Centre Number	Candidate Number

Candidate Name _____

International General Certificate of Secondary Education

CAMBRIDGE INTERNATIONAL EXAMINATIONS

COMBINED SCIENCE 0653/3

PAPER 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.

University of Cambridge Local Examinations Syndicate

[Turn over

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.

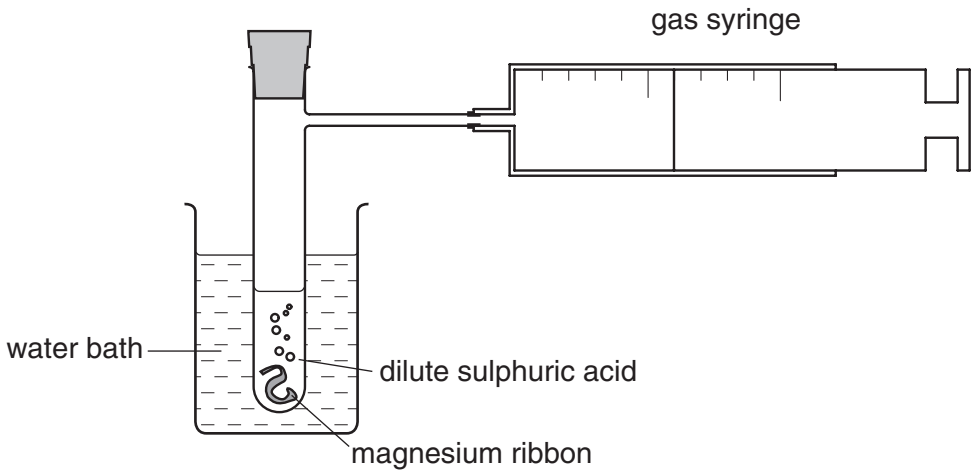


Fig. 3.1

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.

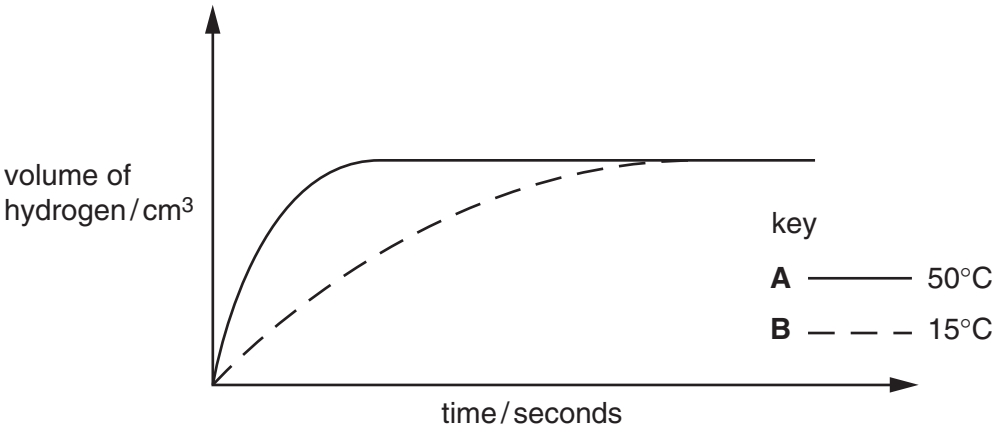


Fig. 3.2

(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]

[Turn over

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.

area or animal	*concentration of DDT / parts per million*
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.

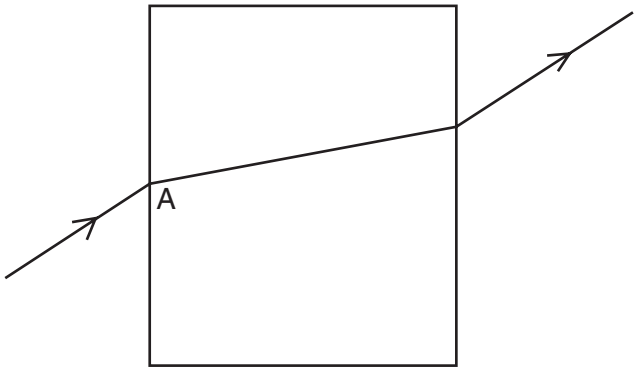


Fig. 5.1

(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.

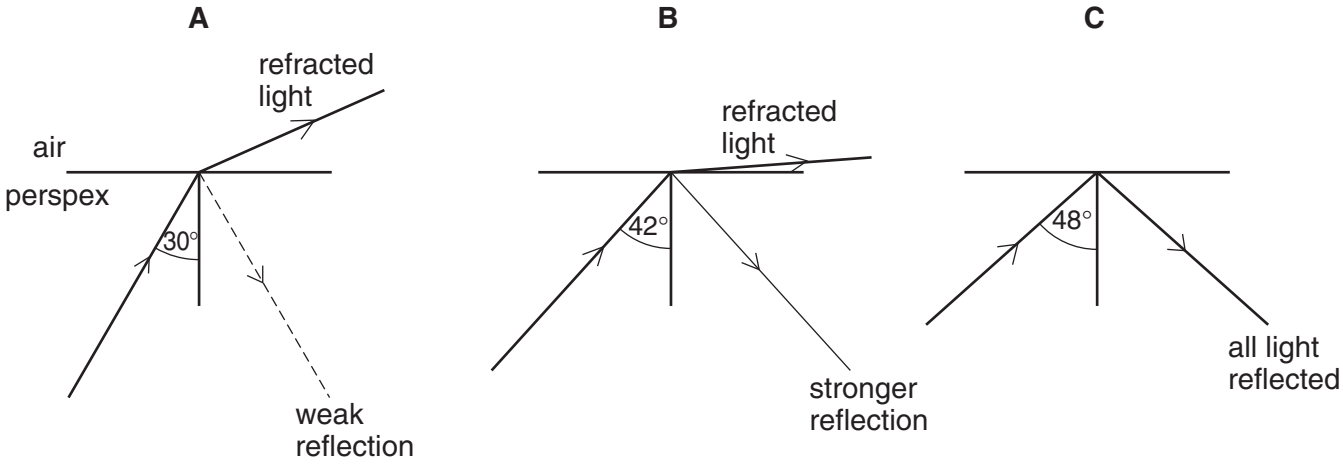


Fig. 5.2

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.

