



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

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**COMBINED SCIENCE**

**0653/03**

Paper 3 (Extended)

**October/November 2009**

**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 20.

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	
<b>Total</b>	

This document consists of **20** printed pages.



1 Fig. 1.1 shows a transverse section of part of a leaf. The arrows show water movement.

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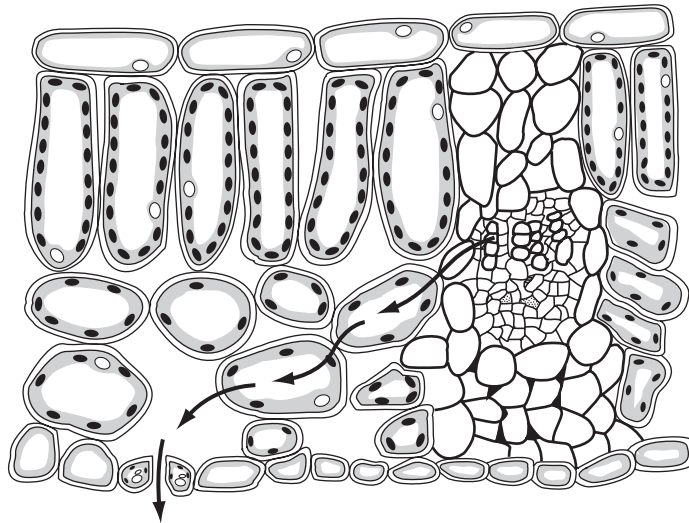


Fig. 1.1

(a) (i) On Fig. 1.1, label a palisade cell, using a label line. [1]

(ii) Explain why palisade cells need a good supply of water.

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

(b) (i) Name the type of cell that transports water from the roots to a leaf. [1]

.....

(ii) Name the process by which water moves from one plant cell to another, as it moves across the leaf. [1]

.....

(c) The loss of water vapour from the leaf to the air is called transpiration.

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(i) Describe and explain how temperature affects the rate of transpiration.

.....  
.....  
.....  
.....  
..... [3]

(ii) Explain why temperature also affects the rate at which water is transported up to the leaves from the roots.

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

2 Radiation can be used to monitor the thickness of paper in a paper mill.

Fig. 2.1 shows a radiation detector connected to a control unit. This sends messages to machines that adjust the gap between the rollers.

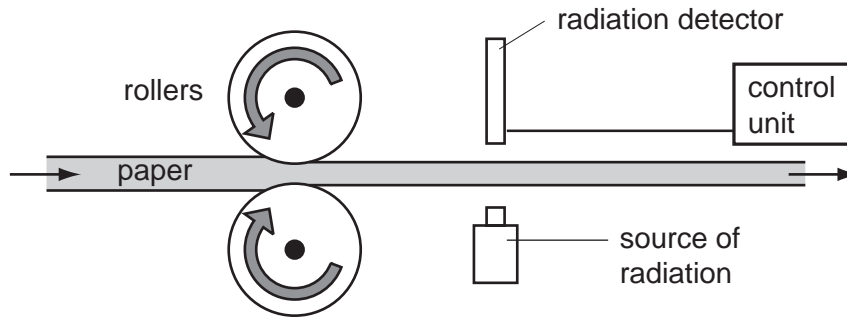


Fig. 2.1

(a) The following sentences describe what happens if the paper sheet produced is too thin.

The sentences are in the wrong order.

- A The gap between the rollers is increased.
- B The paper sheet is now rolled a little thicker.
- C A signal goes from the detector to the control unit.
- D The paper sheet absorbs less beta radiation so more reaches the detector.

Arrange the sentences in the correct order.



[2]

(b) Explain why an alpha radiation source **cannot** be used to monitor the thickness of the paper sheet.

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

- (c) Table 2.1 shows the half-life and type of radiation given out by four different radioactive isotopes.

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**Table 2.1**

radioactive isotope	half-life / days	radiation given out
bismuth-210	5.0	beta
polonium-210	138.0	alpha and gamma
radon-222	3.8	alpha
iodine-131	8.0	beta and gamma

- (i) A sample of each isotope has the same count rate today. Which sample will have the highest count rate one month from today?

Explain your answer.

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

- (ii) Which isotopes in the table give out radiation that is the most ionising?

Explain your answer.

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

- 3 (a) Erupting volcanoes release a plume into the air, containing many gases.

