Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

PHYSICAL SCIENCE **0652/03**

Paper 3

May/June 2004

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.

Answer **all** the questions.

Write your answers in the spaces provided.

1 The metal **M** has a relative atomic mass, A_r, of 30.
M is reacted with pure oxygen at room temperature and pressure (r.t.p.) to form the oxide of **M**.
It is found that 5.0 g of **M** react with exactly 2.0 dm^3 of oxygen under these conditions.
1 mole of any gas occupies 24 dm^3 at r.t.p.

(a) Define the term *relative atomic mass*.

.....

.....

.....[2]

(b) **(i)** Find the number of moles in 5.0 g of **M**.

number of moles = ...[2]

(ii) Find the number of moles of oxygen gas that react with 5.0 g of **M**.

number of moles = ...[1]

(iii) From your answers to **(i)** and **(ii)** deduce the number of moles of **M** that react with 1 mole of oxygen gas.

number of moles = ...[1]

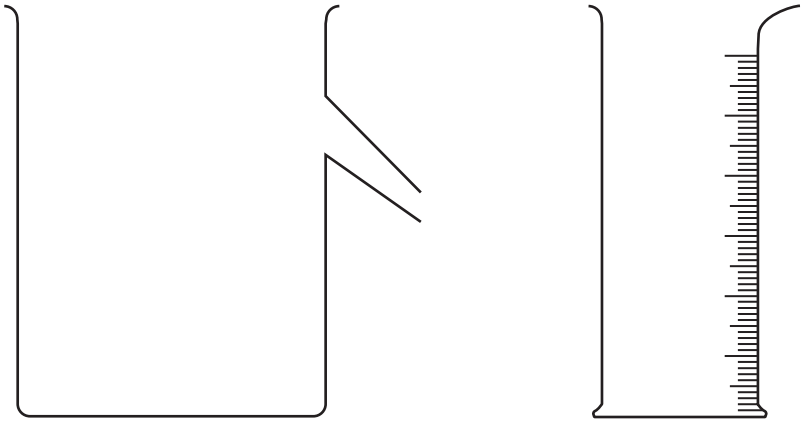
(iv) Write the balanced chemical equation for the reaction between **M** and oxygen.

.....[2]

(c) Calculate the relative formula mass, M_r , for the oxide.

M_r = ... [1]

2 Fig. 2.1 shows apparatus used to measure the volume of an irregularly shaped object.



displacement (eureka) can measuring cylinder

Fig. 2.1

(a) Describe how this apparatus might be used in order to measure the volume of an irregularly shaped object. The dimensions of the object are such that it is too large to fit inside the measuring cylinder.

.....

.....

.....

.....

.....

.....

.....

.....[3]

(b) Fig. 2.2 is a table of the density of some metals.

aluminium	2.7
copper	8.9
gold	19.3
iron	7.8
lead	11.3
magnesium	1.7
platinum	21.4
uranium	18.7

Fig. 2.2

(i) State a unit for density.

.....[1]

(ii) A sample of metal of measured volume 0.8 cm^3 is found to have a mass of 15.4 g.
Calculate the density of the sample.
Write down the equation that you use and show your working.

[2]

(iii) Which of the metals in the table is the sample most likely to be?

.....[1]

(iv) Explain why the value calculated in **(ii)** may not be exactly the same as any of the values in the table.

.....

.....

.....

.....[2]

(c) A second sample of the metal is found to have a mass of 85 g. On the moon it is found to weigh 0.14 N. Calculate the value of the gravitational field strength (*g*) on the moon. Write down the equation that you use and show your working.

value for *g* on the moon = ... [3]

3 Fig. 3.1 contains the melting points of the elements in Period 3 of the Periodic Table.

element	Na	Mg	A*l*	Si	P	S	C*l*	Ar
m.pt./K	371	924	933	1680	317	386	172	84

Fig. 3.1

(a) Describe the trend in melting point of the elements in Period 3.

.....

.....[1]

(b) What does the high melting point of silicon suggest about the structure of solid silicon?

.....

.....

.....

.....[2]

(c) Use your knowledge of the trends in the Periodic Table to deduce which of these elements

(i) is the most reactive metal, ...[1]

(ii) has five electrons in the outer shell of one atom, ...[1]

(iii) forms an ion with a charge of 2+, ...[1]

(iv) does not react with any other element. .....[1]

(d) Suggest why sodium is a softer metal than magnesium.

.....

.....

.....

.....[2]

4 Fig. 4.1 shows a circuit used to measure the resistance of different lengths of wire.

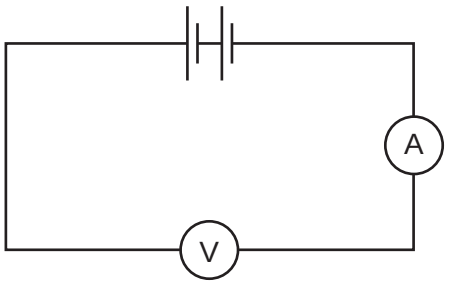


Fig. 4.1

(a) Mark on Fig. 4.1 where the resistance wire should be connected. [1]

(b) The voltmeter shows a value of 4.3 V and the ammeter a value of 2.1 A.
Calculate the resistance of the wire.
Write down the equation that you use and show your working.

resistance of wire = ...[3]

(c) What would you expect the resistance to be when a wire of the same metal and same diameter but of twice the length replaces the one used in **(b)**?

new resistance = ...[1]

(d) It is likely that the temperatures of the two lengths of wire would be different as a result of the different currents flowing through the wires. State and explain the effect that this is likely to have on the resistances of the wires.

