

Centre Number	Candidate Number

Candidate Name \_\_\_\_\_

**International General Certificate of Secondary Education  
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE**

**COMBINED SCIENCE**

**0653/3**

**PAPER 3**

**OCTOBER/NOVEMBER SESSION 2001**

1 hour 15 minutes

Candidates answer on the question paper.  
No additional materials are required.

**TIME** 1 hour 15 minutes

**INSTRUCTIONS TO CANDIDATES**

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

**INFORMATION FOR CANDIDATES**

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 16.

<b>FOR EXAMINER'S USE</b>	
<b>1</b>	
<b>2</b>	
<b>3</b>	
<b>4</b>	
<b>5</b>	
<b>6</b>	
<b>7</b>	
<b>8</b>	
<b>9</b>	
<b>TOTAL</b>	

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**This question paper consists of 16 printed pages.**

1 (a) Fig. 1.1 shows a man looking into a mirror, as seen from above.

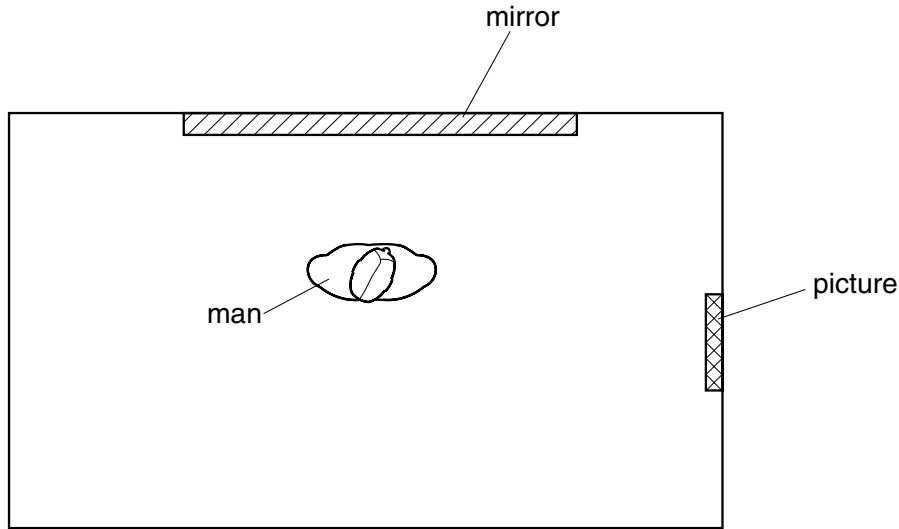


Fig. 1.1

There is a picture on the wall.

- (i) By making an accurate drawing, show that a ray of light, which passes from the picture and is reflected in the mirror, enables the man to see an image of the picture. [2]
- (ii) Label clearly the angle of incidence of the ray at the mirror. [1]
- (iii) Mirrors produce virtual images.

Explain the meaning of the term *virtual image*.

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

(b) Light waves are part of the electromagnetic spectrum. This means that they are transverse waves which can travel through a vacuum. The frequency and wavelength of electromagnetic waves change across the electromagnetic spectrum.

- (i) Explain what a *transverse* wave is.  
 .....  
 ..... [2]

(ii) State the speed at which all electromagnetic waves travel through a vacuum.  
 ..... [1]

- (iii) Explain the meaning of the terms  
*frequency*, .....  
 .....  
*wavelength*. .....  
 ..... [2]

