

Centre Number

Candidate Name

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

**PHYSICAL SCIENCE
PAPER 3**

0652/3

OCTOBER/NOVEMBER 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 16.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

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

element	density in g/cm ³	melting point in K	type of structure	type of oxide
nitrogen	0.0012	63	covalent molecule	acidic
phosphorus	2.2	317	covalent molecule	
arsenic	5.7	1090	metallic	amphoteric
antimony		905		amphoteric
bismuth	9.8	545	metallic	amphoteric

Fig.1.1

- (a) Complete the table by suggesting the density of antimony, the type of structure for antimony and the type of oxide formed by phosphorus. [3]
- (b) Suggest a reason why the melting points of the elements do not show a steady trend.

.....

.....

.....

..... [2]

- 2 Fig. 2.1 shows a force of 80 N applied to the pedal of a bicycle. The force is applied at a distance of 30 cm from the axis about which the gear wheel turns.

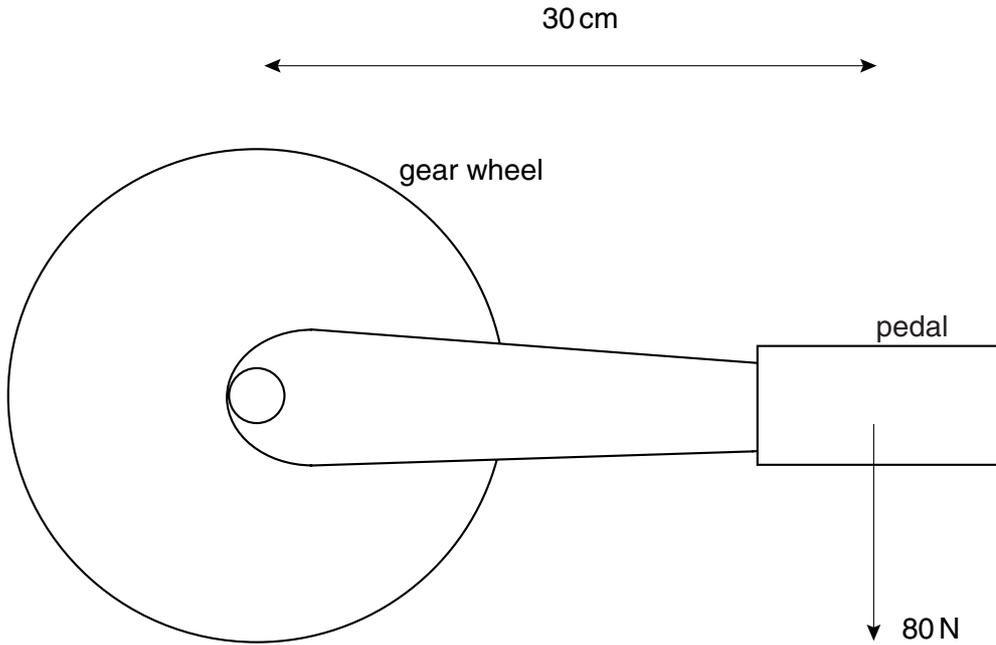


Fig. 2.1

- (a) Calculate the moment of the force about the axis.

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

moment of the force = [3]

- (b) (i) Explain what is meant by *power*.

.....
 [1]

- (ii) Suggest why the power input to the gear wheel changes with the position of the pedal.

.....

 [2]

3 Iron is extracted from the ore haematite, Fe₂O₃, in a blast furnace by reduction with carbon monoxide. The carbon is put into the furnace in the form of coke.

(a) (i) Use the Periodic Table on page 16 of this paper to deduce the charge on an oxide ion.

charge on oxide ion [1]

(ii) Use the answer to (i) and the formula of haematite to find the charge on the ion of iron present in haematite.

charge on iron ion [1]

(iii) Write down the formula of the chloride which would be formed using the ion of iron in (ii).

formula of chloride [1]

(iv) Iron forms another chloride named iron(II) chloride. Describe a simple chemical test to distinguish between a solution of the chloride of iron in (iii) and a solution of iron(II) chloride.

