

Candidate  
Number

Centre Number

Candidate Name \_\_\_\_\_

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**International General Certificate of Secondary Education  
CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**PHYSICAL SCIENCE**

PAPER 3

**0652/3**

**MAY/JUNE SESSION 2002**

1 hour 15 minutes

Candidates answer on the question paper.  
No additional materials are required.

**TIME** 1 hour 15 minutes

**INSTRUCTIONS TO CANDIDATES**

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Periodic Table is printed on page 12.

FOR EXAMINER'S USE	
1	
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5	
6	
7	
8	
9	
10	
TOTAL	

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**This question paper consists of 12 printed pages.**

- 1 The table, Fig. 1.1, shows some of the properties of the elements in Group IV of the Periodic Table.

element	density in g/cm <sup>3</sup>	melting point in °C	type of structure	type of oxide
carbon	2.25	3700	giant covalent	acidic
silicon	2.33	1683		acidic
germanium		1210	giant covalent	amphoteric
tin	7.31	505	metallic	
lead	11.35	601	metallic	amphoteric

**Fig. 1.1**

- (a) Complete the table by suggesting the density of germanium, the type of structure for silicon and the type of oxide formed by tin. [3]

- (b) Suggest why the melting points of the elements do not show a steady trend.

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

- (c) There is another form of carbon which has a density of 3.53 g/cm<sup>3</sup>. This different density is a result of the different structure of this form of carbon.

Explain the difference in densities in terms of the structures of the two forms of carbon.

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

2 (a) For a moving object what is the difference between its speed and its velocity?

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

(b) A car initially moving with a speed of 20 m/s accelerates at a steady rate until it reaches a speed of 30 m/s. This takes a time of 5 s.

(i) Calculate the acceleration of the car.

Write down the equation that you use and show your working.

acceleration = ..... [3]

(ii) The mass of the car is 600 kg. Calculate the driving force needed to accelerate the car.

Write down the equation that you use and show your working.

force = ..... [3]

(c) The force provided by the engine is greater than the force calculated in (b). Explain why this is the case.

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

3 Ethene,  $C_2H_4$ , is described as an unsaturated hydrocarbon. Ethene does not occur naturally, but is formed by the catalytic cracking of saturated hydrocarbons.

(a) Write a balanced equation for the catalytic cracking of propane,  $C_3H_8$ , to produce ethene and methane.

..... [2]

(b) Draw a dot-and-cross diagram to show the bonding in ethene. You need only show the outer shell electrons in each atom.

[2]

(c) (i) Explain why ethene can undergo an addition reaction with bromine but ethane cannot.

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

(ii) Describe how you would use the reaction in (c)(i) to distinguish between ethene and ethane.

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

4 (a) (i) Name the process by which light nuclei join with each other at a very high temperature to form heavier nuclei.

..... [1]

(ii) Name a place where such a reaction may occur.

..... [1]

(iii) A very high temperature is required to provide the nuclei with kinetic energy. Why is such a large amount of kinetic energy required to force the nuclei together?

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

(b) In a nuclear reaction of this type the nuclei of two atoms of the isotope hydrogen-2,  ${}^2_1\text{H}$ , may combine to form a nucleus of a helium atom,  ${}^4_2\text{He}$ .

(i) Explain the meaning of the word *isotope*.

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

(ii) Write down the number of protons and the number of neutrons in  ${}^2_1\text{H}$ .

number of protons .....

number of neutrons ..... [2]

(iii) The total mass of the two hydrogen nuclei is  $6.67 \times 10^{-27}$  kg. The mass of the helium nucleus formed is  $6.64 \times 10^{-27}$  kg.

Calculate the amount of energy released in this reaction.

Write down the equation that you use and show your working.

(speed of light =  $3.0 \times 10^8 \text{ms}^{-1}$ )

energy released = ..... J [4]

5 Copper and tin are both soft metals. Bronze is an alloy of copper with tin. Bronze is much harder, and more brittle than either copper or tin.

(a) Describe the bonding between the particles in a pure metal such as copper.

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

(b) Explain how the structure of bronze causes it to be harder and more brittle than either copper or tin.

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

(c) Electrical wires for domestic appliances such as kettles are made of copper. Suggest **two** reasons why copper is preferred to bronze for this use.

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

- 6 The heating coil in an electric heater consists of a length of wire. It is designed to give out 3 kW of power while operating at a p.d. of 250 V.

- (a) Calculate the current passing through the heating coil under these conditions.

Write down the equation that you use and show your working.

current = ..... [3]

- (b) Calculate the resistance of the heating coil.

