



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

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**PHYSICAL SCIENCE**

**0652/21**

Paper 2 (Core)

**October/November 2012**

**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.

You may use a soft pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** questions.

A copy of the Periodic Table is printed on page 16.

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.

**For Examiner's Use**

<b>1</b>	
<b>2</b>	
<b>3</b>	
<b>4</b>	
<b>5</b>	
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<b>7</b>	
<b>8</b>	
<b>9</b>	
<b>10</b>	
<b>Total</b>	

This document consists of **16** printed pages.



- 1 Fig. 1.1 shows an uncalibrated liquid-in-glass thermometer.



Fig. 1.1

For  
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Use

- (a) (i) Name a suitable liquid to use in the thermometer.

..... [1]

- (ii) State the physical property of the liquid on which the operation of the thermometer depends.

..... [1]

- (b) (i) Explain what is meant by a *fixed point*.

.....  
 .....  
 ..... [2]

- (ii) What are the values of the fixed points on the Celsius temperature scale?

upper fixed point .....

lower fixed point ..... [2]

- (c) The thermometer is to be calibrated.

The two fixed points are marked on the thermometer.

Describe the remaining stages in calibrating the thermometer.

.....  
 .....  
 ..... [2]

2 Chlorine is a member of Group VII of the Periodic Table.

(a) (i) State the name given to Group VII elements.

..... [1]

(ii) Name a Group VII element which is less reactive than chlorine.

..... [1]

(iii) Name the Group I element which is in the same Period as chlorine.

..... [1]

(b) Complete Table 2.1 by giving the name and chemical formula of an ionic and a covalent compound of chlorine.

**Table 2.1**

compound	name	formula
ionic		
covalent		

[4]

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3 Fig. 3.1 shows a man balancing on a tightrope.

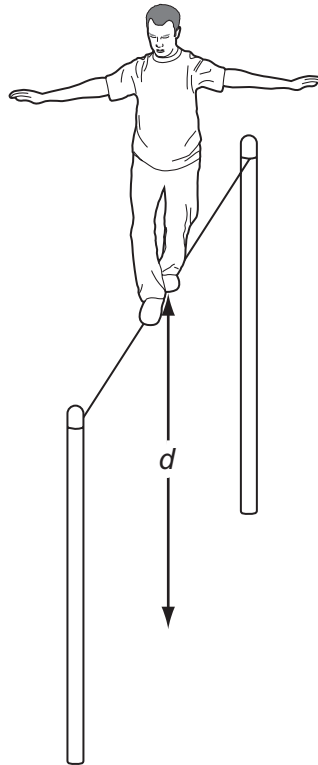


Fig. 3.1

For  
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Use

(a) On Fig. 3.1 mark a possible position of the centre of mass of the man. Label it **C**. [1]

(b) The mass of the man is 75 kg.

(i) Explain what is meant by *mass*.

.....  
..... [1]

(ii) Calculate the weight of the man.

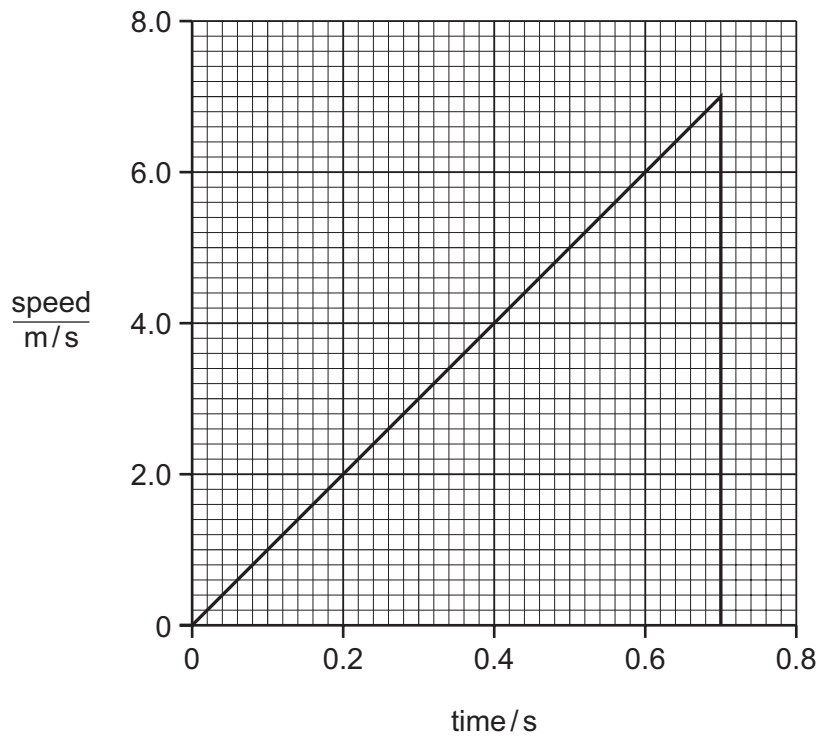
[ $g = 10 \text{ N/kg}$ ]

