Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

PHYSICAL SCIENCE **0652/03**

Paper 3

October/November 2005

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.
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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2	
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Total	

This document consists of **14** printed pages and **2** blank pages.

1 Fig. 1.1 shows the arrangement of electrons in a lithium atom.

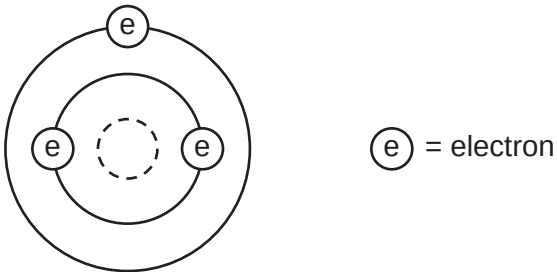


Fig. 1.1

(a) Lithium and potassium are both Group I metals.
Complete the diagram in Fig. 1.2 to show the arrangement of electrons in a potassium atom.

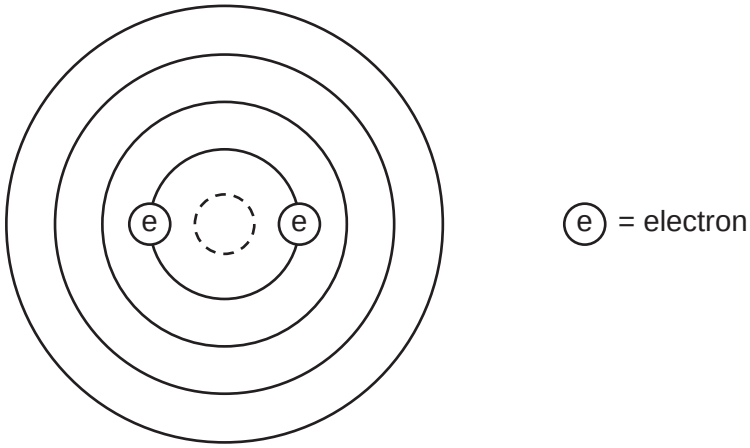


Fig. 1.2 [2]

(b) When a small piece of lithium is dropped into a trough half filled with water a reaction takes place. Bubbles of the gas hydrogen are given off slowly and lithium hydroxide is formed.

(i) Write a balanced equation for this reaction.

..... [2]

(ii) Describe how you could prove that the gas given off is hydrogen.

test .....

.....

result .....

..... [2]

(c) A small piece of potassium is dropped into a trough half filled with water.
Describe two differences that you would see between the reaction of lithium with water and that of potassium with water.

1. .....

.....

2. .....

..... [2]

2 A ray of light enters a rectangular glass block at an angle of incidence of 66°. The glass has a refractive index of 1.45.

(a) Calculate the angle of refraction for this ray of light.
Write down the equation that you use and show all your working.

[3]

(b) Draw a fully labelled diagram to show the refraction of the light as it enters and leaves the glass block.

[3]

[Turn over

3 Copper(II) oxide reacts with dilute sulphuric acid.

$$CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$$

In the preparation of copper(II) sulphate, copper(II) oxide is added to 20 cm^3 of sulphuric acid of 1.0 mol/dm^3 concentration until no more reacts.

(a) (i) Calculate the number of moles in the 20 cm^3 of sulphuric acid.

moles of sulphuric acid = ... [1]

(ii) How many moles of copper(II) sulphate are produced in the reaction?

moles of copper(II) sulphate = ... [1]

(iii) Calculate the relative formula mass, M_r, of copper(II) sulphate, $CuSO_4$.

Show your working.

M_r = ... [2]

(iv) Calculate the mass of copper(II) sulphate, $CuSO_4$, formed.

Show your working.

mass = ... g [2]

(b) Describe how crystals of copper(II) sulphate can be prepared from the mixture of excess copper(II) oxide and copper(II) sulphate solution obtained when the reaction stops.

.....

.....

.....

..... [3]

4 A player throws a ball, of mass 0.15 kg, horizontally.
The ball has a constant acceleration for a time of 0.10s and then moves at a constant speed of 20.0 m / s for 0.80 s before being caught and brought to rest in a further time of 0.30 s.
As the ball is caught it decelerates non-uniformly.

(a) On Fig. 4.1 draw a graph showing the speed of the ball from when it was thrown until the time it came to rest.

