

Centre Number

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Candidate Name _____

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.

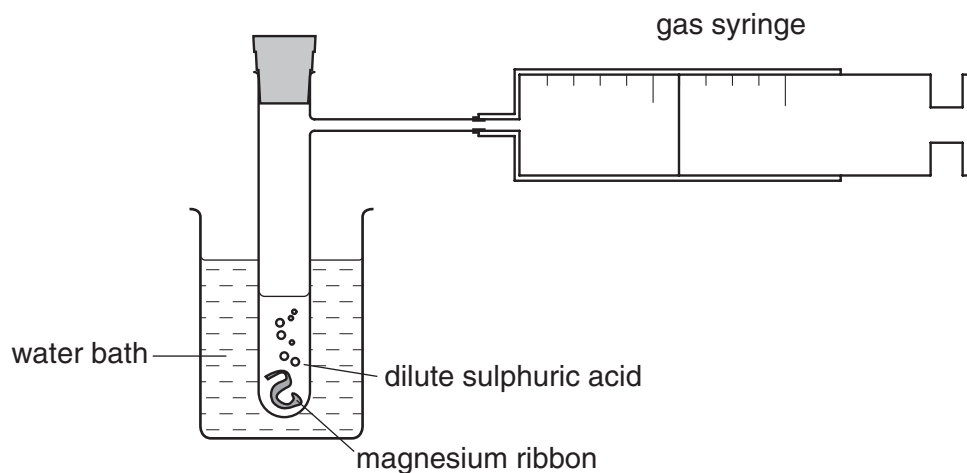


Fig. 3.1

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.

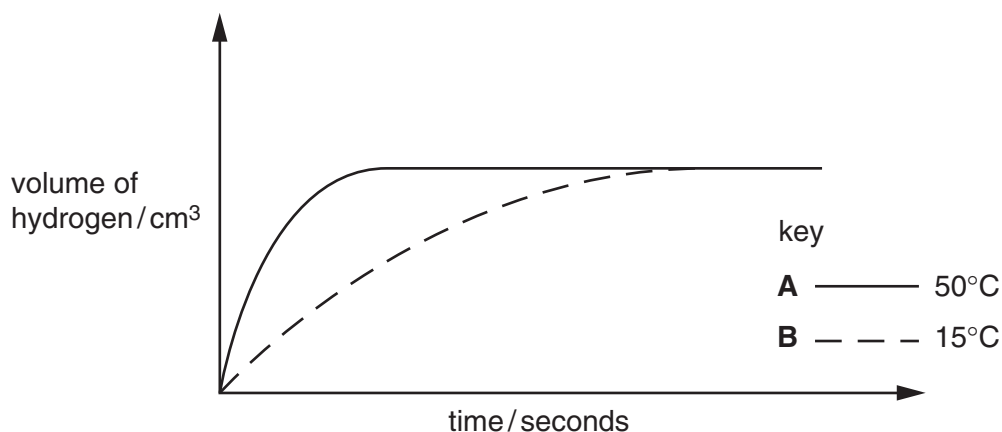


Fig. 3.2

- (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.

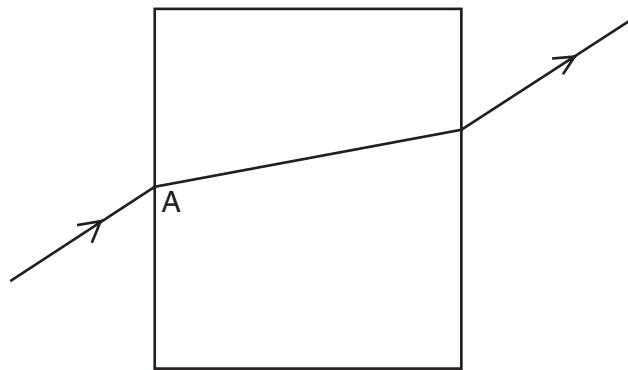


Fig. 5.1

(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.

