



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

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**PHYSICAL SCIENCE**

**0652/21**

Paper 2 (Core)

**October/November 2015**

**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 an HB pencil for any diagrams, graphs, tables or rough working.

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

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

A copy of the Periodic Table is printed on page 20.

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.

This document consists of **18** printed pages and **2** blank pages.

2

1 Carbon-12 and carbon-14 are isotopes of carbon.

(a) Explain what is meant by the term *isotope*.

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

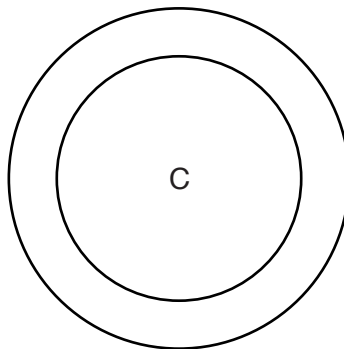
(b) Carbon-14 can be represented by  $^{14}_6\text{C}$ .

State what the numbers 6 and 14 stand for.

6 .....

14 ..... [2]

(c) Complete Fig. 1.1 to show the electron arrangement in an atom of carbon-14.



**Fig. 1.1**

[1]

- 2 Fig. 2.1 shows a beam fixed into a wall at one end. **C** marks the centre of mass of the beam. Point **X** acts as the pivot.

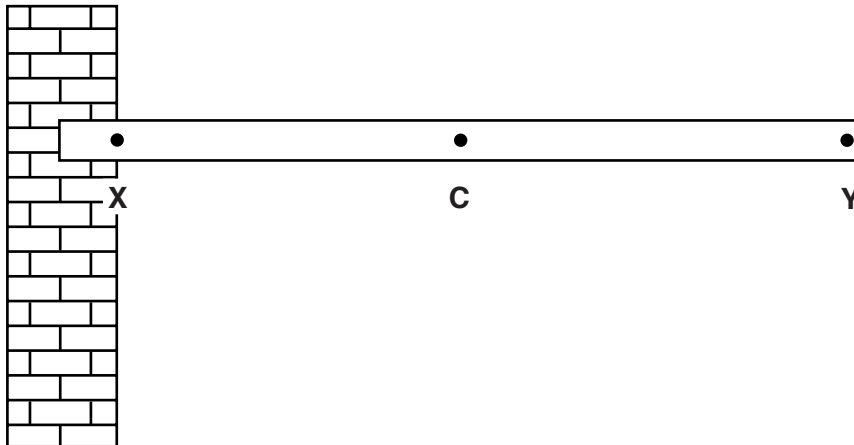


Fig. 2.1

- (a) Draw an arrow to show where the weight of the beam acts and the direction in which it acts. [2]
- (b) A man of mass 80 kg stands on the beam at point **Y**.
- (i) Calculate the weight of the man and give the unit. Use  $g = 10 \text{ m/s}^2$ .

weight ..... unit ..... [2]

- (ii) The distance from **X** to **Y** is 6.0 m.

Calculate the moment at point **X** produced by the man when he is at point **Y**.

moment = ..... Nm [2]

- (iii) State and explain how the moment produced at **X** changes as the man walks towards the wall.

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

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3 Use words from the list below to complete Table 3.1.

Each word may be used once, more than once, or not at all.

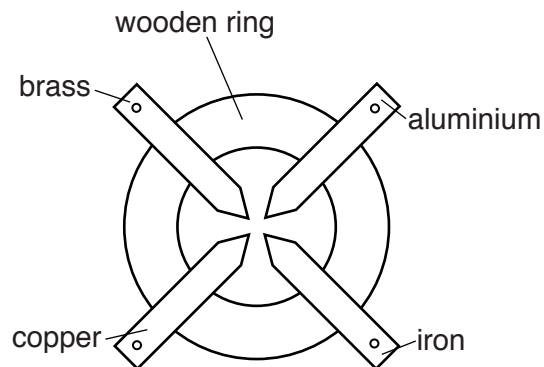
**air**            **brass**            **bromine**            **chlorine**  
**graphite**            **nitrogen**            **steel**            **sulfur**

**Table 3.1**

description	substance
an alloy containing zinc	
a solid non-metallic element	
a gaseous mixture	
an element which is a good conductor of electricity	
a gaseous element used in water purification	

[5]

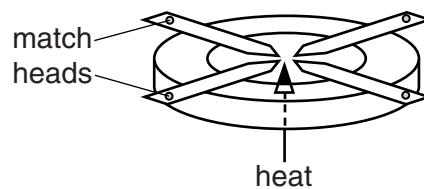
- 4 Fig. 4.1 shows a piece of apparatus, viewed from above. Four different metal strips are fixed to a wooden ring.



