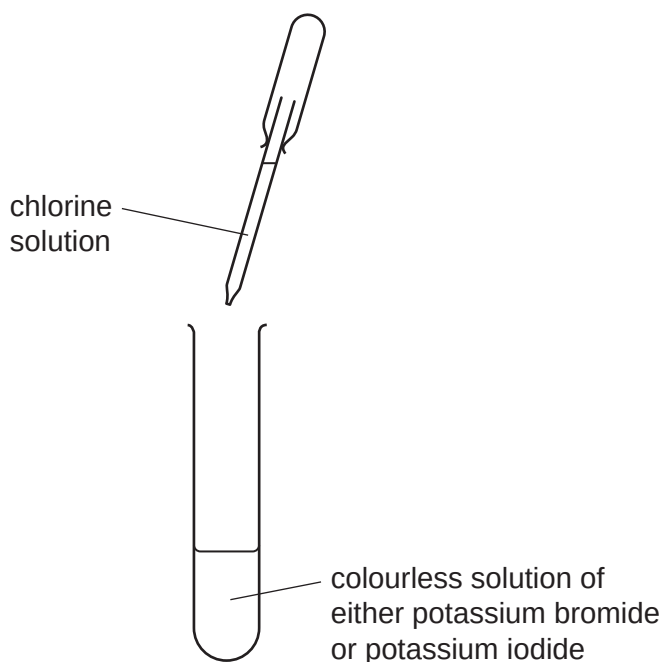


Fig. 2.2

Predict the colour the student would see if the test-tube contained

- potassium bromide, ...
- potassium iodide.

Explain your predictions.

.....

.....

.....

..... [3]

- (ii) The student is asked to predict which pair of elements, chosen from those in Fig. 2.1, would react together most vigorously.

He predicts that the reaction between lithium and fluorine would be the most vigorous.

Explain whether or not the student has made a correct prediction.

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

- (c) Potassium bromide contains potassium ions, K^+ and bromide ions, Br^- .

Construct a balanced symbolic equation for the reaction between potassium and bromine to form potassium bromide.

..... [3]

- 3 Fig. 3.1 shows four swimmers at the start of a race.

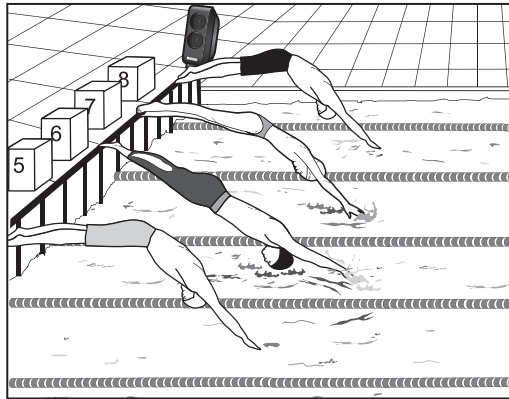


Fig. 3.1

- (a) The swimmers start their race when they hear a loud, high-pitched sound from a loudspeaker.

- (i) Explain why sound travels at a different speed through water than through air.

.....

 [2]

- (ii) Fig. 3.2 shows the trace of a sound wave as it appears on an oscilloscope screen.

On Fig. 3.2 draw another trace of a sound wave from a sound that is louder than the one shown, but has the same pitch.

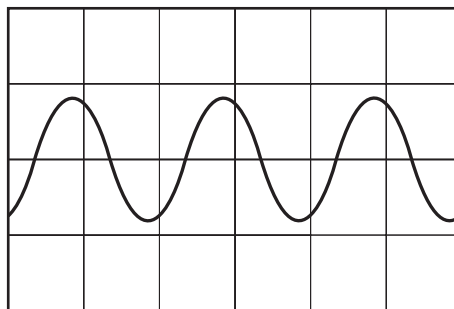


Fig. 3.2

[2]

- (iii) The swimmers can hear the sound from the loudspeaker only if the frequency of the sound lies within a range of frequencies which the human ear can detect.

State this range of frequencies.

..... Hz to Hz [1]

- (iv) Waves are either longitudinal or transverse.

State whether each of the following is an example of a transverse or longitudinal wave.

the sound waves produced by the loudspeaker

the water waves produced by the swimmers in the pool [1]

- (b) Sound travels at 330 m/s in air. One swimmer is 0.4 m from the loudspeaker when he hears the sound.

- (i) Calculate the time taken for the sound to travel from the loudspeaker to the swimmer.

State the formula that you use and show your working.

formula used

working

..... [2]

- (ii) The loudspeaker produces a sound with a frequency of 2200 Hz.

Calculate the wavelength of this sound.

State the formula that you use and show your working.

formula used

working

..... [2]

- 4 (a) Fig. 4.1 shows part of a food web in a forest ecosystem.

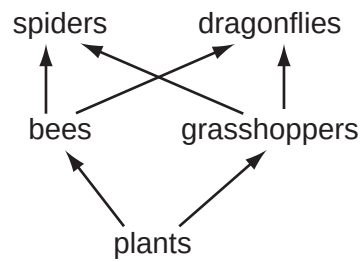


Fig. 4.1

- (i) Define the term *ecosystem*.

.....

 [2]

- (ii) What do the arrows in the food web represent?

..... [1]

- (iii) State the trophic level at which spiders feed.

..... [1]

- (iv) The food web contains several food chains.

Explain why food chains usually have fewer than five trophic levels.

.....

 [2]

- (b) The food web shows that bees depend on plants. Some flowering plants also depend on bees to help them to reproduce.

Explain how bees help flowering plants to reproduce.

.....

.....

.....

.....

.....

..... [3]

- 5 (a) A student investigated the reaction between antacid tablets and dilute hydrochloric acid.

The antacid tablets contain a mixture of sodium hydrogencarbonate, calcium carbonate and magnesium carbonate.

Fig. 5.1 shows one of the experiments the student carried out.

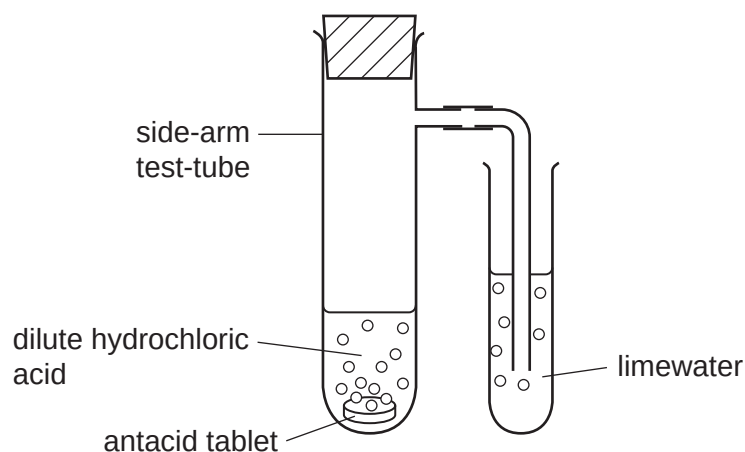


Fig. 5.1

Carbon dioxide gas was given off when the antacid tablet reacted with the dilute hydrochloric acid.