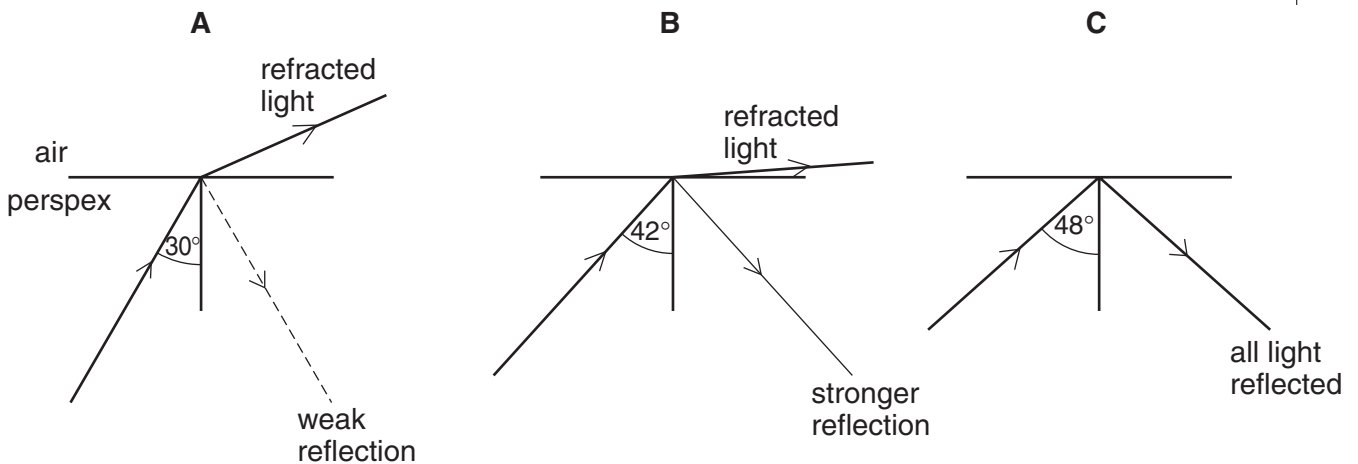


Fig. 5.2

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.

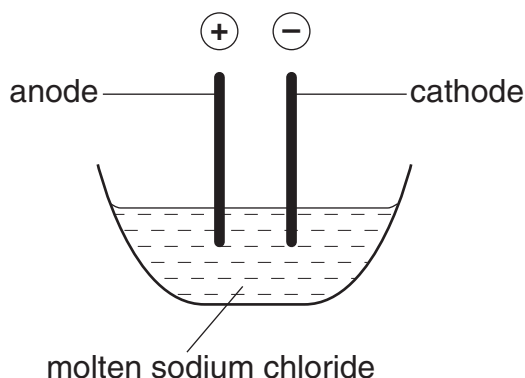


Fig. 6.1

- (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.

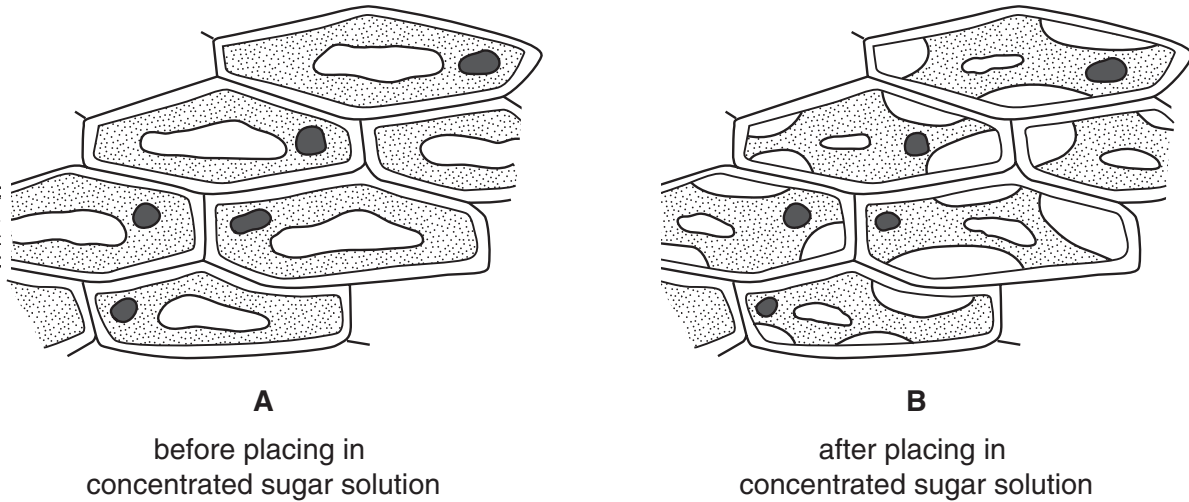


Fig. 7.1

- (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.

