| Centre Number | Candidate Number | Name |
|---|---|---|
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

**COMBINED SCIENCE** **0653/02**

Paper 2 (Core)

October/November 2006

**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.

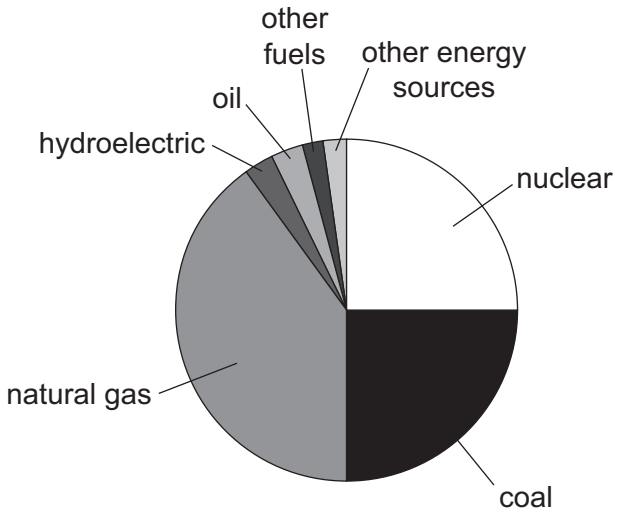
Answer **all** questions.
A copy of the Periodic Table is printed on page 20.

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.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| Total | |

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

**1** **(a)** The pie chart in Fig. 1.1 shows the energy sources used to generate the electricity in a European country in one year.




| | |
|---|---|
| nuclear | 25 % |
| coal | 25 % |
| natural gas | 40 % |
| hydroelectric | 3 % |
| oil | 3 % |
| other fuels | 2 % |
| other energy sources | 2 % |

**Fig. 1.1**

**(i)** Suggest **one** fuel which could have been included in the 'other fuels' section.

.....

[1]

**(ii)** Calculate the percentage of the country's electricity that comes from fossil fuels listed in Fig. 1.1.

.....

[1]

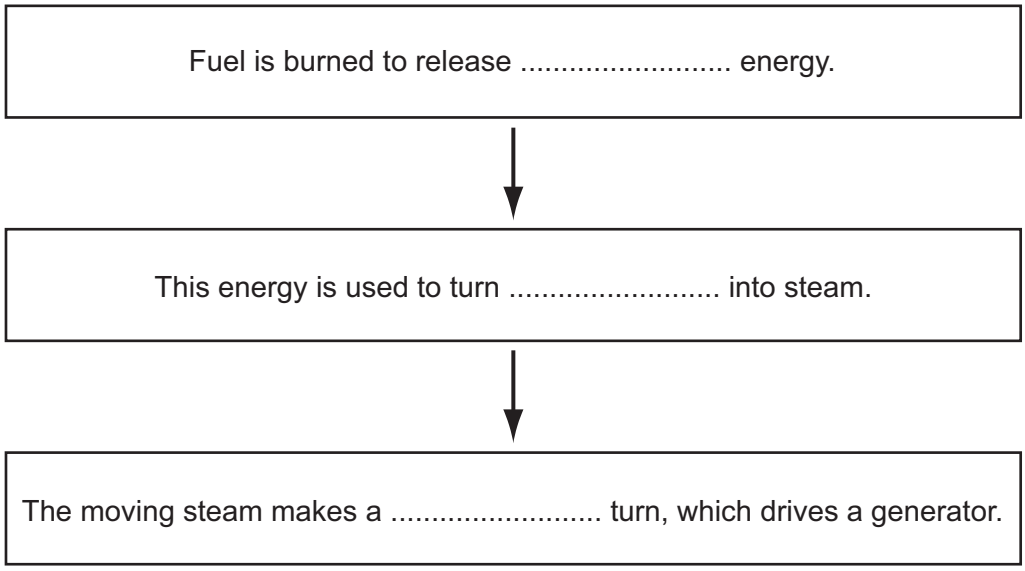
**(iii)** Hydroelectricity is a renewable energy resource.
Name two other renewable energy resources.

1. .....

2. .....

[2]

**(b)** Generators are required in order to produce electricity in a power station. Complete the diagram below to show the processes involved.




[3]

**(c)** Transformers are used to increase the voltage before electricity is transmitted.

Explain why this is done.

.....

..... [1]

**2** A student uses the apparatus shown in Fig. 2.1 to investigate several different chemical reactions. In each reaction, a solid reacts with hydrochloric acid and a gas is produced. The volume of gas produced in each case can be measured using the gas syringe.

