Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

PHYSICAL SCIENCE **0652/03**

Paper 3 Extended

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	
Total	

This document consists of **17** printed pages and **3** blank pages.

1 **(a)** A spring is loaded with a mass of 250 g and comes to rest as shown in Fig. 1.1. Mark on Fig. 1.1 the size and direction of the forces acting on the **mass** in this position.

g = 10 N / kg

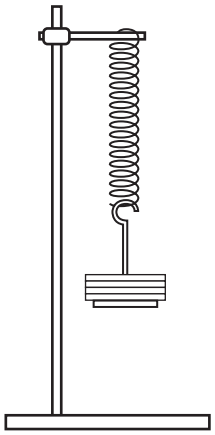


Fig. 1.1 [4]

(b) Masses are added to the spring and it stretches beyond its limit of proportionality.

(i) Sketch, on Fig. 1.2, the shape of the graph you would expect. [2]

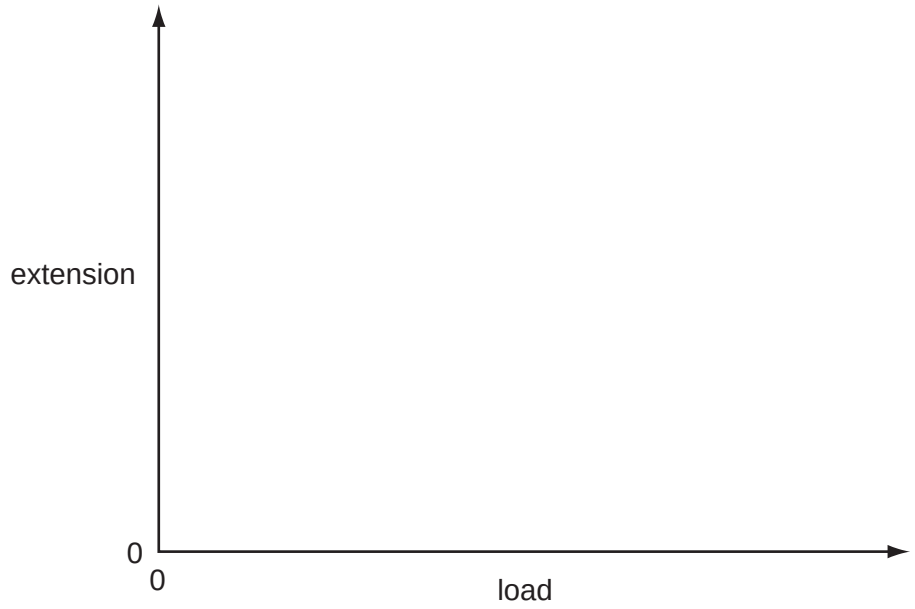


Fig. 1.2

(ii) On your graph, clearly label the limit of proportionality. [1]

(c) The spring is loaded with a 250 g mass. The mass is raised 8.0 cm above its normal rest position and released.

(i) Calculate the additional gravitational potential energy given to the mass in raising it 8.0 cm.

additional gravitational potential energy = ... [2]

(ii) Calculate the maximum speed that the mass gains after it has been released.

maximum speed = ... [3]