Describe and explain the change in appearance of the limewater during the experiment.

.....

.....

..... [2]

(b) Fig. 5.2 shows apparatus the student used to measure the rate of reaction between antacid tablets and hydrochloric acid.

- He added both hydrochloric acid and water to the side-arm test-tube to produce diluted hydrochloric acid.
- He dropped an antacid tablet into the diluted hydrochloric acid and immediately inserted the bung.
- He started the stop clock and timed how long it took for 25 cm^3 of gas to bubble up into the measuring cylinder.

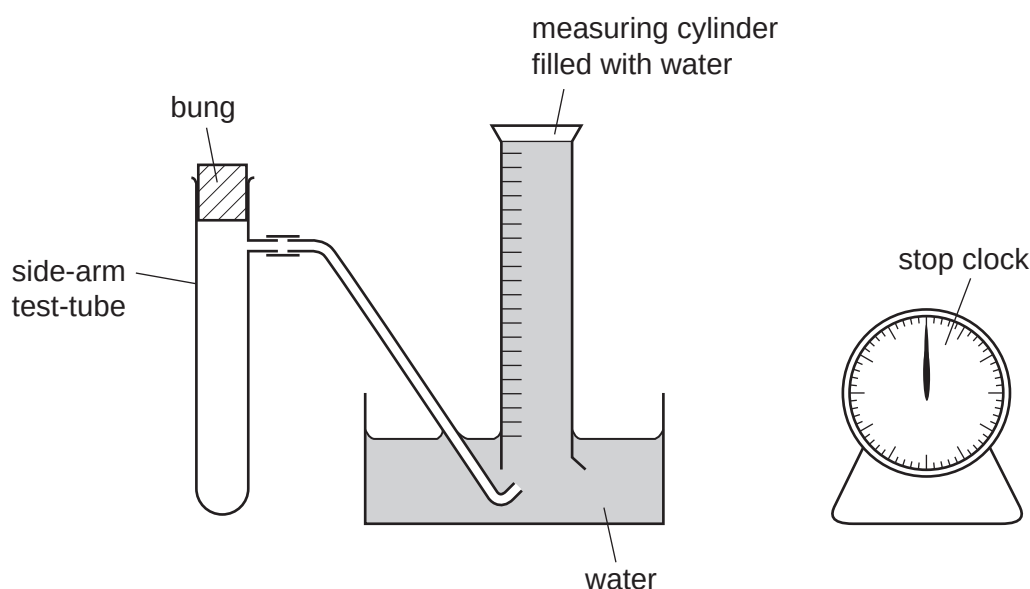


Fig. 5.2

The student carried out four experiments **A**, **B**, **C** and **D** in which he investigated the effect of changing reaction conditions on the rate.

Table 5.1 shows the data the student obtained.

Table 5.1

	volume of hydrochloric acid used / cm^3	volume of water used / cm^3	temperature of diluted hydrochloric acid / $^{\circ}\text{C}$	time taken to collect 25 cm^3 gas / seconds
A	20	0	35	18
B	20	0	25	36
C	15	5	25	48
D	10	10	25	72

- (i) State in which experiment, **A**, **B**, **C** or **D**, the reaction rate was the lowest.

.....

- (ii) State briefly the conclusions the student can draw from the results of experiments **A** and **B** and from the results of experiments **B**, **C** and **D**.

conclusion from experiments **A** and **B**

.....

.....

conclusion from experiments **B**, **C** and **D**

.....

..... [2]

- (iii) Explain the conclusion from experiments **A** and **B**, in terms of collisions between particles.

.....

.....

.....

..... [2]

- 6 (a) Fig. 6.1 shows a circuit for measuring the current through a filament lamp potential difference is changed.

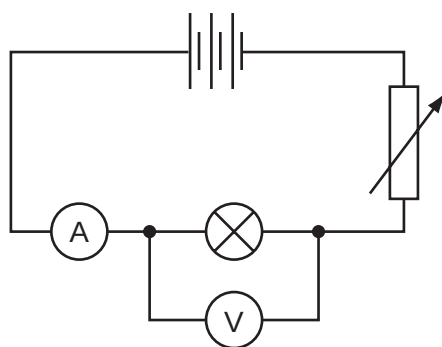


Fig. 6.1

Fig. 6.2 shows a graph of the results from an experiment using this circuit.

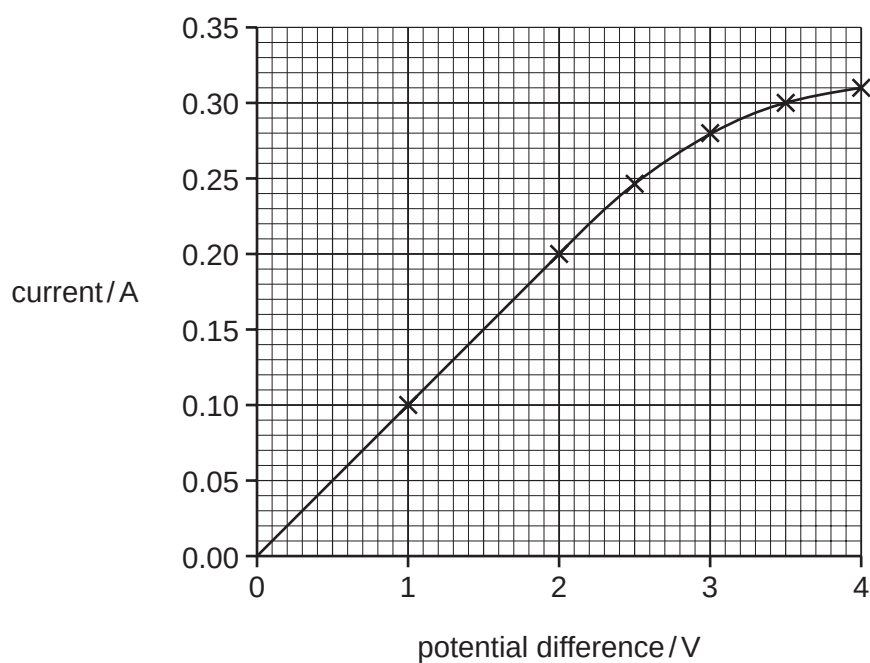


Fig. 6.2

- (i) Use the graph to calculate the resistance of the lamp when the potential difference was 2.0 V and when the potential difference was 4.0 V.