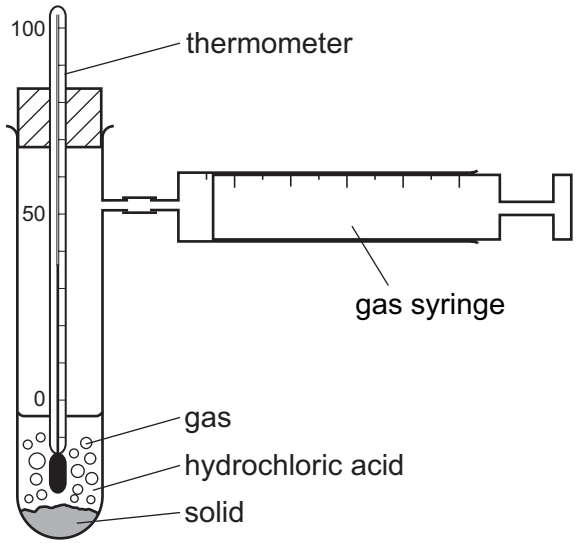



**Fig. 2.1**

**(a) (i)** Table 2.1 lists three experiments in which three different solids react with hydrochloric acid.

Complete Table 2.1 by writing in the right hand column the name of the gas produced.

**Table 2.1**

| experiment number | solid reacted | gas produced |
|---|---|---|
| **1** | calcium carbonate | |
| **2** | magnesium | |
| **3** | sodium hydrogencarbonate | |

[3]

**(ii)** Write the chemical formula of hydrochloric acid.

..... [1]

**(iii)** Choose **one** of the gases you have named in Table 2.1 and describe the test for this gas.

.....

.....

..... [2]

**(b)** How would the student use the apparatus shown in Fig. 2.1 to find out whether a reaction was exothermic?

.....

..... [1]

**(c)** The student finds that the rate of reaction is greatest for experiment **3**.

**(i)** Suggest the measurements which the student took in order to find the rate of reaction in each experiment.

.....

.....

..... [2]

**(ii)** Suggest **one** way in which the student could change the conditions of experiment **3** in order to **reduce** the rate of reaction.

.....

..... [1]

**3** Fig 3.1 shows a human fetus just before birth.

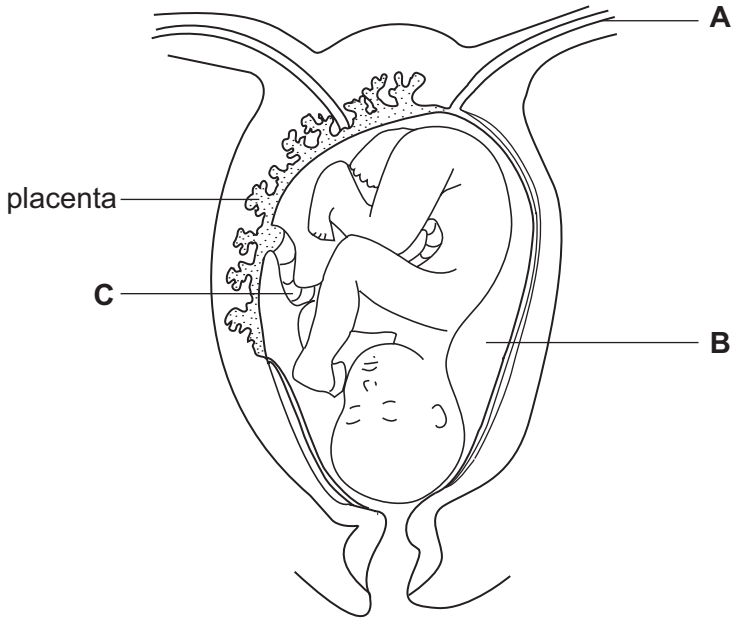



**Fig. 3.1**

**(a)** Name structures **A** to **C**, using some of these words.

**amniotic fluid** **artery** **cervix** **oviduct** **umbilical cord** **zygote**

**A** .....

**B** .....

**C** ..... [3]

**(b)** Explain how the developing fetus obtains nutrients while it is in the uterus.

.....

.....

.....

..... [3]

**(c)** Outline what happens during the birth of the baby.

.....

.....

.....

..... [2]

**(d)** If a mother has AIDS, there is a risk that her baby may be born with HIV and develop AIDS.

Explain how this could happen.

.....

.....

