



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.

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.

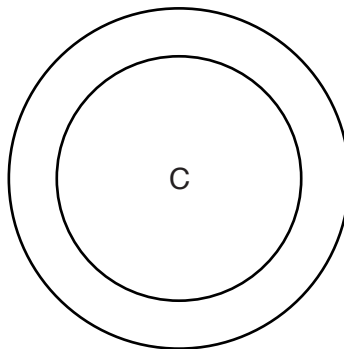


Fig. 1.1

[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.

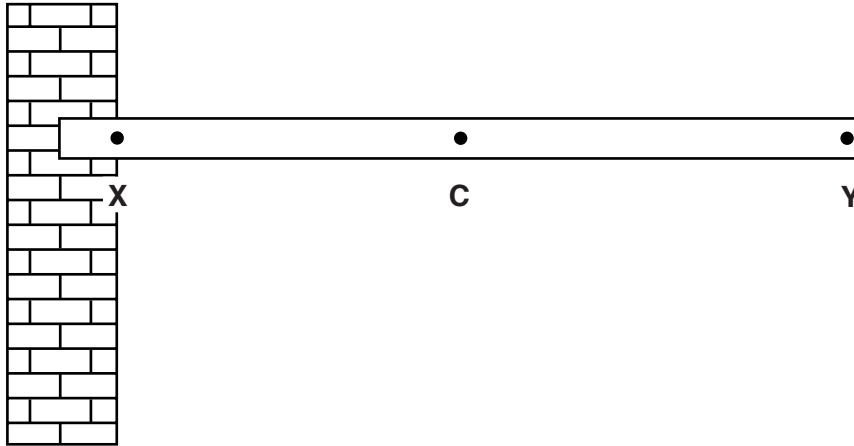


Fig. 2.1

- (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]

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.

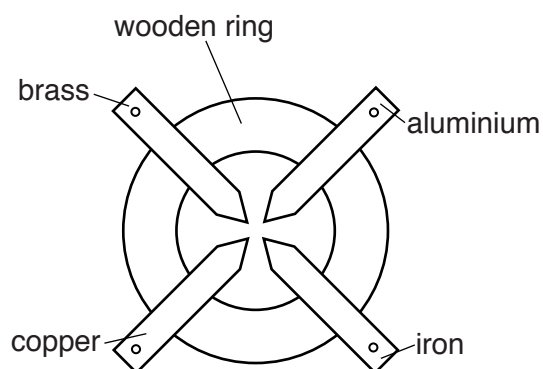


Fig. 4.1

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.

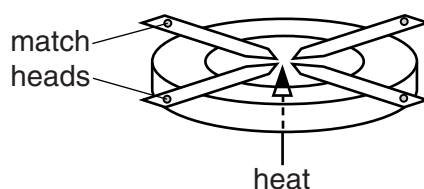


Fig. 4.2

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, 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, 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**.

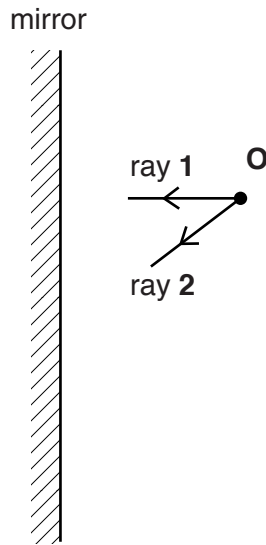


Fig. 6.1

- (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, 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, 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.

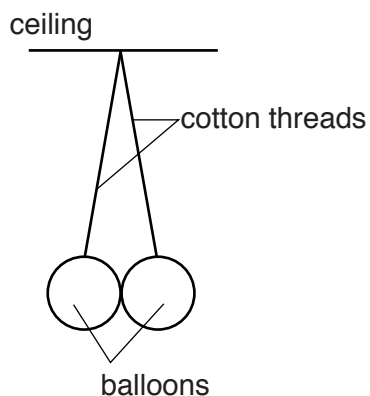


Fig. 8.1a

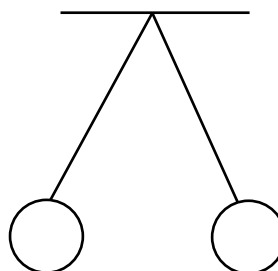


Fig. 8.1b

(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.

