UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE 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

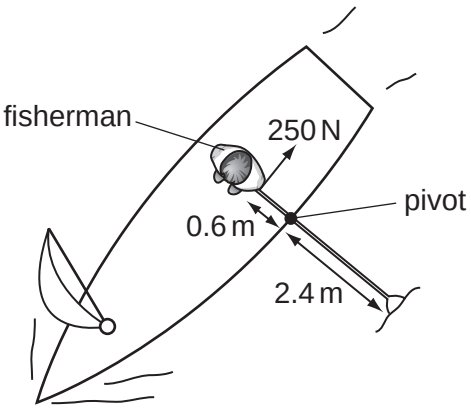


Fig. 1b

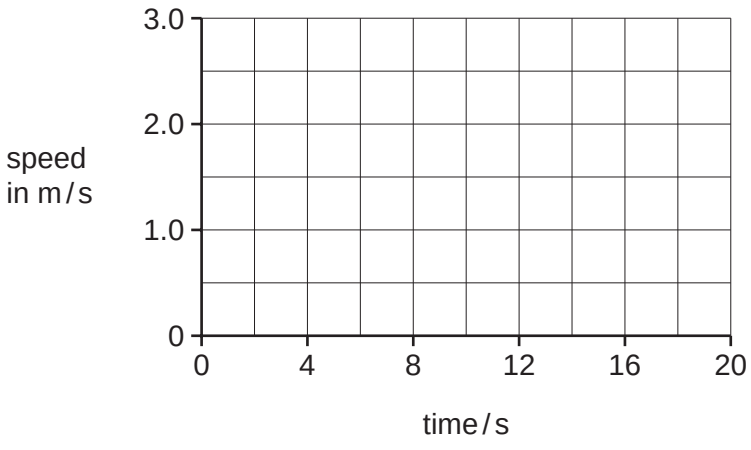
Calculate the force the oar produces on the water.

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.



[2]

Fig. 1.2

(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 p
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.

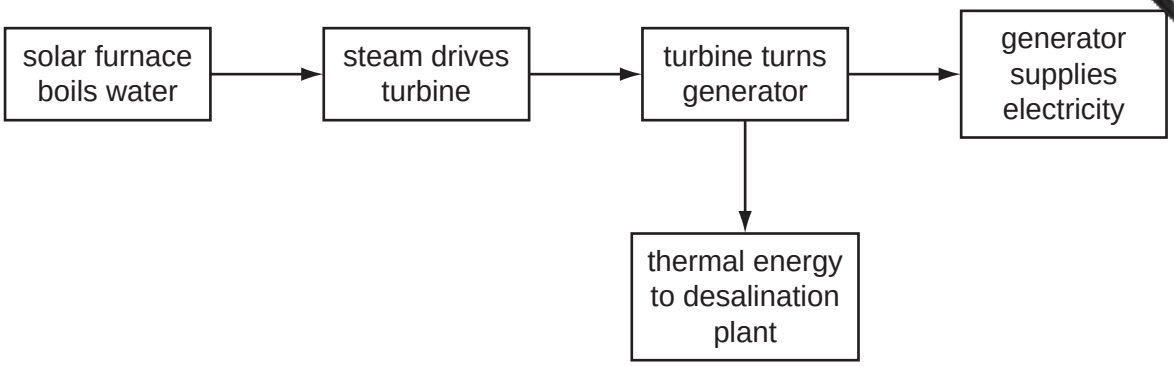


Fig. 3.1

(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.