**Fig. 4.1**

Fig. 4.2 shows an experiment using the apparatus.

A match head is placed on the end of each metal strip. The strips are then heated at the centre.



**Fig. 4.2**

Each of the match heads ignites after a different length of time. This is shown in Table 4.1.

**Table 4.1**

metal strip	time for match head to ignite/minutes
aluminium	4
brass	3
copper	1
iron	8

(a) Name the form of thermal energy transfer which causes the match to ignite.

..... [1]

(b) List the metals in order of the speed at which they transfer thermal energy.

fastest .....

.....

.....

slowest .....

[2]

5 Sodium chloride,  $\text{NaCl}$ , is an ionic compound containing sodium ions and chloride ions.

(a) (i) Explain how a sodium ion is formed from a sodium atom.

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

(ii) Give the symbol for a chloride ion and the total number of electrons it contains.

symbol .....

number of electrons ..... [2]

(b) In the box, draw a dot and cross diagram to show the electrons in a molecule of hydrogen chloride,  $\text{HCl}$ .

Include outer electrons only.

[2]

(c) Sodium chloride can be made by reacting hydrogen chloride with an alkali.

Name a suitable alkali and the other product or products of the reaction with this alkali.

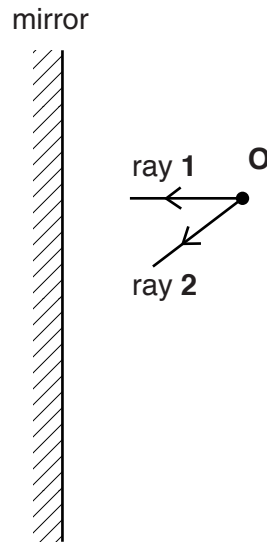
alkali .....

other product(s) .....

..... [2]



- 6 Fig. 6.1 shows an illuminated object **O** in front of a plane mirror. Two rays of light are shown leaving object **O**.



**Fig. 6.1**

- (a) (i) On Fig. 6.1, mark the position of the image of object **O** formed by the mirror and label it **I**. [1]
- (ii) Complete ray **1** showing how it is reflected from the mirror. [1]
- (iii) Complete ray **2** showing how it is reflected from the mirror. [1]
- (iv) Identify and label, with the letter **r**, the angle of reflection that ray **2** makes with the mirror. [1]
- (v) Complete the diagram to show how the image **I** is formed. [2]
- (vi) Mark the position of an eye for the image to be seen and label it **E**. [1]

- (b) State the relationship between the angle of incidence and the angle of reflection.

..... [1]

- (c) The image formed in a plane mirror is upright and the same size as the original object.

State one other property of the image.

..... [1]

7 Calcium carbonate,  $\text{CaCO}_3$ , and ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$ , may be used by farmers to improve crop yields.

- (a) Complete Table 7.1 by writing the names of the three other elements present in ammonium sulfate and the relative numbers of atoms of each in the compound. One element is done for you.

**Table 7.1**

element	relative number of atoms
sulfur	1
.....	.....
.....	.....
.....	.....

[3]

- (b) Calculate the relative molecular mass of calcium carbonate,  $\text{CaCO}_3$ .

[Relative atomic masses:  $A_r$ : Ca, 40; C, 12; O, 16]

relative atomic mass = ..... [2]

- (c) Many crops grow best in neutral or weakly alkaline soils. Calcium carbonate is added to acidic soils to increase their pH.

- (i) Suggest the pH number of a weakly acidic soil.