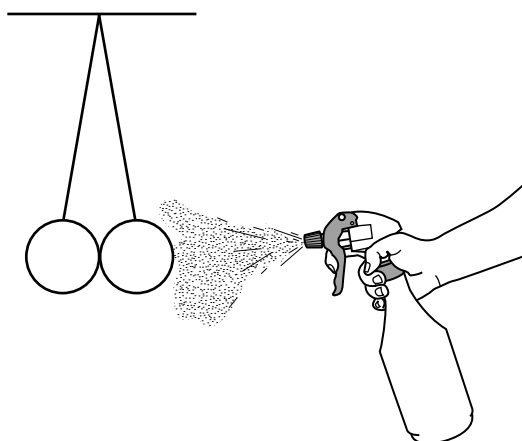


Fig. 8.2

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.

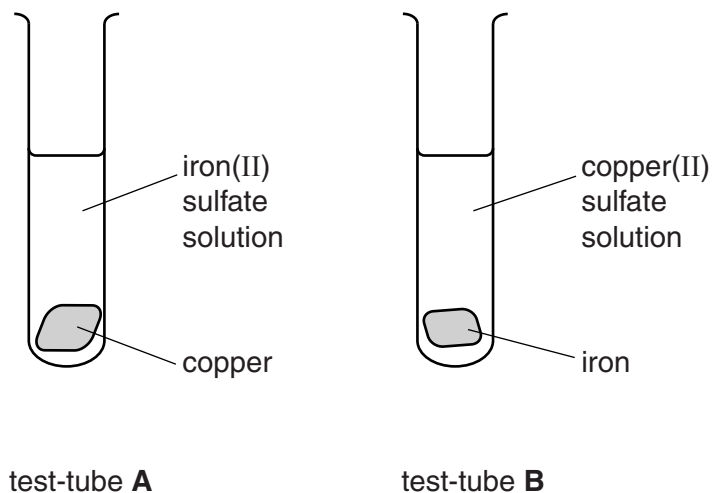


Fig. 9.1

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]

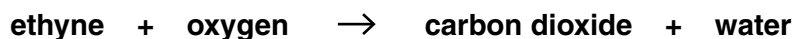
10 Ethyne (acetylene), C_2H_2 , is used as a fuel when metals are welded together.

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.



..... [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.

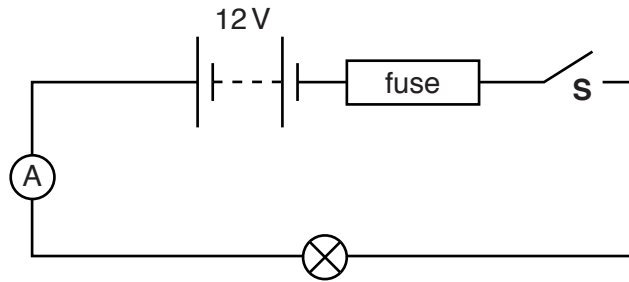


Fig. 11.1

(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.

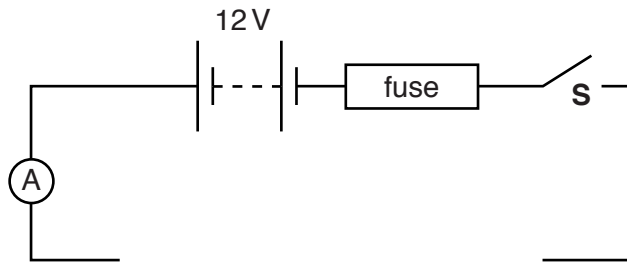


Fig. 11.2

[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.