2 Complete the passage by writing suitable words in the spaces.

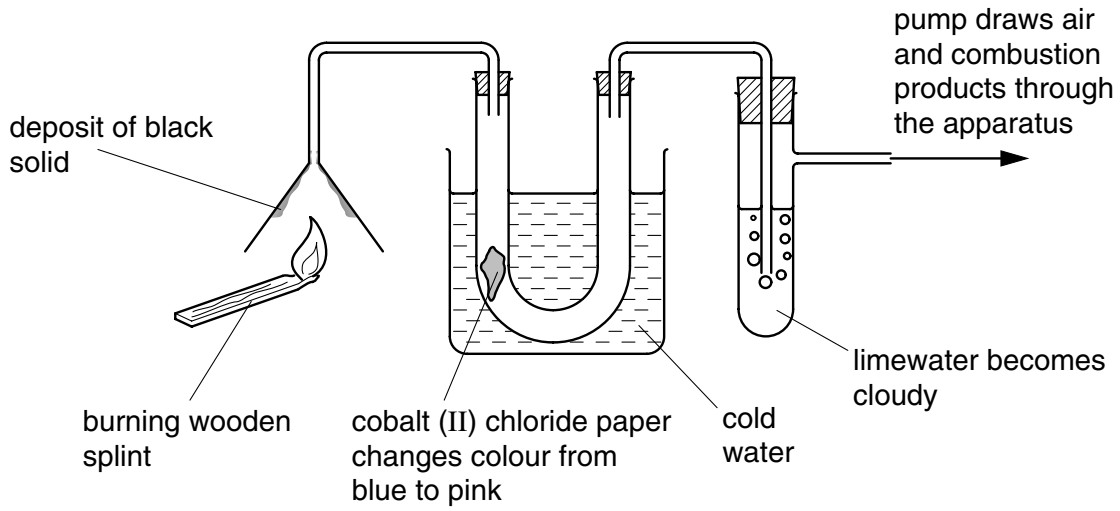
White blood cells help to fight against pathogens, which are organisms that cause ..... . Phagocytes are white cells that ingest and destroy pathogens, but ..... are white cells that secrete chemicals called antibodies.

The first time a particular kind of pathogen enters the body, it takes some time for the white cells to recognise it and produce the appropriate antibody to destroy it. However, if the person recovers from this infection, they will probably have become ..... to the disease, because large numbers of the white cells that secrete this antibody remain in the blood. Another way of achieving this is by .....

White blood cells treat any 'foreign' cells as though they were pathogens, and so will attack and destroy tissue introduced into the body during a transplant operation. The chances of this happening can be reduced by choosing a ..... as the donor of the organ, and also by using ..... drugs. [6]

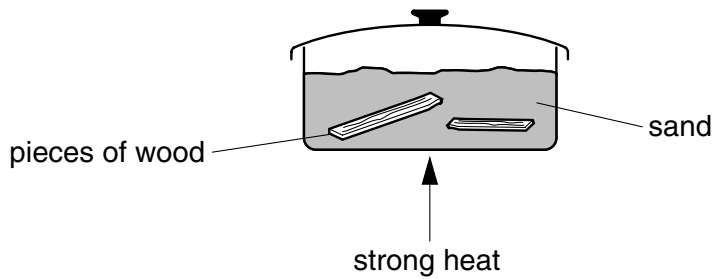
- 3 The reactions in experiments **A** and **B**, shown in Figs. 3.1 and 3.2, involve cellulose, which is a carbohydrate found in wood.

**experiment A**



**Fig. 3.1**

**experiment B**



**Fig. 3.2**

- (a) Name two products formed during experiment **A**. State the evidence shown in Fig. 3.1 for the products you have named.

*name of product* .....

*evidence* .....

.....

*name of product* .....

*evidence* .....

..... [4]

(b) (i) When experiment **B** is finished, the pieces of wood have changed into charcoal. Charcoal contains mainly the element carbon.

Suggest and explain how the mass of the charcoal compares with the mass of the wood before the reaction.

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

(ii) During experiment **B**, energy is absorbed by the chemical bonds in the cellulose molecules in the wood.

State what is caused by this energy within the cellulose molecules during the reaction in experiment **B**.

..... [1]

(c) What types of chemical reaction are taking place during experiments **A** and **B**?

*experiment A* .....

*experiment B* ..... [2]

- 4 (a) Complete the table in Fig. 4.1 to describe and explain some of the differences between insect-pollinated and wind-pollinated flowers. The first row has been done for you.

feature	insect-pollinated flower		wind-pollinated flower	
	description	explanation	description	explanation
position of anthers	inside the ring of petals	so that insects brush against them and pick up pollen	hanging outside the petals	so that the wind can blow them and carry pollen away
appearance of petals				
appearance of stigma				

[4]

Fig. 4.1

(b) Fig. 4.2 shows a gardener taking cuttings of some plants, in order to propagate them.



**Fig. 4.2**

(i) Suggest why gardeners often take cuttings, rather than allowing the plants to reproduce sexually.

