

Centre Number	Candidate Number	Name
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

COMBINED SCIENCE

0653/02

Paper 2

October/November 2004

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 in the spaces provided on the Question Paper.
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.

Answer **all** questions.
The number of marks is given in brackets [] at the end of each question or part question.
A copy of the Periodic Table is printed on page 20.

For Examiner's Use	
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If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

This document consists of **17** printed pages and **3** blank pages.



1 (a) Blood contains red cells, white cells and platelets.

(i) Describe how you can recognise red blood cells, apart from their colour, if you are looking at a blood sample using a microscope.

.....
[1]

(ii) What is the function of platelets?

.....[1]

(b) Fig. 1.1 is an outline of the human double circulatory system.

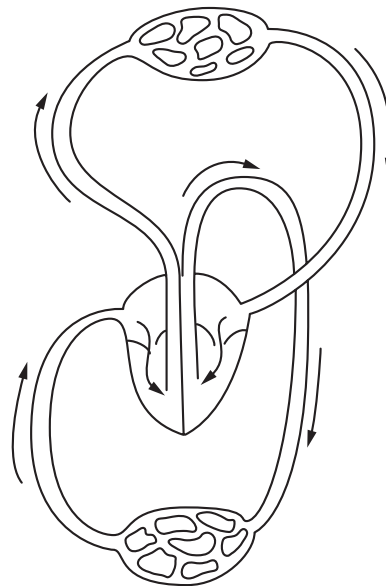


Fig. 1.1

(i) On the diagram,
 write the letter **O** where the blood becomes oxygenated;
 write the letter **A** on a vein which carries deoxygenated blood. [2]

(ii) The oxygenated blood goes back to the heart before it travels to the other parts of the body. Suggest why this is an advantage to the body.

.....

[2]

- (iii) People who smoke cigarettes take carbon monoxide into their lungs. The carbon monoxide diffuses into their blood and combines with haemoglobin inside the red blood cells.

Explain why this can be harmful to a person's health.

.....

.....

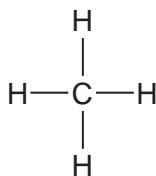
.....[2]

- 2 Petroleum (crude oil) is processed to make a very large number of important products. Table 2.1 shows information about some of the fractions obtained from petroleum during the process of fractional distillation.

Table 2.1

fraction	boiling range /°C	number of carbon atoms per molecule
petroleum gas	less than 20	1 to 4
gasoline	70 to 120	5 to 10
kerosene	120 to 170	10 to 16

- (a) One of the compounds in petroleum gas is methane. The displayed formula of methane is shown below.



- (i) State the number of chemical bonds shown in the formula of methane.

.....[1]

- (ii) Which type of chemical bonding is found in methane?

.....[1]

- (iii) Using methane as an example, describe **one** difference between an atom and a molecule.

.....

.....

.....[1]

- (b) The formula of another compound found in petroleum is shown in Fig. 2.1.

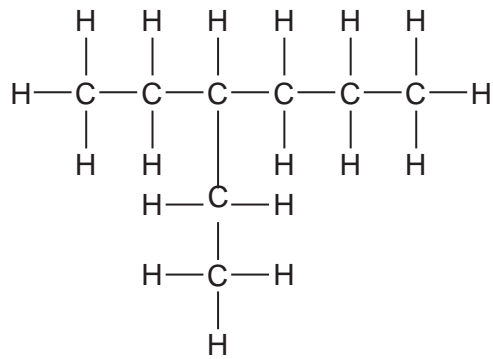


Fig. 2.1

- (i) Name the fraction in Table 2.1 in which this molecule is most likely to be found.
[1]
- (ii) Suggest **one** important use of the compound made of molecules like the one shown in Fig. 2.1.
[1]
- (c) Some of the compounds in petroleum are processed into different compounds which can then be converted into polymers. Polymers are used to make articles such as plastic bottles for drinks.
- (i) What name is given to small molecules which react to produce polymers?
[1]
- (ii) Suggest **one** advantage of using plastic rather than glass bottles for holding drinks.

