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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.

For Examiner's Use	
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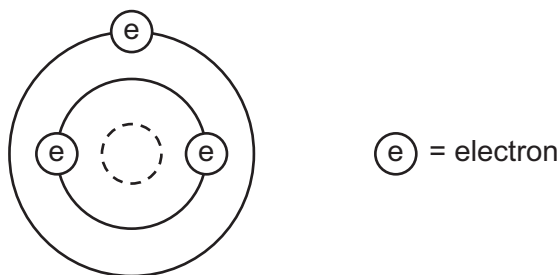
If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

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

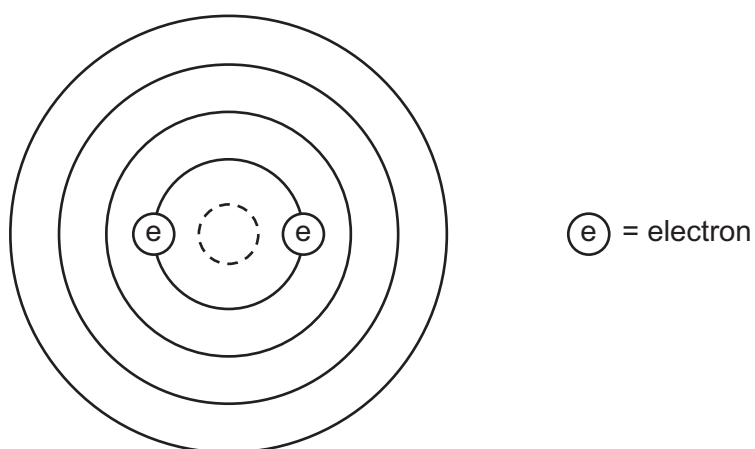


- 1 Fig. 1.1 shows the arrangement of electrons in a lithium atom.



**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  $66^\circ$ . 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]

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



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

- (a) (i) Calculate the number of moles in the 20 cm<sup>3</sup> 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<sub>4</sub>.

Show your working.

$M_r$  = ..... [2]

- (iv) Calculate the mass of copper(II) sulphate, CuSO<sub>4</sub>, formed.

Show your working.

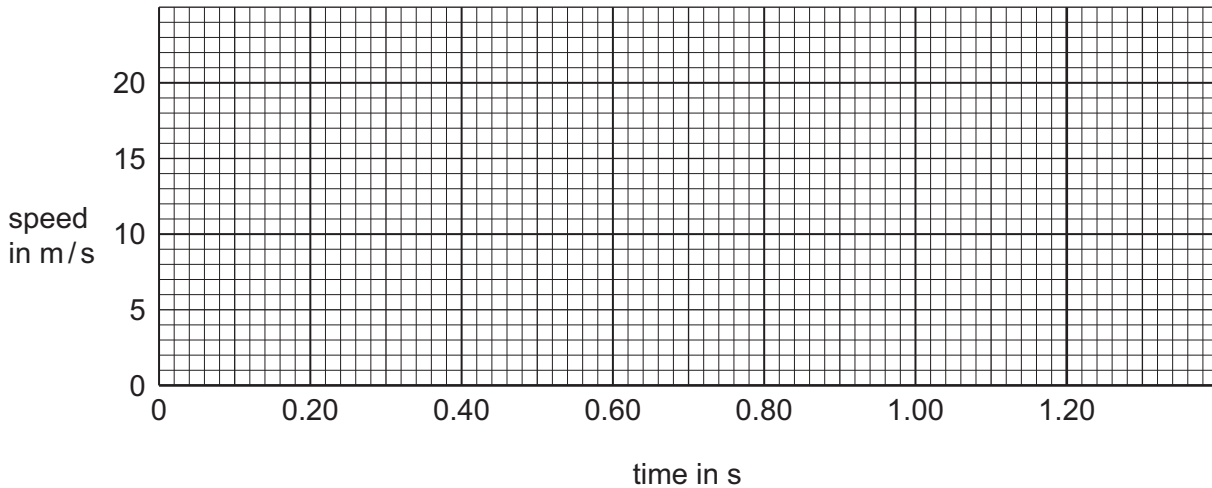
mass = .....g [2]