[Turn over

2 Fig. 2.1 shows the production of iron in a blast furnace.

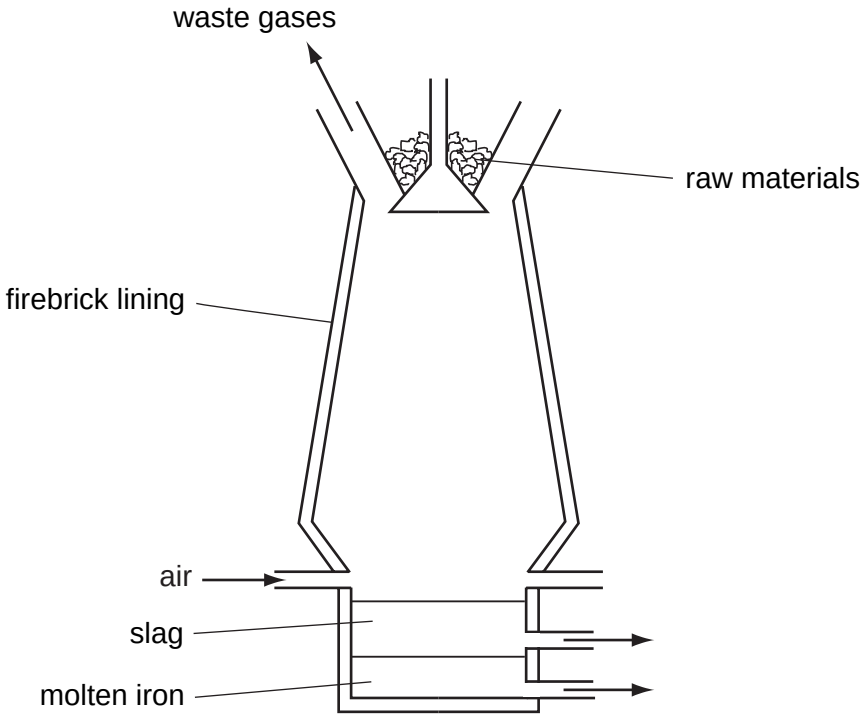


Fig. 2.1

(a) Raw materials loaded into the top of the furnace are iron ore, coke and limestone. In the furnace iron(III) oxide, Fe_2O_3, reacts with carbon monoxide to produce iron metal.

(i) State the name of an ore containing iron(III) oxide.

.....[1]

(ii) Explain how carbon monoxide is formed in the blast furnace.

.....

.....

.....[2]

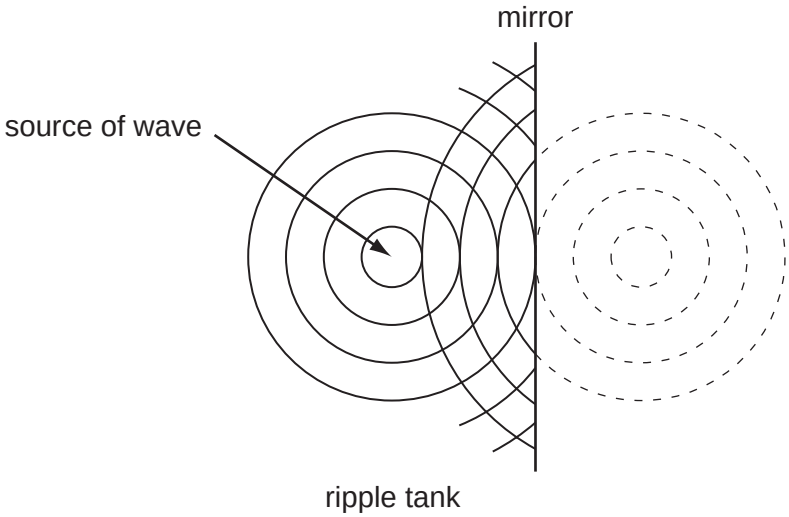
(iii) Write a balanced equation for the reaction between carbon monoxide and iron(III) oxide.

.....[2]

(b) An ore used in a blast furnace contains 80% by mass of iron(III) oxide, Fe_2O_3. The remaining 20% does **not** contain any iron or iron compounds. What mass of iron can be extracted from each tonne of this ore?
Show your working.

mass = ... tonne [4]

3 **(a)** Fig. 3.1 shows one wave property demonstrated by water waves in a ripple tank. The figure is drawn 1/5th full size and the frequency of the waves is 2 Hz.



scale 1:5

Fig. 3.1

(i) Name the property illustrated by this experiment.

..... [1]

(ii) Use Fig. 3.1 to calculate the wavelength of the wave **in the ripple tank**.

wavelength = ... [2]

(iii) Calculate the speed of the water waves.

speed = ... [2]

(b) Fig. 3.2 and Fig. 3.3 show a second property of waves demonstrated by another experiment in a ripple tank.

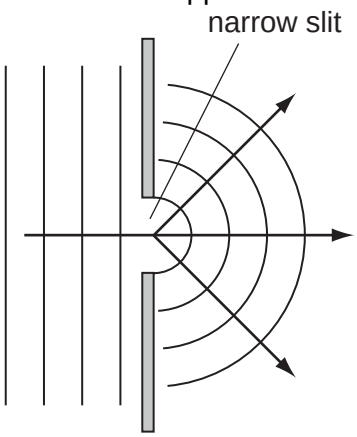


Fig. 3.2

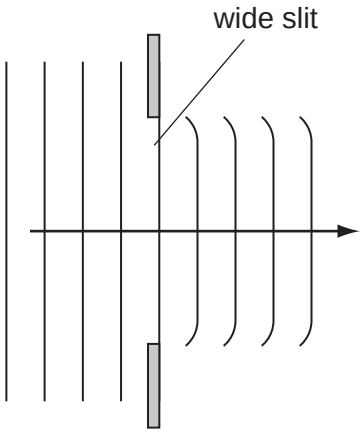


Fig. 3.3

(i) Name the property illustrated by this experiment.

..... [1]

(ii) Different widths of slits are used in the two parts of the experiment. Describe the effect this has on the waves.

.....

.....