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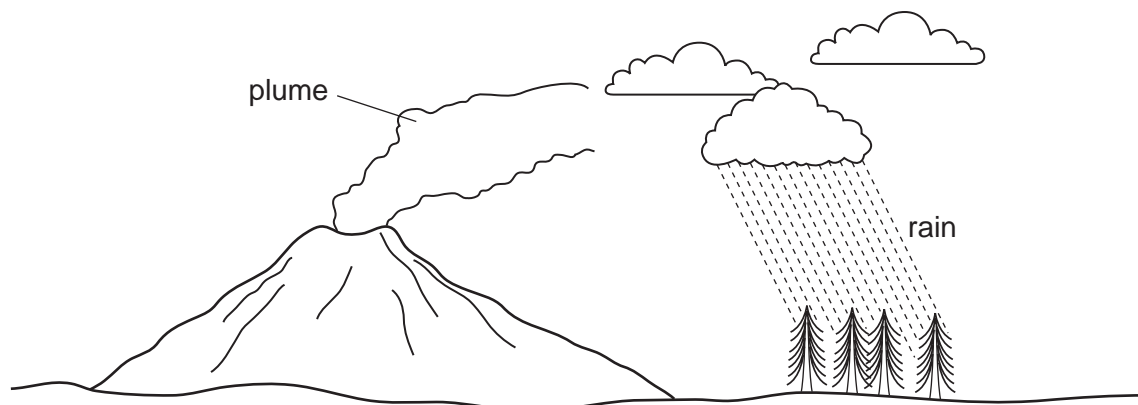


Table 3.1 shows some of the gases released by three volcanoes **A**, **B** and **C**.

**Table 3.1**

gas in plume	% of each gas in the plume		
	volcano <b>A</b>	volcano <b>B</b>	volcano <b>C</b>
H <sub>2</sub> O	37.1	77.2	97.1
CO <sub>2</sub>	48.9	11.3	1.44
SO <sub>2</sub>	11.8	8.34	0.50
H <sub>2</sub>	0.49	1.39	0.70
CO	1.51	0.44	0.01

- (i) Explain why hydrogen is an element and the other gases are compounds.

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

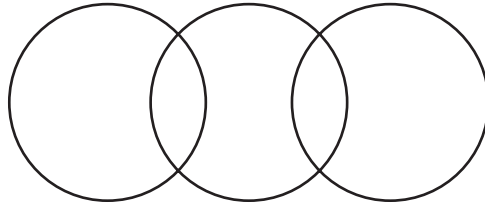
- (ii) The plume from volcano **A** could be much more damaging to plant life than the plumes from the other volcanoes.

Use the information in Table 3.1 to explain why.

.....  
 .....  
 .....  
 .....  
 ..... [3]

**(b) (i)** Complete the bonding diagram below to show

- the chemical symbols of the elements in a molecule of carbon dioxide,
- the arrangement of the outer electrons in each atom.



[2]

**(ii)** Use information in the Periodic Table on page 20 to calculate the relative molecular mass of sulfur dioxide.

Show your working.

..... [1]

**(c)** The air also contains noble gases, such as argon, which are very unreactive.

Draw a diagram of an argon atom showing how all of the electrons are arranged.

[2]

4 The enzyme amylase is present in saliva. It helps to digest starch in the mouth.

(a) (i) Name the substance that is produced when amylase digests starch.

..... [1]

(ii) State **one** part of the alimentary canal, other than the mouth, where amylase digests starch.

..... [1]

(b) There is a rare allele of the gene that is responsible for the production of amylase. A person with only one copy of this allele still produces amylase. However, a person with two copies of the allele does not produce amylase.

(i) State how this information shows that this allele is recessive.

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

(ii) Explain why a person with two copies of this allele would not be able to obtain energy from any starch in their diet.

.....  
.....  
.....  
..... [3]







(iii) Complete the genetic diagram to show how two people who both produce amylase can have a child who does not produce amylase.