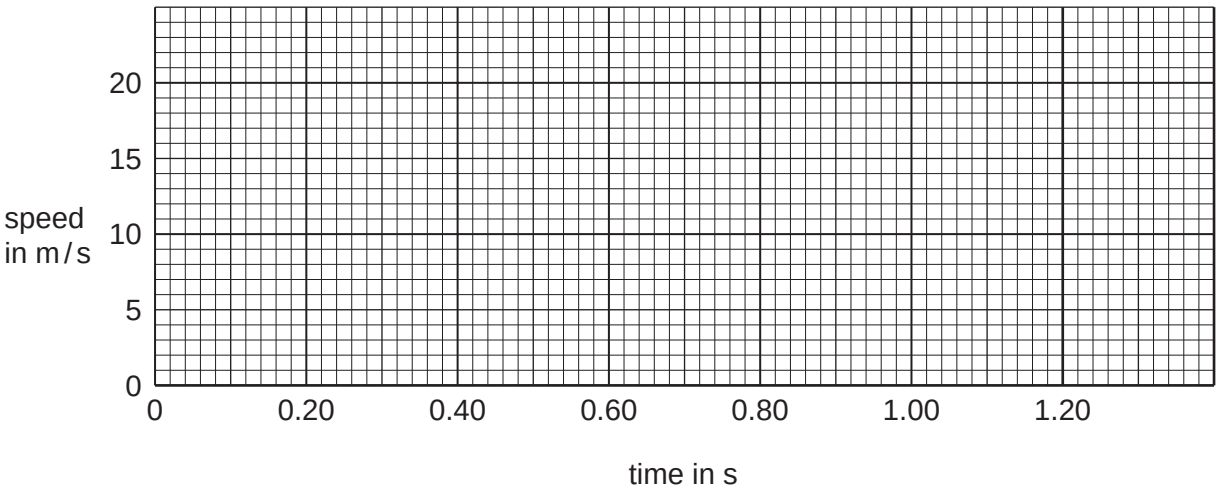


Fig. 4.1 [4]

(b) Calculate the maximum kinetic energy of the ball. Show all your working.

maximum kinetic energy = ... [3]

(c) Calculate the acceleration of the ball during the first 0.10 s. Write down the equation that you use and show all your working.

acceleration = ... [3]

5 Fig. 5.1 shows the gas hydrogen being burned in air.

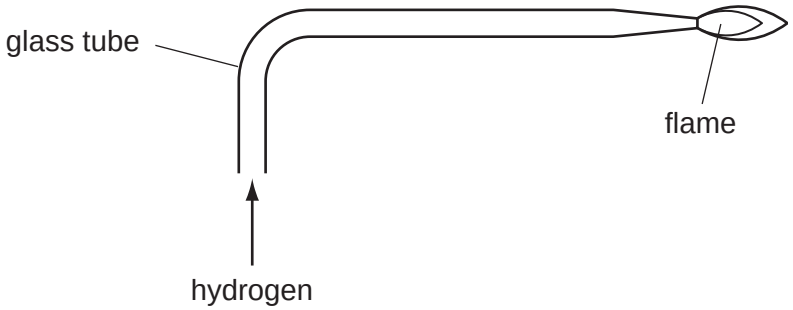


Fig. 5.1

(a) When hydrogen burns the only product is water.
Write a balanced equation for the burning of hydrogen.

..... [2]

(b) When petrol is burned in a car engine a number of products are formed.
Some of these products cause pollution.
These include carbon monoxide and oxides of nitrogen.

(i) How are the oxides of nitrogen removed from the exhaust gases of modern cars.

..... [1]

(ii) Why may the presence of carbon monoxide in car exhaust systems cause a health problem?

..... [1]

(c) It has been suggested that hydrogen may replace petrol as a fuel for cars.
Suggest one advantage and one disadvantage of using hydrogen instead of petrol.

advantage .....

.....

disadvantage .....

..... [2]

6 **(a)** Explain what is meant by an object being in *equilibrium*.

.....

.....

..... [2]

(b) Fig. 6.1 shows a method of measuring the mass of a uniform loaded ruler. The ruler is pivoted at the 18 cm mark.