Test
.....

Result with iron(II) chloride
.....

Result with chloride of iron in (iii)
..... [3]

(b) Write a balanced equation for the reduction of haematite, Fe₂O₃, by carbon.
..... [2]

(c) (i) What other solid is mixed with the coke and iron ore in a blast furnace?
.....

(ii) What is the reason for adding this substance to the furnace?
.....
.....
..... [2]

- 4 Fig. 4.1 shows the fruit of a plant. Its structure allows the fruit to fall slowly so that its seeds can be scattered by horizontal breezes.

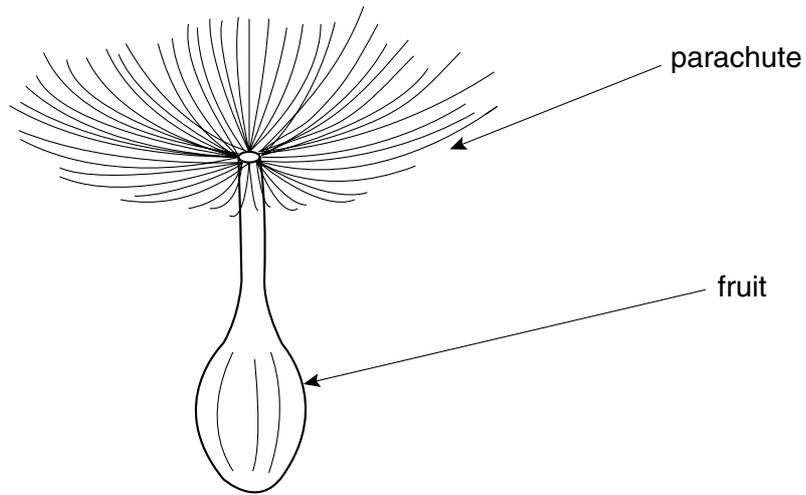


Fig. 4.1

The mass of the fruit and parachute of tiny hairs is 1.2 g.

- (a) (i) Calculate the weight of the fruit and parachute.
[$g = 10 \text{ N/kg}$]

weight = [2]

- (ii) When the fruit falls at a constant vertical speed what is the magnitude of the upward force acting on it?

magnitude of upward force = [1]

- (iii) The fruit falls at 0.2 m/s. Calculate the kinetic energy of the fruit.

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

kinetic energy = [3]

(b) The fruit falls to the ground from a height of 0.3 m in 1.5 s at a constant vertical speed.

(i) Calculate the gravitational potential energy of the fruit before it falls.

Show your working.

gravitational potential energy = [2]

(ii) On the grid of Fig. 4.2 show how the gravitational potential energy changes over the 1.5 s period. Mark numbers and units on the vertical axis.