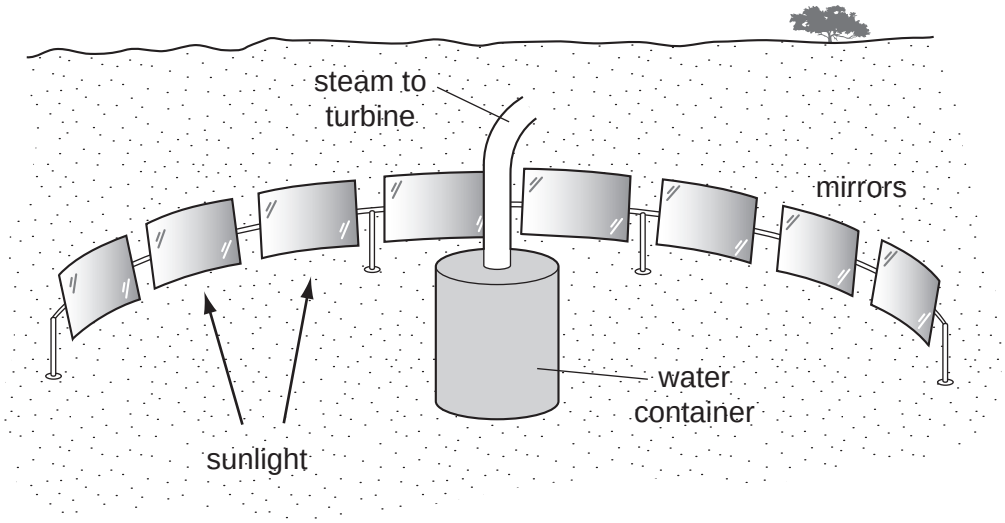


Fig. 3.2

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

.....

[1]

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

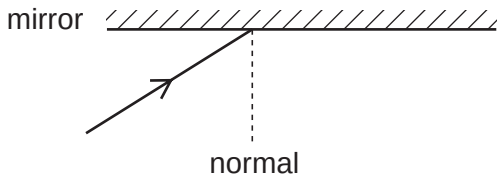
.....

.....

[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.



[1]

Fig. 3.3

(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.

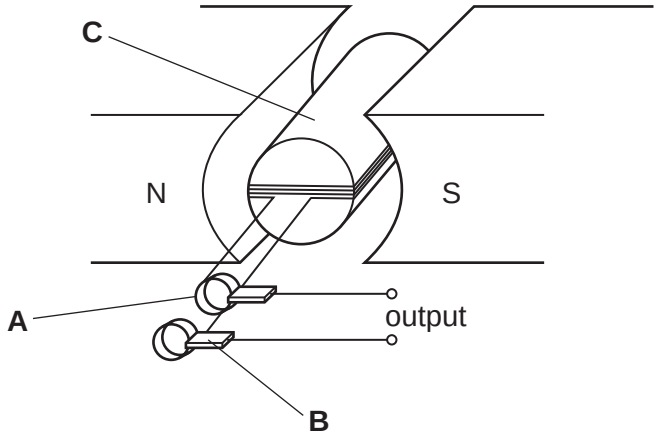


Fig. 3.4

(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).

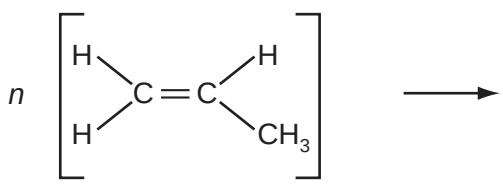
State the name of this process.

.....

[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 wire of length 0.5 m connected across **AB**. There is a current of 2.4 A in the circuit.

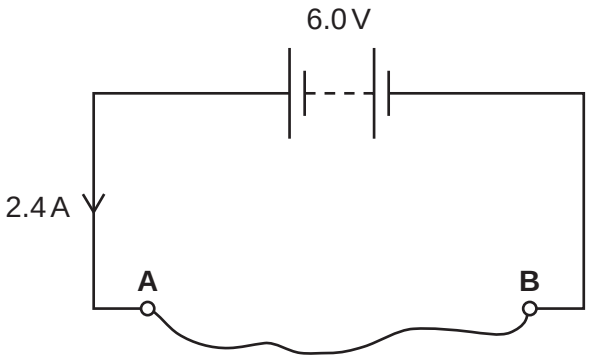


Fig. 5.1

(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 length1.5 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)**.

[3]

6 Green plants make glucose by the process of photosynthesis.

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

(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 dm^3 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 i
phosphorus-34.