[1]
- (iii) One method of disposing of unwanted plastic bottles is to burn them. A scientist studied the gases produced when a plastic bottle underwent complete combustion. She found that the only products of combustion were carbon dioxide and water.

Suggest which two elements were combined in the polymer molecules in the plastic bottles.

Explain your answer.

elements

explanation

.....

.....[3]

- 3 (a) A solid is made up of particles. In Fig. 3.1 one particle has been drawn. Draw eleven more particles to show the arrangement of particles in a solid.

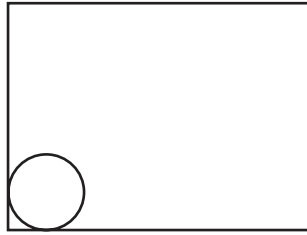


Fig. 3.1

[2]

- (b) Fig. 3.2 shows a block of solid copper.

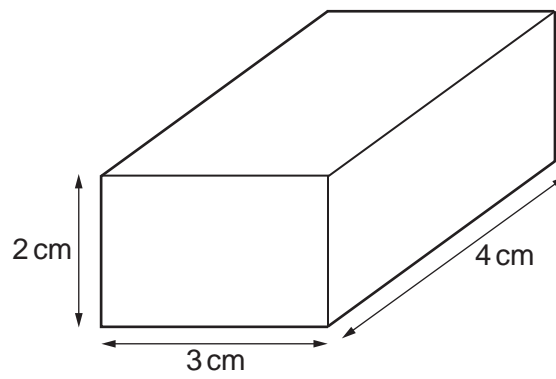


Fig. 3.2

The block has a mass of 212 g.

Calculate the density of the block using this formula.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Show your working and state the units of your answer.

.....[3]

(c) The block has a weight of 2.12 N and it is raised vertically by 3 m.

Calculate the work done when raising this block.

Show your working and state the formula that you use.

formula used

working

.....J [2]

(d) After the block is raised, it has gained energy.
Which form of energy is gained?

.....[1]

4 Fig. 4.1 shows an insect-pollinated flower.

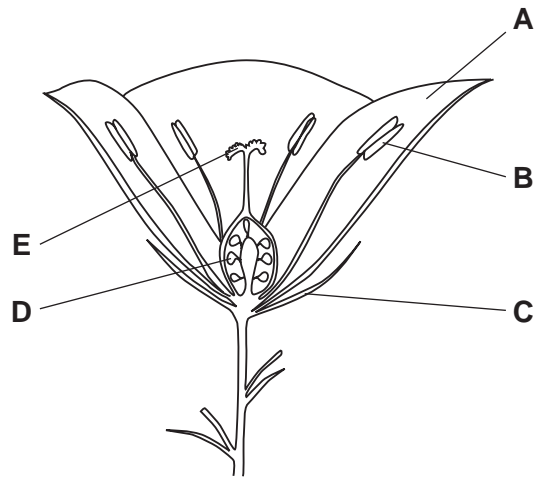


Fig. 4.1

- (a) Give the **letter** of the part of the flower which attracts insects to the flower;
- contains the female gametes.

[2]

(b) Describe how this flower could be pollinated.

.....

.....

.....

.....[3]

- (c) Apple trees are grown for their fruit. They have insect-pollinated flowers. Farmers often place hives of honey bees near the trees when the trees are flowering.

Table 4.1 shows the yield of apples from a tree where a hive was placed nearby, and also from a similar tree where this was not done.

Table 4.1

tree	fruit yield / kg
hive placed nearby	23
no hive placed nearby	3

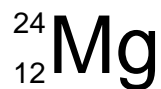
Suggest an explanation for these results.

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

- (d) Describe how you could test an apple for the presence of reducing sugars.

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

- 5 The full chemical symbol for the element magnesium is shown below.



- (a) (i) Draw a diagram of one atom of magnesium showing how all of the electrons are arranged.