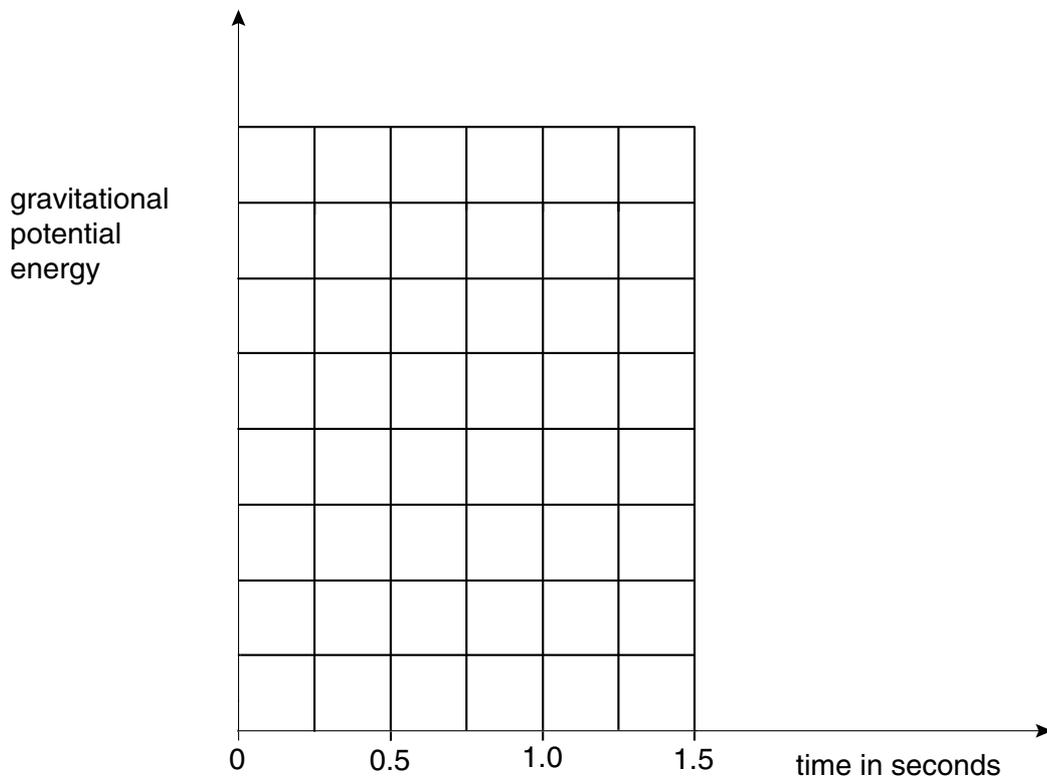


Fig. 4.2

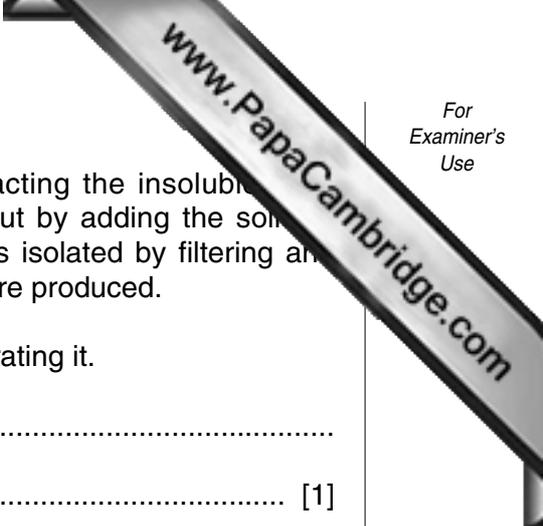
[2]

(iii) Explain the energy change that occurs as the fruit falls through the air.

.....

.....

..... [2]



5 The soluble salt magnesium sulphate can be prepared by reacting the insoluble magnesium oxide with sulphuric acid. The reaction is carried out by adding the solid to warm dilute sulphuric acid until no more solid reacts. The salt is isolated by filtering and slowly evaporating the solution until crystals of the hydrated salt are produced.

(a) Explain why it is necessary to filter the solution before evaporating it.

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

(b) Calcium sulphate is an insoluble salt, but calcium nitrate is soluble.

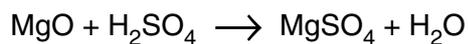
(i) Explain why the method described above cannot be used to prepare calcium sulphate crystals from calcium oxide.

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

(ii) Suggest a suitable method for preparing calcium sulphate using sulphuric acid as one of the starting materials.

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

- (c) The equation for the reaction between magnesium oxide and sulphuric acid is written:



- (i) Calculate the relative molecular mass, M_r , for magnesium oxide.

You should use the Periodic Table on page 16 of this paper to help you answer this question.

M_r of magnesium oxide = [1]

- (ii) Calculate the number of moles in 8 g of magnesium oxide.

number of moles of magnesium oxide = [1]

- (iii) Hence calculate the volume of sulphuric acid of concentration 2 mol/dm^3 which will react with 8 g of magnesium oxide.