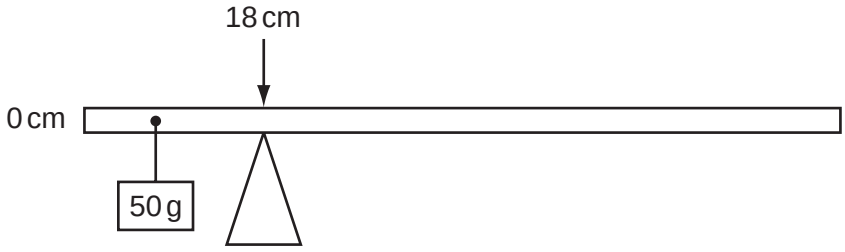


Fig. 6.1

(i) The ruler is uniform. What does this tell you about the position of its centre of mass?

.....

..... [1]

(ii) The total length of the ruler is 80 cm. The 50 g mass is hung from the 8 cm mark on the ruler. Calculate the mass of the ruler. Show all your working.

mass of ruler = ... g [4]

[Turn over

7 Powdered calcium carbonate is added to excess hydrochloric acid of three different concentrations, **A**, **B** and **C**.

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + CO_2 + H_2O$$

In each experiment the same mass of powder is used and the acid is at the same temperature.
The volume of carbon dioxide gas given off is measured at time intervals.
The results of these experiments are shown in Fig. 7.1.

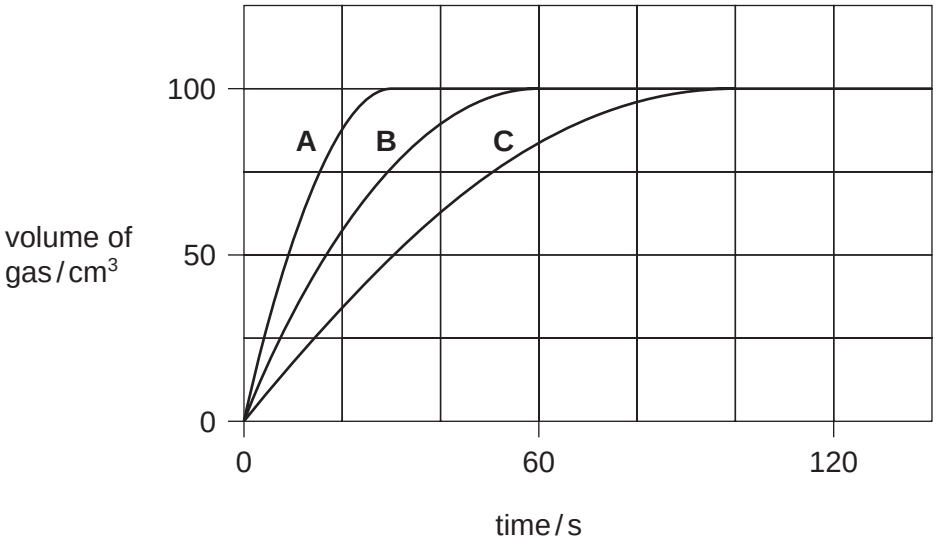


Fig. 7.1

(a) (i) Which of the three solutions of hydrochloric acid, **A**, **B** or **C**, is the most concentrated?

..... [1]

(ii) Explain how Fig. 7.1 shows your answer to **(i)** is correct.

.....

.....

..... [2]

(iii) Why do each of the three experiments give the same total volume of gas?

.....

..... [1]

(b) A fourth experiment is carried out using hydrochloric acid solution **A** and the same mass of powdered calcium carbonate.
This time the experiment is carried out at a higher temperature.
Sketch on Fig. 7.1 the result you would expect for this fourth experiment. [2]

(c) (i) Calculate the number of moles in the 100 cm^3 of carbon dioxide gas produced. (Assume the volume of carbon dioxide is measured at r.t.p. The volume of one mole of any gas is 24 dm^3 at r.t.p.).

moles of carbon dioxide = ... [1]

(ii) Calculate the number of moles of calcium carbonate used to produce 100 cm^3 of carbon dioxide gas.

moles of calcium carbonate = ... [1]

(iii) Calculate the mass of calcium carbonate used to produce 100 cm^3 of carbon dioxide gas.
Show your working.
(The relative formula mass, M_r, of calcium carbonate = 100.)

mass of calcium carbonate = ... g [2]

8 **(a)** **(i)** Name the process by which the Sun produces energy.

.....

[1]

(ii) Explain what happens in this process.

.....

.....

.....

.....

.....