[2]

- (ii) Using the Periodic Table on page 20, name the element whose atoms have two **fewer** protons than a magnesium atom.

.....[1]

- (iii) Is the element you have named in (ii) reactive or unreactive?

Explain your answer.

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

- (b) The list below shows some metals arranged in order of their reactivity. The element carbon has also been included.

sodium (most reactive)
calcium
magnesium
aluminium
carbon
lead
copper (least reactive)

A student investigates redox reactions between carbon and the oxides of some of the metals in the list. The experiments he carries out are shown in Fig. 5.1.

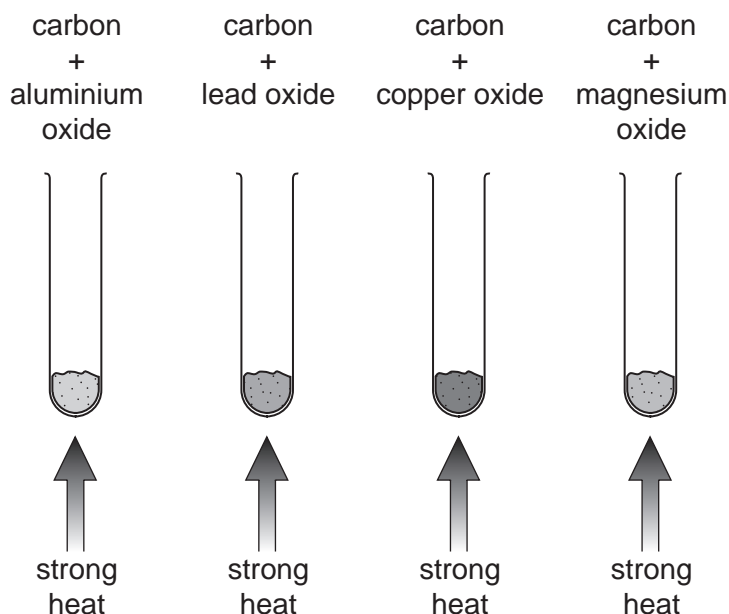


Fig. 5.1

State **two** mixtures shown in Fig. 5.1 in which the metal oxide will be reduced.

.....[1]

- (c) The metal oxides in (b) are ionic compounds.

(i) Describe, in terms of electrons, the difference between a sodium atom and a sodium ion.

.....[1]

(ii) Explain why the sodium ions and the oxide ions in sodium oxide bond together.

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

(iii) Write a word equation for the reaction in which sodium oxide is formed from sodium.

.....[1]

- 6 (a) A Geiger counter is used to investigate a radioactive source.

The Geiger counter is clamped in position and the count rate measured.

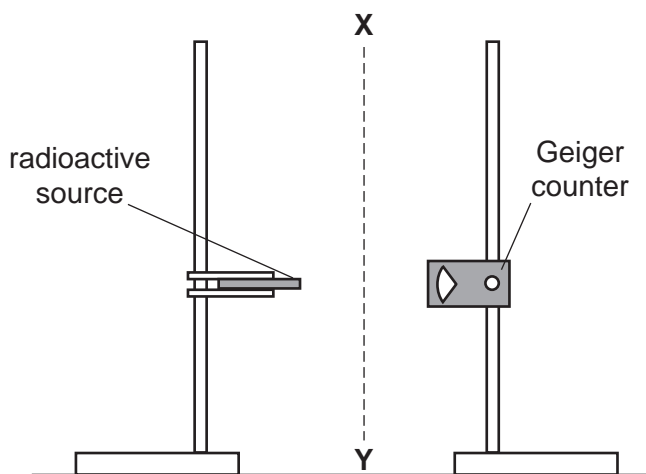


Fig. 6.1

The radioactive source is clamped facing the Geiger counter as shown in Fig. 6.1, and the count rate is measured again.

The count rate is measured twice more, once with a sheet of paper placed between X and Y and then with a 4 mm thick sheet of aluminium placed between X and Y.

