Centre Number	Candidate Number	Name

CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

PHYSICAL SCIENCE **0652/03**

Paper 3

May/June 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	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **13** printed pages and **3** blank pages.

University of Cambridge

1 Fig. 1.1 shows the trends in some of the properties of the elements in Group Periodic Table.

nitrogen	non-metal	acidic oxide	gas at 20°C
phosphorus	↓	↓	↓
arsenic			
antimony			
bismuth	metal	basic oxide	solid at 20°C

Fig. 1.1

(a) (i) Describe the structure and bonding in nitrogen.

....

....

(ii) Explain how this structure relates to the properties shown above.

....

....[3]

(b) Suggest, with a reason, the type of oxide you would expect arsenic to form.

....

....

....[2]

(c) Antimony is a metallic element. Suggest why you would expect antimony to have a higher melting point than bismuth.

....

....

....

....[2]

(d) Write down the formula that you would expect for a chloride of phosphorus.

....[1]

2 A child throws a beach ball, of mass 0.075 kg, vertically upwards from the ground. takes 0.3 s to accelerate from rest to 11 m/s.

(a) Calculate the acceleration of the ball. Write down the equation that you use and show all your working.

acceleration = ... [3]

(b) Calculate the maximum kinetic energy of the ball. Write down the equation that you use and show all your working.

maximum kinetic energy = ... [3]

(c) The ball reaches a vertical height of 2.7 m. Calculate the maximum gravitational potential energy of the ball. Write down the equation that you use and show all your working. [$g = 10$ N/kg]

maximum gravitational potential energy = ... [3]

(d) (i) Explain what is meant by the term *efficiency*.

....

....

....[2]

(ii) Discuss whether or not the energy conversion from kinetic to gravitational potential has been done efficiently.

....

....

....[2]

3 Many substances need to be kept under carefully controlled conditions. Use your kno
of the reactions of the substances involved to explain each of the following.

(a) Silver nitrate is stored in dark brown bottles.

....

....

....[2]

(b) Sodium metal is stored immersed in liquid paraffin.

....

....

....[2]

(c) Anhydrous copper(II) sulphate is stored in a desiccator.

....

....

....[2]

(d) Bromine should be kept cold and in a fume cupboard.

....

....

....[2]

4 An object of height 2.0 cm is placed 3.0 cm to the left of a converging (convex) lens length 5.0 cm.

(a) On the grid below draw a ray diagram to show the formation of the image by the lens. The central line shows the centre of the lens.
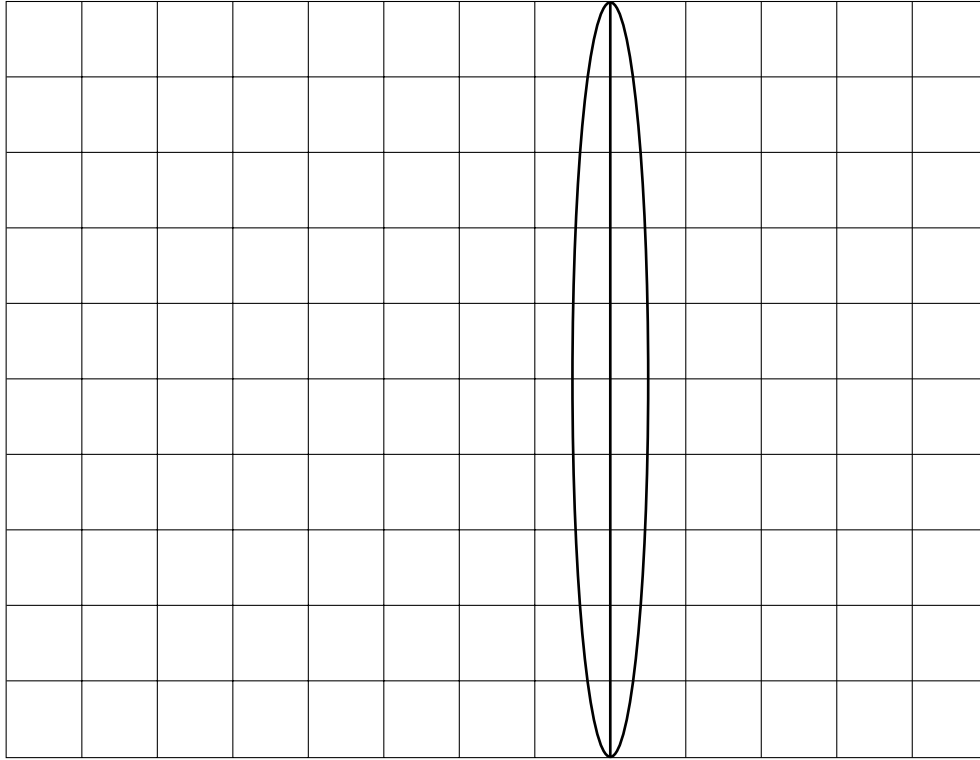
[3]

(b) Write down **three** properties of the image.

....

