

Candidate Name _____

Centre Number	Candidate Number

International General Certificate of Secondary Education
CAMBRIDGE INTERNATIONAL EXAMINATIONS
COMBINED SCIENCE
PAPER 3

0653/3

OCTOBER/NOVEMBER SESSION 2002

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.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

This question paper consists of 15 printed pages and 1 blank page.



1 (a) The table in Fig. 1.1 lists two features that are found in blood vessels.

Complete the table by putting a tick if the feature is present, and a cross if it is not. Do not leave any boxes in the table blank.

feature	arteries	veins	capillaries
valves present			
walls are one cell thick			

Fig. 1.1 [3]

(b) Oxygen is carried in the blood from the lungs to the rest of the body inside the red blood cells.

Explain how each of the following features of red blood cells helps them to carry out their function.

(i) Red blood cells have no nucleus.

.....

[2]

(ii) Red blood cells are shaped like biconcave discs.

.....

[2]

(c) When a person is exercising, the blood is not always able to transport oxygen to the muscles as fast as they need it.

Explain what happens in the muscles if they do not get enough oxygen.

.....

[2]

2 The isotope thorium-228 decays by emitting alpha radiation and gamma radiation. Thorium-228 has a half-life of 1.91 years.

(a) Explain the meaning of the terms *radioactive decay* and *half-life*.

radioactive decay
.....
half-life
.....[2]

(b) 0.400 mg of thorium-228 decays until 0.025 mg remain. Calculate how long this takes. Show your working.

.....[2]

(c) Explain how you would be able to tell the difference between alpha and beta particles in an electric field.

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

(d) When alpha particles pass through materials, they cause ionisation. Explain how this ionisation is caused.

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

- 3 Hydrogen gas is formed when magnesium reacts with dilute sulphuric acid.
The apparatus shown in Fig. 3.1 can be used to study the rate of this reaction.

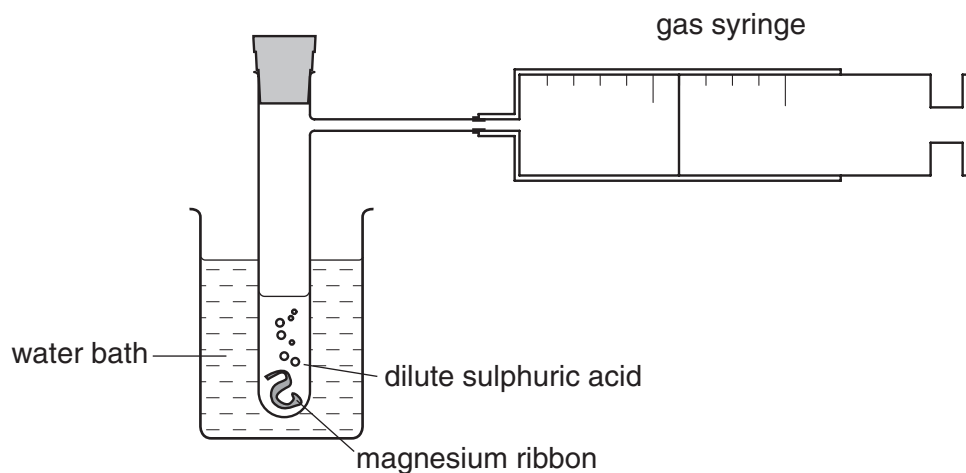


Fig. 3.1

A student carried out a **fair test** to find out how the temperature of the sulphuric acid affected the rate of reaction. He added magnesium ribbon to excess sulphuric acid.

He carried out two experiments, **A** and **B**, the results of which are shown in Fig. 3.2.

