Centre Number	Candidate Number	Name

CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

PHYSICAL SCIENCE **0652/03**

Paper 3

October/November 2003

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 pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
At the end of the examination, fasten all your work securely together.
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.

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.

For Examiner's Use	
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Total	

This document consists of **15** printed pages and **1** blank page.

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate
[Turn over

1 The soluble salts of most metals can be prepared by adding the insoluble carbonate of the metal to the appropriate acid until excess carbonate is present.

(a) Name the acid which would be added to copper(II) carbonate to produce copper(II) nitrate.

.....[1]

(b) Write a balanced equation for the reaction.

.....[2]

(c) Describe the changes that you would observe during this reaction.

.....

.....

.....[2]

(d) Describe how you would obtain a solid sample of the copper(II) nitrate.

.....

.....

.....[2]

(e) Suggest why it is not possible to use a similar method to prepare the salt sodium nitrate.

.....

.....[1]

2 A student designs the apparatus of Fig. 2.1 as a device to detect thermal radiation. The flask is tightly covered with a material that absorbs thermal radiation well.

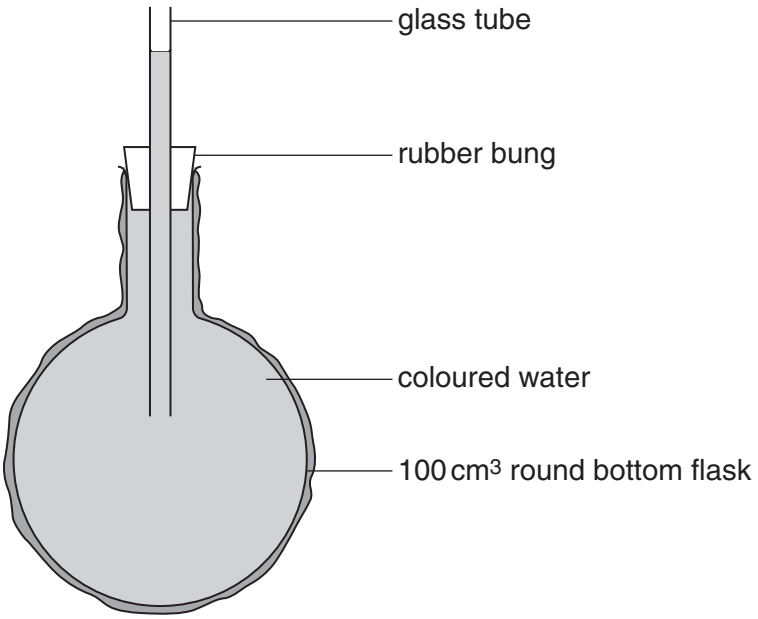

Fig. 2.1

(a) (i) Describe the appearance of the material that the student should use to cover the flask and explain why it would be effective for absorbing thermal radiation.

.....

.....

.....

.....

.....

.....[3]

(ii) Describe and explain what the student would see when intense thermal radiation is shone onto the apparatus.

.....

.....

.....

.....

.....

.....[2]

(b) (i) Explain why the apparatus is **not** likely to detect low intensity thermal radiation.

.....

.....

.....

[2]

(ii) State and explain **two** changes that could be made in order to improve the effectiveness of this apparatus.

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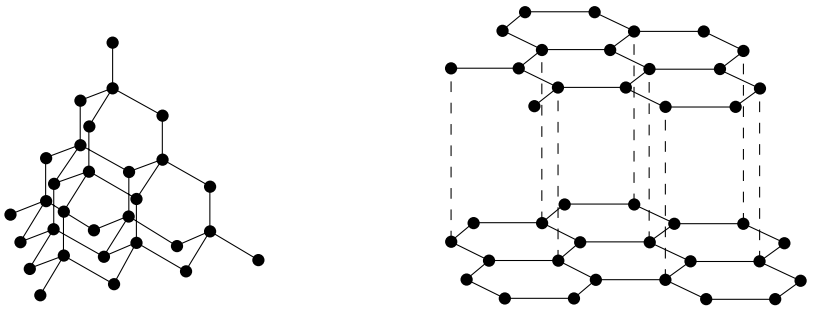
[4]

3 The diagrams in Fig. 3.1 show the crystal structures of two forms of the element carbon.



diamond *graphite*

Fig. 3.1

In diamond crystals every carbon atom is linked to four other carbon atoms by covalent bonds.