- (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 0.10 s 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]

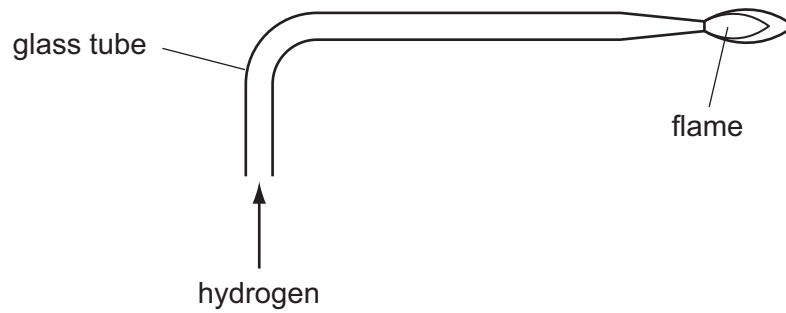
- (b) Calculate the maximum kinetic energy of the ball. Show all your working.

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.

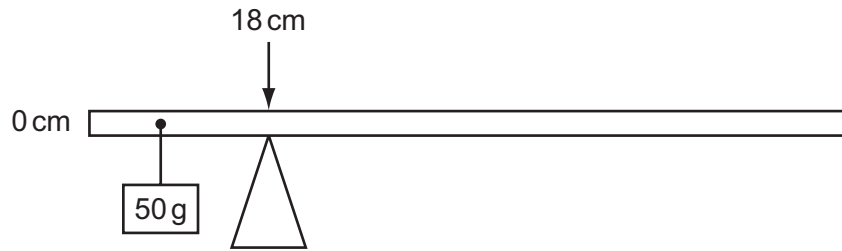


Fig. 6.1

(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]

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



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.

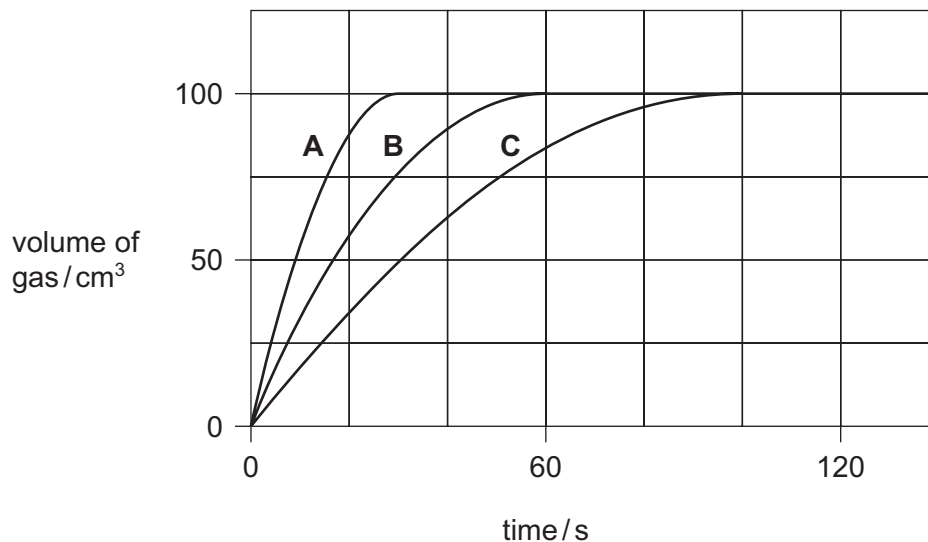


Fig. 7.1

- (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  $100 \text{ cm}^3$  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  $24 \text{ dm}^3$  at r.t.p.).

moles of carbon dioxide = ..... [1]

- (ii) Calculate the number of moles of calcium carbonate used to produce  $100 \text{ cm}^3$  of carbon dioxide gas.

moles of calcium carbonate = ..... [1]

- (iii) Calculate the mass of calcium carbonate used to produce  $100 \text{ cm}^3$  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]

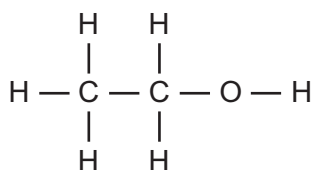
- (ii) Explain what happens in this process.