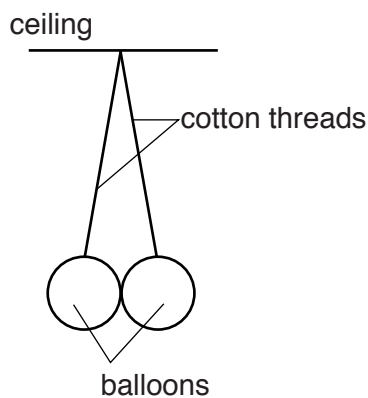
..... [1]

- (ii) State the pH number of neutral soil.

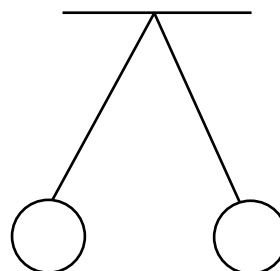
..... [1]

- 8 A student hangs two balloons from the ceiling as shown in Fig. 8.1a.

The student then rubs the two balloons on his jumper. The balloons now hang as shown in Fig. 8.1b.



**Fig. 8.1a**



**Fig. 8.1b**

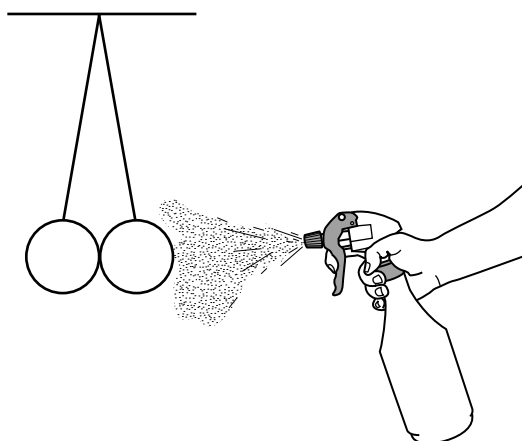
- (a) Explain why the balloons are no longer touching.

.....

.....

..... [3]

- (b) A fine mist of water is sprayed near the balloons. The balloons move back so that they are touching each other as shown in Fig. 8.2.



**Fig. 8.2**

Explain why the balloons move back to this position.

.....

.....

..... [2]

9 Copper is a transition element.

(a) Transition elements are metals.

State one other characteristic of transition elements.

..... [1]

(b) Name a non-metallic element in the same period as copper.

..... [1]

(c) Copper is found in the Earth's crust, either as an ore or 'native'.

(i) Name an ore of copper.

..... [1]

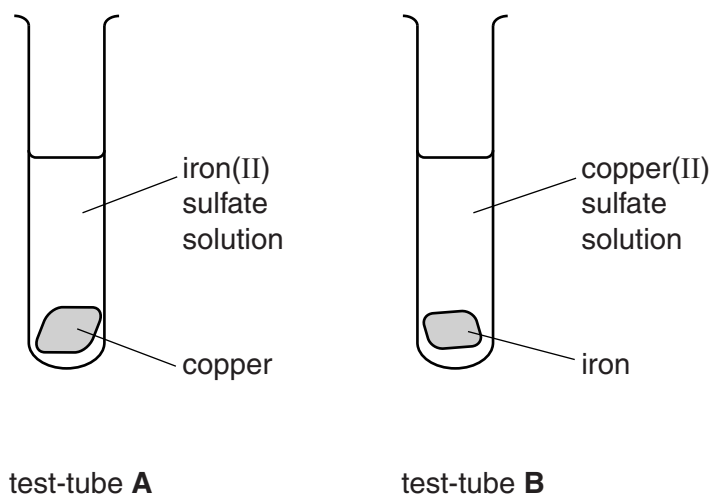
(ii) Name another metal which is also found 'native' in the Earth's crust.

..... [1]

(iii) Give a reason why these metals are found 'native'.

..... [1]

(d) A student sets up the apparatus as shown in Fig. 9.1.



**Fig. 9.1**

She observes the apparatus after one hour.

(i) State what she sees in each test-tube after one hour.

test-tube **A** .....

.....

test-tube **B** .....

.....

[2]

(ii) Explain these observations.

.....