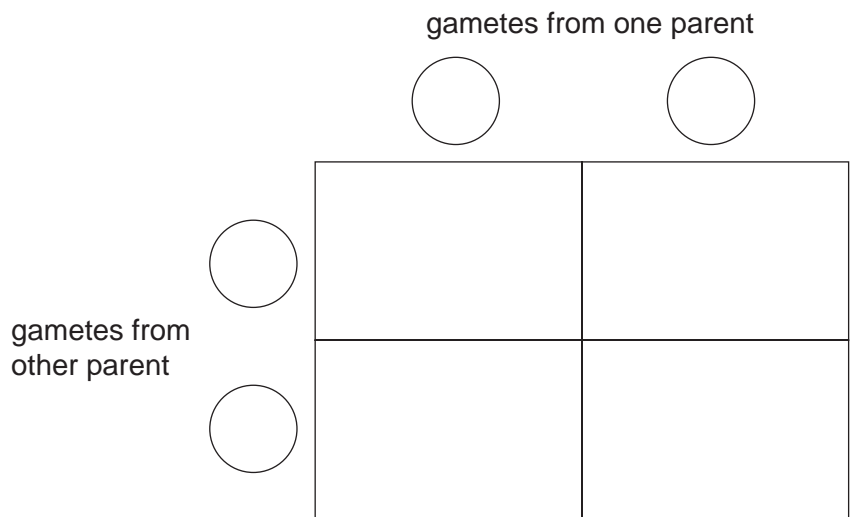
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Use the symbol **A** for the dominant allele and **a** for the recessive allele.

phenotypes of parents      produces amylase                  produces amylase

genotypes of parents                  **Aa**                  .....

gametes                   and                    and 



[4]

- 5 A student uses dilute hydrochloric acid to test four pieces of rock, **W**, **X**, **Y** and **Z**. She allows some of the acid to fall onto the samples and observes what happens.

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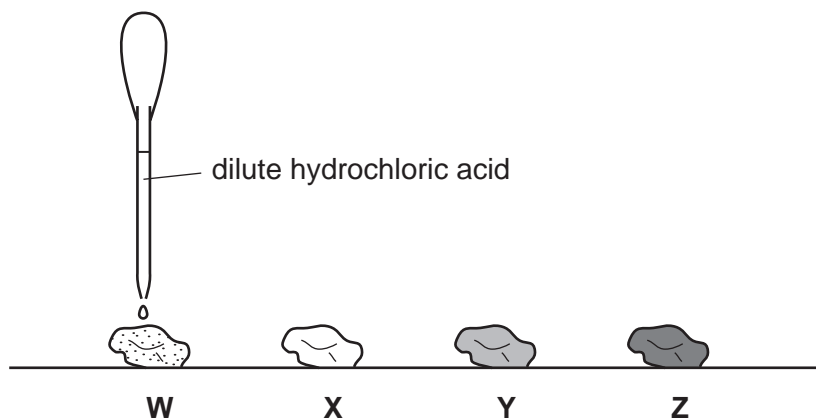


Fig. 5.1

The appearance of the rock samples before hydrochloric acid was added is shown in Table 5.1.

Table 5.1

rock	appearance
<b>W</b>	light grey
<b>X</b>	white
<b>Y</b>	green
<b>Z</b>	dark grey

- (a) (i) Describe what the student will observe if the rock she is testing with acid contains a carbonate.

..... [1]

- (ii) Suggest and explain which of the rock samples, **W**, **X**, **Y** or **Z**, contains a compound of a transition metal.

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

- (b) Copper metal can be extracted from copper carbonate in two stages, as shown in Fig. 5.2.

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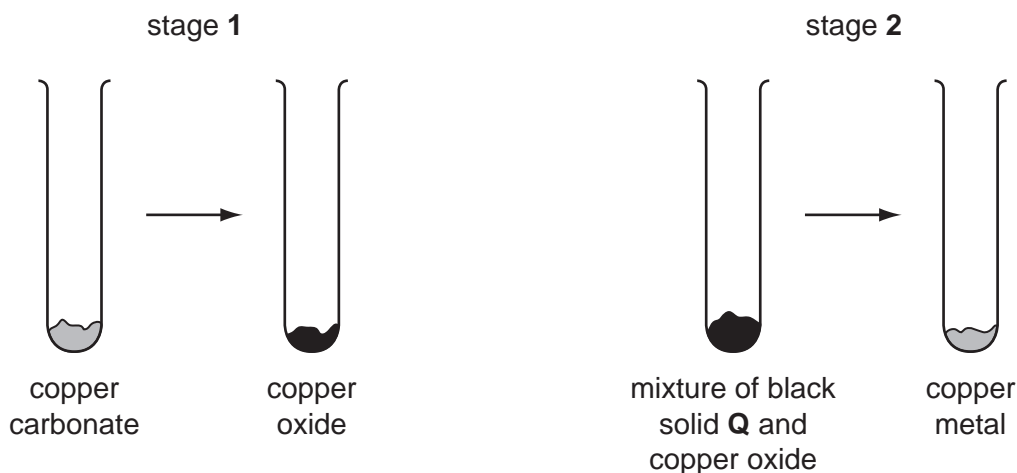


Fig. 5.2

- (i) The reaction in stage 1 occurs when copper carbonate is heated strongly.