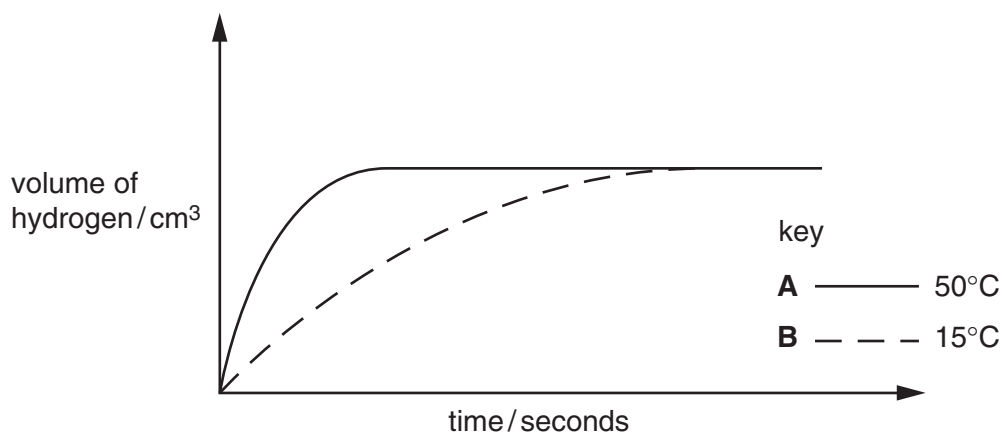


Fig. 3.2

- (a) (i) State **one** of the variables the student must keep the same in both experiments, **A** and **B**, so that he carries out a fair test.

.....[1]

- (ii) Explain why the volume of hydrogen that is eventually formed is the same in both **A** and **B**.

.....

.....[1]

- (b) (i) What conclusion can the student make about the effect of temperature on reaction rate?

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

- (ii) Explain the results of these experiments in terms of the collisions between particles.

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

- (c) (i) Complete the word equation below.

magnesium + sulphuric acid →

[1]

- (ii) Write the formula of an ion, showing its symbol and charge, whose concentration decreases during the reactions in experiments **A** and **B**.

.....[2]

- 4 Read the passage about DDT, and then use the information in the passage and your own knowledge to answer the questions which follow.

DDT is a pesticide that has been used in many parts of the world to kill insect pests, including the mosquitoes that transmit malaria. DDT is very harmful to insects, but not harmful to other animals unless it is present in high concentrations. It is not very soluble in water, and it only breaks down very slowly.

The table shows the concentration of DDT in some parts of Lake Michigan in the USA, and in the bodies of some of the animals that live there. A lot of DDT was used in this area in the 1960s to kill insect pests on fruit trees.

<i>area or animal</i>	<i>concentration of DDT/parts per million</i>
water in the lake	0.00002
mud at the bottom of the lake	0.014
small invertebrates in the lake	0.410
herring gulls	99
peregrine falcons (birds of prey)	5000

Human deaths from malaria have greatly decreased since DDT was introduced in the 1940s. However, many people are worried that high concentrations of DDT are very harmful to animals, and so its use has now been banned. People are trying to find other ways of killing mosquitoes, including biological control.

(a) Explain why DDT is still present in Lake Michigan, even though its use was stopped in that area in 1973.

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

(b) Suggest why the concentration of DDT in the bodies of peregrine falcons is so much greater than that in the water of the lake.

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

(c) (i) Explain what is meant by the term *biological control*.

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

(ii) Describe one example of the use of biological control.

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

5 Fig. 5.1 shows a ray of light passing through a glass block.

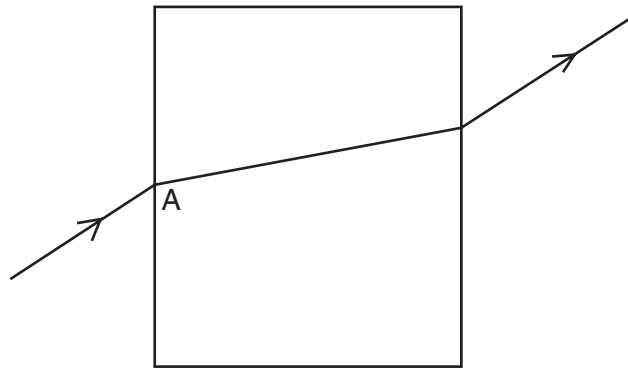


Fig. 5.1

(a) On Fig. 5.1 draw the normal at point A.
Label the angle of incidence and the angle of refraction. [2]

(b) If the angle of incidence is 40° , what can be deduced about the value of the angle of refraction?

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

(c) The three diagrams A, B and C, shown in Fig. 5.2 show what happens when rays of light in a perspex block reach the surface of the block at different angles.