Show your working.

volume of sulphuric acid = [3]

- 6 Fig. 6.1 shows a section through a ripple tank. The dipper is made to bounce up and down by the rotation of a motor mounted on a pair of rubber bands. For each rotation of the motor, one new wave is sent out.

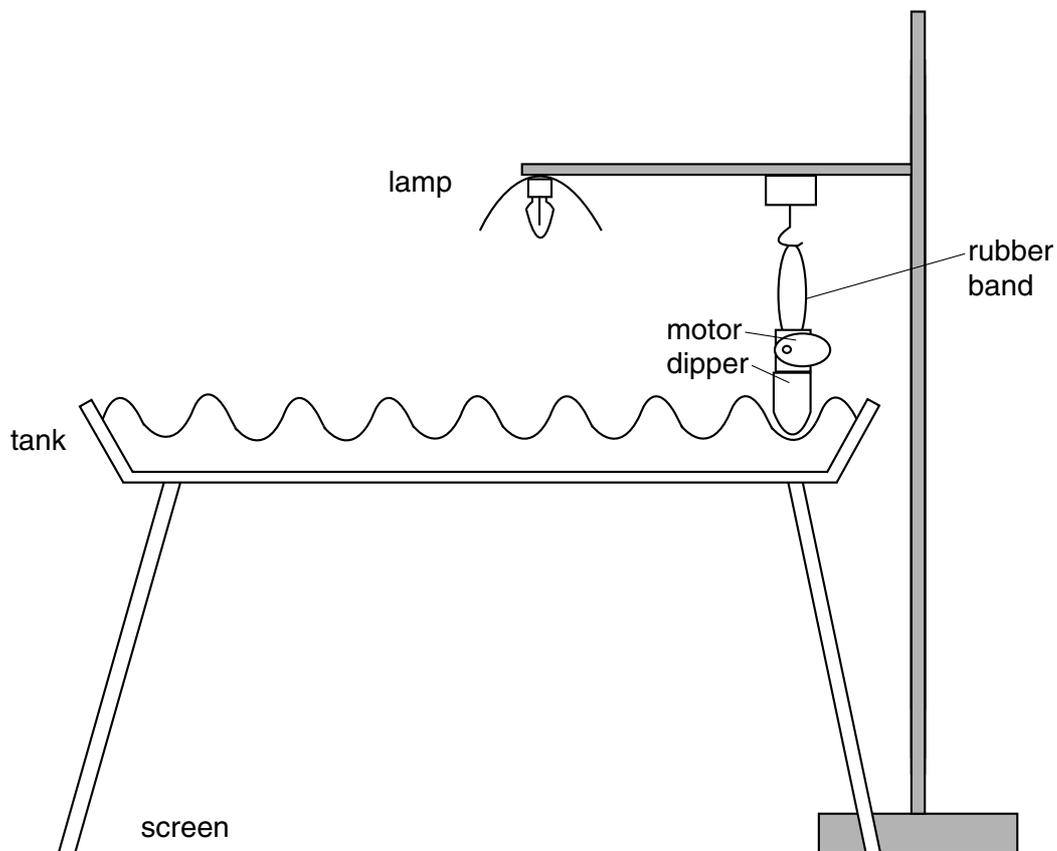


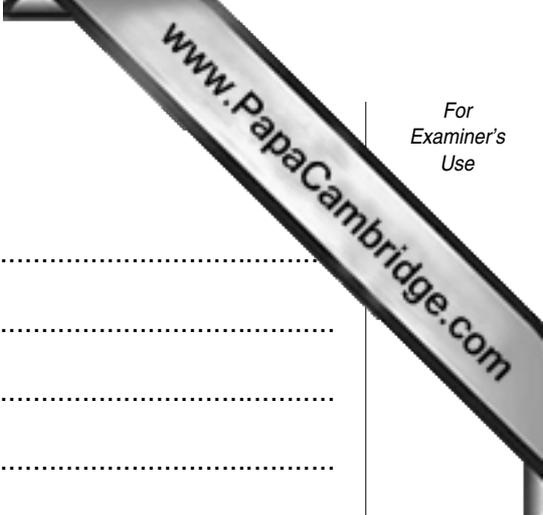
Fig. 6.1

- (a) A series of alternate bright and dark lines can be seen on the screen below the tank. Suggest how this pattern is formed.