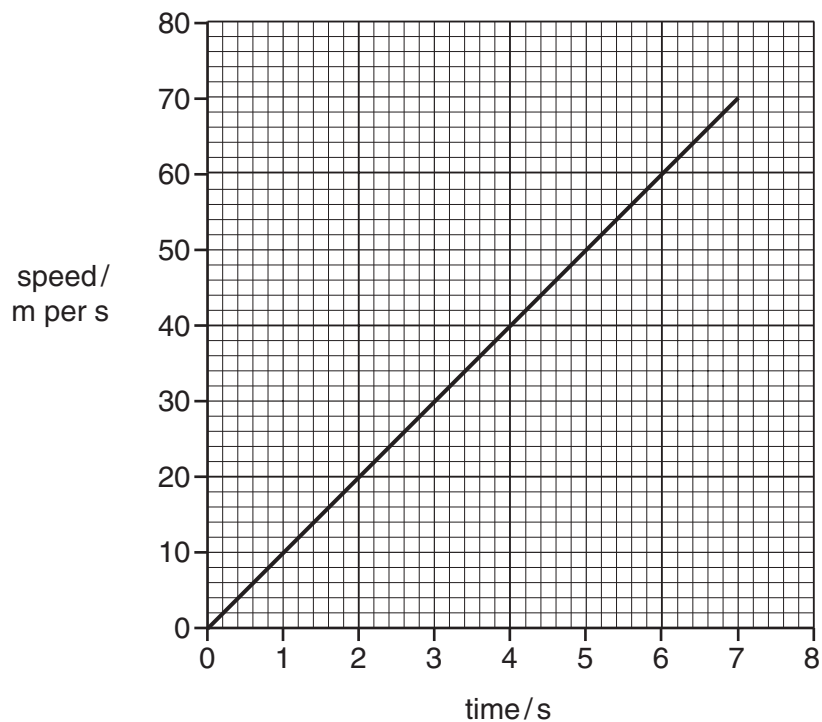


Fig. 8.1

- (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 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	9	11	12	13	14	15	16	17	18	19	20												
Li Lithium 3	Be Beryllium 4	B Boron 5	C Carbon 6	Al Aluminium 13	N Nitrogen 7	O Oxygen 8	F Fluorine 9	Ne Neon 10	Si Silicon 14	P Phosphorus 15	S Sulphur 16	Cl Chlorine 17	Ar Argon 18										
23	24	25	26	27	28	29	30	31	32	33	34	35	36										
Na Sodium 11	Mg Magnesium 12	Mn Manganese 25	Fe Iron 26	Co Cobalt 27	Ni Nickel 28	Cu Copper 29	Zn Zinc 30	Ga Gallium 31	Ge Germanium 32	As Arsenic 33	Se Selenium 34	Br Bromine 35	Kr Krypton 36										
39	40	41	42	43	44	45	46	47	48	49	50	51	52										
K Potassium 19	Ca Calcium 20	Cr Chromium 24	Mn Manganese 25	Fe Iron 26	Ru Ruthenium 44	Rh Rhodium 45	Pd Palladium 46	Ag Silver 47	Cd Cadmium 48	In Indium 49	Sn Tin 50	Sb Antimony 51	Te Tellurium 52										
85	88	91	92	93	94	95	96	97	98	99	100	101	102										
Rb Rubidium 37	Sr Strontium 38	Zr Zirconium 40	Nb Niobium 41	Mo Molybdenum 42	Tc Technetium 43	Ru Ruthenium 44	Rh Rhodium 45	Pd Palladium 46	Ag Silver 47	Cd Cadmium 48	In Indium 49	Sb Antimony 51	Te Tellurium 52										
133	137	178	184	186	190	192	195	197	201	204	207	209	210										
Cs Caesium 55	Ba Barium 56	Hf Hafnium 72	W Tungsten 74	Re Rhenium 75	Os Osmium 76	Ir Iridium 77	Pt Platinum 78	Au Gold 79	Hg Mercury 80	Tl Thallium 81	Pb Lead 82	Bi Bismuth 83	Po Polonium 84										
226	227	232	238	238	238	238	238	238	238	238	238	238	238										
Fr Francium 87	Ra Radium 88	Ac Actinium 89	Th Thorium 90	Pa Protactinium 91	U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Fm Fermium 100	Md Mendelevium 101										
175	173	169	167	165	162	159	157	152	150	144	141	140	137										
Lu Lutetium 71	Yb Ytterbium 70	Tm Thulium 69	Er Erbium 68	Ho Holmium 67	Dy Dysprosium 66	Tb Terbium 65	Gd Gadolinium 64	Eu Europium 63	Sm Samarium 62	Pm Promethium 61	Nd Neodymium 60	Ce Cerium 58	Ba Barium 56										
Lr Lawrencium 103	No Nobelium 102	Md Mendelevium 101	Fm Fermium 100	Es Einsteinium 99	Cf Californium 98	Bk Berkelium 97	Cm Curium 96	Am Americium 95	Pu Plutonium 94	Np Neptunium 93	U Uranium 92	Th Thorium 90	Ra Radium 88										

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

Key

a	X
b	X

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.).