The results are shown in Table 6.1.

Table 6.1

experiment		counts per minute
1	with no source present	12
2	with source only as shown in Fig. 6.1	196
3	with source and sheet of paper placed between X and Y	72
4	with source and a 4 mm thick sheet of aluminium placed between X and Y	72

- (i) Explain why the Geiger counter gave a reading when no source was present.

.....
 [1]

- (ii) Calculate the count rate due to the source.

.....
counts per minute [1]

(iii) The count rate calculated in (ii) is **not** the total radioactivity emitted by the source.

Explain this statement.

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

(iv) In experiment 3, some of the radiation emitted by the source was stopped by the sheet of paper.

Suggest the type of radiation that was stopped.

.....[1]

(v) Name the other type of radiation that is emitted by the source.

Explain your answer.

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

(vi) State **one** precaution needed when handling radioactive materials.

.....[1]

(b) An atom of radon-220 decays by emitting an alpha particle.

(i) What is an alpha particle?

.....[1]

(ii) State two properties of an alpha particle.

1
2[2]

(c) Energy can be released from atoms during both nuclear fission and nuclear fusion.

Describe what happens to the nuclei of atoms during

(i) nuclear fission,[1]

(ii) nuclear fusion.
.....[1]

7 Fig trees grow in tropical rainforests. Fig trees provide food for monkeys and birds such as toucans. These animals may be eaten by eagles.

(a) (i) Construct a food web showing the feeding relationships between these four organisms.

[2]

(ii) What term is used to describe all the organisms in this food web, other than the fig trees?

.....[1]

(b) Photosynthesis takes place in the leaves of the fig trees.



Explain how photosynthesis transfers energy from sunlight into chemical energy.

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

(c) Describe the role of decomposers in an ecosystem such as a tropical rainforest.

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

(d) Tropical rainforests in many parts of the world are being destroyed by logging. Give **two** reasons why the conservation of tropical rainforests is important.

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

- 8 (a) A student used the apparatus shown in Fig. 8.1 to study the reaction between dilute hydrochloric acid and copper carbonate.

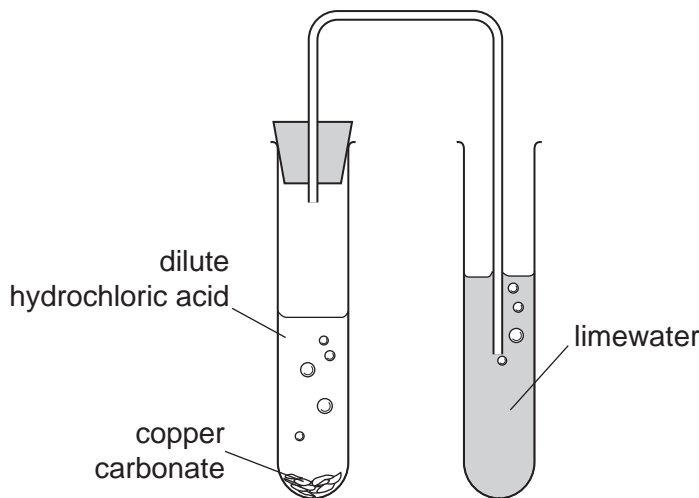


Fig. 8.1

- (i) State and explain what is observed in the test-tube containing limewater.

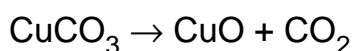
.....

[2]

- (ii) Name the salt produced when dilute hydrochloric acid reacts with copper carbonate.

.....[1]

- (b) The equation below shows what happens when copper carbonate is heated.



Kai-Yee describes this reaction as combustion but her friend Aysha says this is incorrect and that the reaction is an example of thermal decomposition.

Explain which student is correct.

.....

[2]

- (c) Many carbonates, such as calcium carbonate and sodium carbonate, are white solids.

Suggest whether or not copper carbonate is also likely to be a **white** solid.

Explain your answer briefly.