State the formula that you use and show your working.

formula used

working

resistance at 2.0 V

resistance at 4.0 V [2]

- (ii) Describe how the current through the filament lamp changes as the voltage increases above 2.0 V.

.....
 [1]

- (b) A single ray of light from a torch (flashlight) is shone onto a mirror as shown in Fig. 6.3.

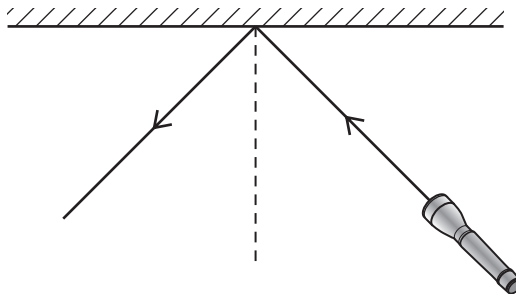


Fig. 6.3

- (i) Label the angle of incidence and angle of reflection. [1]

- (ii) The angle of incidence = 45° .

Write down the value of the angle of reflection.

..... [1]

- 7 (a) Fig. 7.1 shows the human alimentary canal.

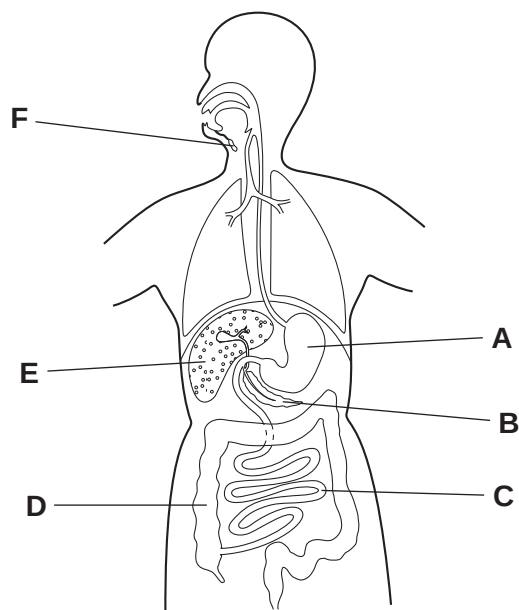


Fig. 7.1

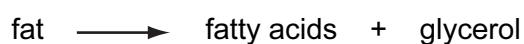
State the **letter** that indicates

the liver, ...

the area where digested food is absorbed.

[2]

- (b) Lipase is an enzyme that catalyses the breakdown of fats to fatty acids and glycerol.



A student carried out an experiment to investigate the effect of temperature on the rate of the breakdown of fats by lipase. Fig. 7.2 shows how she set up the two test-tubes.

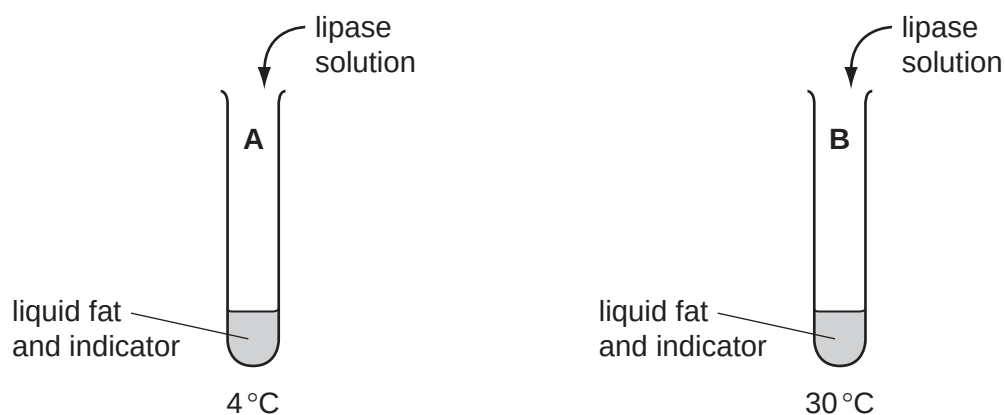


Fig. 7.2

The indicator that the student used changes colour from blue to yellow when falls below 5.

Table 7.1 shows her results.

Table 7.1

time / minutes	tube A (4 °C)	tube B (30 °C)
0	blue	blue
5	blue	yellow
10	blue	yellow
15	yellow	yellow

- (i) Using the information in the word equation, explain why the indicator eventually changed to yellow in both tubes.

.....

 [2]

- (ii) Explain the reason for the difference between the results for tube **A** and tube **B**.

.....

 [3]

- (c) Fat is an important component of a balanced diet.

Explain why a balanced diet should **not** contain too much fat.

.....

 [2]

- 8 Large amounts of chemical energy are stored in the world's reserves of fossil fuels such as natural gas and petroleum (crude oil).

(a) (i) Name the main compound in natural gas.

.....

Write the **word** chemical equation for the complete combustion of this compound.

..... [3]

(ii) Before it is refined, petroleum contains sulfur compounds.

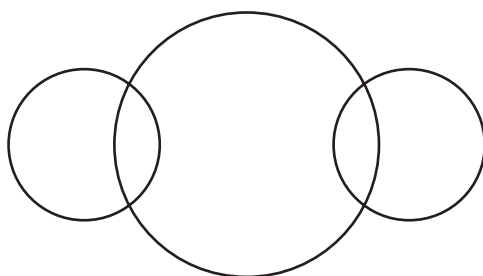
Describe and explain how water in rivers and lakes could become polluted if sulfur compounds are **not** removed from fossil fuels before they are used.

.....
.....
.....
.....
.....
..... [4]

(b) Sulfur is removed from petroleum by combining it with hydrogen to form the gaseous compound hydrogen sulfide, H_2S . Sulfur is in Group 6 of the Periodic Table.

Complete the bonding diagram of one molecule of hydrogen sulfide below to show

- the chemical symbols of the elements
- how the outer electrons in each element are arranged.



[2]

- 9 Fig. 9.1 shows a toy car travelling over a plastic surface.

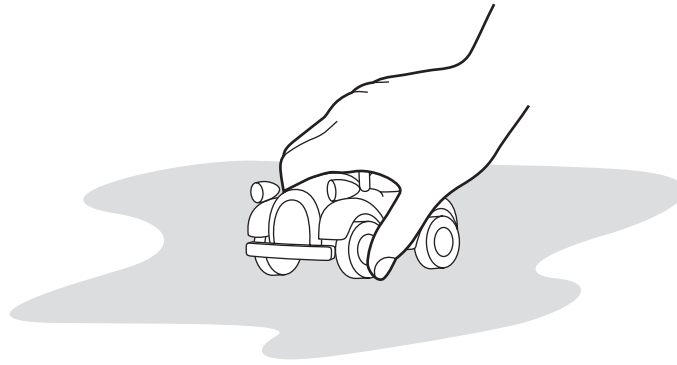


Fig. 9.1

- (a) The car, of mass 0.5 kg is moving at a steady speed of 0.5 m/s .