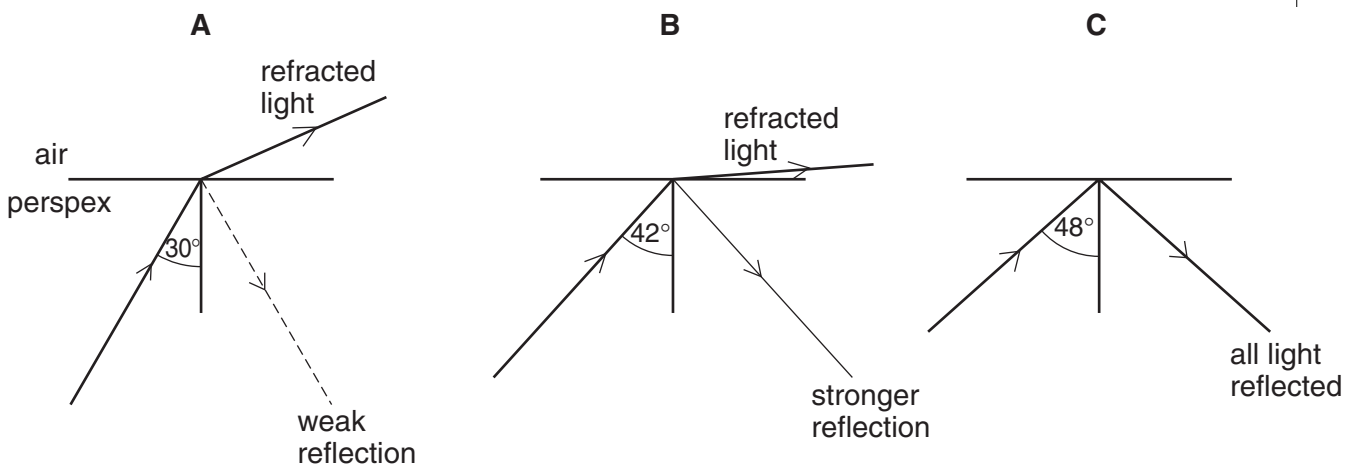


Fig. 5.2

Use these diagrams to explain the meaning of the terms *total internal reflection* and *critical angle*.

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

(d) A camera lens has a focal length of 3 cm and produces a real image on the film in the camera.

(i) Explain what is meant by a *focal length of 3 cm*. You may draw a diagram if you wish.

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

(ii) How does a real image differ from a virtual image?

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

- 6 Sodium metal can be produced by electrolysis, using an electrolyte of molten sodium chloride. Fig. 6.1 shows a simplified version of the apparatus.

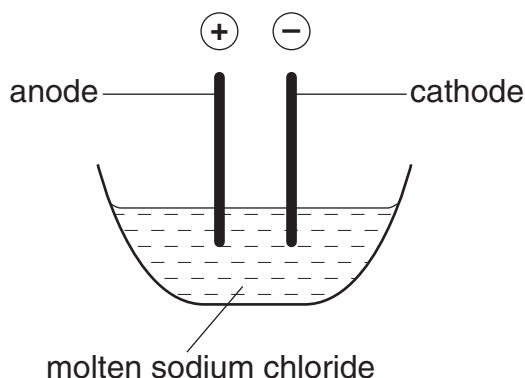


Fig. 6.1

- (a) An electric current is the flow of charged particles through a conductor.
An electrolyte is a liquid which conducts an electric current.

- (i) What are the charged particles which flow through the electrolyte during the electrolysis of sodium chloride?

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

- (ii) Describe, in terms of ions, electrons and atoms, how sodium atoms form at the cathode during the electrolysis of molten sodium chloride.

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

- (iii) Explain why an electrolyte made of an aqueous solution of sodium chloride would not produce any sodium.

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

- (b) Sodium atoms are converted into sodium ions when sodium reacts with water. The equation for this reaction is shown below.



- (i) Explain why sodium atoms are said to be oxidised in this reaction.

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

- (ii) If the water contains Universal Indicator before the sodium is added, describe and explain the colour change which is seen as the result of the reaction.

.....

[2]

- 7 Fig. 7.1 shows a piece of the epidermal tissue of an onion bulb, before and after it was placed in a concentrated sugar solution.