weight = ..... [2]

(c) The man jumps off the tightrope.

The graph in Fig. 3.2 shows his speed in a vertical direction after jumping.

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**Fig. 3.2**

Use Fig. 3.2 to find

(i) the maximum speed of the man,

speed = ..... m/s [1]

(ii) the height,  $d$ , of the wire above the ground.

$d$  = ..... m [3]

(d) (i) Name the form of energy the man has due to his motion as he falls to the ground.

..... [1]

(ii) Suggest what happens to this energy when he hits the ground.

.....  
 .....  
 ..... [2]

- 4 Fig. 4.1 shows apparatus used to react copper(II) oxide with hydrogen.

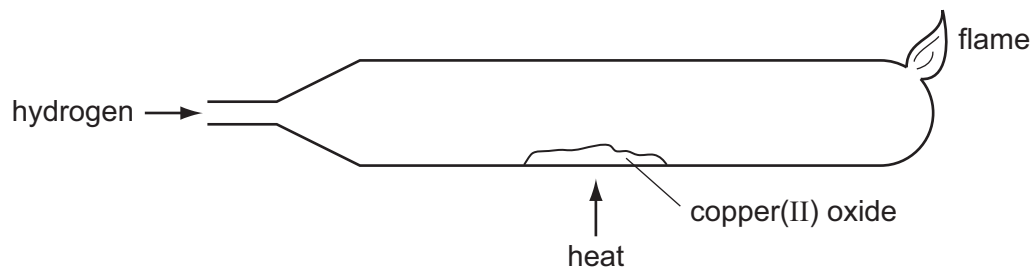


Fig. 4.1

For  
Examiner's  
Use

- (a) (i) Copper(II) oxide is black.

State the colour change you would see when copper(II) oxide is reduced to copper by hydrogen.

.....  
..... [1]

- (ii) Write a balanced equation for this reaction.

..... [1]

- (iii) Explain what this reaction shows about the relative reactivity of copper and of hydrogen.

.....  
..... [1]

- (b) Describe how you could show that carbon (charcoal) is more reactive than copper and less reactive than magnesium.

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

5 Ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$ , and ammonium nitrate,  $\text{NH}_4\text{NO}_3$ , are important nitrogen-containing fertilisers.

For  
Examiner's  
Use

(a) Name **two** substances which react together to make ammonium nitrate.

1 .....

2 ..... [2]

(b) Calculate the relative molecular mass of ammonium sulfate.

[Relative atomic masses:  $A_r$ : H,1; N,14; O,16; S,32.]

answer ..... [2]

(c) Show by calculation that there is 35% nitrogen by mass in ammonium nitrate,  $\text{NH}_4\text{NO}_3$ .

[Relative molecular mass of ammonium nitrate is 80]

[2]

(d) Ammonium sulfate contains less nitrogen by mass than ammonium nitrate.

Suggest why ammonium sulfate is sometimes preferred as a fertiliser.

..... [1]

- 6 Fig. 6.1 shows the refraction of red light as it passes through a parallel sided glass block.