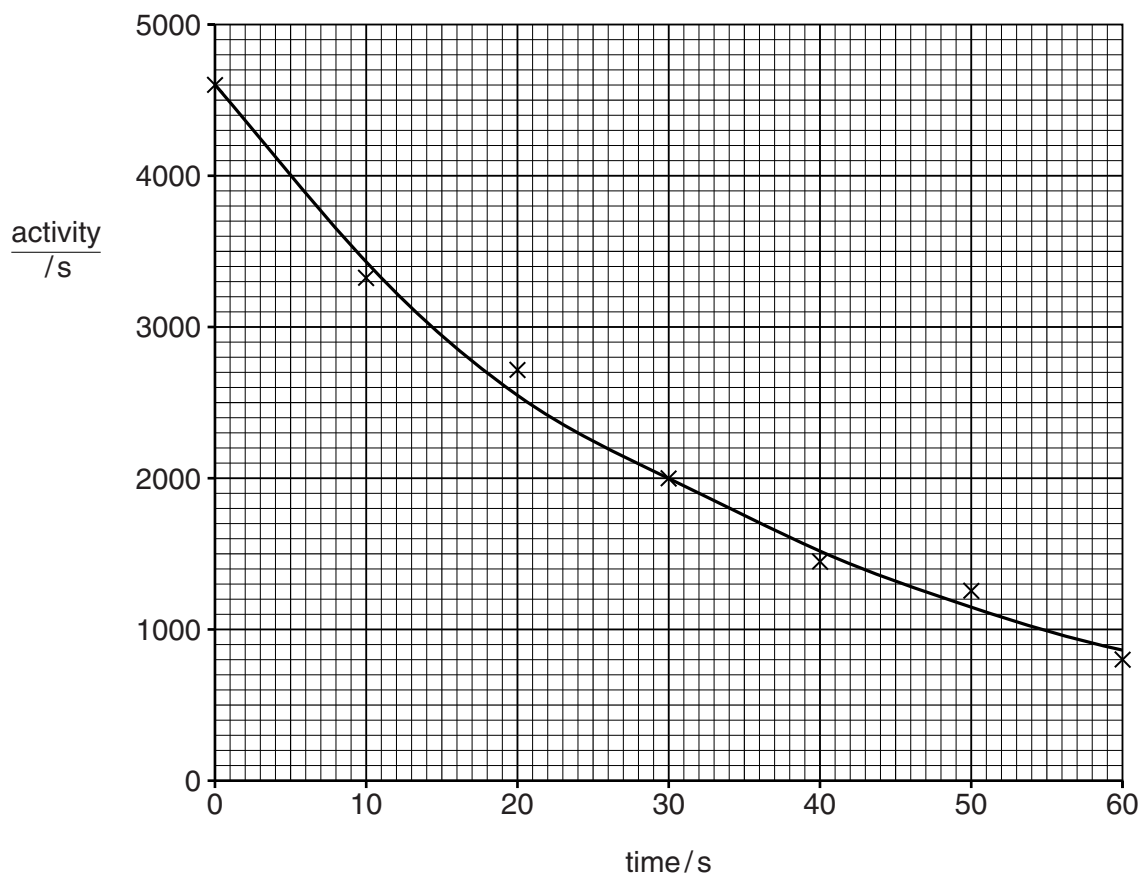


Fig. 12.1

(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

I		II		Group										III	IV	V	VI	VII	O										
7 Li Lithium 3	9 Be Beryllium 4											1 H Hydrogen 1											4 He Helium 2						
23 Na Sodium 11	24 Mg Magnesium 12											5 B Boron 5	6 C Carbon 6	7 N Nitrogen 7	8 O Oxygen 8	9 F Fluorine 9	10 Ne Neon 10												
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	101 Ru Ruthenium 44	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	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	190 Os Osmium 76	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	222 Rn Radon 86															
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89																											
		* 58–71 Lanthanoid series		† 90–103 Actinoid series																									
		<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td style="padding: 2px;">a</td> <td style="padding: 2px;">X</td> </tr> <tr> <td style="padding: 2px;">b</td> <td style="padding: 2px;"></td> </tr> </table>		a	X	b		a = relative atomic mass X = atomic symbol b = atomic (proton) number																					
a	X																												
b																													
		140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 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	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	244 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	247 Bk Berkelium 97	251 Cf Californium 98	252 Es Einsteinium 99	257 Fm Fermium 100	258 Md Mendelevium 101	259 No Nobelium 102	260 Lr Lawrencium 103

The volume of one mole of any gas is 24dm³ at room temperature and pressure (r.t.p.).