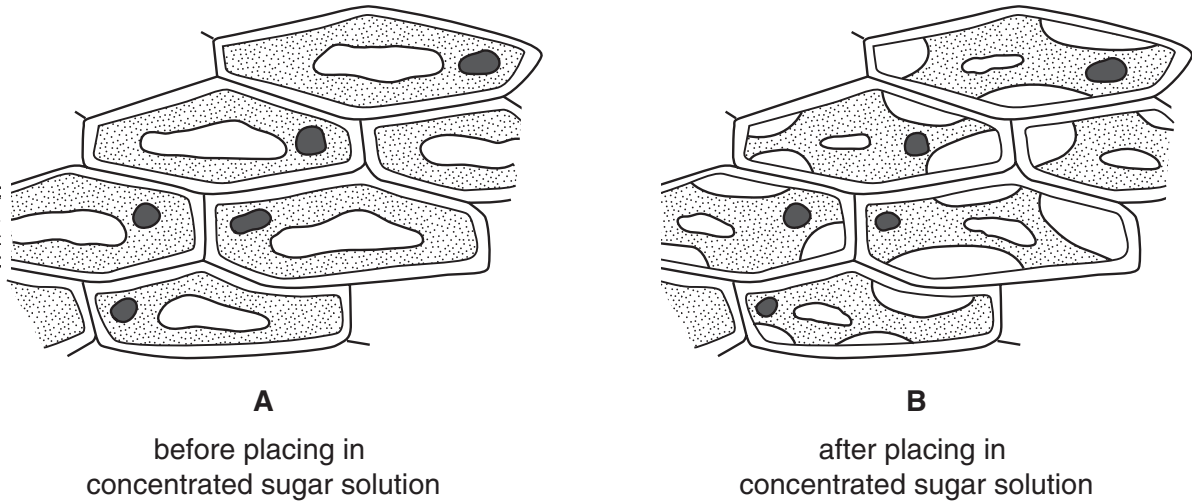


Fig. 7.1

- (a) Explain the meaning of the term *tissue*.

.....
[2]

- (b) On diagram **A**, draw a label line to a partially permeable membrane, and label it **P**. [1]

- (c) Explain why the cytoplasm and vacuoles in the cells in diagram **B** have a smaller volume than in diagram **A**.

.....

[4]

- (d) Explain why an animal cell bursts if it is placed into distilled water, but a plant cell does not.

.....

[2]

- 8 A stone weighing 0.5 N is dropped from a height of 300 m above the ground. Fig. 8.1 shows the motion of the stone for the first 7 seconds after it is released.

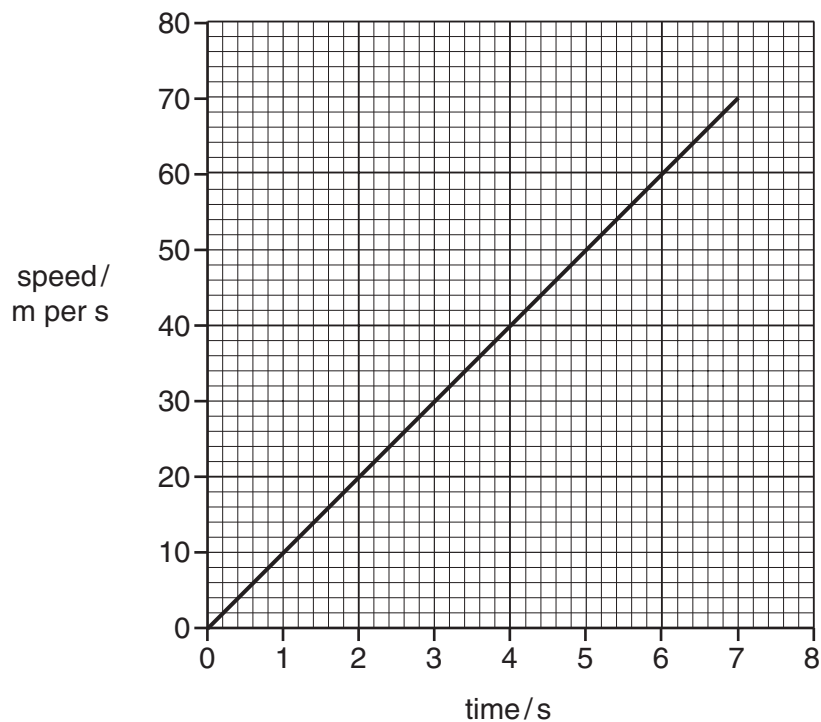


Fig. 8.1

- (a) State the speed of the stone after 7 seconds.

.....[1]

- (b) Use the graph to calculate the acceleration of the stone.
Show your working.

.....[2]

- (c) Calculate the distance fallen in 7 seconds.
Show your working.