Calculate the kinetic energy of the car.

State the formula that you use and show your working.

formula used

working

..... [2]

- (b) While the car is moving, the wheels are rubbing against the plastic surface. The car becomes electrostatically charged with a positive charge.

Explain how this happens.

.....

.....

.....

.....

..... [3]

- (c) A speed – time graph for the car is shown in Fig. 9.2. It shows the motion of the car over a 25 second period.

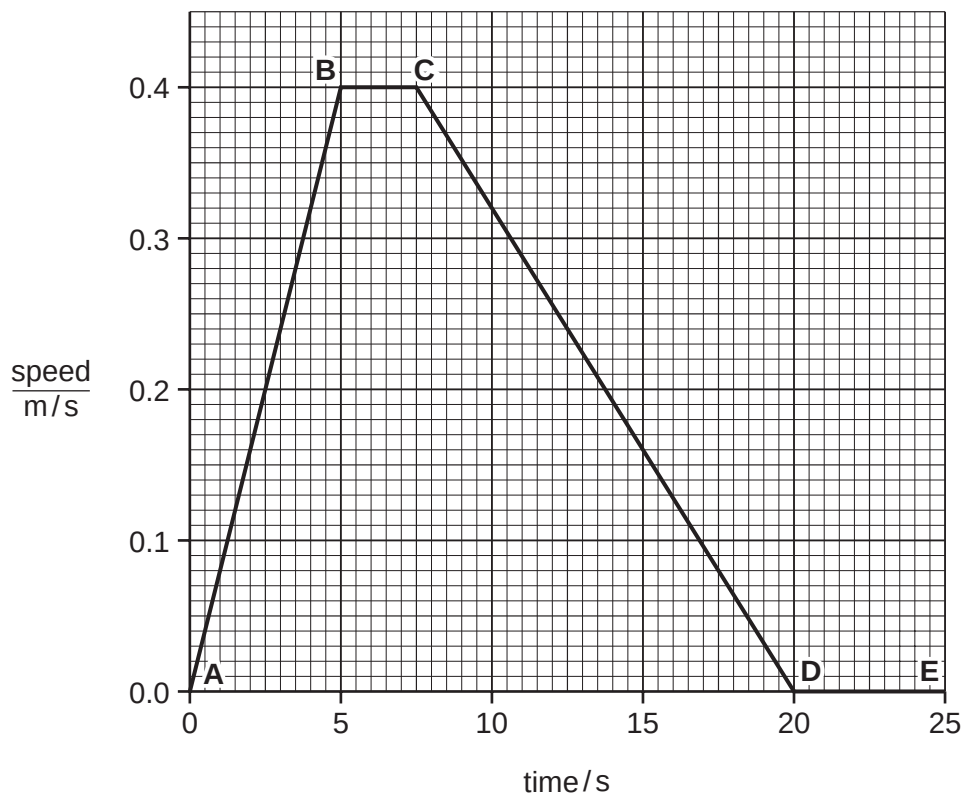


Fig. 9.2

- (i) State the part of the graph when the car is not moving.

..... [1]

- (ii) State **one** part of the graph when the car was travelling at constant speed and write down the value of this speed.

part of graph

speed [1]

- (iii) State **one** part of the graph when the car was accelerating and calculate its acceleration.

Show your working.

part of graph

acceleration

[2]

- (iv) Calculate the distance travelled by the car between **A** and **D**.

Show your working.

..... [3]

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																						
23 Na Sodium 11	24 Mg Magnesium 12																						
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	101 Ru Ruthenium 44	101 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	127 Te Tellurium 52	131 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									
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89																					
58-71 Lanthanoid series																							
90-103 Actinoid series																							
175 Lu Lutetium 71																							
173 Yb Ytterbium 70																							
169 Tm Thulium 69																							
167 Er Erbium 68																							
165 Ho Holmium 67																							
162 Dy Dysprosium 66																							
159 Tb Terbium 65																							
157 Gd Gadolinium 64																							
152 Eu Europium 63																							
150 Sm Samarium 62																							
144 Nd Neodymium 60																							
141 Pr Praseodymium 59																							
140 Ce Cerium 58																							
238 U Uranium 92																							
238 Pa Protactinium 91																							
232 Th Thorium 90																							
232 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																							

a

X

b

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

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

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

0653/33

Paper 3 (Extended)

October/November 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 **23** printed pages and **1** blank page.



1 Flowers are organs in which sexual reproduction takes place.

(a) Sexual reproduction can be defined as:

"the process involving the fusion of haploid nuclei to form a diploid zygote and the production of genetically dissimilar offspring."

(i) Explain the meaning of the term *diploid*.

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

(ii) State the scientific term for the fusion of two nuclei. [1]

(b) Fig. 1.1 shows a section through a flower.

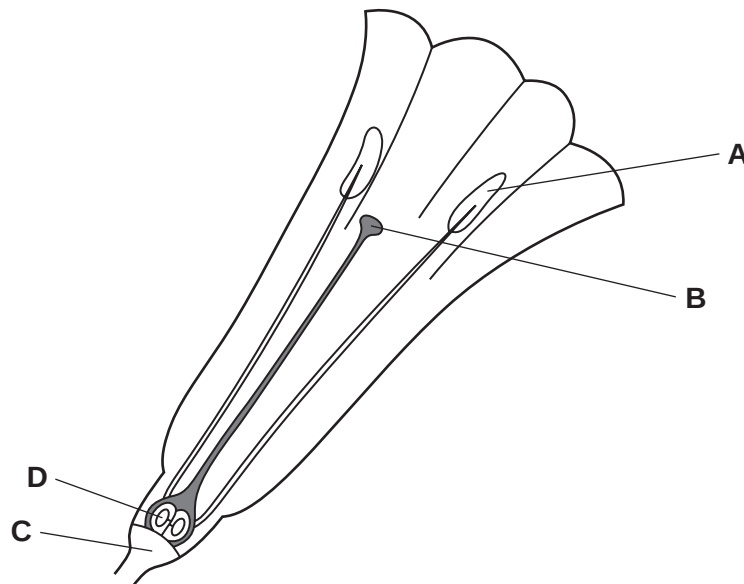


Fig. 1.1

(i) State the **letter** of the part in which

the male gametes are produced, ...

a zygote is produced.

