



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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PHYSICAL SCIENCE

0652/03

Paper 3 (Extended)

October/November 2009

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	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

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



- 1 (a) A fisherman is steering his boat using a single oar as shown in Fig. 1.1a. Fig. 1.1b shows the same boat viewed from above. To keep the oar stationary the fisherman applies a force of 250 N to the end of the oar.



Fig. 1a

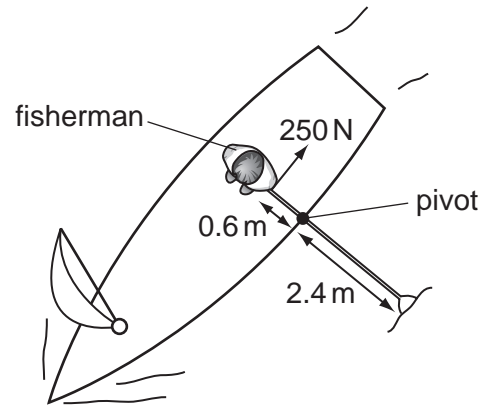


Fig. 1b

Calculate the force the oar produces on the water.

Show your working.

force = [4]

- (b) The boat moves through the water at a steady speed of 2.5 m/s for 12 s. It then decelerates to rest at a uniform rate in a further 8.0 s.

- (i) On Fig. 1.2 draw a speed-time graph to show this motion.

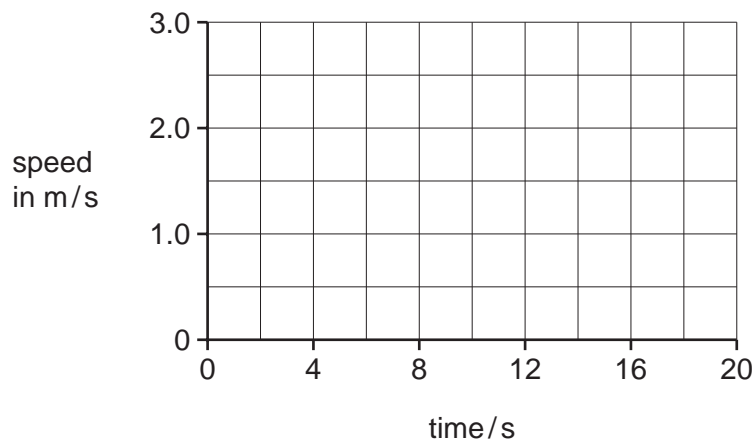


Fig. 1.2

[2]

3

(ii) Calculate the deceleration of the boat.

Show your working.

deceleration = [2]

(iii) Calculate the total distance travelled by the boat.

Show your working.

distance travelled = [2]

2 The elements in each group of the Periodic Table show trends in chemical and physical properties.

(a) Lithium, sodium and potassium are the first three elements in Group I.

(i) Describe the reaction of each element with water to show the trend in the chemical properties of these three elements.

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

(ii) Lithium reacts with water to produce lithium hydroxide and hydrogen.

Write a balanced symbol equation for the reaction of lithium with water.

..... [2]

(b) Table 2.1 shows information about three elements in Group II.

Table 2.1

element	atomic number	relative atomic mass	electron arrangement	density in g/cm ³	melting point in °C
beryllium	4	9	2,2	1.85	1278
magnesium	12	24	2,8,2	1.74	649
calcium	20	40	2,8,8,2	1.54	839

(i) Explain how information in Table 2.1 shows that these three elements are in the same group of the Periodic Table.

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

(ii) The elements in Group II show a trend in physical properties.

Use information from Table 2.1 to describe this trend.

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

(iii) Magnesium reacts with chlorine to form magnesium chloride. This compound contains the ions Mg^{2+} and Cl^- .

What is the formula of magnesium chloride?

..... [1]

(iv) All of the metals in Group II conduct electricity.

Use ideas about metallic bonding to explain this fact.

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

- 3 A solar power station is designed for use in desert countries. Fig. 3.1 shows the steps involved in the production of electricity.