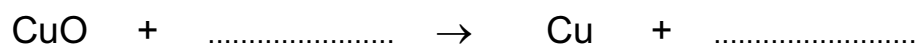
Suggest the word equation for the reaction.

..... [1]

- (ii) Solid Q is a non-metallic element.

Suggest the identity of this element. .... [1]

- (iii) Using your answer to (ii) complete and balance the symbolic equation for the reaction in stage 2.



[2]

- (iv) The compound copper oxide contains copper ions.

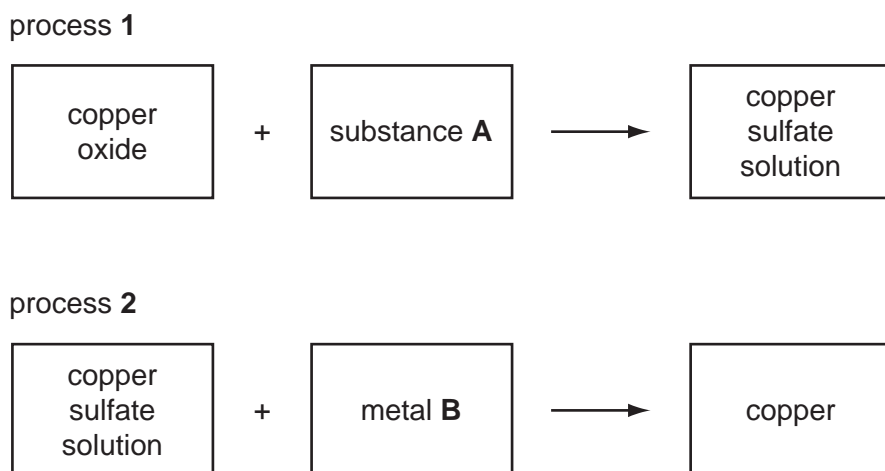
State whether copper ions must gain or lose electrons in order to be converted into copper atoms.

Explain your answer.

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

(c) Copper metal can also be made from copper oxide by a different method.

Fig. 5.3 shows some of the reactants and products involved.



**Fig. 5.3**

- (i) Suggest the name of substance **A**. ..... [1]
- (ii) Suggest the name of metal **B**. ..... [1]
- (iii) Name the type of chemical change which occurs in process 2.  
..... [1]
- (iv) Explain why copper is formed in process 2.  
.....  
..... [1]

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- 6 A motorcyclist begins a journey on his motorcycle. The motorcycle starts from rest and stops at a road junction after 80 seconds. The motorcycle then moves off again and completes the journey.

For  
Examiner's  
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(a) Fig 6.1 shows the motion of the motorcycle.

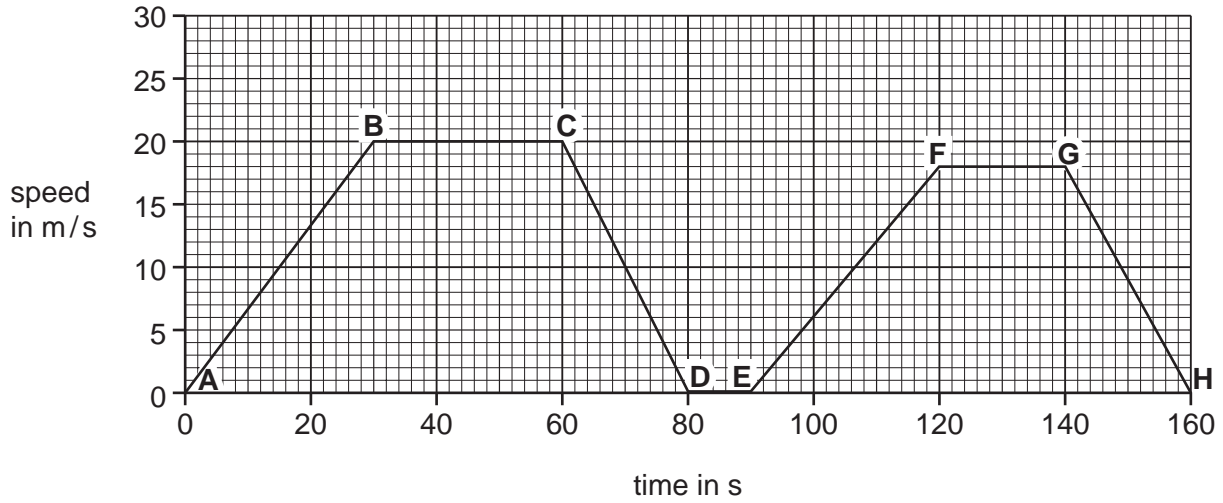


Fig. 6.1

- (i) From the start of the journey, how long did it take the motorcyclist to reach a speed of 10 m/s?