....

....[3]

(c) Suggest a use for a lens forming an image in this way.

....

....[1]

5 The two diagrams in Fig. 5.1 represent the structures of a pure metal and one of its a

metal   alloy
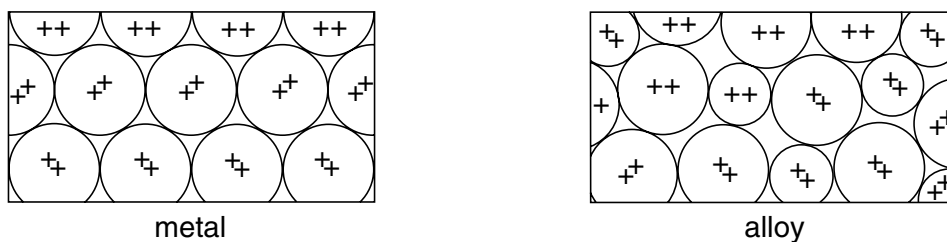
Fig. 5.1

(a) State what holds the positive metal ions together.

....

....[1]

(b) By referring to the diagrams, explain why pure metals are more malleable than alloys.

....

....

....

....

....

....[4]

(c) Both the metals in the alloy belong to Group II in the Periodic Table. The smaller circles represent magnesium ions.

(i) Suggest what ions the larger circles represent. ....   [1]

(ii) Describe **two** changes that you would expect to observe if a sample of the pure metal were placed in cold water.

....

....

....

....[2]

6 Fig. 6.1 shows a coil of copper wire wound on a cardboard tube. The ends of the connected to a cathode ray oscilloscope (c.r.o.) and a magnet is released so that it vertically down the tube.

Fig. 6.2 shows the trace seen on the c.r.o., along with its y-gain and time-base settings.

S — magnet

→ to c.r.o.

N

coil of copper wire

cardboard tube

→ to c.r.o.

A

B

voltage (y-gain): 0.2V/division
time-base: 20ms/division
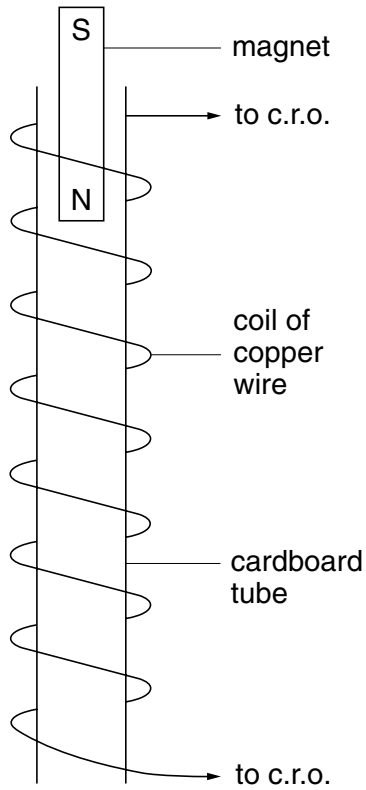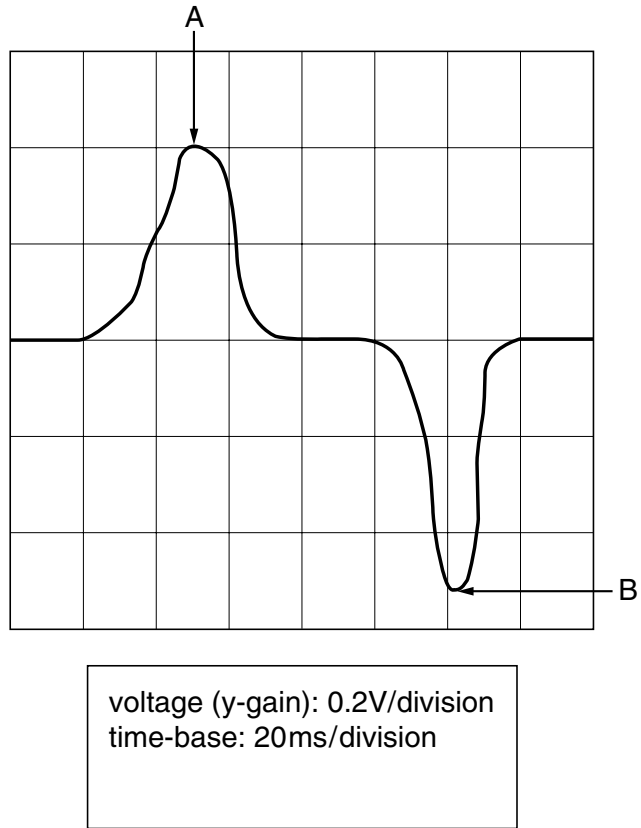
Fig. 6.1   **Fig. 6.2**

(a) Write down the voltages at **A** and **B**.

voltage at **A** = ...V

voltage at **B** = ...V
[2]

(b) Explain why these voltages are produced.

....

....

....

....[2]

(c) State and explain **two** things about the shape of the trace.