[2]

- (ii) Explain how the structure of the flower in Fig. 1.1 indicates that it is pollinated by insects.

.....

.....

.....

.....

.....

..... [3]

- (c) After pollination, seeds are produced. A student set up an experiment to investigate conditions needed for the germination of lettuce seeds.

He placed five lettuce seeds on cotton wool in each of five test-tubes. Fig. 1.2 shows the conditions present in each tube.

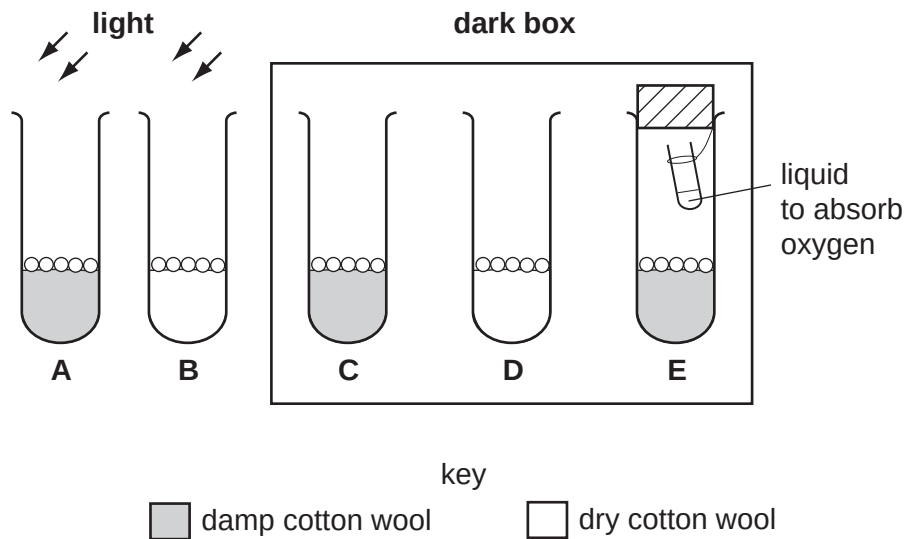


Fig. 1.2

Table 1.1 shows his results.

Table 1.1

tube	number of seeds that germinated
A	5
B	0
C	5
D	0
E	0

What conclusions can the student make from these results?

.....

.....

.....

..... [3]

Please turn over for Question 2.

- 2 Fig. 2.1 represents what happens when calcium carbonate, an **insoluble** ionic added to water.

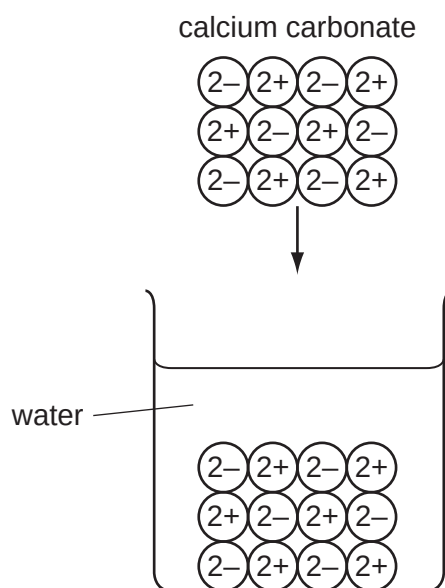


Fig. 2.1

- (a) Sodium chloride is a **soluble** ionic salt.

On Fig. 2.2, sketch how the ions from sodium chloride are arranged after it is added to water.

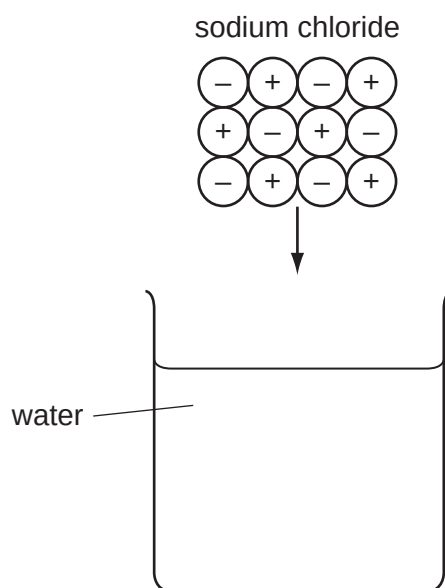


Fig. 2.2

[2]

- (b) Explain, in terms of relative numbers of protons and electrons, why calcium ions have an electrical charge of $2+$, but sodium ions have a charge of $1+$.

.....

.....

.....

.....

..... [3]

- (c) The formula of a sodium ion is Na^+ . The formula of a carbonate ion is CO_3^{2-} .

Use this information to deduce the chemical formula of sodium carbonate.

Show how you arrived at your answer.

.....

..... [2]

- 3 Fig. 3.1 shows two speed / time graphs for a car.

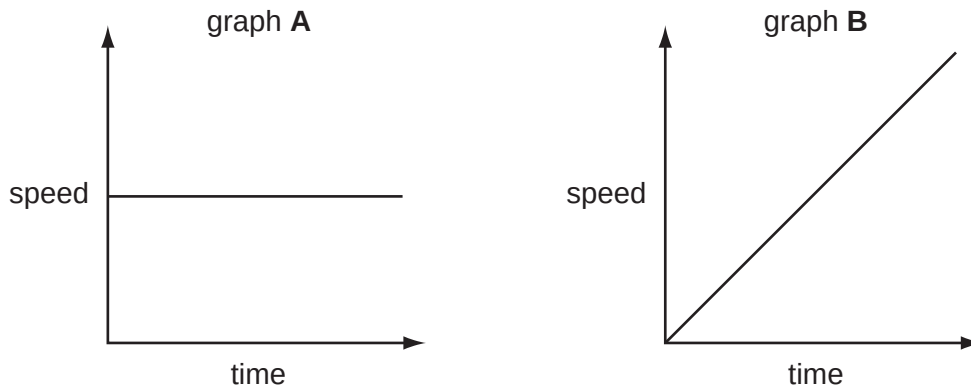


Fig. 3.1

- (a) Describe the motion of the car in

graph A, ...

graph B. [1]

- (b) The car travels at 20 m/s for 90 seconds.

The total force driving the car forward is 1000 N.

- (i) Calculate the work done by this force during this 90 second journey.

State the formulae that you use and show your working.

formulae used

working

..... [3]

- (ii) Calculate the useful power output of the engine during this time.

State the formula that you use and show your working.

formula used

working

..... [2]

- (c) The car accelerates from 0 to 33 m/s in 11 seconds.

Calculate the acceleration of the car during the 11 seconds.