..... [1]

- (ii) For how long was the motorcyclist travelling at a steady speed of 20 m/s?

..... [1]

- (iii) During which two parts of the journey was the motorcyclist slowing down?

from ..... to .....

and from ..... to ..... [1]

- (iv) Use Fig. 6.1 to show how far the motorcyclist travelled between 0 seconds and 80 seconds.

Show your working.

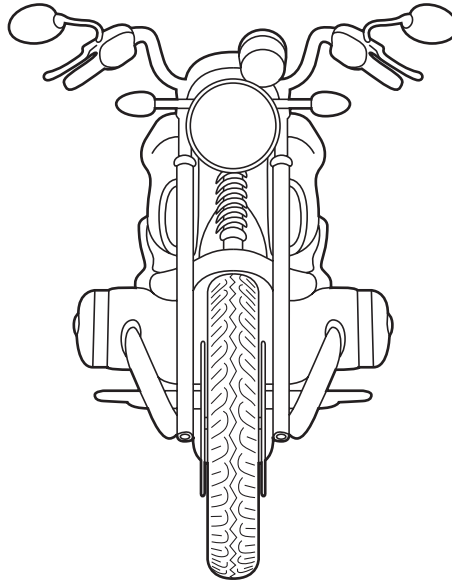
..... [2]

(b) Describe the motion of the moving motorcycle if the total frictional force it experiences is the same as the force produced by the engine.

Explain your answer.

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

(c) Explain in terms of centre of mass why a stationary motorcycle is very unstable.



.....  
.....  
.....  
.....  
.....  
..... [3]

(d) The motorcycle has two lamps connected in a parallel circuit shown in Fig. 6.2.

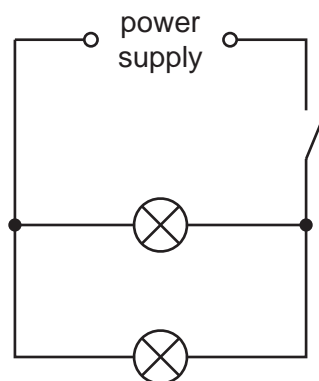


Fig. 6.2

One lamp when lit has a resistance of  $1\ \Omega$ . The other lamp when lit has a resistance of  $2\ \Omega$ .

Calculate the combined resistance of the two lamps.

State the formula that you use and show your working.

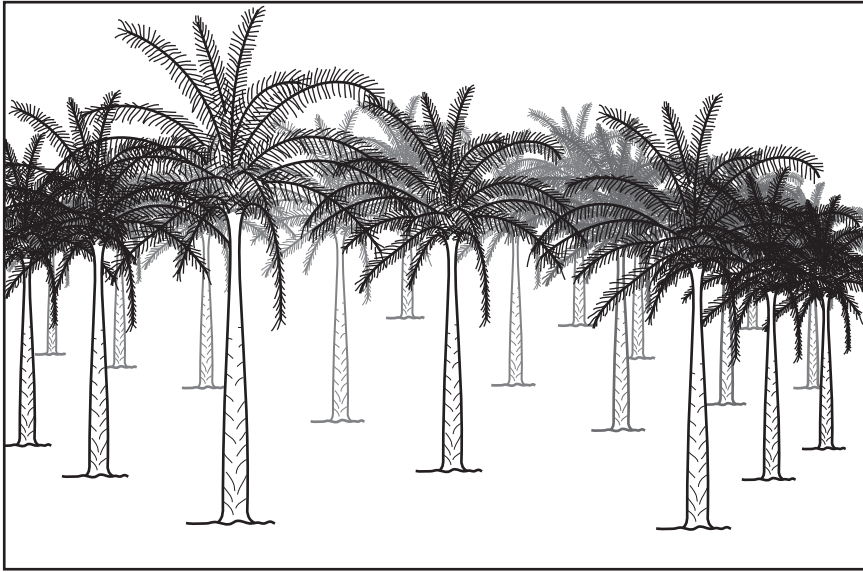
formula

working

..... [3]

7 In some countries in south-east Asia, large areas of tropical rainforest have been cut down to clear the land. The land has then been planted with oil-palm trees.

