

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	
1	
2	
3	
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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.

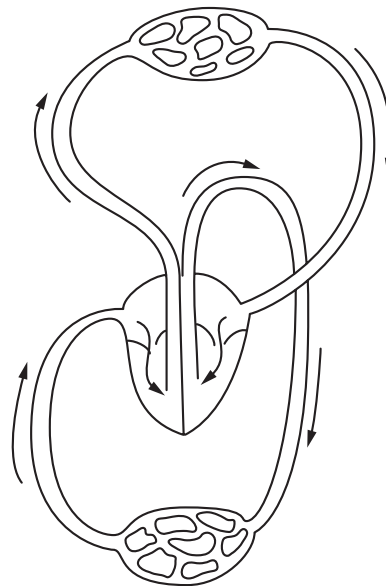


Fig. 1.1

(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.

.....

.....

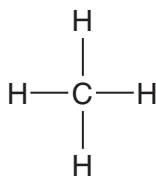
.....[2]

- 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.

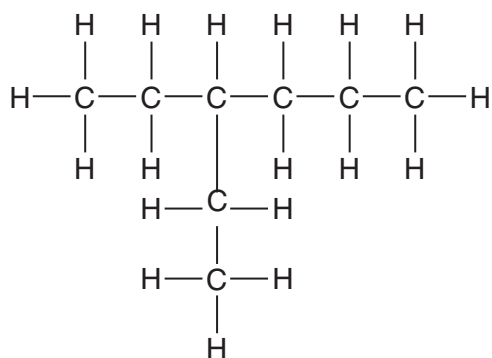


Fig. 2.1

- (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.

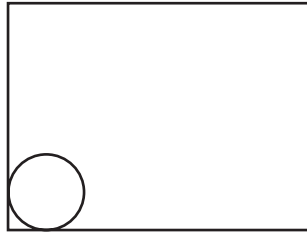


Fig. 3.1

[2]

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

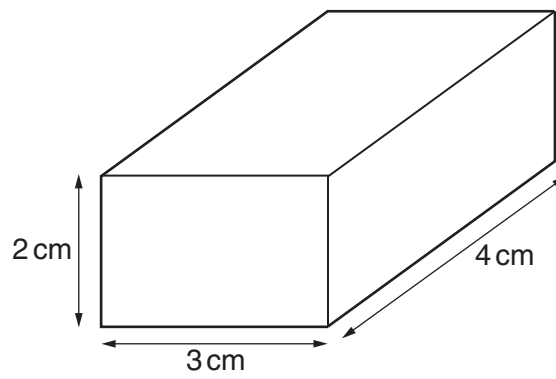


Fig. 3.2

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.

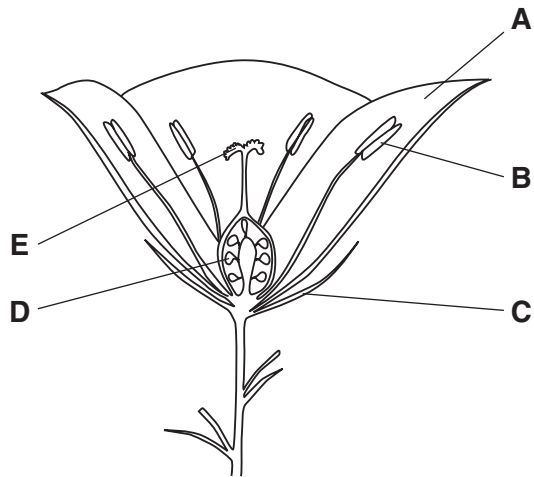


Fig. 4.1

- (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]

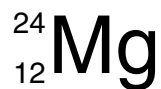
- (d) Describe how you could test an apple for the presence of reducing sugars.

.....

.....

.....[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.