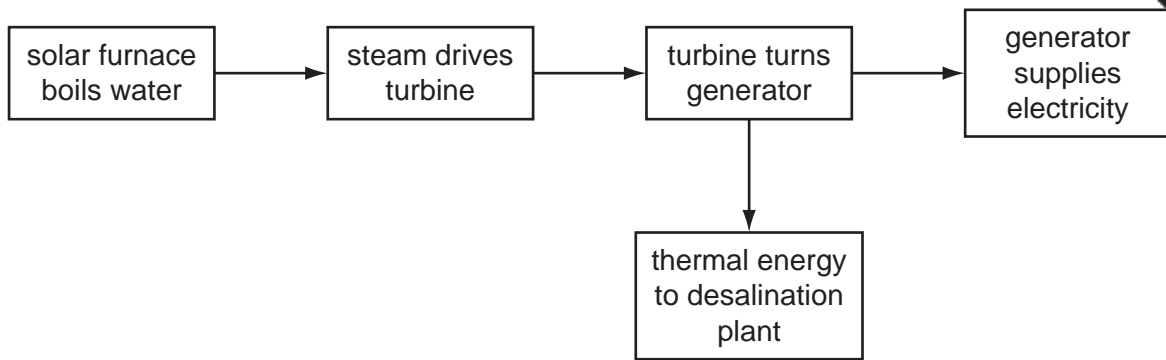


Fig. 3.1

- (a) A solar furnace consists of many mirrors. These mirrors are arranged so that sunlight is reflected onto a large container of water, as shown in Fig. 3.2.

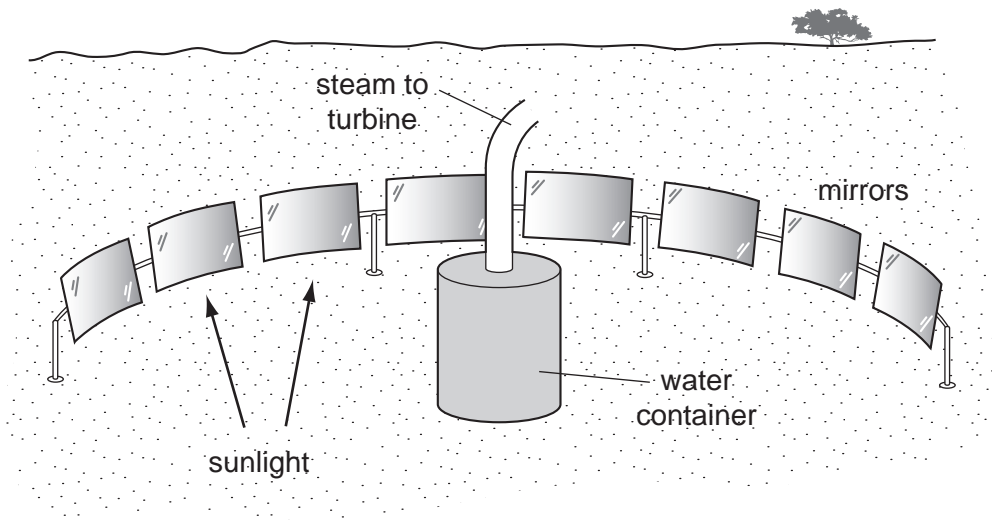


Fig. 3.2

- (i) Name the process by which the Sun's energy is transmitted to Earth.

..... [1]

- (ii) State why the water container is painted black.

.....
 [1]

(iii) Fig. 3.3 shows a ray of sunlight incident on a mirror.

Complete the diagram to show the ray after it is reflected from the mirror.

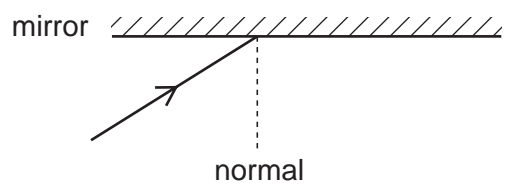


Fig. 3.3

[1]

(b) (i) Name the process by which the energy passes through the wall of the water container.

..... [1]

(ii) Explain why the water at the top of the water container is hotter than the water at the bottom of the container.

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

(c) Fig. 3.4 shows the generator.

