Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

PHYSICAL SCIENCE **0652/03**

Paper 3

October/November 2004

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 in the spaces provided on the Question Paper.
You may use a pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
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 16.

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

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

This document consists of **15** printed pages and **1** blank page.

Answer **all** the questions.

Write your answers in the spaces provided.

1 Element *X* burns in excess air to form the oxide XO_2. This oxide dissolves in water to form an acid H_2XO_3.
The two reactions are represented by the following equations.

$$X + O_2 = XO_2$$

$$XO_2 + H_2O = H_2XO_3$$

(a) (i) The relative atomic mass, A_r, of element *X* is 32. Calculate the number of moles in 4.8 g of *X*.

number of moles = ...[2]

(ii) How many moles of oxygen gas are required to react completely with 4.8 g of *X*?

number of moles of oxygen = ...[1]

(iii) How many moles of H_2XO_3 would be formed if all the XO_2 formed was dissolved in water?

number of moles H_2XO_3 = ...[1]

(iv) Calculate the mass of H_2XO_3 formed.

mass of H_2XO_3 formed = ...[2]

(b) The acid H_2XO_3 reacts with aqueous sodium hydroxide to form a salt and water. Complete the following equation which represents this reaction:

$$H_2XO_3 + 2NaOH = \text{.....} + \text{.....} \quad [2]$$

(c) Suggest the identity of element *X*, stating your reason.

X is ..... because .....[1]

[Turn over

2 Fig. 2.1 shows three situations in which forces act on a book.

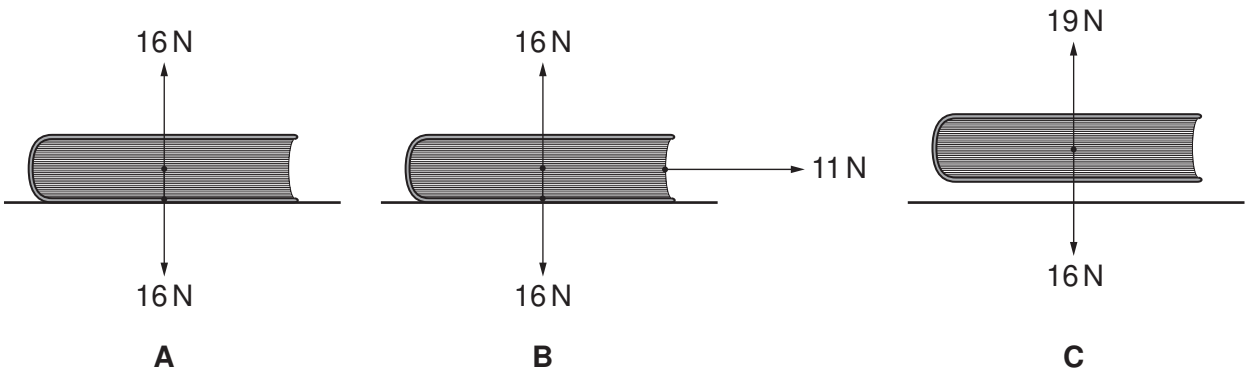

Fig. 2.1

A shows the book resting on a bench.
B shows the book being dragged horizontally for a distance of 0.3 m by a net pulling force of 11 N.
C shows the book being lifted through a vertical distance of 0.5 m.
In **B** and **C** the movement takes place over a period of 0.7 s.

Calculate the work done and the power used in each case. Show any working that you do and write down any equations that you use.

Case **A**

work done = ...

power used = ...
[2]

Case **B**

work done = ...

power used = ...
[3]

Case **C**

work done = ...

power used = ...
[3]

3 Use the Periodic Table on page 16 to help you answer the following questions.

(a) Use your knowledge of the trends across Period 3 (sodium to argon) to deduce which of these elements

(i) is the metal with the lowest melting point, ...[1]

(ii) is a covalent macromolecule, ...[1]

(iii) has four electrons in the outer shell of one atom, ...[1]

(iv) forms an ion with a charge of –2, ...[1]

(v) is a reactive gas at room temperature. .....[1]

(b) The boiling point of argon is 87 K. Explain what this very low boiling point suggests about the forces between argon atoms.

.....

.....

.....

.....[2]

(c) Suggest why sodium is a more reactive metal than aluminium.

.....

.....

.....

.....[2]

4 Fig. 4.1 shows a block of a thermal conductor that is being heated at the left edge. The block is painted silver.

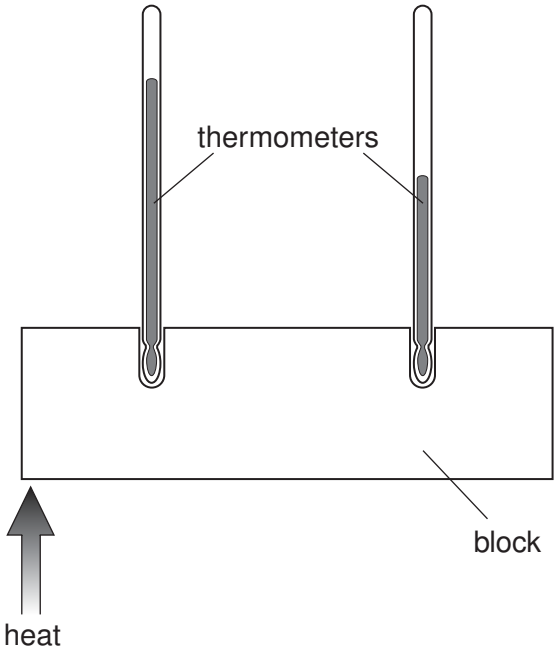

Fig. 4.1

(a) With the aid of a diagram explain how heat is transferred along the block.