In graphite each carbon atom is linked to three other carbon atoms by covalent bonds to form layers. The fourth outer shell electrons in the carbon atoms then form delocalised layers of electrons.

(a) Explain how these differences in the crystal structures produce differences in the following properties of the two forms

(i) hardness,

.....

.....

.....

.....[2]

(ii) electrical conductivity.

.....

.....

.....

.....[2]

(b) During combustion, carbon and many of its compounds combine with oxygen to form two different oxides, carbon monoxide and carbon dioxide.

(i) Draw a diagram to show the formation of the bonds in carbon dioxide.

You need only show the outer shell electrons in each atom.

[2]

(ii) State the condition needed for combustion to form carbon monoxide rather than carbon dioxide.

.....

.....[1]

(iii) Explain how carbon monoxide affects the respiration of mammals.

.....

.....[1]

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[Question 4 can be found on page 8]

4 A cathode-ray oscilloscope (c.r.o.) is used to investigate the circuit of Fig. 4.1.

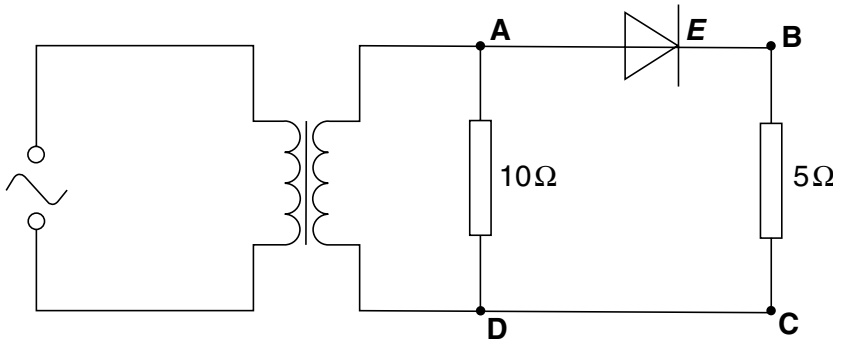
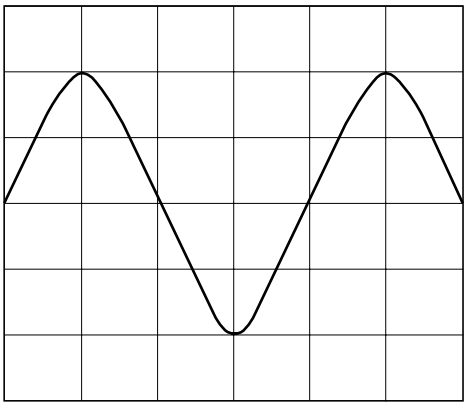


Fig. 4.1

Fig. 4.2 shows the trace on the oscilloscope screen together with the time-base and y-gain (voltage) settings when the oscilloscope is connected across **AD**.



Voltage (y-gain): 4V/division
time-base: 20ms/division

Fig. 4.2

(a) (i) Calculate the peak voltage (amplitude) across **AD**.

peak voltage = ... V [2]

(ii) Calculate the peak current in the 10 Ω resistor.

current = ... [2]

(iii) The primary (input) coil of the transformer has 30 turns and the secondary has 20 turns.

Calculate the peak input voltage supplied to the transformer.

Write down the equation that you use and show all your working.

voltage supplied = ...V [3]

(iv) Calculate the time taken for one complete cycle of the a.c. supply.

time for one cycle = ... [3]

(b) (i) Name the component labelled ***E*** in Fig. 4.1.

.....[1]

(ii) On Fig. 4.3, draw the trace that would be seen if the c.r.o. were connected across **BC**.