Write down the equation that you use and show your working.

resistance = ..... [3]

- (c) To change the resistance of the wire in the heating coil, either its length or its cross-sectional area could be changed. State how you would change these quantities to **increase** the resistance of the wire.

(i) change to length .....

(ii) change to cross-sectional area .....

[2]

- 7 (a) Aluminium is higher in the reactivity series than iron. However, iron structures need protection, such as galvanising, to prevent corrosion. Aluminium needs no such protection.

(i) State what is meant by *galvanising*.

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

(ii) Explain how galvanising protects iron from corrosion.

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

(iii) Explain why aluminium appears to resist corrosion.

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

(b) Zinc oxide is insoluble in water, but most salts of zinc are soluble.

When zinc chloride crystals are heated gently, the water of crystallisation reacts with the chloride to form the oxide.

Hydrated zinc chloride crystals can be prepared from zinc oxide.

(i) Name the other reactant that is used.

..... [1]

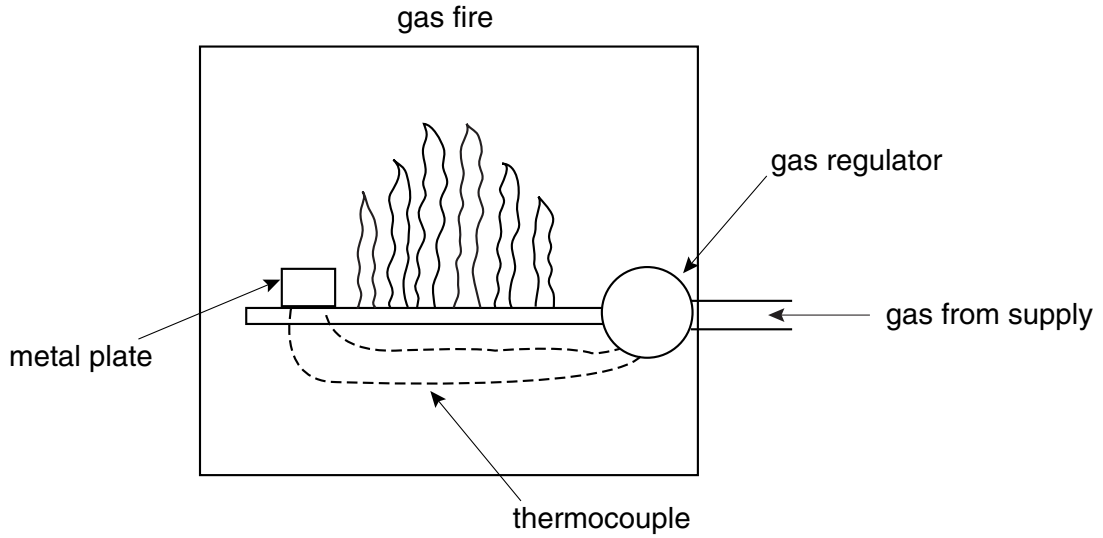
(ii) State how you would carry out the reaction to obtain a solution which contains only zinc chloride.

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

(iii) State how you would obtain crystals of zinc chloride from the solution.

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





**Fig. 8.1**

**(a)** Fig. 8.1 shows a gas fire that has its temperature regulated using a thermocouple connected to a metal plate. When the temperature of the metal plate changes, the thermocouple controls the gas regulator to alter the rate of flow of gas.

**(i)** Describe the construction of a thermocouple.

..... [1]

**(ii)** Suggest why a thermocouple is suitable for this purpose.

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

**(iii)** Explain how the heat from the flames reaches the metal plate.

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

**(b)** The inside of the fire becomes sufficiently warm so that it emits some radiation.

**(i)** The back of the fire could be treated in order to reflect the radiation into the room. What would be the best type of surface coating in order to reflect the radiation?

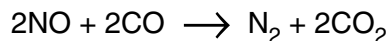
..... [1]

**(ii)** Name the region of the electromagnetic spectrum that is associated with thermal radiation.

..... [1]

- 9 To try to reduce the pollution caused by car engines in densely populated areas the exhausts are often fitted with catalytic converters. These catalysts only function at very high temperatures.

- (a) One reaction that is catalysed is the removal of nitrogen oxide and carbon monoxide from the exhaust. The equation for this reaction is:



- (i) Find the relative molar mass,  $M_r$ , of nitrogen oxide, NO.

You should use the Periodic Table on page 12 of this question paper to help you answer this question.

$M_r$  of nitrogen oxide = ..... [2]

- (ii) Calculate the volume of 150 g of nitrogen oxide at room temperature and pressure (r.t.p.)