..... [1]



10 Ethyne (acetylene),  $C_2H_2$ , is used as a fuel when metals are welded together.

Ethyne burns in oxygen to form carbon dioxide and water in an exothermic reaction.

(a) (i) State what is meant by *exothermic*.

..... [1]

(ii) Write a balanced equation for the burning of ethyne underneath the word equation.

**ethyne + oxygen → carbon dioxide + water**

..... [2]

(b) (i) Name the harmful gas that is formed when ethyne burns in a limited supply of oxygen.

..... [1]

(ii) Explain why this gas is harmful.

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

(c) Ethyne is a member of a homologous series.

(i) State one characteristic of a homologous series.

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

(ii) Ethene,  $C_2H_4$ , and ethane,  $C_2H_6$ , are members of different homologous series.

Explain how ethene and ethane are different in terms of their bonding.

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

11 A student draws the circuit diagram shown in Fig. 11.1.

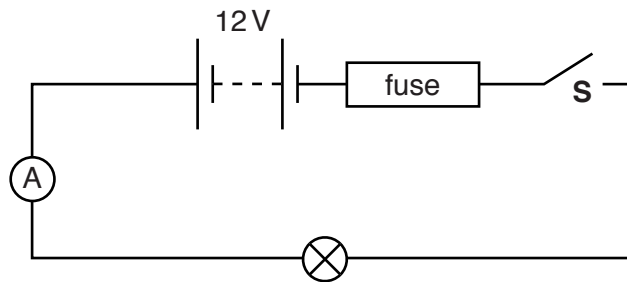


Fig. 11.1

(a) He has drawn the wrong symbol for a fuse.

Draw the correct symbol for a fuse in the space below.

[1]

(b) The student constructs the circuit shown in his diagram.

He closes switch **S** and the reading on the ammeter is 3.2 A.

Calculate the resistance of the lamp. Give the unit.

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

(c) Fuses of the following ratings are available: 3 A, 5 A, and 13 A.

State which fuse would be most suitable to use in the circuit shown in Fig. 11.1 and give an explanation for your choice.

fuse rating .....

explanation .....

.....

..... [3]



(d) The student adds an identical second lamp, in parallel with the original lamp.

(i) Complete Fig. 11.2 to show the two lamps connected in parallel in the circuit.

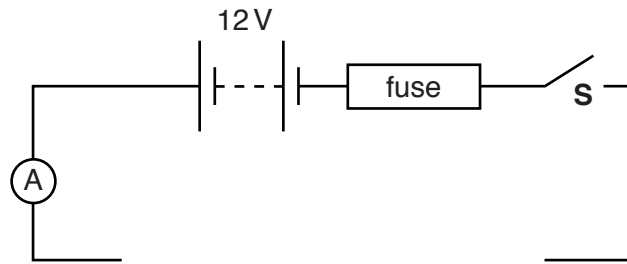


Fig. 11.2

[1]

(ii) When switch **S** in the second circuit is closed the fuse blows.

Explain why the fuse blows.

.....

.....

..... [2]

- 12 The graph in Fig. 12.1 shows the results from an experiment to measure the half life of a radioactive isotope.