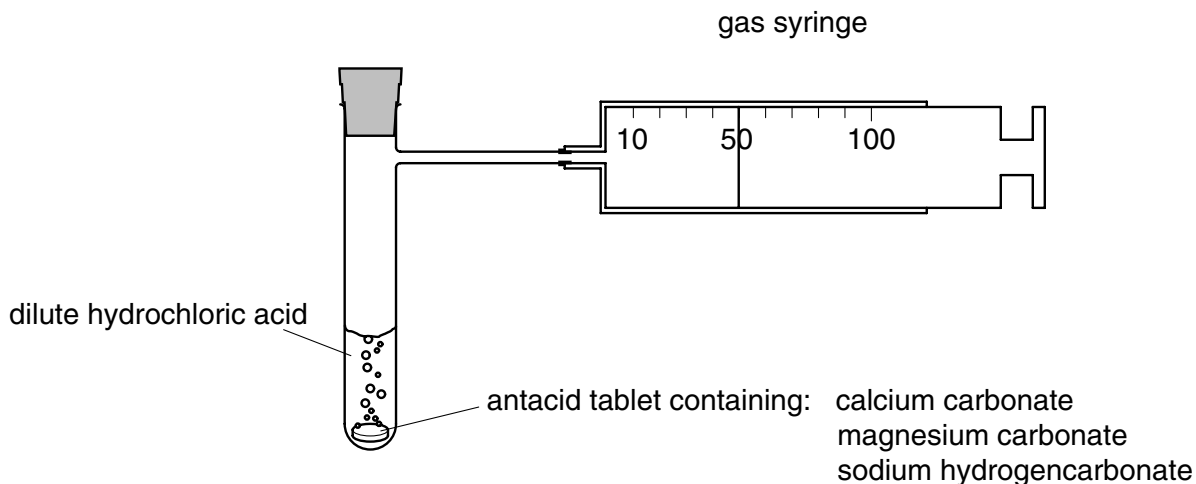
.....  
.....  
.....  
..... [2]

(ii) When the cuttings have been taken, the lower end of the stem is placed in soil and left for several weeks so that it will grow roots. During this time, the cuttings are covered with transparent plastic bags.

Suggest why it is necessary to cover the cuttings until they have grown roots.

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

- 5 The apparatus in Fig. 5.1 can be used to measure the rate of reaction between an antacid tablet and dilute hydrochloric acid.



**Fig. 5.1**

- (a) (i) Name **one** salt which will be present in the mixture at the end of the reaction.

..... [1]

- (ii) Write the formula, including the charge, of an ion which is present in dilute hydrochloric acid and also in dilute sulphuric acid. Do **not** write an equation.

..... [1]

- (b) A student uses the apparatus in Fig. 5.1 to investigate what happens to the rate of reaction when the temperature of the acid is changed. In each experiment, she uses one antacid tablet and the same volume and concentration of acid.

Her results are shown in the table in Fig. 5.2.

experiment	temperature / °C	time to collect 50 cm <sup>3</sup> of gas / s
1	20	350
2	25	210
3	32	150
4	40	80

**Fig. 5.2**

- (i) Explain these results in terms of collisions between particles in the mixture.

.....  
 .....  
 .....  
 .....

[3]

(ii) Explain briefly, in terms of collisions between particles, how a change in the concentration of the acid could also change the rate of this reaction, even if the temperature of the acid is kept constant.

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

6 (a) During radioactive decay, three types of radiation may be emitted, alpha, beta and gamma.

Describe **one** way in which you could distinguish between alpha-radiation and gamma-radiation.

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

(b) Describe **one** way in which radiation can be harmful to humans.

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

(c) Electricity can be generated by nuclear fission.

Describe what happens to an atom during nuclear fission.

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

(d) Energy from nuclear fission may be converted into electrical energy. The first stage of this process is the conversion of nuclear energy into heat energy.

Describe how the heat energy is converted into electrical energy.

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

7 Fig. 7.1 shows a woman in a supermarket filling a shelf with 2 kg bags of sugar.



Fig. 7.1

She lifts 60 bags of sugar to a height of 1.5 m in 5 minutes.

- (a) (i) Calculate the work done by the woman in lifting the bags of sugar from the ground to the shelf.  
Show your working and state any formula that you use.