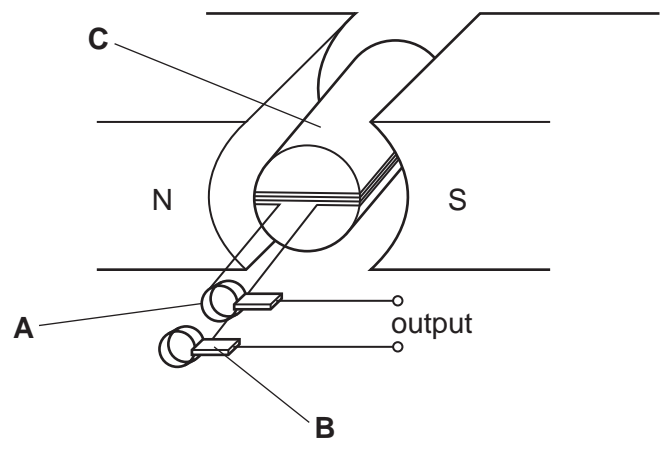


Fig. 3.4

(i) Name part A [1]

(ii) Name part B [1]

(iii) Name the material part C is made from, and explain why this material is used

material

explanation

..... [2]

(d) (i) At the desalination plant thermal energy from the turbine is used to recover pure water from sea water.

Name the process by which pure water is recovered from sea water in this desalination plant.

..... [1]

(ii) Explain the advantage of combining the desalination plant with the power station.

.....

..... [1]

4 Petroleum contains hydrocarbon molecules with different chain lengths.

Long-chain hydrocarbons can be broken down into smaller more useful hydrocarbons.

(a) (i) Name the process used to break long-chain hydrocarbons into smaller hydrocarbons.

..... [1]

(ii) State an essential condition used in this process and explain why this is used.

condition

explanation

..... [2]

(b) In this process an alkane, $C_{15}H_{32}$, is broken down.

Octane, C_8H_{18} , and the alkenes propene, C_3H_6 , and ethene, C_2H_4 , are formed.

(i) Write a balanced symbol equation for this reaction.

..... [1]

(ii) Describe a chemical test you could use to distinguish between octane and propene.

test

result for octane

result for propene [3]

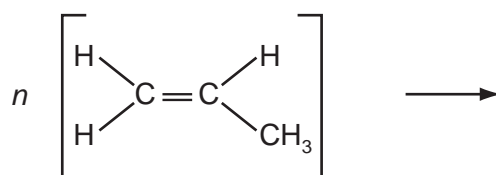
(iii) Ethene can be used to make poly(ethene).

State the name of this process.

..... [1]

(iv) Propene can be used to make poly(propene).

Complete this equation for the formation of poly(propene).



[2]

5 Fig. 5.1 shows a circuit diagram, with a battery of e.m.f. of 6.0 V and a resistance length 0.5 m connected across **AB**. There is a current of 2.4 A in the circuit.

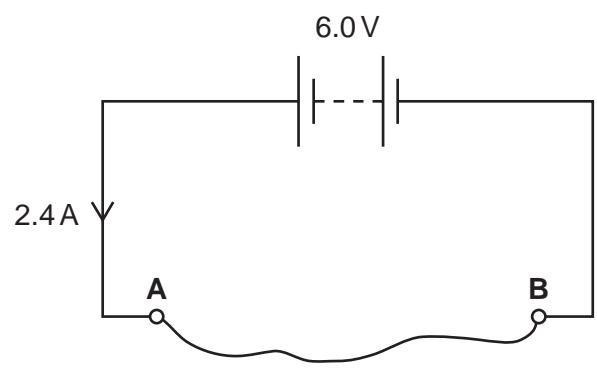


Fig. 5.1

(a) Calculate the resistance of the resistance wire.

resistance = [2]

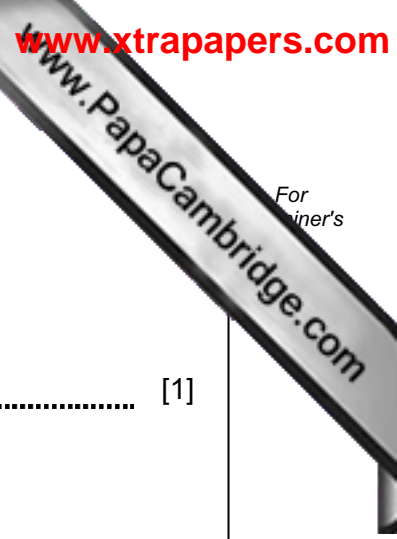
(b) Calculate the power output from the battery.