Show your working.

..... [2]

- 4 Bats use echo location to detect objects around them. To do this, they emit ultrasound.

- (a) (i) Ultrasound is sound that has a frequency too high for a human to hear.

Suggest a frequency for the ultrasound emitted by bats. [1]

- (ii) Underline the word or words that correctly describe an ultrasound wave.

electromagnetic **longitudinal** **transverse** [1]

- (b) Most bats drink by flying close to the surface of a pond and taking mouthfuls of water from it.

Researchers thought that bats may be able to tell where water is present because the water has a much smoother surface than the surrounding ground. They put several thirsty bats into a closed room. They placed sheets of two rough materials and two smooth materials on the floor.

rough materials	smooth materials
metal grid	metal sheet
tree bark	smooth wood

The researchers counted the number of times the bats tried to drink from the surface of each material. Their results are shown in Fig. 4.1.

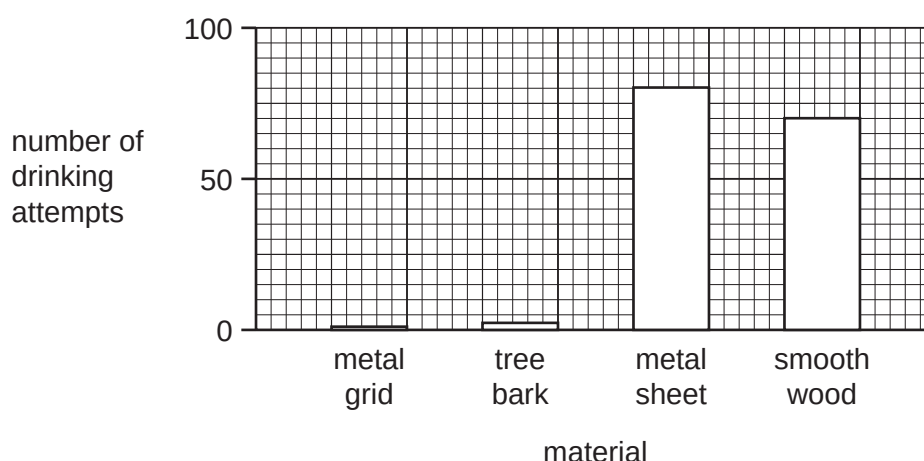


Fig. 4.1

- (i) Compare the results for the rough materials and the smooth materials.

.....

 [2]

- (ii) The ultrasound waves reflect from surfaces and are detected by receptors in the bat's head.

Fig. 4.2 shows how ultrasound waves are reflected from a rough surface and from a smooth surface. The arrows show the direction in which the sound waves travel.

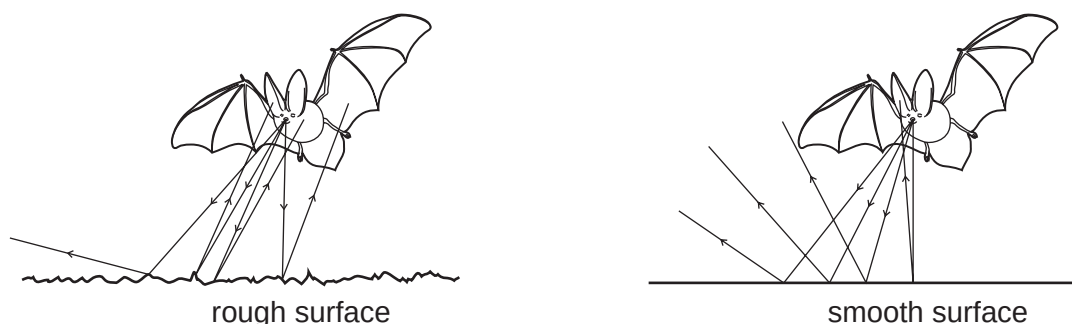


Fig. 4.2

Use the information in Fig. 4.1 and Fig. 4.2 to suggest how bats detect a water surface.

.....

.....

.....

..... [2]

- (c) The droppings of bats are used as a fertiliser in many parts of the world. They contain large quantities of nitrate and phosphate, which plants need for healthy growth.

However, if more fertiliser is added to the soil than the crop plants can absorb, some of the fertiliser may wash into rivers when it rains.

Explain how this can cause fish to die.

.....

.....

.....

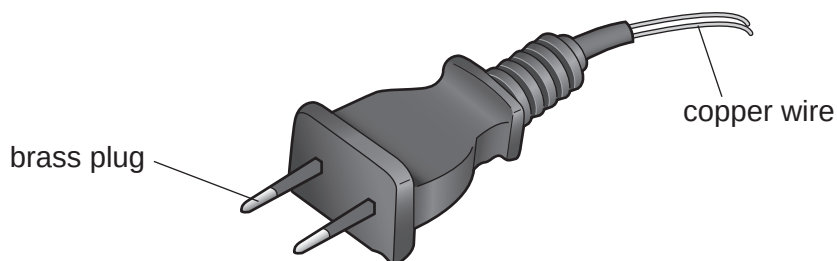
.....

..... [3]

- 5 Metallic copper is a very important material that has been extracted from compounds for thousands of years.

(a) Copper is used to make electrical wires.

Copper wires are connected to the mains electrical supply using brass plugs. Brass is an alloy of copper and zinc, and is a much less malleable material than pure copper.



Draw a simple diagram of the atoms in brass, and use it to help you explain why brass is less malleable than pure copper.

.....

.....

.....

..... [3]

- (b) One of the processes used in the extraction of copper involves heating copper(I) sulfide, Cu_2S , in air. One of the reactions that occurs is between copper(I) sulfide and oxygen. This reaction produces copper and sulfur dioxide, SO_2 .

Construct a balanced symbolic equation for this reaction.

..... [1]

- (c) Small metallic objects can be covered with a thin layer of copper metal (copper plating) using electrolysis.

Fig. 5.1 shows the apparatus a student used to cover a steel spoon with copper.

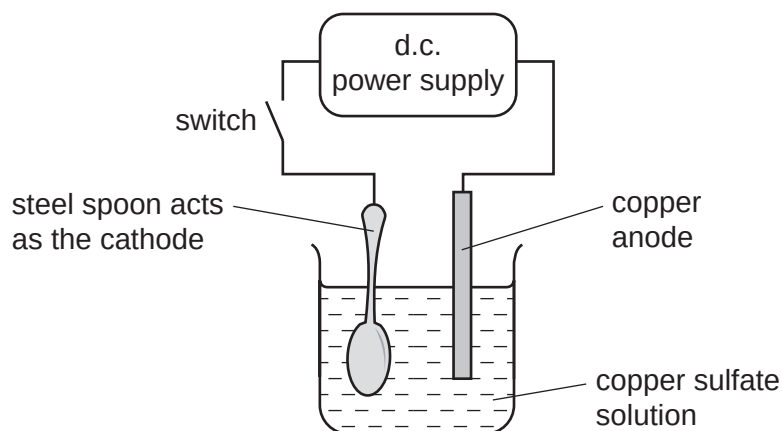


Fig. 5.1

In this process, aqueous copper ions, Cu^{2+} , move from the electrolyte and are converted into atoms of metallic copper on the surface of the steel spoon.