..... [2]

[Turn over

4 A little metal powder is added to an aqueous solution of a metal salt. Any change to the appearance of the solid is noted. The experiment is repeated with different metals and metal salt solutions.
Results for these experiments are shown in Fig. 4.1.

	aqueous solution of metal salt			
metal powder	copper(II) sulphate	iron(II) sulphate	magnesium sulphate	aluminium sulphate
aluminium	forms a red-brown solid	forms a dark grey solid	no change	no change
copper	no change	no change	no change	no change
iron	forms a red-brown solid	no change	no change	no change
magnesium	forms a red-brown solid	forms a dark grey solid	no change	forms a dark grey solid

Fig. 4.1

(a) (i) A red-brown solid is formed when magnesium is added to aqueous copper(II) sulphate.
Name this solid.

..... [1]

(ii) Write a balanced equation for the reaction that takes place between magnesium and copper(II) sulphate.

..... [2]

(b) Use the information in Fig. 4.1 to place the four metals in order of reactivity.

most reactive .....

.....

.....

least reactive ..... [3]

(c) (i) When left in damp conditions iron rusts but aluminium does not show any change. Explain this difference.

.....

.....

..... [2]

(ii) Suggest how another metal can be used to prevent iron from rusting.

.....

.....

..... [2]

[Turn over

5 **(a)** Fig. 5.1 illustrates a simple alternating current generator.

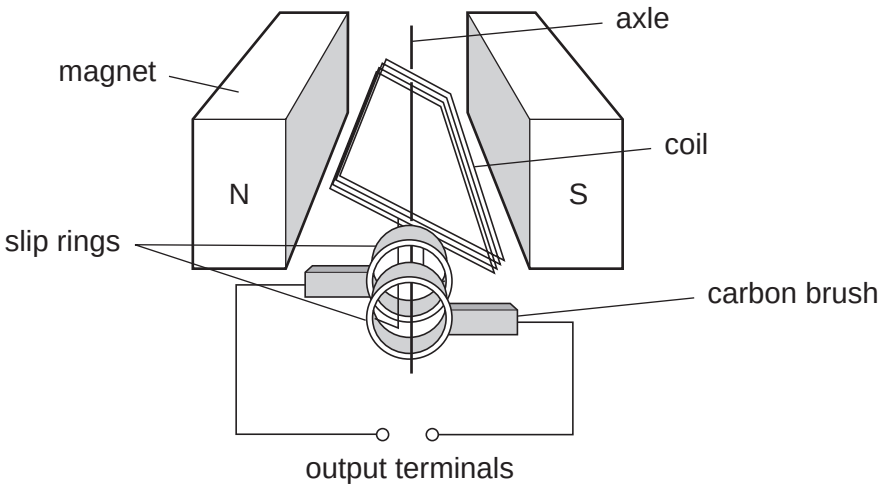


Fig. 5.1

(i) Name the principle used to explain how a generator works.

.....[1]

(ii) State three ways of increasing the voltage generated.

1. .....

2. .....

3. .....[3]

(iii) Explain why the direction of the voltage reverses each half revolution of the coil.

.....

.....

.....

.....

.....

.....[2]

(b) (i) Draw a circuit that could be connected to the output terminals to produce a direct current.
Label your components.

output terminals

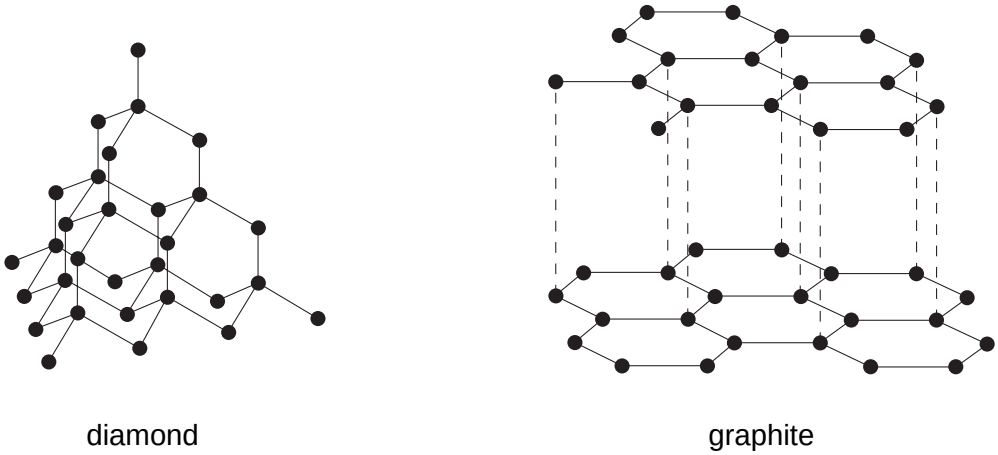
○ ○

[2]

(ii) State the difference between the direction of conventional current and the direction of electron flow.