For  
Examiner's  
Use

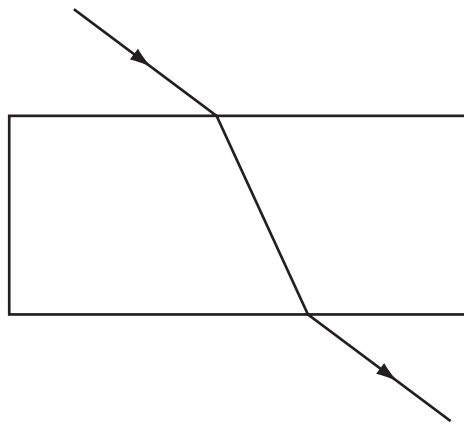


Fig. 6.1

- (a) On Fig. 6.1 mark

- (i) an angle of incidence and label it  $i$ , [1]  
(ii) an angle of refraction and label it  $r$ . [1]

- (b) Blue light refracts more than red light.

Blue light is shone along the same incident path as the red light.

On Fig. 6.1, draw the path of the blue light as it passes through the block and emerges into the air. [2]



(c) Fig. 6.2 shows a parallel beam of light incident on a converging lens.

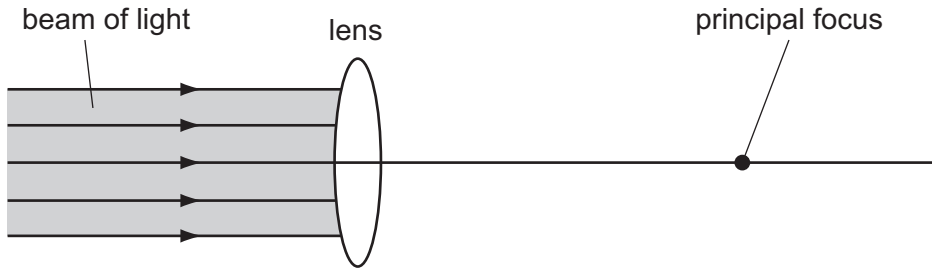


Fig. 6.2

- (i) On Fig. 6.2 draw rays to show the path of the light after it passes through the lens. [3]
- (ii) On Fig. 6.2 draw an arrow to show the focal length of the lens. [1]

(d) Powerful lenses are usually very thick.

Images formed by these lenses have coloured edges.

Suggest and explain a reason for this. You will find it helpful to use the information from parts (b) and (c) in your explanation.

.....

.....

..... [2]

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- 7 Danielle is investigating the resistance of a length of constantan wire.  
She builds the circuit shown in Fig. 7.1.

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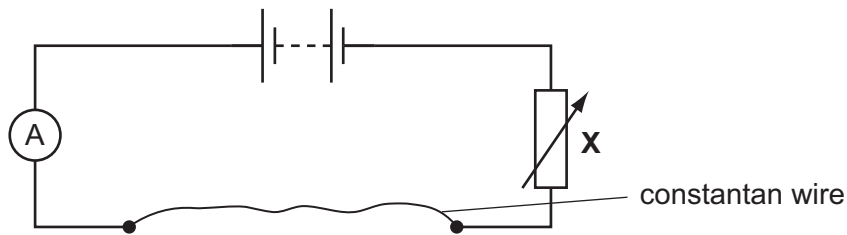


Fig. 7.1

(a) (i) Name the component labelled X. .... [1]

(ii) Explain the use of this component in the circuit.

.....  
..... [1]

(iii) On Fig. 7.1, show how Danielle should connect a meter to measure the potential difference across the wire. [2]

(b) When the potential difference across the constantan wire is 4.5V, the reading on the ammeter is 0.12A.

Calculate the resistance of the constantan wire.

resistance = ..... unit ..... [3]

(c) Danielle connects a second identical constantan wire in parallel with the original wire.

State how

(i) the total resistance in the circuit changes,

..... [1]

(ii) the reading on the ammeter changes.

..... [1]

(d) A third piece of constantan wire has the same length as the original wire but has a larger diameter.

State how the resistance of the third wire compares with the resistance of the original wire.