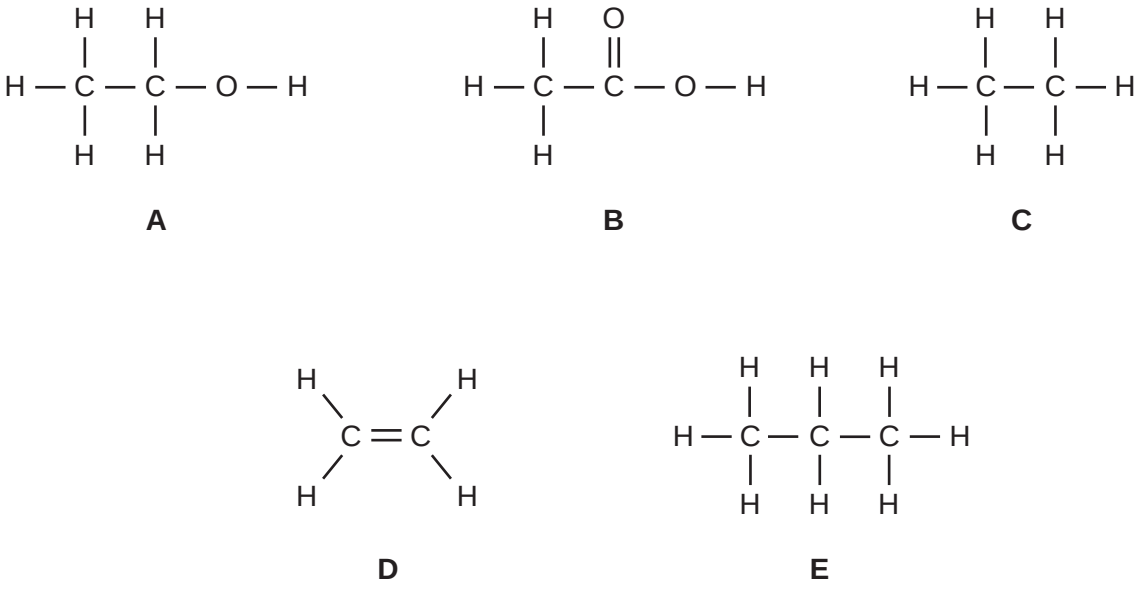
.....

[3]

(b) Calculate the energy released in the Sun when its mass decreases by 1200 kg as a result of this process. Write down the equation you use and show all your working.
The speed of light = 3.0×10^8 m / s.

energy released = ... J [4]

9 Fig. 9.1 shows the graphical formulae of five organic compounds.



A **B** **C**

D **E**

Fig. 9.1

(a) (i) Which **two** compounds are alkanes?

.....

[1]

(ii) Which compound dissolves in water to give an acidic solution?

.....

[1]

(b) (i) Describe a test to distinguish between compounds **C** and **D**.

test .....

.....

result .....

.....

[2]

(ii) In industry compound **D** is made from compound **C**.
Name the type of reaction that is used.

.....

[1]

(c) Compound **D** can be used to make a polymer.
Draw the structure for this polymer.

[2]

10 Fig. 10.1 shows a circuit with a high resistance voltmeter being used to measure the e.m.f. of a cell.

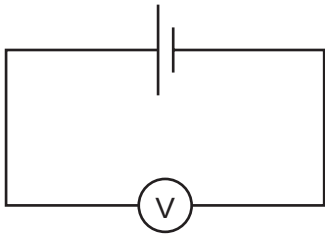


Fig. 10.1

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

.....

.....

..... [2]

(b) Fig. 10.2 shows a cell with an internal resistance of 5 Ω. A voltmeter which has a resistance of 995 Ω is connected across the cell. The e.m.f. of the cell is 1.50 V.

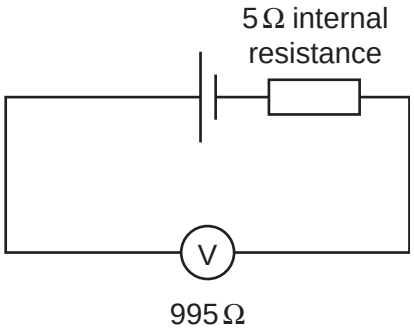


Fig. 10.2

(i) Calculate the current in the circuit.

current = ... A [3]

(ii) Calculate the potential difference across the voltmeter.

potential difference = ... V [2]

(iii) Explain why this voltmeter gives a good approximation to the e.m.f. of the cell.

.....

.....

.....

..... [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															

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.).