.....  
 .....  
 .....  
 .....  
 .....  
 ..... [3]

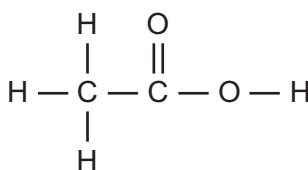
- (b) Calculate the energy released in the Sun when its mass decreases by 1200 kg as a result of this process. Write down the equation you use and show all your working. The speed of light =  $3.0 \times 10^8$  m/s.

energy released = ..... J [4]

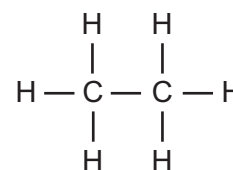
- 9 Fig. 9.1 shows the graphical formulae of five organic compounds.



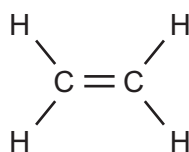
A



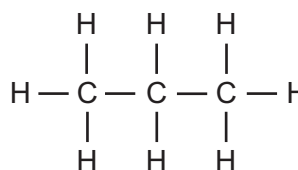
B



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.

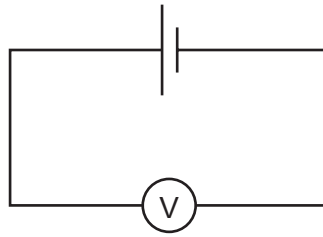


Fig. 10.1

- (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  $5\ \Omega$ . A voltmeter which has a resistance of  $995\ \Omega$  is connected across the cell. The e.m.f. of the cell is  $1.50\ \text{V}$ .

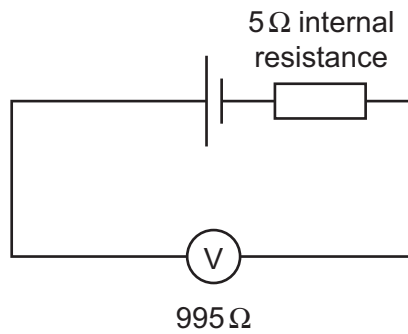


Fig. 10.2

- (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	O																							
		1 <b>H</b> Hydrogen 1																2 <b>He</b> Helium 2												
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4																	19 <b>F</b> Fluorine 9												
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12																	16 <b>O</b> Oxygen 8												
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	51 <b>V</b> Vanadium 23	52 <b>Cr</b> Chromium 24	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	84 <b>Kr</b> Krypton 36	88 <b>Sr</b> Strontium 38	89 <b>Y</b> Yttrium 39	137 <b>Ba</b> Barium 56	131 <b>Xe</b> Xenon 54												
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71	37 <b>Rb</b> Rubidium 37	41 <b>Nb</b> Niobium 41	43 <b>Tc</b> Technetium 43	44 <b>Ru</b> Ruthenium 44	45 <b>Rh</b> Rhodium 45	46 <b>Pd</b> Palladium 46	47 <b>Ag</b> Silver 47	48 <b>Cd</b> Cadmium 48	49 <b>In</b> Indium 49	50 <b>Sn</b> Tin 50	51 <b>Sb</b> Antimony 51	52 <b>Te</b> Tellurium 52	53 <b>I</b> Iodine 53	87 <b>Fr</b> Francium 87	226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	86 <b>Rn</b> Radon 86
<p>*58-71 Lanthanoid series 90-103 Actinoid series</p>																														

**Key**

a	<b>X</b>
b	

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

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