For  
Examiner's  
Use



(a) Explain how cutting down tropical rainforest may affect each of the following.

(i) soil erosion

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

(ii) species diversity

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



(b) Rats can become serious pests in oil-palm plantations. The rats damage the crops obtained from the oil-palms.

(i) The rats can be controlled by putting down poison for them to eat.

Suggest two disadvantages, other than the cost of the poison, of this method of control.

1 .....

.....

2 .....

..... [2]

(ii) An alternative method of controlling the rats is to encourage owls to nest in the oil-palms by providing them with nest boxes. Owls are predators of rats.

Suggest **one** disadvantage of this method of control.

.....

..... [1]

- 8 (a) Fig. 8.1 shows an aluminium saucepan on a cooker. Vegetables are being cooked in boiling water in the pan.

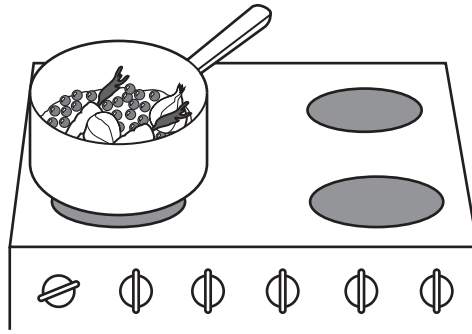


Fig. 8.1

State how the energy passes from the hot cooker through the base of the saucepan in to the water inside.

..... [1]

- (b) Fig. 8.2 shows a block of aluminium which has a mass of 540 g.

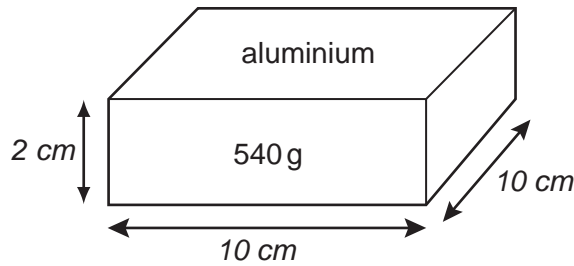


Fig. 8.2

Calculate the density of the block.

Show your working.

..... [3]

- (c) Describe how you would find the volume of an irregularly shaped object such as a carrot. You may draw a diagram if it helps your answer.

For  
Examiner's  
Use

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

- 9 Poly(ethene) is a compound used in making plastics. Poly(ethene) is a polymer made from the monomer, ethene ( $C_2H_4$ ).

- (a) Describe how ethene molecules react to form poly(ethene). In your answer include a diagram showing the displayed (graphical) formulae of **two** ethene molecules and how these are changed during the reaction.

.....  
.....  
..... [3]

- (b) Describe and explain what is observed when gaseous ethene is bubbled through a solution of bromine.

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

**DATA SHEET**  
**The Periodic Table of the Elements**

			<b>Group</b>							
I	II	III	IV	V	VI	VII	0			
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10		
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12		27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulfur 16	35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18		
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20		70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36		
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38		65 <b>Zn</b> Zinc 30	64 <b>Cu</b> Copper 29	59 <b>Ni</b> Nickel 28	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	64 <b>Cu</b> Copper 29		
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56		115 <b>In</b> Indium 49	108 <b>Ag</b> Silver 47	106 <b>Pd</b> Palladium 46	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	112 <b>Cd</b> Cadmium 48		
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89		204 <b>Tl</b> Thallium 81	197 <b>Au</b> Gold 79	195 <b>Pt</b> Platinum 78	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	201 <b>Hg</b> Mercury 80		
*58-71 Lanthanoid series										
†90-103 Actinoid series										
			140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64		
			232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92	238 <b>Pa</b> Protactinium 91	238 <b>Np</b> Neptunium 93	238 <b>Pu</b> Plutonium 94	238 <b>Cm</b> Curium 96		
			162 <b>Dy</b> Dysprosium 66	162 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71		
			98 <b>Cf</b> Californium 98	99 <b>Es</b> Einsteinium 99	100 <b>Fm</b> Fermium 100	101 <b>Md</b> Mendelevium 101	102 <b>No</b> Nobelium 102	103 <b>Lr</b> Lawrencium 103		

**Key**

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

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

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