..... [3]

- (ii) Calculate the average power input by the woman into lifting the bags of sugar.  
Show your working and state any formula that you use.

..... [3]

(b) (i) A machine is able to do the same job in 15 seconds.

Has the machine done more, less or the same amount of work as the woman on the bags of sugar? Explain your answer.

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

(ii) Is the power input to lifting the bags by the machine more, less or the same as that of the woman? Explain your answer.

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

(c) Fig. 7.2 shows two bags of sugar, **A** and **B**.

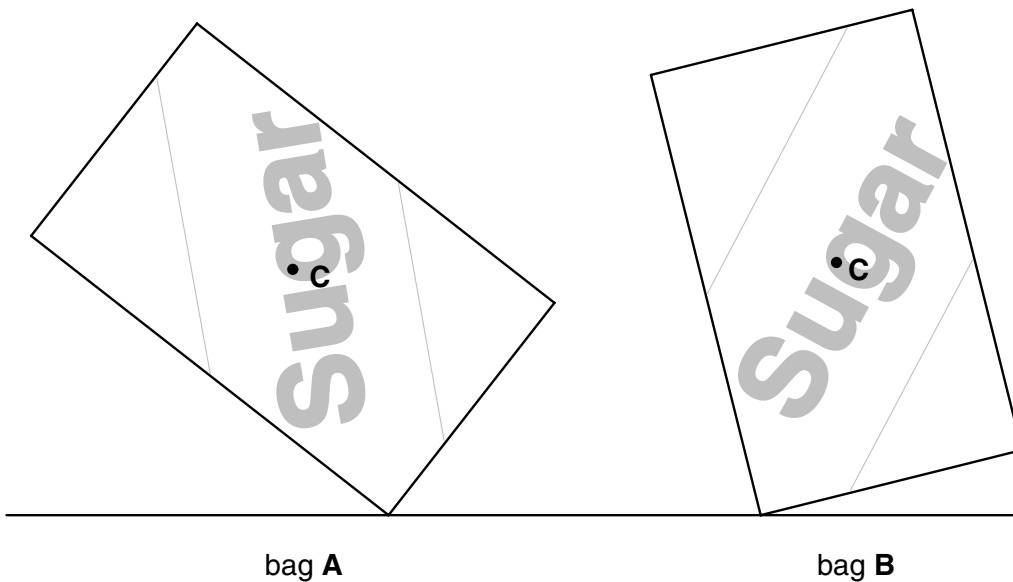


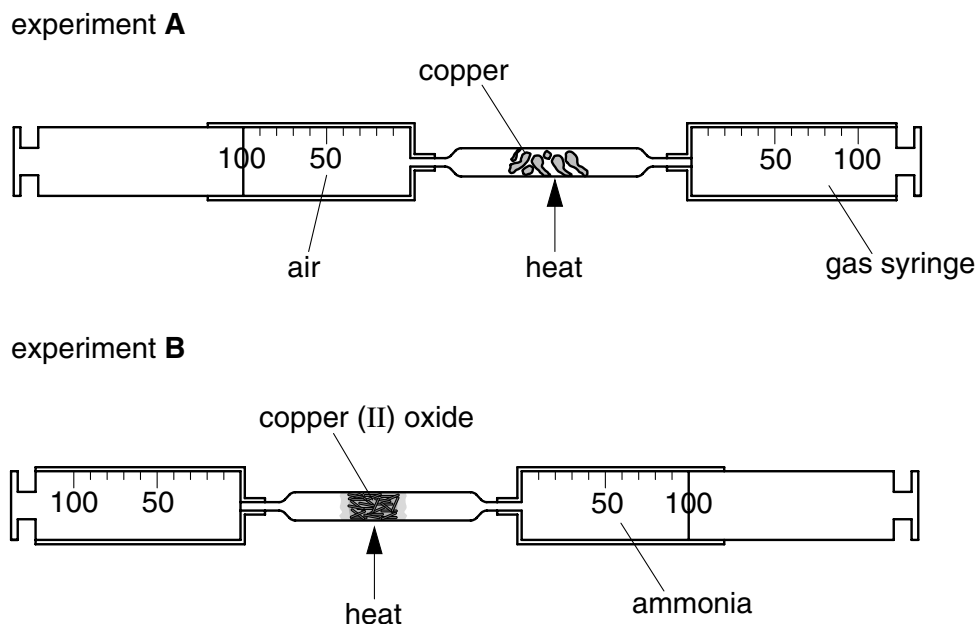
Fig. 7.2

The centres of mass of each bag are labelled **C**.