- (i) Explain why the steel spoon must be made the cathode in this process.

.....

 [2]

- (ii) Describe, in terms of ions, electrons and atoms, what happens at the surface of the spoon that results in the building up of a layer of metallic copper.

.....

 [3]

- 6 Fig. 6.1 shows a washing machine.

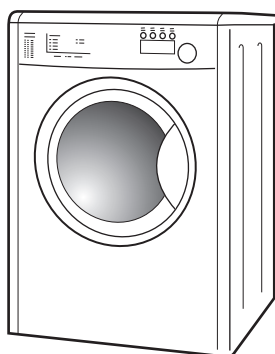


Fig. 6.1

- (a) Complete the sentence below using **two** of the words in the list.

heat kinetic light potential sound

A washing machine is designed to transform electrical energy into
energy and energy. [2]

- (b) (i) Some of the water inside the washing machine evaporates.

Explain the process of evaporation in terms of particles.

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

- (ii) Explain why evaporation has a cooling effect.

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

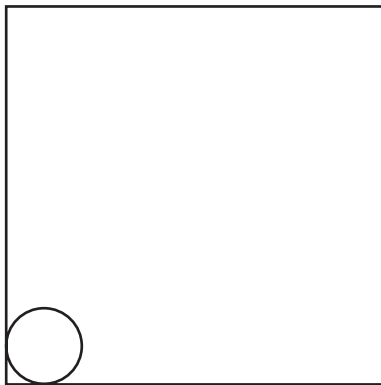
- (iii) The water inside the washing machine is heated by an electric heater.

Describe how heat energy is able to pass through the metal parts of the heater.

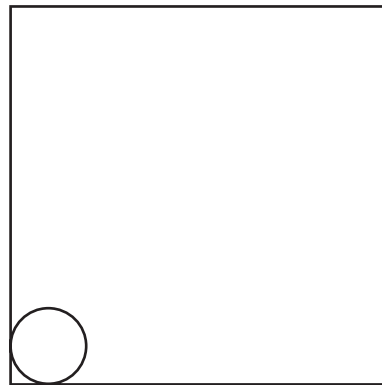
.....
.....
..... [2]

- (c) The casing of the washing machine is a solid. The water used in it is a liquid.

Complete the diagrams below to show the arrangement of particles in a solid and in liquid.



solid



liquid

[2]

- (d) Before buying a washing machine, a person may research several types to find out which washing machine has the greatest energy efficiency.

Explain the meaning of the term *efficiency*.

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

- 7 (a) Fig. 7.1 shows two human teeth.

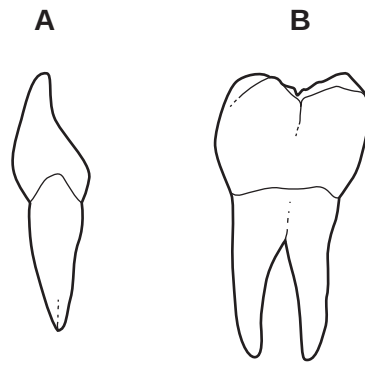


Fig. 7.1

- (i) Name the **two** types of teeth shown in Fig. 7.1.

tooth **A**

tooth **B** [2]

- (ii) Explain how tooth **B** helps to digest a food such as bread.

.....

 [2]

- (b) Bread contains starch. Starch molecules are very large, and must be broken down into smaller sugar molecules before they can be absorbed. This is done by enzymes.

- (i) Name **one** part of the alimentary canal in which starch is broken down.

..... [1]

- (ii) Name the part of the alimentary canal where the sugar molecules are absorbed into the blood.

..... [1]

- (c) Fig. 7.2 shows how pH affects the activity of the enzyme that breaks down starch in the human alimentary canal.

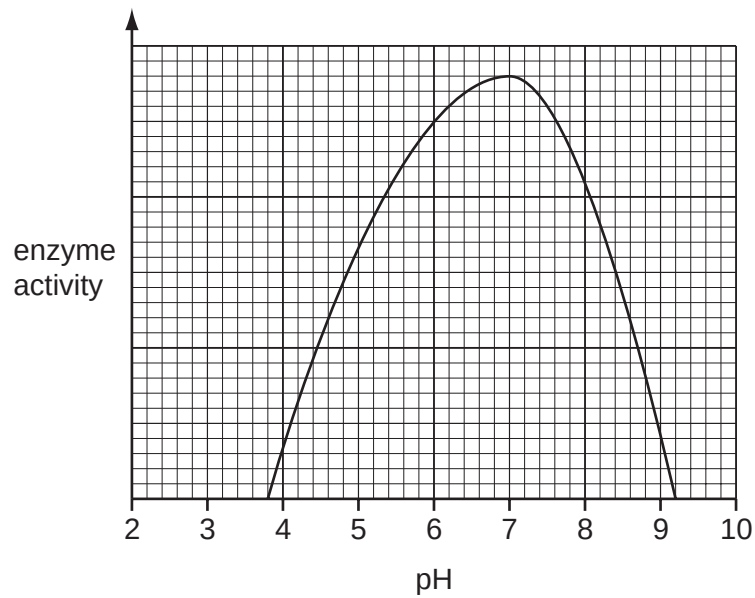


Fig. 7.2

Explain the reasons for the differences in activity of the enzyme at pH 5 and pH 7.

.....

.....

.....

.....

..... [3]

8 Carbon occurs naturally as an element and also in a very large number of compounds.

- (a) (i) The most common atom of carbon has a proton number of 6 and a nucleon number of 12.

Draw a diagram of **one** atom of this isotope of carbon. Label the positions and numbers of the protons, neutrons and electrons.

[2]

- (ii) Fig. 8.1 shows diagrams of particles in some substances. In these diagrams, different circles are used to represent different types of atoms.