.....
[2]

- 9 (a) An experiment is carried out to find out which of two teapots emits more infra-red radiation. Teapot **X** is black and dull. Teapot **Y** is silvery and shiny. The two teapots are otherwise identical.

Fig. 9.1 shows teapot **Y**.



teapot **Y**

Fig. 9.1

Both teapots are filled with the same amount of boiling water.

- (i) State two ways, other than by emitting infra-red radiation, by which energy is lost from both teapots.

1

2[2]

- (ii) The water in teapot **Y** cools more slowly than the water in teapot **X**.

Explain why this happens.

.....
[1]

- (iii) A cover made of wool or other material is often placed over a teapot to help to keep the contents hot for longer.

Explain **one** way by which the cover slows down the rate of cooling of a pot of hot water.

.....

[2]

- (b) Infra-red radiation and visible light are two regions of the electromagnetic spectrum. Name **one** other region of the electromagnetic spectrum and state a use for it.

region

use[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
3	4	7 Li Lithium	9 Be Beryllium		6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11	12	23 Na Sodium	24 Mg Magnesium	13 Al Aluminium	14 Si Silicon	15 P Phosphorus	16 S Sulphur	17 Cl Chlorine	18 Ar Argon
19	20	39 K Potassium	40 Ca Calcium	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37	38	85 Rb Rubidium	88 Sr Strontium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55	56	133 Cs Caesium	137 Ba Barium	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87	88	226 Fr Francium	226 Ra Radium	80 Hg Mercury	79 Au Gold	78 Pt Platinum	77 Ir Iridium	76 Os Osmium	75 Re Rhenium
				201 Zn Zinc	197 Cu Copper	195 Pd Palladium	192 Rh Rhodium	190 Ru Ruthenium	186 Rh Rhenium
				30 Zn Zinc	29 Cu Copper	28 Ni Nickel	27 Co Cobalt	26 Fe Iron	25 Mn Manganese
				48 Ti Titanium	45 Sc Scandium	46 V Vanadium	47 Cr Chromium	44 Ru Ruthenium	43 Tc Technetium
				72 Hf Hafnium	71 Y Yttrium	70 Zr Zirconium	69 Nb Niobium	68 Ru Ruthenium	67 Tc Technetium
				106 Pd Palladium	105 Rh Rhodium	104 Pt Platinum	103 Rh Rhodium	102 Ru Ruthenium	101 Tc Technetium
				112 Cd Cadmium	111 Ag Silver	110 Pd Palladium	109 Rh Rhodium	108 Ru Ruthenium	107 Tc Technetium
				159 Tb Terbium	157 Gd Gadolinium	156 Eu Europium	155 Sm Samarium	154 Pm Promethium	153 Nd Neodymium
				97 Bk Berkelium	96 Cm Curium	95 Am Americium	94 Pu Plutonium	93 Np Neptunium	92 U Uranium
				162 Dy Dysprosium	161 Ho Holmium	160 Er Erbium	159 Tm Thulium	158 Yb Ytterbium	157 Lu Lutetium
				82 Pb Lead	81 Tl Thallium	80 Pb Lead	79 Bi Bismuth	78 Po Polonium	77 At Astatine
				100 Fm Fermium	99 Es Einsteinium	98 Cf Californium	97 Bk Berkelium	96 Cm Curium	95 Am Americium
				102 No Nobelium	101 Md Mendelevium	100 Fm Fermium	99 Es Einsteinium	98 Cf Californium	97 Bk Berkelium
				103 Lr Lawrencium	102 No Nobelium	101 Md Mendelevium	100 Fm Fermium	99 Es Einsteinium	98 Cf Californium
				175 Lu Lutetium	174 Yb Ytterbium	173 Er Erbium	172 Tm Thulium	171 Lu Lutetium	170 Lr Lawrencium
				103 Lr Lawrencium	102 No Nobelium	101 Md Mendelevium	100 Fm Fermium	99 Es Einsteinium	98 Cf Californium

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

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.).