Explain why bag **A** will fall on to its side but bag **B** will not.

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

- 8 Fig. 8.1 shows two experiments, **A** and **B**, in which a gas is passed through a heated solid using gas syringes. The gas syringes are used to push gas forwards and backwards several times through the heated solid.



**Fig. 8.1**

In experiment **A**, air is passed through heated copper.

In experiment **B**, ammonia is passed through heated copper(II) oxide.

- (a) In experiment **A**, the copper turns black and the volume of the gas in the apparatus decreases.

- (i) Name the **two** gases which together make up nearly 99% by volume of air.

..... [1]

- (ii) Write a **word** equation for the reaction that occurs in experiment **A**.

..... [1]

- (iii) Explain why the volume of gas in the apparatus in experiment **A** decreases to a value of about  $79 \text{ cm}^3$  but does **not** decrease any further.

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

(b) In experiment **B**, the copper(II) oxide is changed into copper when it reacts with the ammonia.

(i) Ammonia,  $\text{NH}_3$ , is a covalent compound.

In the space below, draw a dot and cross diagram to show how the outer electrons of each atom are arranged in an ammonia molecule.

[2]

(ii) In experiment **B**, two ammonia molecules react with copper(II) oxide,  $\text{CuO}$ , to produce one nitrogen molecule,  $\text{N}_2$ , three water molecules and three copper atoms.

Use this information to construct a balanced symbol equation for the reaction.

..... [2]

(c) In which experiment, **A** or **B**, is the heated solid **reduced** when it reacts with the gas passing through it? Explain your answer.

.....

..... [1]

- 9 A survey was carried out in a tropical rain forest in south-east Asia, to investigate the effects of logging (cutting down trees) on the populations of gibbons (a species of ape), maroon langurs and white-fronted langurs (two species of monkeys).

The site on which the logging took place was on a steep slope with thin soil and high rainfall. Trees were cut down using chainsaws and they were then dragged out of the forest using large tractors.

The numbers of groups of the three species of animals on the site were counted:

- before logging started
- immediately after logging
- 2 years after logging
- 4 years after logging

The results are shown in Fig. 9.1.

species	groups per km <sup>2</sup>			
	before logging	immediately after logging	2 years after logging	4 years after logging
gibbons	4.73	1.36	2.08	2.00
maroon langurs	0.38	0.21	1.25	0.05
white-fronted langurs	0.87	0.57	0.58	1.50

**Fig. 9.1**

(a) (i) Which species has suffered the greatest percentage decrease in numbers four years after logging?

..... [1]

(ii) Describe the effect of logging on the population of gibbons, and suggest an explanation for this.

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

(b) Describe and explain the possible effects of the logging operations on the soil in this area.

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

(c) The loss of trees over large areas could increase the amount of carbon dioxide in the atmosphere.

Explain why this is so.

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

(d) Suggest why some governments allow logging to take place, despite its harmful effects on animals, soil and the atmosphere.

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

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

		Group													
I	II	III	IV	V	VI	VII	O								
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	13 <b>Al</b> Aluminium 13	27 <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	55 <b>Mn</b> Manganese 25	59 <b>Co</b> Cobalt 27	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	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	89 <b>Y</b> Yttrium 39	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54	
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	186 <b>Re</b> Rhenium 75	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	210 <b>Po</b> Polonium 84	210 <b>Rn</b> Radon 86	
87 <b>Fr</b> Francium	88 <b>Ra</b> Radium	226 <b>Ac</b> Actinium													

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	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>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	244 <b>Pu</b> Plutonium 94	244 <b>Am</b> Americium 95	244 <b>Cm</b> Curium 96	244 <b>Bk</b> Berkelium 97	244 <b>Cf</b> Californium 98	244 <b>Es</b> Einsteinium 99	244 <b>Fm</b> Fermium 100	244 <b>Md</b> Mendelevium 101	244 <b>No</b> Nobelium 102	244 <b>Lr</b> Lawrencium 103

a	<b>X</b>
b	

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

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

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