1 mole of any gas occupies 24 dm<sup>3</sup> at r.t.p.

volume of nitrogen oxide = ..... dm<sup>3</sup> [2]

- (iii) Hence calculate the volume of nitrogen produced when 150 g of nitrogen oxide reacts completely with carbon monoxide.

volume of nitrogen = ..... dm<sup>3</sup> [2]

- (b) Explain how car engines produce carbon monoxide.

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

- (c) State how carbon monoxide acts as a poison.

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

- 10 On the grid of Fig. 10.1 draw a ray diagram to show how a converging (convex) lens can be used as a magnifying glass. Mark in and label the lens, the object, the image and the focus of the lens.

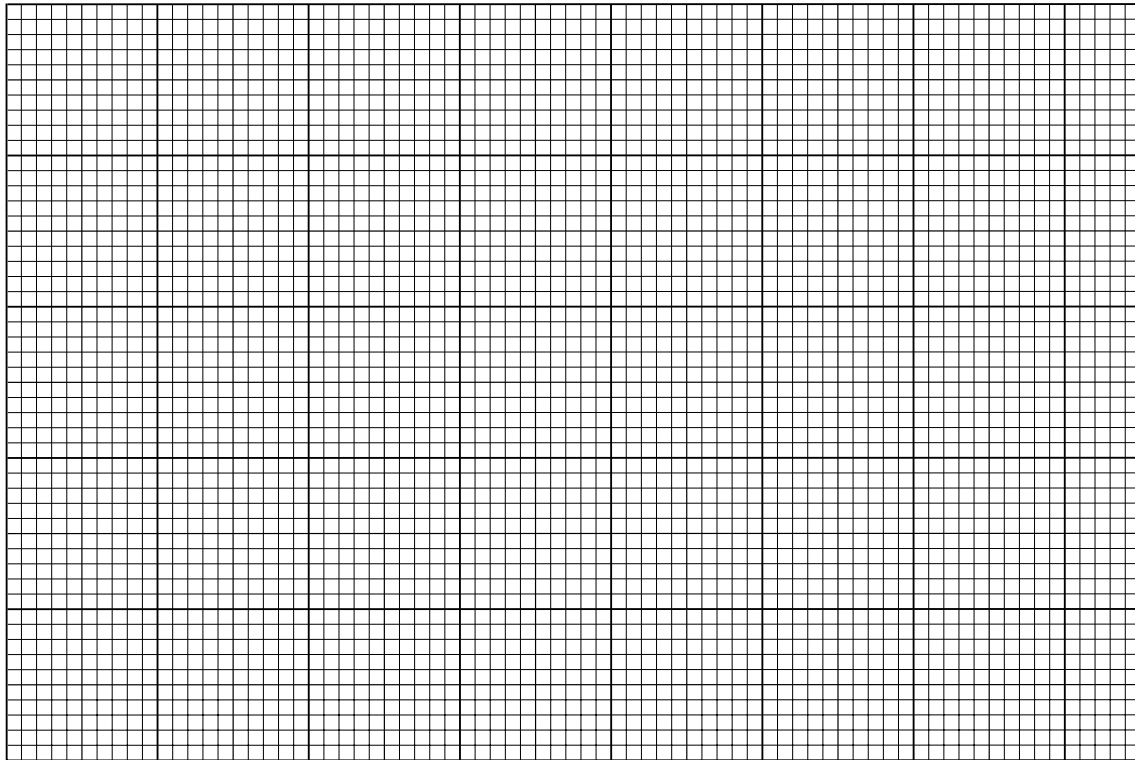


Fig. 10.1

[4]

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

		Group												
I	II	III	IV	V	VI	VII	O							
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1										4 <b>He</b> Helium 2		
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10	27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulphur 16	35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18	
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	59 <b>Co</b> Cobalt 27	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	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	103 <b>Rh</b> Rhodium 45	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54		
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	184 <b>W</b> Tungsten 74	186 <b>Re</b> Rhenium 75	190 <b>Os</b> Osmium 76	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	209 <b>Po</b> Polonium 84	209 <b>At</b> Astatine 85	226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	
226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	157 <b>Gd</b> Gadolinium 64	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	238 <b>U</b> Uranium 92
87 <b>Fr</b> Francium	88 <b>Ra</b> Radium	90 <b>Th</b> Thorium	91 <b>Pa</b> Protactinium	92 <b>U</b> Uranium	94 <b>Pu</b> Plutonium	96 <b>Cm</b> Curium	98 <b>Cf</b> Californium	99 <b>Es</b> Einsteinium	100 <b>Fm</b> Fermium	101 <b>Md</b> Mendelevium	102 <b>No</b> Nobelium	103 <b>Lr</b> Lawrencium	99 <b>Es</b> Einsteinium	100 <b>Fm</b> Fermium

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

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

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