.....

.....

.....

.....

.....

.....[4]

(b) When the two thermometers show constant temperatures the block is said to be in thermal equilibrium. The block is still being heated.
Explain why the block reaches thermal equilibrium.

.....

.....

.....

.....

.....

.....[3]

(c) Suggest and explain what difference painting the block a dull black colour would make.

.....

.....

.....

.....

.....

.....[3]

5 (a) (i) Draw the arrangements of the electrons in shells for an atom of carbon and an atom of oxygen. You may wish to refer to the Periodic Table on page 16.

electron arrangement of carbon	electron arrangement of oxygen

[2]

(ii) Draw a dot-cross diagram to show how bonds are formed between carbon and oxygen in carbon dioxide.

[2]

(iii) By referring to your diagram, explain why carbon dioxide is relatively unreactive.

.....

.....

.....

.....[2]

(b) Magnesium oxide has a similar relative formula mass to carbon dioxide, but magnesium oxide is a very high melting point solid. Explain this difference in terms of the structures of the two oxides.

.....

.....

.....

.....[2]

[Turn over

6 Fig. 6.1 shows how the ripples in a pond spread out as they pass through a gap between two concrete pillars.

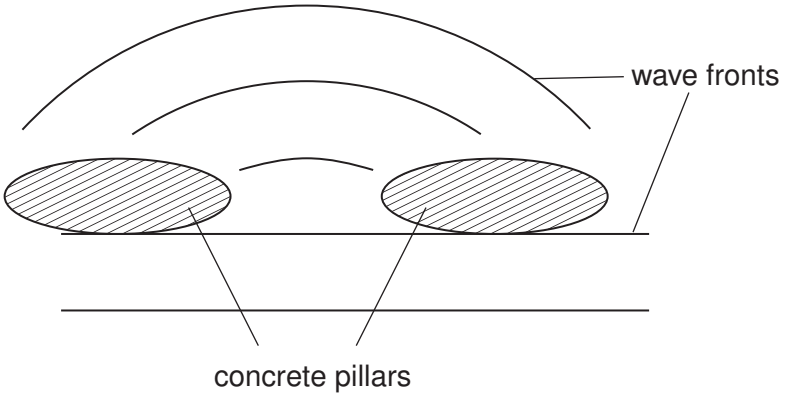

Fig. 6.1

(a) Name the process by which the waves spread out after passing through the gap between the pillars.

.....[1]

(b) Mark on the diagram the wavelength of the waves. [1]

(c) The diagram is drawn $\frac{1}{20}$th full size. The frequency of the waves is 3 Hz.

Calculate the speed of the waves. Show all your working and write down any equation that you use.

wave speed = ... [3]

(d) Explain how you would use the pond and any other necessary apparatus to demonstrate **(i)** reflection and **(ii)** refraction of waves. In each case draw a diagram to help your explanation.

reflection

.....

.....

.....

.....

.....[3]

refraction

.....

.....

.....

.....

.....[3]

7 **(a)** A number of pollutants may be found in car exhaust gases. Explain how the following pollutants are formed:

(i) oxides of nitrogen .....[2]

.....

(ii) carbon monoxide .....

.....[1]

(b) Name **one** other pollutant formed in car exhaust gases.

.....[1]

(c) Explain how nitrogen oxides in the atmosphere can cause damage to limestone buildings.

.....

.....

.....

.....[2]

(d) Both nitrogen monoxide, NO, and carbon monoxide, CO, can be removed from exhaust fumes by using a catalyst to make them react together. The products are carbon dioxide and nitrogen. Write a balanced equation for this reaction.

.....[2]

8 Fig. 8.1 shows a transformer. The output is connected to a lamp rated at 6 V, 1.8 W and the input is connected to a 220 V supply.

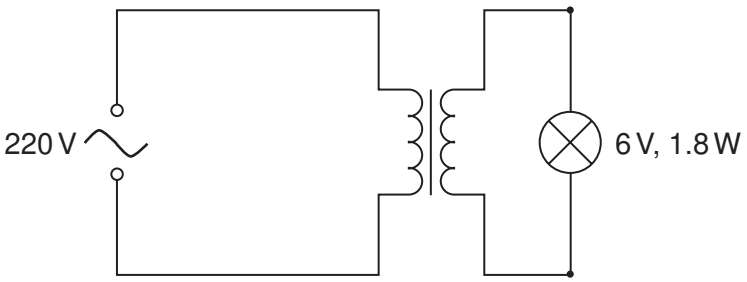

Fig. 8.1

(a) **(i)** Name the type of transformer used.

.....[1]

(ii) Calculate the ratio of the number of turns on the secondary to the number of turns on the primary.
Write down the equation that you use and show your working.

turns ratio = ... [2]

(b) (i) Calculate the normal working current for the lamp.
Write down the equation that you use and show your working.

current = ... [3]

(ii) Calculate the working resistance of the lamp.
Write down the equation that you use and show your working.

resistance = ... [2]

(iii) Explain why the initial current for the lamp is likely to be higher than the normal working current.

.....

.....

.....

.....

.....

.....[3]

9 The salt lead(II) chloride is insoluble in cold water, whereas the salt lead(II) nitrate is soluble.

(a) Lead(II) chloride is to be prepared from a solution of lead(II) nitrate.

(i) What other solution should be added to the solution of lead(II) nitrate?

.....[1]

(ii) How would you decide when to stop adding this solution?

.....[1]

(iii) How would you separate a sample of lead(II) chloride from the mixture?

.....

.....

.....[2]

(b) Draw a labelled diagram of the apparatus to carry out the separation described in **(a)(iii)**.

[2]

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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 = 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.).