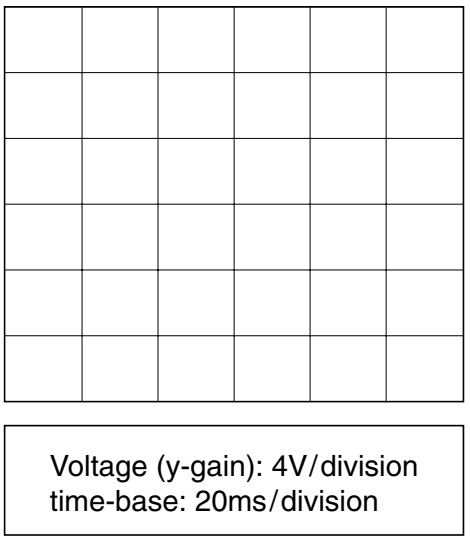


Fig. 4.3

[1]

5 Fig. 5.1 shows an experiment to compare the rates of movement of two gases.

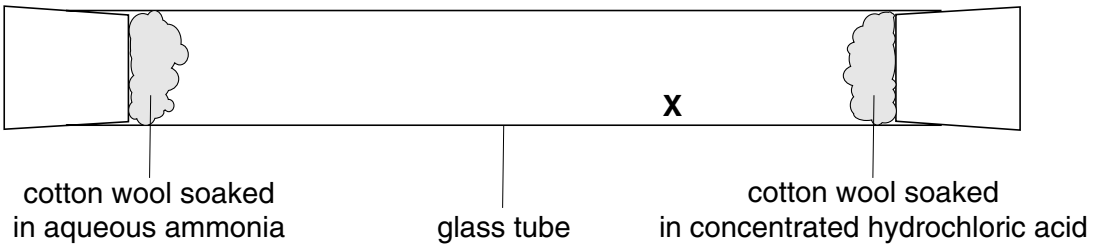


Fig. 5.1

After a few minutes, solid ammonium chloride appears at **X** inside the tube.

The equation for the reaction that occurs can be written as below.

$$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$$

(a) Name the process by which the two gases move along the tube. .....[1]

(b) Suggest and explain why the solid is formed nearer to the end where the hydrogen chloride enters the tube.

.....

.....

.....[2]

(c) Explain this reaction in terms of proton transfer.

.....

.....

.....[2]

(d) Describe the chemical test that you could perform to show that the solid contained ammonium ions and state the result you would expect.

test .....

.....

result .....

.....
[2]

6 **(a)** Define *refractive index*.

.....

.....

.....[2]

(b) Fig. 6.1 shows a fish below the surface of water in a lake.

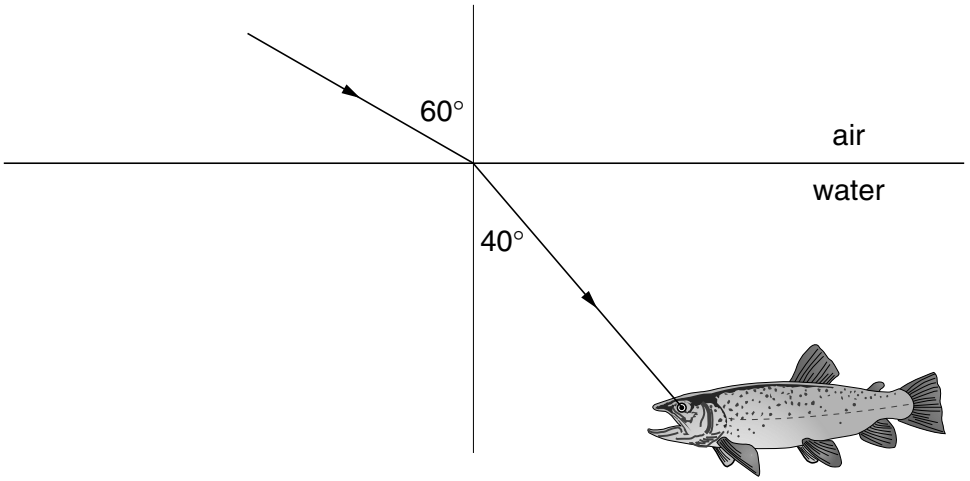


Fig. 6.1

(i) Explain why refraction means that the fish can see through a wider range of angles than if there were no water present.