..... [1]

6 **(a)** Fig. 6.1 shows the arrangement of atoms in diamond and graphite.



diamond graphite

Fig. 6.1

(i) Describe two differences in the properties of diamond and graphite.

1 .....

.....

2 .....

..... [2]

(ii) Use the structures in Fig. 6.1 to explain **one** of the differences you described in **(a)**.

.....

.....

.....

..... [2]

(b) Fig. 6.2 shows the arrangement of particles in a metal.

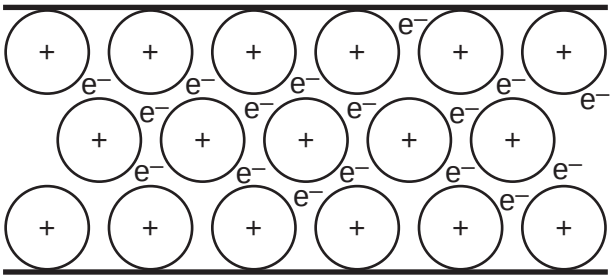


Fig. 6.2

Use information from Fig. 6.2 to help explain the following facts about this metal.

(i) The metal conducts electricity.

.....

.....

..... [2]

(ii) The metal is malleable.

.....

.....

..... [2]

(c) The metal is mixed with another metal to make an alloy.

(i) Suggest how the malleability of the alloy will compare with that of the metal in Fig. 6.2.

..... [1]

(ii) Explain your suggestion.

.....

.....

..... [2]

7 Fig. 7.1 shows a refrigerator in which a liquid absorbs thermal energy from the cold compartment and evaporates. As the vapour is compressed by the pump, work is done on it. The vapour condenses, giving out thermal energy to the surroundings through the cooling fins on the back of the refrigerator.

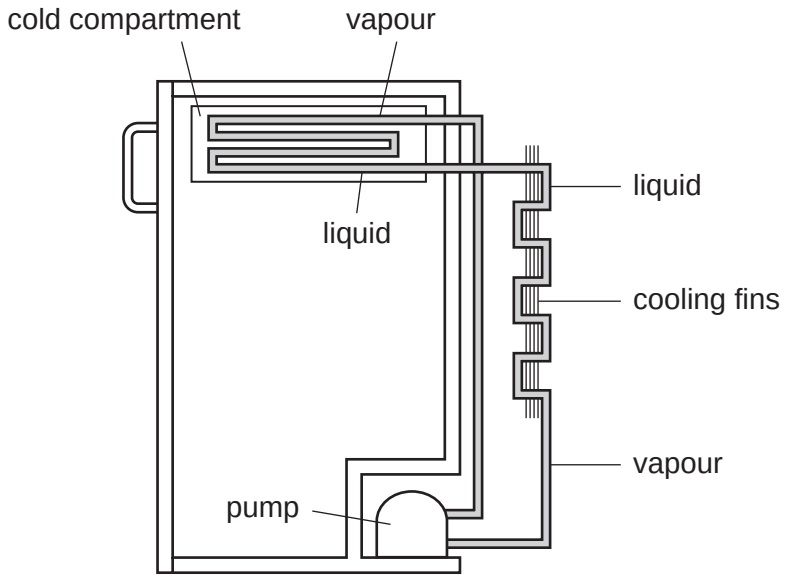


Fig. 7.1

(a) Explain the difference between boiling and evaporation.

.....

.....

.....

.....

.....

..... [3]

(b) Explain why the pump compresses the vapour much more than it could compress a liquid.

.....

.....

.....

..... [2]

(c) Explain the effect that a refrigerator has on the temperature of the air surrounding it.

.....

..... [1]

(d) The pump is rated at 220 V, 110W.

(i) Calculate the working current of the pump.
Show your working.

current = ... [3]

(ii) Calculate the working resistance of the pump.

resistance = ... [2]

8 Methanol, CH_3OH, and ethanol, C_2H_5OH, belong to the homologous series of alcohols.

(a) What is meant by the term *homologous series*?

.....

.....

..... [2]

(b) Ethanol is manufactured from ethene.

(i) How is this process carried out?

.....

..... [2]

(ii) Write an equation for the process.

..... [1]

(iii) Name another way that ethanol is made.

..... [1]

(iv) State **one** industrial use of ethanol.

..... [1]

(c) The atoms in methanol, CH_3OH, are joined by covalent bonds.
Draw a diagram to show the electron arrangement in methanol.
Show only outer shell electrons in your diagram.

[3]

BLANK PAGE

BLANK PAGE

BLANK PAGE

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.).