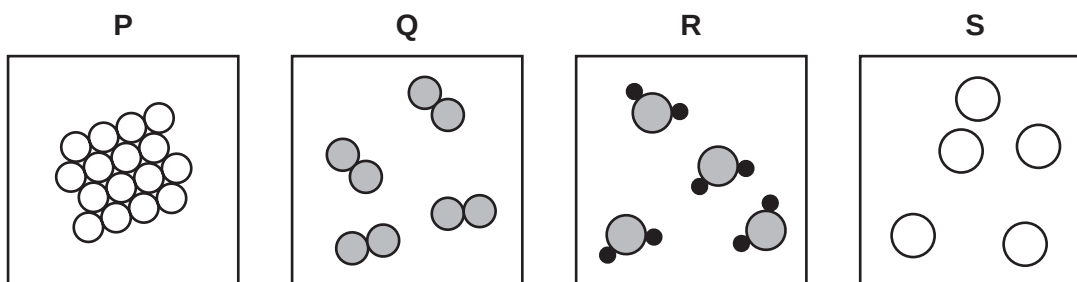


Fig. 8.1

Explain which of the diagrams, **P**, **Q**, **R** and **S**, represent elements and which represent compounds.

diagram(s) representing elements

explanation

.....

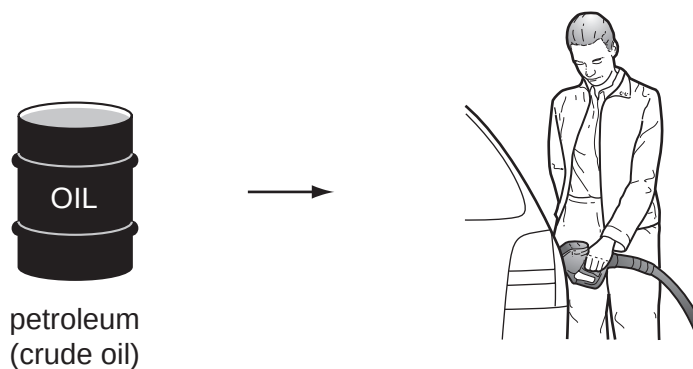
diagram(s) representing compounds

explanation

.....

[4]

- (b) Petroleum (crude oil) is the raw material from which gasoline (car fuel) is obtained.



- (i) The extraction of gasoline from petroleum includes the process of fractional distillation.

Explain whether fractional distillation involves physical or chemical changes.

main type of change

explanation

..... [1]

(ii) Fig. 8.2 shows a simplified diagram of industrial fractional distillation.

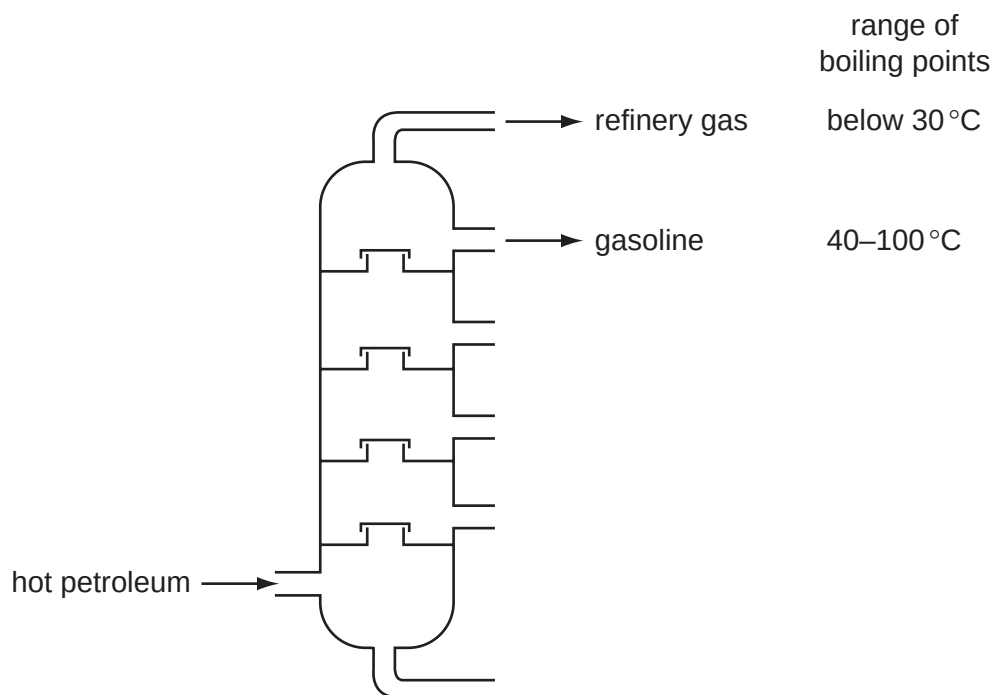


Fig. 8.2

Explain, in terms of molecules, why gasoline boils at a higher temperature than refinery gas.

.....

 [2]

(c) Some car manufacturers are researching the use of alternative fuels to replace gasoline.

One possible alternative fuel is hydrogen gas, H_2 , which is oxidised in the car's engine.

Explain why air pollution caused by car engines would be greatly reduced if hydrogen could be used as the fuel instead of gasoline.

.....

 [3]

- 9 (a) Fig. 9.1 shows an electrical circuit for a torch (flashlight).

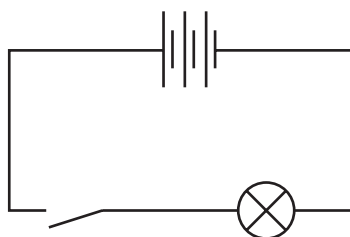


Fig. 9.1

- (i) How many cells are fitted in the torch? [1]
- (ii) A voltmeter is used to check the voltage across the light bulb.
Draw the symbol for the voltmeter in the correct position on the circuit. [1]
- (iii) The current passing through the light bulb was 0.3 A when the voltage across it was 6 V .

Calculate the resistance of the light bulb.

Show your working and state the formula that you use.

formula used

working

..... [2]

- (b) A single ray of light from a torch is shone onto a mirror as shown in Fig. 9.2.

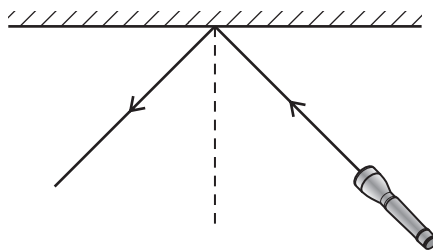


Fig. 9.2

- (i) On Fig. 9.2, label the angle of incidence and angle of reflection. [1]
- (ii) The angle of incidence = 45° .

Write down the value of the angle of reflection. [1]

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	101 Ru Ruthenium 44	101 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	127 Te Tellurium 52	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	Rn Radon 86					
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89																				
58-71 Lanthanoid series																						
90-103 Actinoid series																						
		140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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								
Key	X	a	a = relative atomic mass																			
			X = atomic symbol																			
		b	b = proton (atomic) number																			
			Lr Lawrencium 103																			

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

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