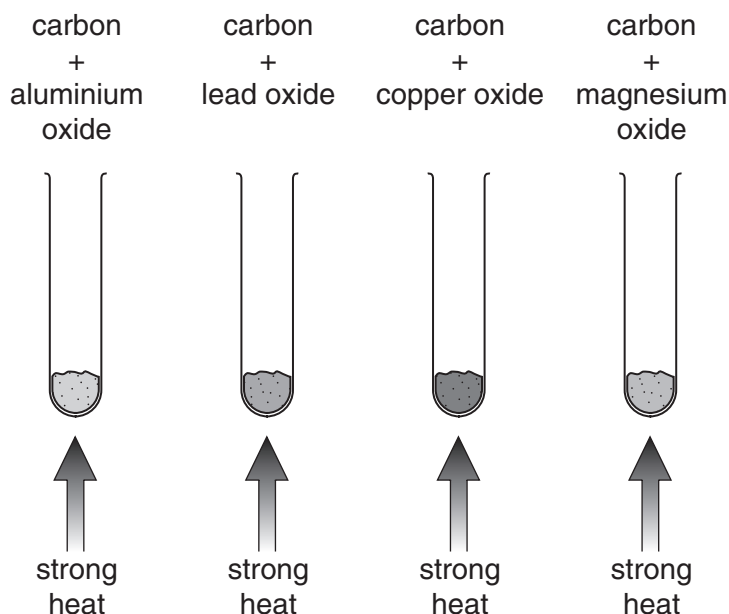


Fig. 5.1

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.

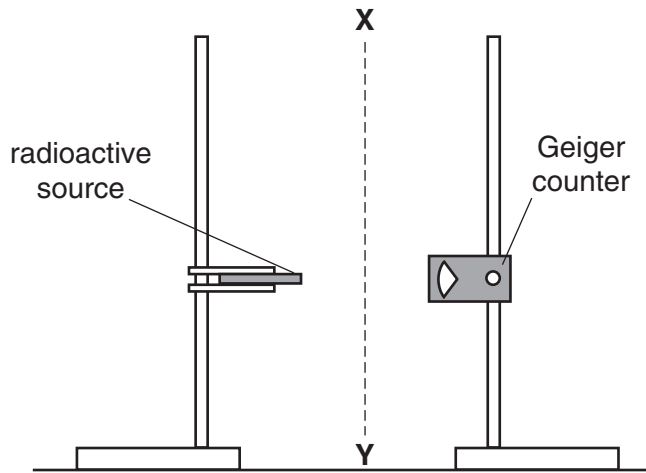


Fig. 6.1

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 <b>X</b> and <b>Y</b>	72
4	with source and a 4 mm thick sheet of aluminium placed between <b>X</b> and <b>Y</b>	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.

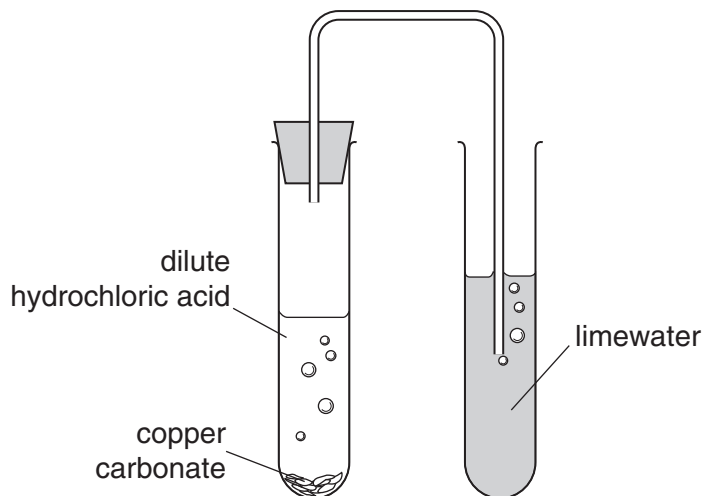


Fig. 8.1

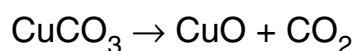
- (i) State and explain what is observed in the test-tube containing limewater.

.....  
 .....  
 .....[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			
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	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	4 <b>He</b> Helium 2		
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> Sulphur 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	45 <b>Sc</b> Scandium 21	48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	52 <b>Cr</b> Chromium 24	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	89 <b>Y</b> Yttrium 39	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> Lanthanum 57	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	190 <b>Os</b> Osmium 76	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89									

140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	162 <b>Dy</b> Dysprosium 66	165 <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
232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92	238 <b>Np</b> Neptunium 93	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103

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

a	<b>X</b>	b
---	----------	---

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

**Key**

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