Centre Number	Candidate Number

Candidate Name _____

International General Certificate of Secondary Education
CAMBRIDGE INTERNATIONAL EXAMINATIONS

PHYSICAL SCIENCE 0652/3

PAPER 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	
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7	
8	
9	
10	
TOTAL	

This question paper consists of 12 printed pages.

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Local Examinations Syndicate

[Turn over

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^3	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^3. 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]

[Turn over

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, ${}^{2}_{1}\mathrm{H}$, may combine to form a nucleus of a helium atom, ${}^{4}_{2}\mathrm{He}$.

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

.....

..... [2]

(ii) Write down the number of protons and the number of neutrons in ${}^{2}_{1}\mathrm{H}$.

number of protons .....

number of neutrons ..... [2]

(iii) The total mass of the two hydrogen nuclei is 6.67×10^{-27} kg. The mass of the helium nucleus formed is 6.64×10^{-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 = $3.0 \times 10^{8}\,\mathrm{ms}^{-1}$)

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]

8

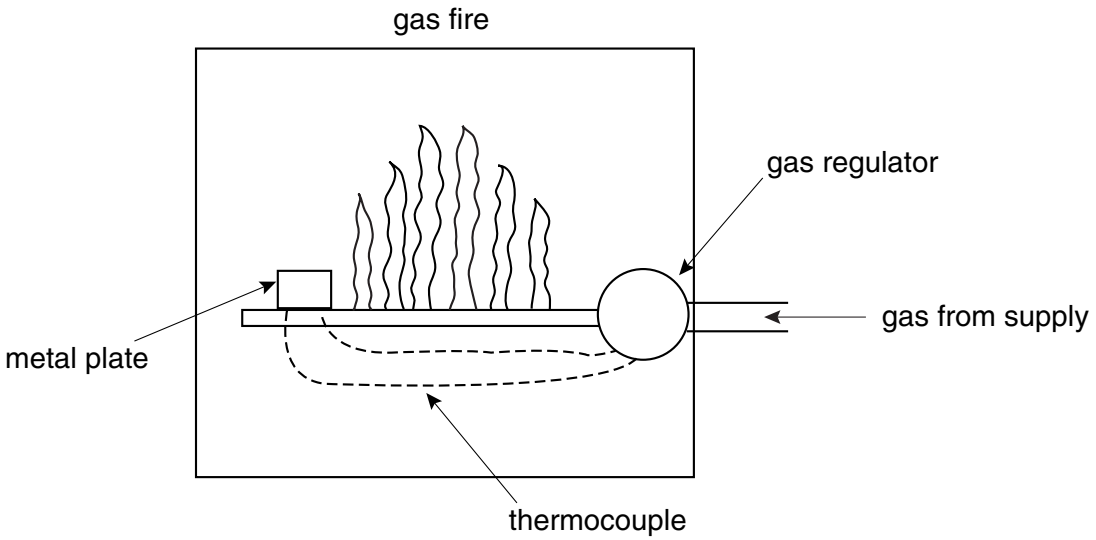

Fig. 8.1

(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:

$$2NO + 2CO \longrightarrow N_2 + 2CO_2$$

(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^3 at r.t.p.

volume of nitrogen oxide = ... dm^3 [2]

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

volume of nitrogen = ... dm^3 [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.

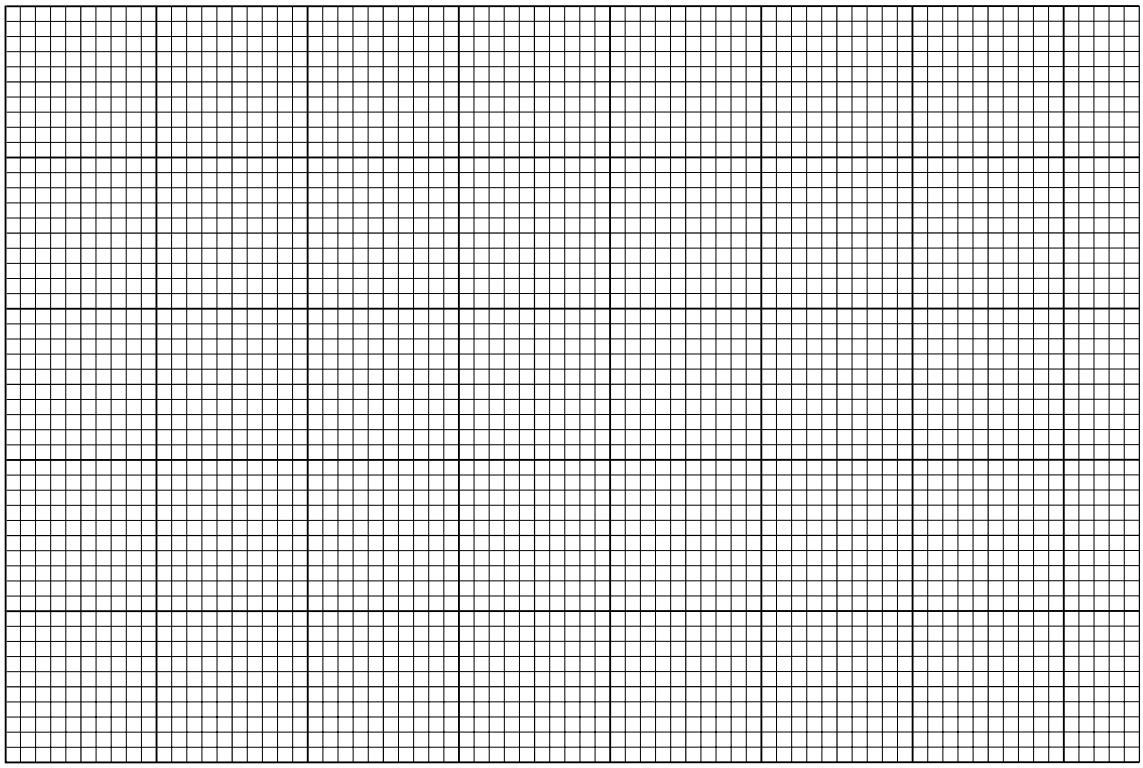

Fig. 10.1

[4]

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	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 = 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.).