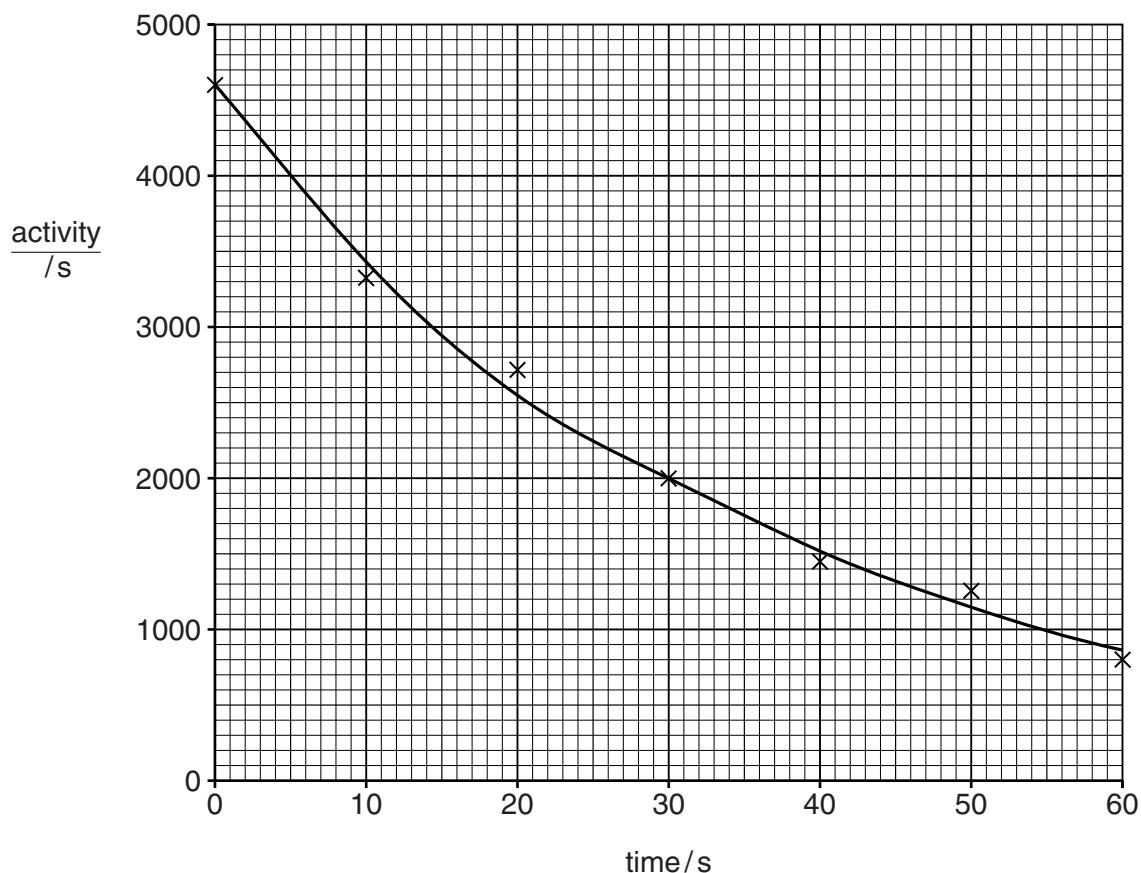


Fig. 12.1

- (a) Suggest why the points do not lie precisely on the drawn curve.

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

- (b) (i) Determine the initial activity of the sample.

..... [1]

- (ii) Use your graph to calculate the half life of the isotope. Show on your graph how you determined your answer.

half life = .....s [2]

(c) Radioactive isotopes can be dangerous to health.

Give **one** precaution that should be taken when using radioactive isotopes.

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

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

		Group													
		I	II	III	IV	V	VI	VII	VIII	IX	X				
		1 <b>H</b> Hydrogen 1													
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4														
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12														
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	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	91 <b>Zr</b> Zirconium 40	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	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	127 <b>I</b> Iodine 53	128 <b>Te</b> Tellurium 52	131 <b>Xe</b> Xenon 54	
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	178 <b>Hf</b> Hafnium 72	184 <b>W</b> Tungsten 74	186 <b>Re</b> Rhenium 75	190 <b>Os</b> Osmium 76	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	209 <b>Po</b> Polonium 84	222 <b>Rn</b> Radon 86	
223 <b>Fr</b> Francium 87	226 <b>Ra</b> Radium 88														
		* 58–71 Lanthanoid series † 90–103 Actinoid series													
		140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	147 <b>Pm</b> Promethium 61	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	159 <b>Tb</b> Terbium 65	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
		232 <b>Th</b> Thorium 90	231 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	237 <b>Np</b> Neptunium 93	244 <b>Pu</b> Plutonium 94	243 <b>Am</b> Americium 95	247 <b>Cm</b> Curium 96	247 <b>Bk</b> Berkelium 97	251 <b>Cf</b> Californium 98	252 <b>Es</b> Einsteinium 99	257 <b>Fm</b> Fermium 100	258 <b>Md</b> Mendelevium 101	259 <b>No</b> Nobelium 102	260 <b>Lr</b> Lawrencium 103

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

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