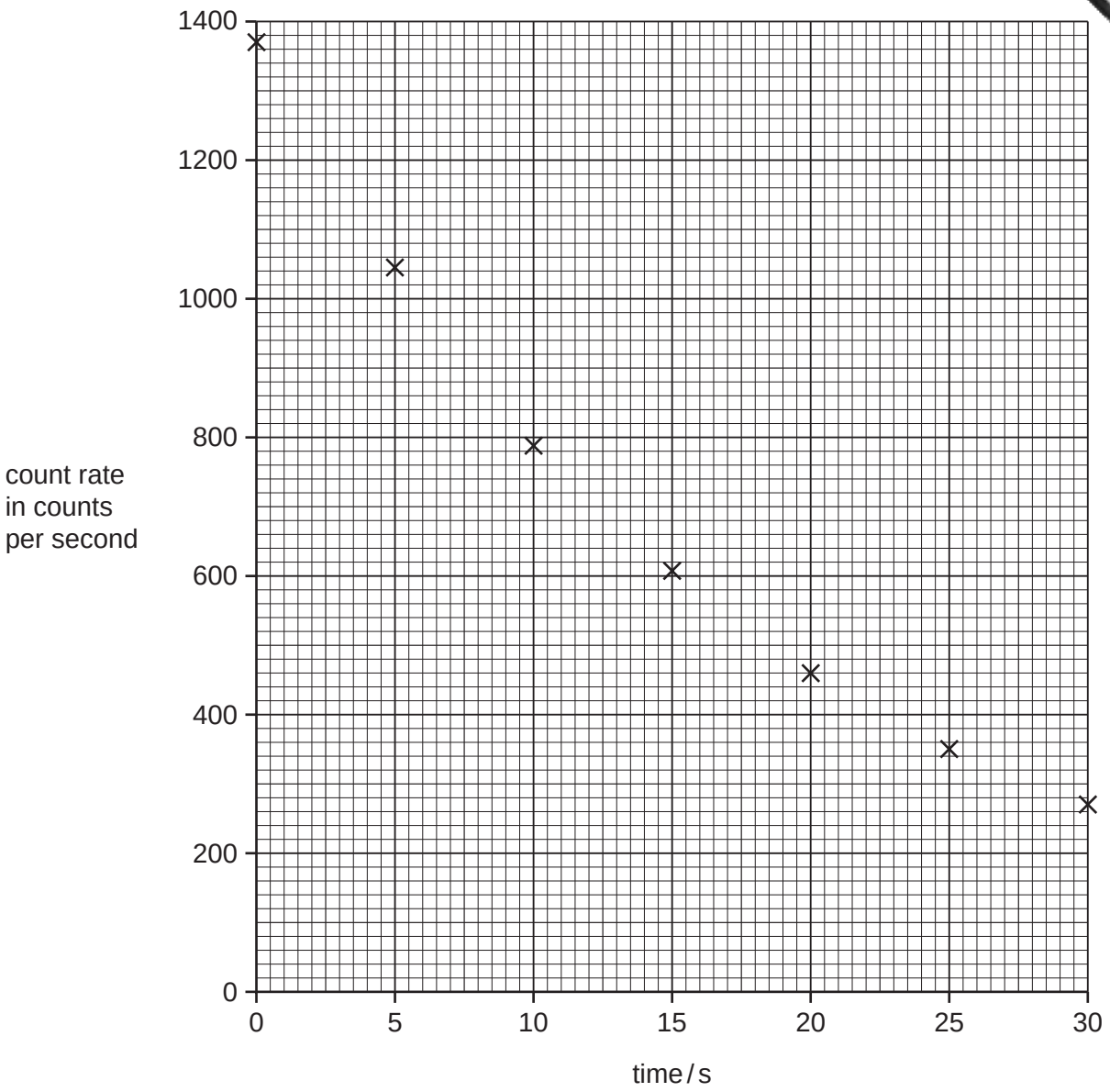


Fig. 7.1

(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:

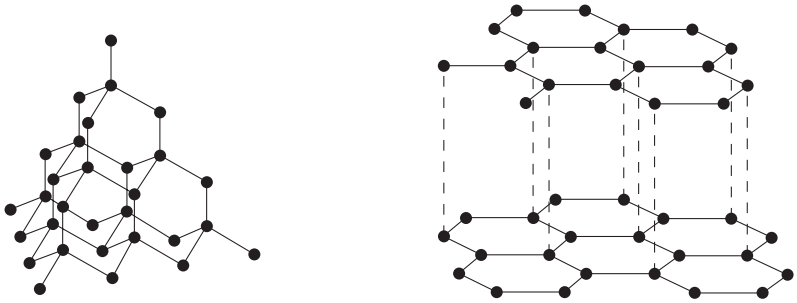
$$^{34}_{15}\mathrm{P} \longrightarrow {}^{x}_{y}\mathrm{S} + {}^{0}_{-1}\beta$$

(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.



diamond 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 [illegible] 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
							1 **H** Hydrogen 1										4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4											11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12											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
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	**Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	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	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**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	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: a above **X**, b below

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

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