.....[2]

- (d) Predict the time at which the stone hits the ground.
Explain your prediction.

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

- (e) (i) Calculate the potential energy lost by the stone as it falls to the ground.
Show your working.

.....[2]

- (ii) This potential energy is converted into the kinetic energy of the falling stone.
What happens to this kinetic energy when the stone hits the ground?

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

- 9 (a) The chemical symbols of two chlorine isotopes are shown below.



- (i) Describe the difference between the structures of the nuclei in the isotopes shown above.

.....

[2]

- (ii) State the total number of electrons in

a chlorine atom,

a chloride ion. [2]

- (b) Chlorine gas reacts with hydrogen gas to form molecules of hydrogen chloride gas, HCl.

- (i) State the type of chemical bonding in hydrogen chloride.

.....[1]

- (ii) State the balanced chemical equation for the reaction between chlorine and hydrogen.

.....[2]

- (iii) In the space below, draw a diagram of a molecule of hydrogen chloride showing how the outer electrons are arranged.

[2]

DATA SHEET
The Periodic Table of the Elements

		Group																																			
		I	II	III	IV	V	VI	VII	0																												
		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center;">1</td> <td style="width: 10%; text-align: center;">H Hydrogen 1</td> <td colspan="8"></td> <td style="width: 10%; text-align: center;">4</td> <td style="width: 10%; text-align: center;">He Helium 2</td> </tr> </table>										1	H Hydrogen 1									4	He Helium 2														
1	H Hydrogen 1									4	He Helium 2																										
7	Li Lithium 3	9	Be Beryllium 4	11	Na Sodium 11	13	Al Aluminium 13	14	C Carbon 6	15	N Nitrogen 7	16	O Oxygen 8	17	F Fluorine 9	18	Ne Neon 10																				
23	Na Sodium 11	24	Mg Magnesium 12	25	Mn Manganese 25	26	Fe Iron 26	27	Co Cobalt 27	28	Ni Nickel 28	29	Cu Copper 29	30	Zn Zinc 30	31	Ga Gallium 31	32	Ge Germanium 32	33	As Arsenic 33	34	Se Selenium 34	35	Br Bromine 35	36	Kr Krypton 36										
39	K Potassium 19	40	Ca Calcium 20	41	Nb Niobium 41	42	Mo Molybdenum 42	43	Tc Technetium 43	44	Ru Ruthenium 44	45	Rh Rhodium 45	46	Pd Palladium 46	47	Ag Silver 47	48	Cd Cadmium 48	49	In Indium 49	50	Sn Tin 50	51	Sb Antimony 51	52	Te Tellurium 52	53	I Iodine 53	54	Xe Xenon 54						
85	Rb Rubidium 37	86	Sr Strontium 38	87	Y Yttrium 39	88	Zr Zirconium 40	89	La Lanthanum 57	90	Ce Cerium 58	91	Pr Praseodymium 59	92	Nd Neodymium 60	93	Pm Promethium 61	94	Sm Samarium 62	95	Eu Europium 63	96	Gd Gadolinium 64	97	Tb Terbium 65	98	Dy Dysprosium 66	99	Ho Holmium 67	100	Er Erbium 68	101	Tm Thulium 69	102	Yb Ytterbium 70	103	Lu Lutetium 71
133	Cs Caesium 55	137	Ba Barium 56	138	La Lanthanum 57	139	Hf Hafnium 72	140	Ta Tantalum 73	141	W Tungsten 74	142	Re Rhenium 75	143	Os Osmium 76	144	Ir Iridium 77	145	Pt Platinum 78	146	Au Gold 79	147	Hg Mercury 80	148	Tl Thallium 81	149	Pb Lead 82	150	Bi Bismuth 83	151	Po Polonium 84	152	At Astatine 85	153	Rn Radon 86		
226	Fr Francium 87	227	Ra Radium 88	228	Ac Actinium 89	229	Th Thorium 90	230	Pa Protactinium 91	231	U Uranium 92	232	Np Neptunium 93	233	Pu Plutonium 94	234	Am Americium 95	235	Cm Curium 96	236	Bk Berkelium 97	237	Cf Californium 98	238	Es Einsteinium 99	239	Fm Fermium 100	240	Md Mendelevium 101	241	No Nobelium 102	242	Lr Lawrencium 103				

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

Key

a	X
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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.).