.....

.....

..... [2]



(b) Explain how you would measure the wavelength of the wave.

.....
.....
.....
.....
.....
..... [4]

(c) The waves travel at a speed of 2.5 cm/s and their wavelength is 4.2 cm.

Calculate how many times the motor must rotate in a minute.

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

number of rotations per minute = [4]

- 7 Ethanol and methanol are members of the same homologous series of organic compounds. Ethanol, C_2H_5OH , may be produced by the addition reaction between ethene, C_2H_4 , and steam.

(a) (i) Write down the formula of methanol. [1]

(ii) Draw a dot-and-cross diagram to show the bonding in methanol.

You need only show the outer shell electrons in each atom.

[2]

(iii) Explain why ethanol and methanol are considered to be members of the same homologous series.

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

(b) (i) Write an equation for the addition reaction between ethene and steam.

..... [2]

(ii) State two of the conditions necessary for this reaction to occur.

1.

2. [2]

(c) State one industrial method of obtaining the ethene used to make ethanol.

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

- 8 Fig. 8.1 shows a circuit in which an ammeter and voltmeter are included.

Calculate the ammeter and voltmeter readings in this circuit. You can only gain full marks for this question by writing down any equations that you use and showing your working.

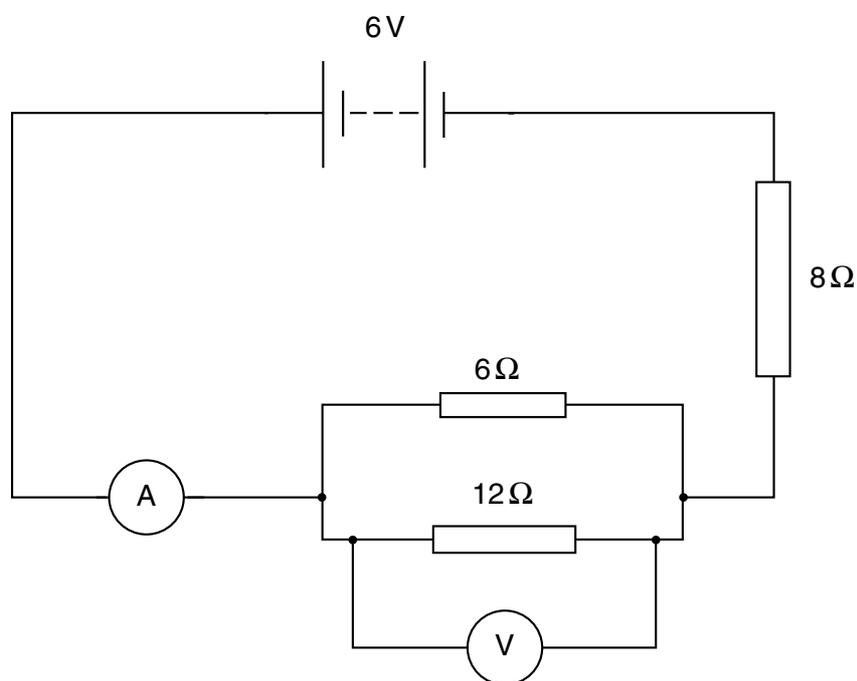


Fig. 8.1

ammeter reading = A

voltmeter reading = V

[6]

9 Aluminium is a very reactive metal which is protected from corrosion by a layer of aluminium oxide. This oxide has amphoteric properties.

(a) Explain why the oxide layer formed on aluminium protects it from corrosion but iron is not protected by the formation of a layer of rust.