..... [2]

**4** **(a)** Fig. 4.1 shows a ray of light passing from air into a glass block.

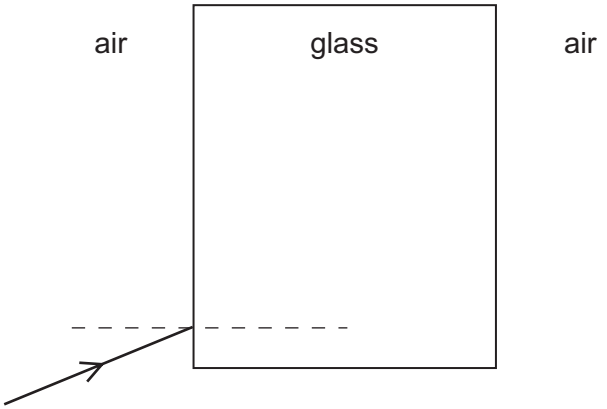
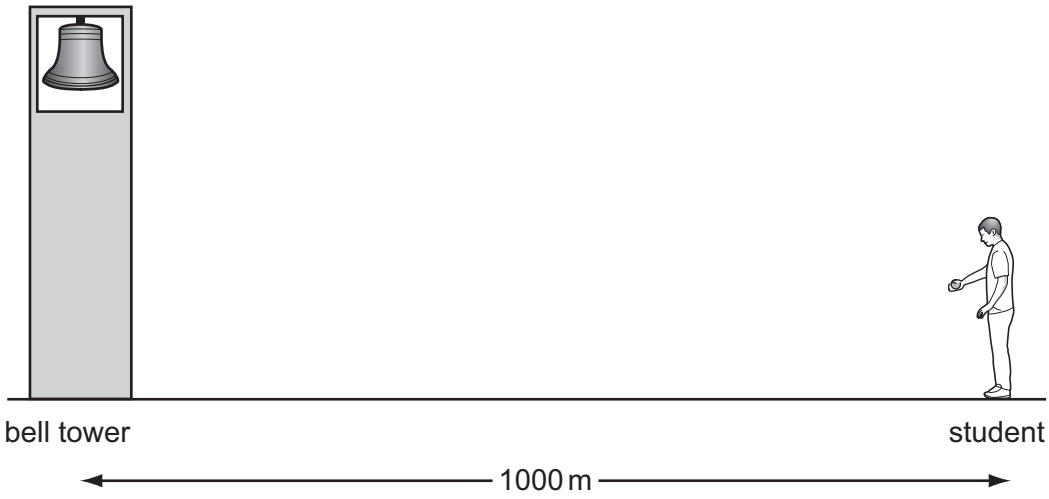



**Fig. 4.1**

**(i)** On Fig. 4.1, draw two straight lines to show what happens to the ray of light as it passes through the block and out into the air. [2]

**(ii)** On Fig. 4.1, indicate the angle of refraction as the ray enters the block. [1]

**(b)** A student carried out an experiment to find the speed of sound in air by watching and listening to a bell being rung.
He stood with a timer 1000 m from the bell.




The sound took 3 seconds to travel from the bell to the student.

Calculate the speed of sound.

Show your working and state the formula that you use.

formula used

working

..... m/s [2]

**5** Fig. 5.1 shows industrial apparatus used to obtain useful products, **A** to **F**, from petroleum (crude oil).

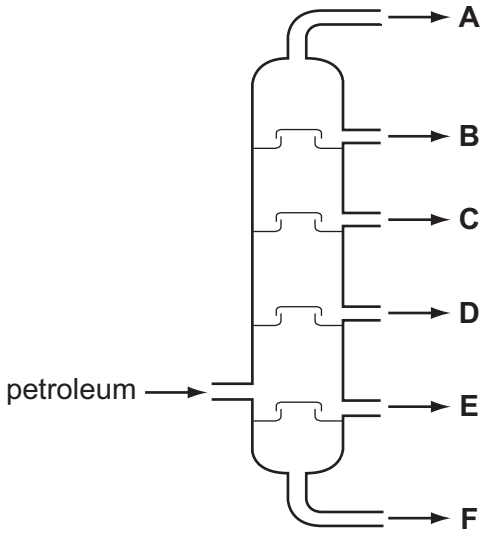



**Fig. 5.1**

**(a) (i)** Name the process shown in Fig. 5.1.

..... [1]

**(ii)** State which of the products, **A** to **F**, is at the highest temperature when it first comes out of the apparatus in Fig. 5.1.

..... [1]

**(b)** Product **B** in Fig. 5.1 is used as fuel for cars.

**(i)** Name the **element** which reacts with molecules of product **B** in car engines.

..... [1]

**(ii)** Describe and explain **one** way in which the use of product **B** as car fuel could be affecting our environment.

.....

.....

.....

..... [3]

**(c)** Plastics contain molecules called polymers.

Describe how a typical polymer molecule such as poly(ethene) is different from a simple molecule such as ethene.

.....

.....

..... [2]

**6** An athlete ran on a treadmill on three different days. He ran a different distance on each day.

The volume of oxygen that he used was measured during each run. The results are shown in Table 6.1.