....

....

....

....

....

....

....

....[4]

7 The equation for the reaction between copper(II) carbonate and dilute hydrochloric a͟ be written as shown below.

$$CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l) + CO_2(g)$$
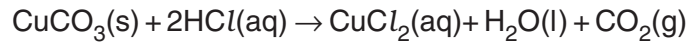
(a) (i) What do you understand by the symbol (II) after the word copper?

....

....[1]

(ii) Why is it **not** necessary to write this symbol after calcium in the name calcium carbonate?

....

....[1]

(b) In an experiment copper(II) carbonate is added to 50 cm^3 of hydrochloric acid of concentration 1 mol/dm^3, until no more will react.

(i) Calculate the number of moles of HCl in the 50 cm^3 of acid.

number of moles of HCl .... [1]

(ii) Calculate the number of moles of copper(II) carbonate that will react with this acid.

number of moles of copper(II) carbonate ....[1]

(iii) Calculate the relative formula mass, M_r, of copper(II) carbonate.
[A_r: C, 12; O, 16; Cu, 64]

M_r of copper(II) carbonate ....[2]

(iv) Calculate the mass of copper(II) carbonate that will react with this acid.

mass of copper(II) carbonate ....[2]

8   Fig. 8.1 shows a circuit with a high-resistance voltmeter being used to measure the ᵉ
a cell.
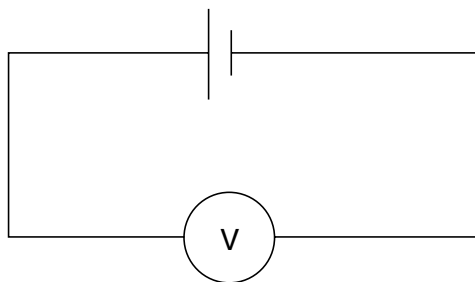
Fig. 8.1

(a) Explain the meaning of the term *e.m.f.*

....

....

....[2]

(b) Explain why the voltmeter must have a high resistance if it is to measure an accurate
value of the e.m.f.

....

....

....[2]

(c) Fig. 8.2 shows a cell with an internal resistance of 2 Ω.

A voltmeter which has a resistance of 100 Ω is connected across the cell. The e.m.f. of
the cell is 1.50 V.

2 Ω internal
resistance

V

100 Ω
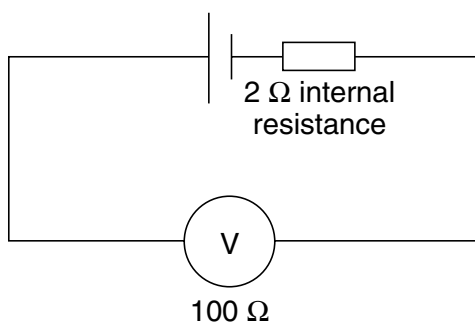
Fig. 8.2
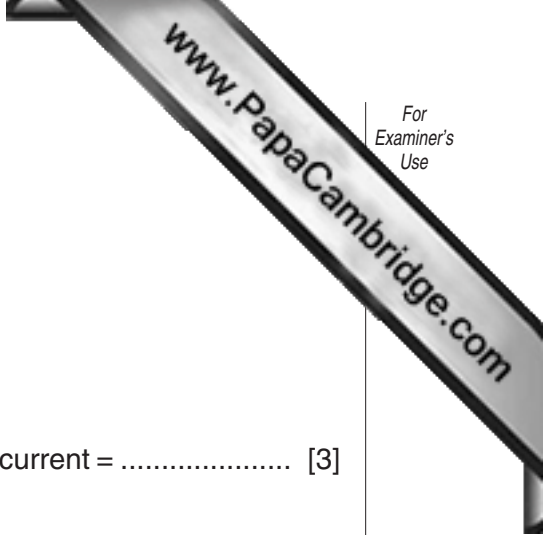
(i) Calculate the current in the circuit.

current = ... [3]

(ii) Calculate the potential difference across the voltmeter.

potential difference = ... [2]

(iii) The potential difference in **(ii)** is **not** equal to the e.m.f. of the cell. Explain why this is the case and state what change you would make in order to give a value much closer to the e.m.f. of the cell.

....

....

....

....

....[3]

9 Ethene, C_2H_4, is the first member of the homologous series of alkenes.

(a) Draw a diagram to show the arrangement of the outer shell electrons in a molecule of ethene.

[2]

(b) In most homologous series the first member contains only one carbon atom.
Explain why this is not the case with alkenes.

....

....

....

....[2]

(c) Ethene and hydrogen can be produced from saturated hydrocarbons by cracking.

(i) Write an equation for the cracking of butane, C_4H_{10}, to produce ethene and hydrogen.

....[2]

(ii) State **two** essential conditions for cracking to occur.

....

....[2]

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DATA SHEET
The Periodic Table of the Elements

16

Group

I	II												III	IV	V	VI	VII	0
																		4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4						1 **H** Hydrogen 1						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
X
b

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.).