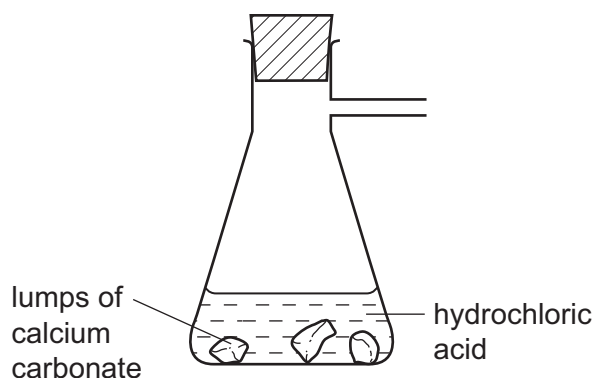
Give a reason for your answer.

.....  
.....  
..... [2]

For  
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Use

- 8 Fig. 8.1 shows apparatus used in an experiment to react hydrochloric acid with excess calcium carbonate to produce carbon dioxide.

For  
Examiner's  
Use



**Fig. 8.1**

- (a) Complete Fig. 8.1 to show apparatus used to collect and measure the volume of the carbon dioxide. [2]

- (b) Describe a test to show that the gas collected is carbon dioxide.

test .....

result ..... [2]

- (c) Table 8.1 shows the volume of carbon dioxide collected during the experiment.

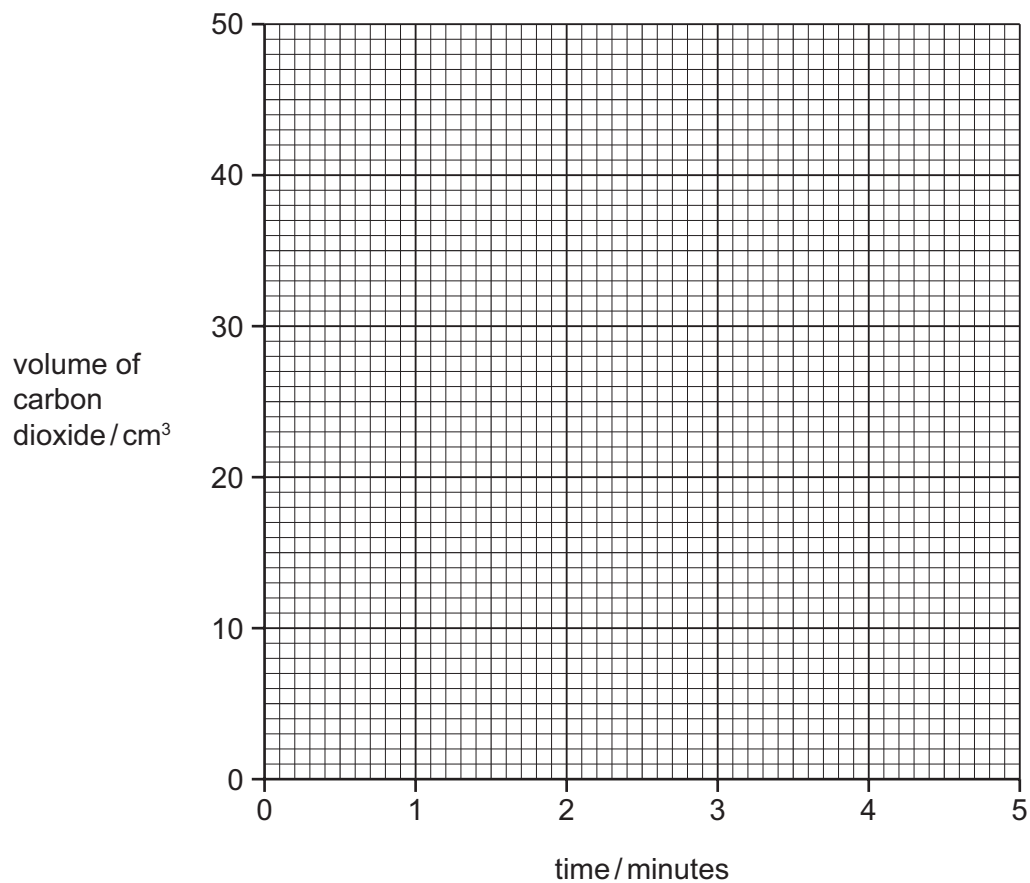
**Table 8.1**

time / minutes	volume of carbon dioxide collected / cm <sup>3</sup>
0	0
1	15
2	26
3	34
4	40
5	40

(i) On Fig. 8.2, plot the results from Table 8.1.