**Table 6.1**

| length of run / m | total oxygen used / $dm^3$ |
|---|---|
| 100 | 10 |
| 1500 | 36 |
| 10 000 | 150 |

**(a) (i)** Calculate the oxygen used per metre in the 100 metre run.

..... $dm^3$ [1]

**(ii)** Describe the relationship shown in Table 6.1 between the oxygen used and the length of the run.

.....

..... [1]

**(b) (i)** Describe how the oxygen breathed in by the athlete was transported to his muscles.

.....

.....

..... [2]

**(ii)** Explain how the oxygen taken in by the athlete was used to provide the energy that he used in the runs.

.....

.....

.....

..... [3]

**(c)** Professional athletes never drink alcohol before a race. Suggest how drinking even a small amount of alcohol could increase an athlete's time in a 100 m race.

.....

.....

..... [2]

**7** **(a)** A torch contains 3 cells, a switch and a lamp connected in series.

**(i)** Draw a circuit diagram for this circuit using the correct symbols.

[3]

**(ii)** The potential difference across each of the cells in the circuit is 1.5 V.

State the total potential difference across the three cells.

..... [1]

**(b)** Visible light is one of the main regions of the electromagnetic spectrum.
Infra-red radiation is also a region of the electromagnetic spectrum.

**(i)** State a source, a detector and a use of infra-red radiation.

source

.....

detector

.....

use

..... [3]

**(ii)** Name **one** other region of the electromagnetic spectrum.

..... [1]

**8** **(a)** Table 8.1 shows some properties of elements.

Write the letter **M** in the right hand column next to properties which are typical of **metallic** elements.

**Table 8.1**

| | |
|---|---|
| can be hammered into different shapes | |
| poor conductor of heat | |
| is a gas at room temperature (20°C) | |
| good conductor of electricity | |
| poor conductor of electricity | |

[2]

**(b)** Aluminium is an important metal in Group III of the Periodic Table.

**(i)** State the chemical symbol for aluminium.

..... [1]

**(ii)** State the number of protons in one atom of aluminium.

..... [1]

**(iii)** Why is aluminium a suitable material for making containers used to store food?

.....

..... [1]

**(c)** Aluminium is obtained from the compound aluminium oxide.

Explain why aluminium oxide is called a compound and not an element.

.....

.....

..... [2]

**(d)** Electrolysis is used to extract aluminium from aluminium oxide, an ionic compound which is insoluble in water.

**(i)** How can aluminium oxide be made into an electrolyte?

..... [1]

**(ii)** Complete the word equation below to show the chemical change that occurs when aluminium oxide undergoes electrolysis.

..... → aluminium + ..... [1]

**9** Fig. 9.1 shows a root hair cell.

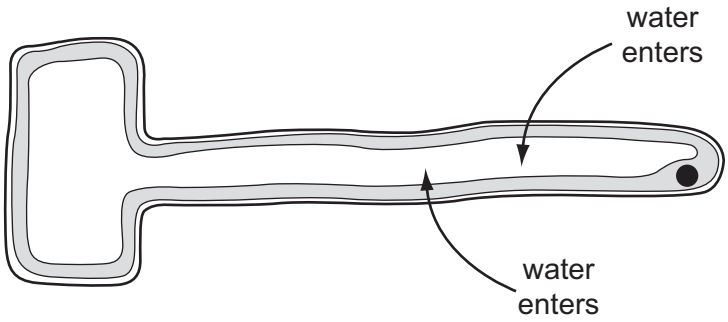



**Fig. 9.1**

**(a)** State two ways in which the structure of this cell differs from a palisade cell in a leaf.

1. .....

.....

2. .....

..... [2]

**(b)** The function of a root hair is to take up water from the soil. The arrows in Fig. 9.1 show water entering the root hair cell.

**(i)** How many membranes does the water pass through between the soil and the vacuole of the root hair cell?

..... [1]

**(ii)** Describe the pathway taken by the water as it travels from the root hair and into the leaves of the plant.

.....

.....

..... [2]

**(iii)** Some of the water is used in photosynthesis in the leaves of the plant.
Write the word equation for photosynthesis.

..... [2]

**(iv)** On a hot, sunny day much more water goes into the root hair cell than on a cold, dull day. Suggest an explanation for this.

.....

.....

..... [1]

**10 (a)** Explain why it could be dangerous to switch on a mains electrical appliance using wet hands.

.....

.....

..... [2]

**(b)** Explain why a source of alpha radiation is more dangerous if it gets inside the human body than outside the body.

.....

.....

..... [2]

**(c)** Explain why small expansion gaps are left between sections of road bridges.

.....

.....

..... [1]

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# 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 Sulphur 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 X b — 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.).