power = [2]

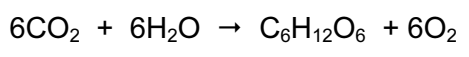
(c) (i) The wire is replaced with a wire of the same material and the same diameter but of length 1.5 m. Calculate the resistance of this longer wire.

resistance = [1]

(ii) By making suitable calculations, compare the power output from the battery in (c)(i) with that in (b).



6 Green plants make glucose by the process of photosynthesis.



(a) From where does the plant obtain the energy needed for this process?

..... [1]

(b) For each 20 g of glucose made by the plant, calculate

(i) the mass of water used,

mass of water = g [3]

(ii) the volume, at room temperature and pressure, of oxygen made.

(The volume of 1 mole of any gas is 24 dm³ at room temperature and pressure.)

volume of oxygen made = unit [3]

7 Fig. 7.1 shows the results of an experiment to measure the half-life of the isotope phosphorus-34.

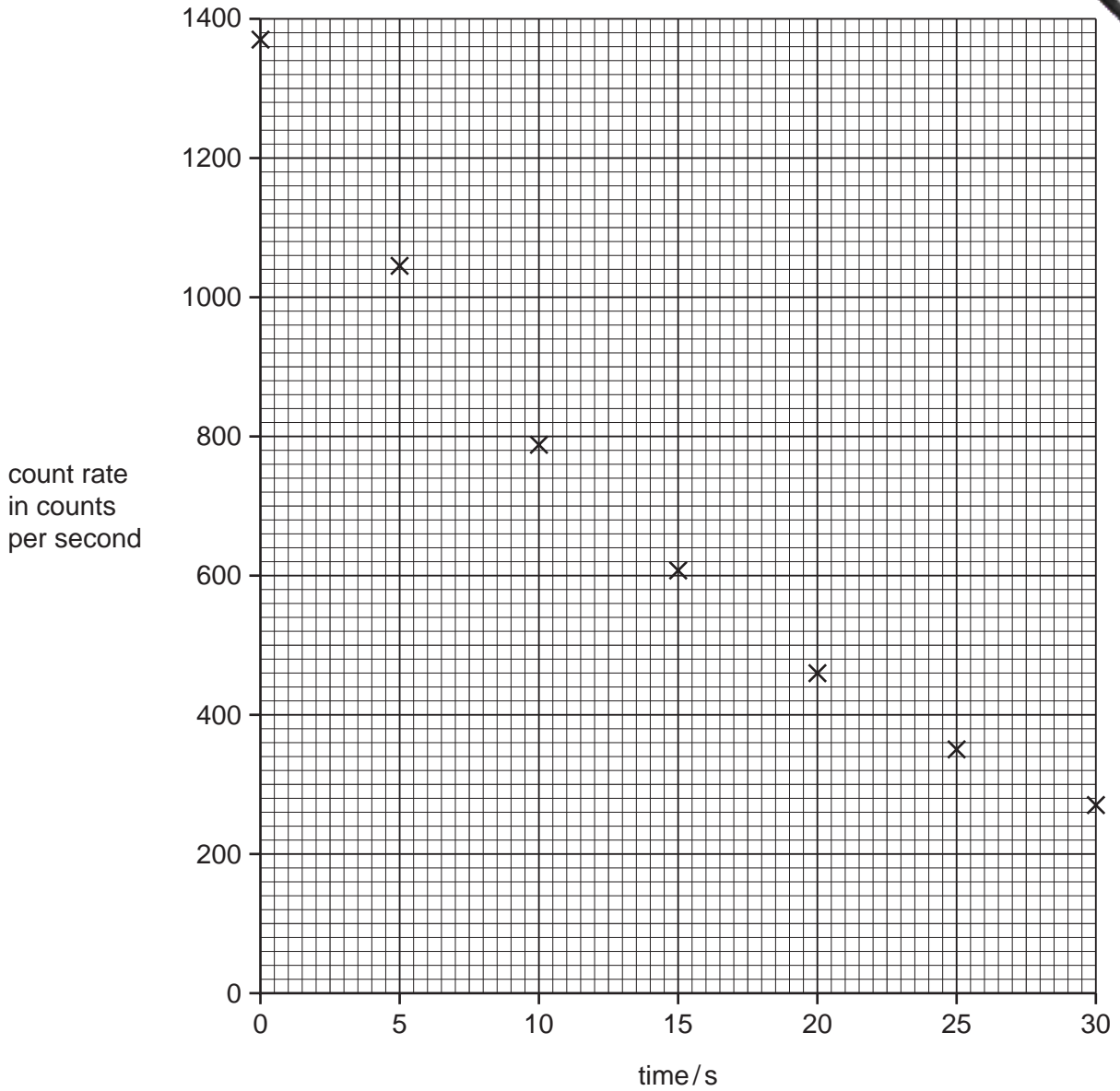


Fig. 7.1

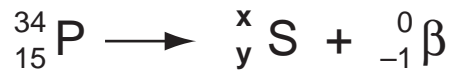
(a) (i) Complete the graph by drawing the best-fit curve. [1]

(ii) Use the graph to find the half-life of the isotope.

Show your working.

half-life = s [2]

(b) Phosphorus-34 decays emitting a β -particle. The equation for this decay is:



- (i) Calculate the value of **x**. [1]
- (ii) Calculate the value of **y**. [1]

Please turn over for Question 8.

8 Fig. 8.1 shows the arrangement of carbon atoms in diamond and graphite.

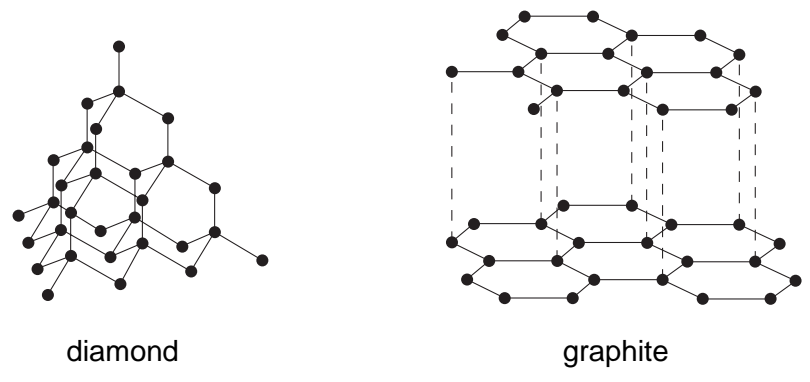


Fig. 8.1

(a) For each of the following properties, compare the two forms of carbon and relate the differences to their structures.

(i) melting point

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