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

(b) Oven cleaners often contain sodium hydroxide to help remove fat. Explain why such a cleaner should not be used on aluminium utensils.

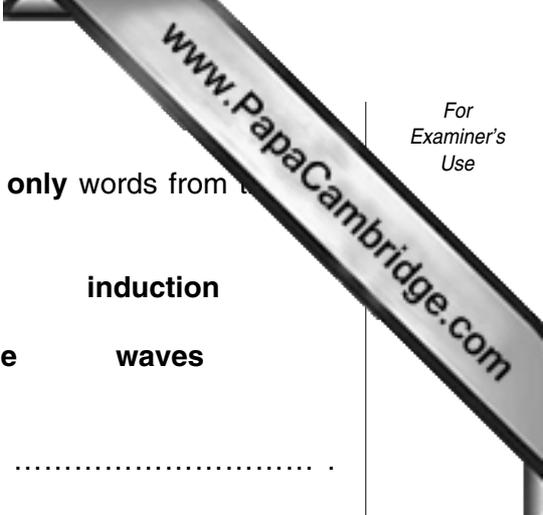
.....
.....
..... [2]

(c) Aluminium is not extracted from its ore by reduction with carbon.

(i) Name the main ore of aluminium. [1]

(ii) Suggest a reason why aluminium cannot be extracted by reduction with carbon.

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



10 (a) Complete the following sentences about transformers using **only** words from the list. Each word may be used once, more than once or not at all.

- changing constant current direct induction
- output primary resistance voltage waves

Transformers work using the principle of electromagnetic

A current in the coil generates a voltage

across the secondary coil. In a step-up transformer the output

is greater than the input voltage. [4]

(b) A step-down transformer with a primary coil of 500 turns is used to transform 120 V to 6 V.

Calculate the number of turns on the secondary coil.

Show all your working.

number of turns = [2]

DATA SHEET
The Periodic Table of the Elements

		Group											
I	II	III	IV	V	VI	VII	0						
7 Li Lithium	9 Be Beryllium	1 H Hydrogen	12 C Carbon	14 N Nitrogen	16 O Oxygen	17 F Fluorine	18 Ne Neon	13 B Boron	14 C Carbon	15 N Nitrogen	16 O Oxygen	17 F Fluorine	18 Ne Neon
23 Na Sodium	24 Mg Magnesium	27 Al Aluminium	28 Si Silicon	31 P Phosphorus	32 S Sulphur	35.5 Cl Chlorine	40 Ar Argon	5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
39 K Potassium	40 Ca Calcium	45 Sc Scandium	48 Ti Titanium	51 V Vanadium	52 Cr Chromium	55 Mn Manganese	56 Fe Iron	59 Co Cobalt	59 Ni Nickel	64 Cu Copper	65 Zn Zinc	79 Se Selenium	84 Kr Krypton
85 Rb Rubidium	88 Sr Strontium	89 Y Yttrium	91 Zr Zirconium	93 Nb Niobium	96 Mo Molybdenum	101 Ru Ruthenium	106 Pd Palladium	106 Pd Palladium	108 Ag Silver	112 Cd Cadmium	115 In Indium	122 Sb Antimony	131 Xe Xenon
133 Cs Caesium	137 Ba Barium	139 La Lanthanum	178 Hf Hafnium	181 Ta Tantalum	184 W Tungsten	190 Os Osmium	195 Pt Platinum	197 Au Gold	201 Hg Mercury	204 Tl Thallium	207 Pb Lead	209 Po Polonium	210 Rn Radon
87 Fr Francium	88 Ra Radium	89 Ac Actinium	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	76 Os Osmium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	84 Po Polonium	86 Rn Radon
3-71 Lanthanoid series													175 Lu Lutetium
0-103 Actinoid series													101 Lr Lawrencium
<div style="display: flex; justify-content: space-between;"> a = relative atomic mass X = atomic symbol </div> <div style="display: flex; justify-content: space-between;"> b = proton (atomic) number </div>													102 No Nobelium

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).