[1]

*For  
Examiner's  
Use*



**Fig. 8.2**

(ii) On Fig. 8.2, draw the curve of best fit.

[2]

(iii) Explain why the reaction stops after 4 minutes.

[1]

.....

(iv) The experiment is repeated using the same mass of calcium carbonate. This time powder is used instead of lumps.

On Fig. 8.2, sketch the curve for this experiment.

[2]

- 9 (a) Complete Table 9.1 to show the gases formed, if any, when each of the substances listed react with dilute sulfuric acid.

For  
Examiner's  
Use

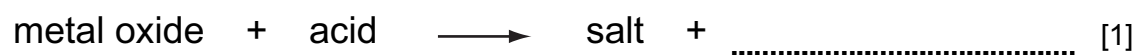
Table 9.1

substance added	gas, if any, formed
copper	
magnesium	
sodium carbonate	

[3]

- (b) A salt is formed when a metal oxide neutralises an acid.

Complete the word equation for this reaction.



10 (a) Fig. 10.1 shows the structure of the alkane, ethane.

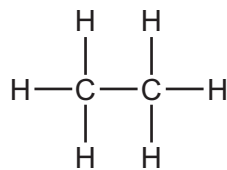


Fig. 10.1

Draw a similar diagram to show the structure of the alkene, ethene.

ethene [2]

(b) Name an alkane with four carbon atoms and give its formula.

name .....

formula ..... [2]

(c) (i) Explain why ethene is more reactive than ethane.

.....  
 ..... [1]

(ii) Explain why ethene is important in the chemical industry.

.....  
 ..... [1]

For  
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Use

**DATA SHEET**  
**The Periodic Table of the Elements**

		Group														
I	II	III	IV	V	VI	VII	0									
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10								
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulfur 16	35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18									
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	56 <b>Fe</b> Iron 26	55 <b>Mn</b> Manganese 25	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	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36			
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	101 <b>Ru</b> Ruthenium 44	101 <b>Tc</b> Technetium 43	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54			
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	186 <b>Os</b> Osmium 76	184 <b>W</b> Tungsten 74	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	210 <b>Po</b> Polonium 84	210 <b>At</b> Astatine 85	210 <b>Rn</b> Radon 86			
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89															
*58-71 Lanthanoid series													175 <b>Lu</b> Lutetium 71			
†90-103 Actinoid series													103 <b>Lr</b> Lawrencium 103			
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="width: 20px;">a</td> <td style="width: 20px;"><b>X</b></td> <td style="width: 20px;">b</td> </tr> </table> <p>Key a = relative atomic mass X = atomic symbol b = proton (atomic) number</p>													a	<b>X</b>	b	169 <b>Tm</b> Thulium 69
a	<b>X</b>	b														
													167 <b>Er</b> Erbium 68			
													165 <b>Ho</b> Holmium 67			
													162 <b>Dy</b> Dysprosium 66			
													159 <b>Tb</b> Terbium 65			
													157 <b>Gd</b> Gadolinium 64			
													152 <b>Eu</b> Europium 63			
													150 <b>Sm</b> Samarium 62			
													144 <b>Nd</b> Neodymium 60			
													141 <b>Pr</b> Praseodymium 59			
													140 <b>Ce</b> Cerium 58			
													238 <b>U</b> Uranium 92			
													232 <b>Th</b> Thorium 90			
													94 <b>Pu</b> Plutonium 94			
													93 <b>Np</b> Neptunium 93			
													95 <b>Am</b> Americium 95			
													96 <b>Cm</b> Curium 96			
													97 <b>Bk</b> Berkelium 97			
													98 <b>Cf</b> Californium 98			
													99 <b>Es</b> Einsteinium 99			
													100 <b>Fm</b> Fermium 100			
													101 <b>Md</b> Mendelevium 101			
													102 <b>No</b> Nobelium 102			

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

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