.....

.....

.....[2]

(ii) Calculate the refractive index of the water in the lake.

Write down the equation that you use and show all your working.

refractive index = ... [3]

7 Aluminium is a metallic element in Group III of the Periodic Table. Aluminium oxide is amphoteric.

(a) Write the formula for aluminium oxide. .....[1]

(b) Explain the meaning of the term *amphoteric.*

.....

.....

.....[2]

(c) State one use of aluminium and describe two properties that make it suitable for that use.

use .....

first property .....

.....

second property .....

.....[3]

(d) Thallium is below aluminium in Group III of the Periodic Table.

Suggest, with a reason, the class of oxide that you would expect thallium to form.

.....

.....

.....[2]

8 The apparatus of Fig. 8.1 is used to take readings from which to calculate the acceleration of free fall.

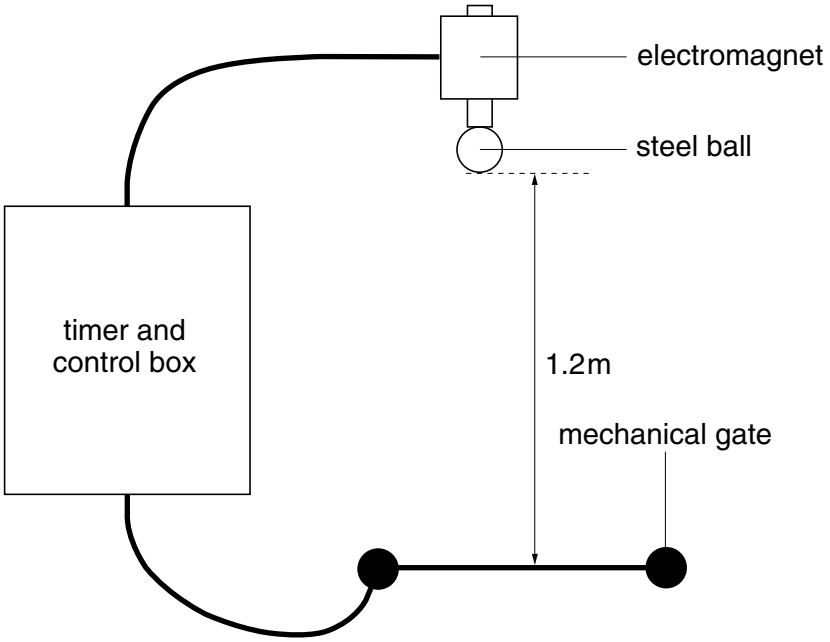


Fig. 8.1

As the control box is switched on the timer starts. At the same instant the steel ball is released from rest. When the ball hits the gate this opens and stops the timer. The mass of the ball is 20.0 g.

(a) Explain what causes the steel ball to be released.

.....

.....

.....[2]

(b) Calculate the weight of the ball in newton.

[g = 10 N/kg]

weight = ... N [2]

(c) Explain whether air resistance is likely to affect the motion of the ball as it falls.

.....

.....

.....[2]

(d) The time measured for the ball to fall a distance of 1.2 m is 0.48 s. Calculate a value for the acceleration of free fall (*g*), using these values. Show your working.

g = ... [4]

9 One method of preparing ethanol is the fermentation of glucose. The equation for this process can be summarised as shown below.

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

(a) State the **three** essential conditions for fermentation to take place.

.....

.....

.....[3]

(b) **(i)** Calculate the relative molecular mass, M_r, of glucose and of ethanol.

[Ar : H, 1; C, 12; O, 16.]

[2]

M_r, of glucose ..... M_r, of ethanol .....

(ii) Hence find the mass of ethanol that could be obtained from 36 g of glucose.

mass of ethanol = ... [2]

(iii) Calculate the volume of carbon dioxide at room temperature and pressure, r.t.p., produced by fermentation of 36 g of glucose.

1 mole of any gas occupies 24 dm^3 at r.t.p.

volume of carbon dioxide = ... [2]

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 †															

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

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

Key

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

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