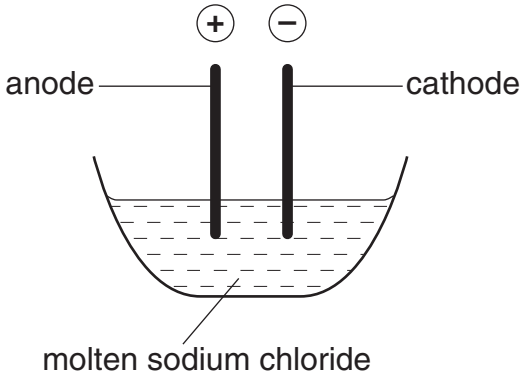


Fig. 6.1

(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.

sodium + water → sodium hydroxide + hydrogen

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

.....

.....[1]

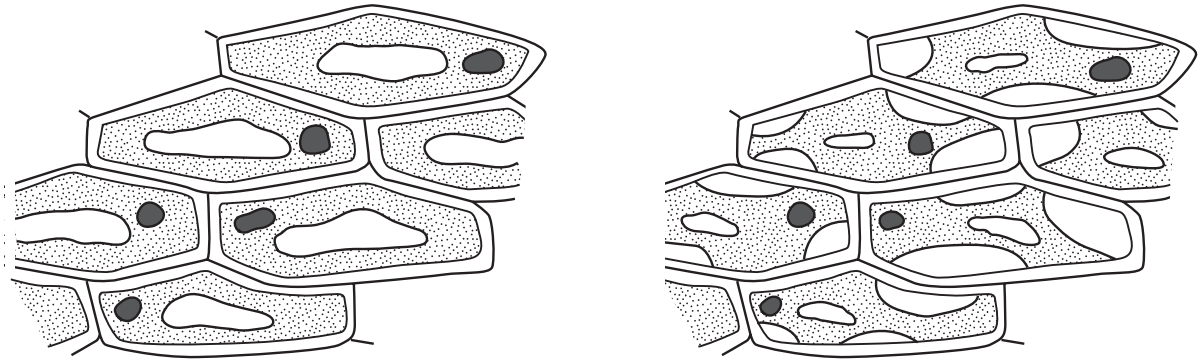
(ii) If the water contains Universal Indicator before the sodium is added, describe and explain the colour change which is seen as the result of the reaction.

.....

.....

.....[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.



A

before placing in concentrated sugar solution

B

after placing in 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]

[Turn over

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.

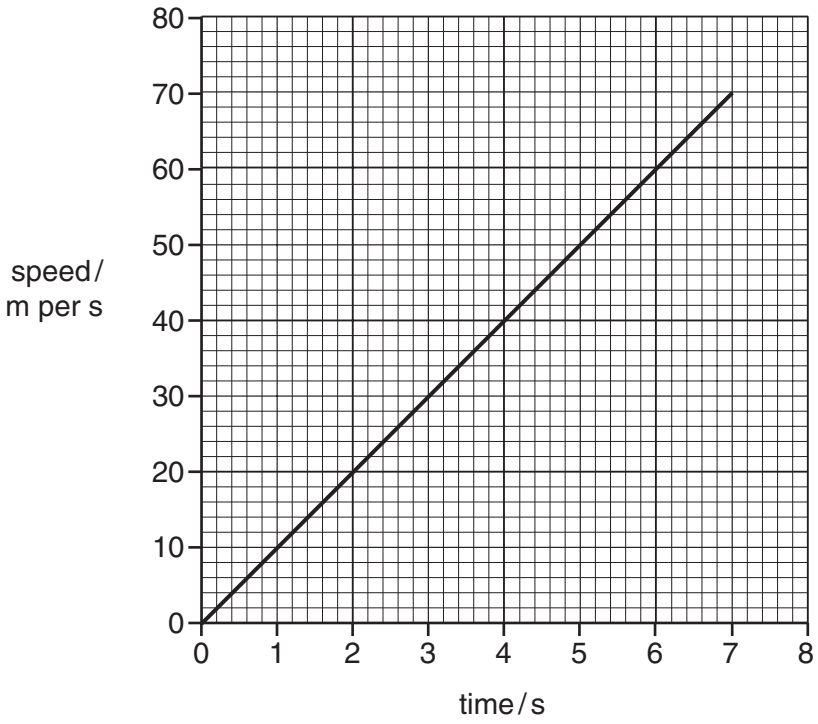


Fig. 8.1

(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]

[Turn over

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

$$^{35}_{17}Cl \qquad\qquad ^{37}_{17}Cl$$

(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, HC*l*.

(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]

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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
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

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

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60
Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63
157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66
165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69
173 Yb Ytterbium 70	175 Lu Lutetium 71	
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92
Np Neptunium 93	Pu Plutonium 94	Am Americium 95
Cm Curium 96	Bk Berkelium 97	Cf Californium 98
Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101
No Nobelium 102	Lr Lawrencium 103	

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

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