.....

.....

.....

.....

.....

.....[3]

(e) Explain why using a very short length of resistance wire could damage the ammeter.

.....

.....

.....

.....[2]

(f) Name a device that could be used to measure the p.d. instead of the voltmeter.

.....[1]

5 **(a)** **(i)** Using the Periodic Table on page16, write down the electronic structures of calcium and fluorine.

electronic structure of calcium .....[1]

electronic structure of fluorine .....[1]

(ii) By reference to these structures, describe how calcium and fluorine form calcium fluoride.

[2]

(iii) State the formula of calcium fluoride.

.....[1]

(b) Solid calcium fluoride does not conduct electricity but molten calcium fluoride does. Liquid fluorine does not conduct electricity.
Explain these observations in terms of the structures of these substances.

.....

.....

.....

.....

.....

.....[3]

6 **(a)** Light travels at a speed of 3×10^n m/s in a vacuum.
Write down the value for n.

n = ...[1]

(b) Sound waves travel with a speed of approximately 340 m/s.
Calculate the time that it takes sound to travel a distance of 80 m.
Write down the equation that you use and show your working.

[2]

(c) Fig. 6.1 shows a method of measuring the speed of sound. An observer watches an assistant fire a gun. On seeing the smoke he starts a stopwatch and on hearing the sound of the gun he stops the watch. It is important that this experiment is performed in a large open space.

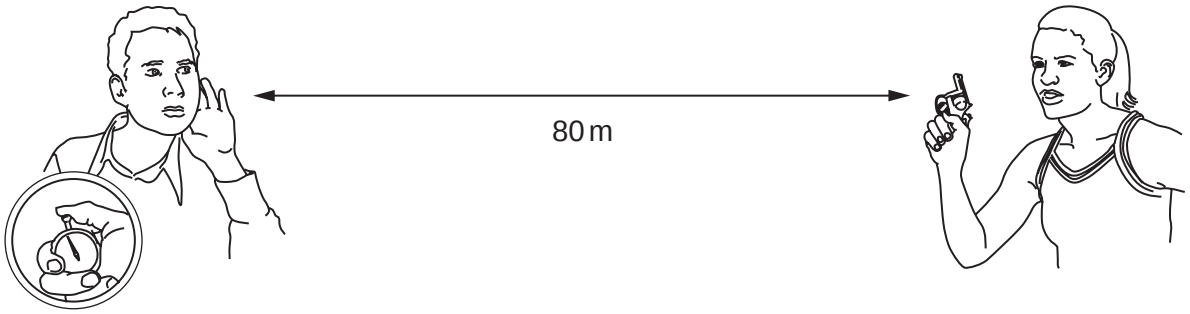


Fig. 6.1

(i) Explain how this experiment depends upon the speed of sound being much less than the speed of light.

.....

.....

.....

.....

.....

.....[2]

(ii) Why is it important to carry out this experiment in an open space?

.....

.....

.....

.....

.....

.....[2]

(d) A particular sound wave has a frequency of 3.5 kHz. What is its wavelength? Write down the equation that you use and show your working.

wavelength of sound = ...[3]

7 When an aqueous solution of sugars is fermented to form ethanol the resulting solution contains about 15% of ethanol.

(a) State two essential conditions for fermentation to occur.

1. .....

2. .....[2]

(b) **(i)** The boiling point of ethanol is 78 °C.
State the name of the method used to separate ethanol from the solution.

.....[1]

(ii) Sketch a labelled diagram of the apparatus that would be used in the laboratory to carry out this separation.

[4]

8 **(a)** Complete the following passage relating to measuring temperatures.

Temperatures indicate the degree of "hotness" of an object and can be measured using a ..... . These are devices that must have a property which ..... with temperature. Ideally this property shows a linear relationship with temperature. This means that the property changes by equal amounts for ..... changes in temperature. The maximum temperature minus the minimum temperature that the device can register is known as the ..... of the device. Devices for which the chosen property makes a large change for a small change in temperature are said to be very ..... . [5]

(b) Name a specific type of temperature measuring device and the property on which its operation depends.

device .....

property .....[2]

9 Three substances are added to a blast furnace during the extraction of iron from its ore. Haematite, Fe_2O_3, is the ore. Limestone, $CaCO_3$, and coke are the other substances needed. The main products are iron, slag and oxides of carbon.

(a) State the reason for adding limestone to the furnace.

.....[1]

(b) Write balanced equations for the reactions that occur when

(i) limestone decomposes, ...

(ii) haematite is reduced. .....[4]

(c) Iron and steel can be prevented from rusting by galvanising. When the covering is complete this prevents the iron being exposed to the air. However, unlike painting, galvanising continues to prevent rusting even when the coating is damaged.
Explain this difference between painting and galvanising.

.....

.....

.....

.....[2]

BLANK PAGE

BLANK PAGE

BLANK PAGE

DATA SHEET
The Periodic Table of the Elements

Group I	Group II						Group III	Group IV	Group V	Group VI	Group VII	Group 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
X
b

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.).