(ii) electrical conductivity

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

(b) Graphite burns in oxygen to produce carbon dioxide.

(i) Name the type of bonding in carbon dioxide.

..... [1]

(ii) Draw a dot and cross diagram to show the arrangement of electrons in dioxide.

[3]

9 The Sun and other stars produce energy by nuclear fusion.

(a) Explain what is meant by the term nuclear fusion.

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

(b) In a fusion reaction 3.84×10^{-29} kg of mass is released as energy. Calculate the energy released in the reaction.
($c = 3 \times 10^8$ m/s)

Show your working.

energy = [3]

DATA SHEET
The Periodic Table of the Elements

		Group																																																																																											
I	II	III	IV	V	VI	VII	0					0																																																																																	
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18	49 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	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	210 Po Polonium 84	210 At Astatine 85	226 Ra Radium 88	227 Ac Actinium 89 †	226 Fr Francium 87	232 Th Thorium 90	232 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103	238 Lu Lutetium 71	238 Yb Ytterbium 70	238 Tm Thulium 69	238 Er Erbium 68	238 Ho Holmium 67	238 Dy Dysprosium 66	238 Ho Holmium 67	238 Er Erbium 68	238 Tm Thulium 69	238 Yb Ytterbium 70	238 Lu Lutetium 71	238 Rn Radon 86

* 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 dm³ at room temperature and pressure (r.t.p.).

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