



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

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PHYSICAL SCIENCE

0652/31

Paper 3 (Extended)

October/November 2012

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.

DO NOT WRITE IN ANY BARCODES.

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	
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7	
8	
9	
10	
Total	

This document consists of **18** printed pages and **2** blank pages.



- 1 Fig. 1.1 shows an uncalibrated liquid in glass thermometer and a ruler. The upper and lower fixed points are marked on the thermometer.

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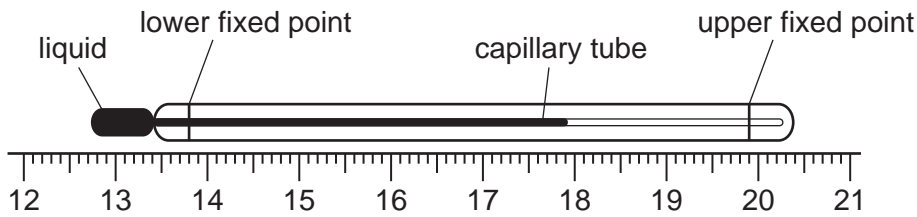


Fig. 1.1

- (a) (i) State the physical property of the liquid on which the operation of the thermometer depends.

..... [1]

- (ii) What are the values of the fixed points on the Celsius temperature scale?

upper fixed point

lower fixed point [1]

- (iii) Take measurements from Fig. 1.1 and use them to calculate the temperature indicated by this thermometer.

temperature = °C [4]

- (b) (i) Explain what is meant by the *sensitivity* of the thermometer.

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

- (ii) Suggest a design change to increase the sensitivity of the thermometer in Fig. 1.1.

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

- (c) Other physical properties can be used to measure temperature.

Name **one** of these properties.

..... [1]

- 2 (a) Table 2.1 shows information about three elements in Group II of the Periodic Table.

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Table 2.1

element	atomic number	relative atomic mass	electron arrangement	density in g/cm ³	melting point in °C
beryllium	4	9	2,2	1.85	1278
magnesium	12	24	2,8,2	1.74	649
calcium	20	40	2,8,8,2	1.54	839

- (i) What information in Table 2.1 shows that these elements are metals?

.....
 [1]

- (ii) Explain how the information in Table 2.1 shows that these are Group II elements and are successive in Group II.

.....

 [2]

- (iii) The elements in Group II show a trend in physical properties.

Use information from Table 2.1 to describe this trend.

.....

 [2]

- (b) Magnesium reacts with chlorine to form magnesium chloride. This compound contains the ions Mg²⁺ and Cl⁻.

Deduce the formula of magnesium chloride. [1]

(c) Magnesium is malleable.

Describe metallic bonding and use this to explain why magnesium is malleable.

.....

.....

.....

.....

..... [3]

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- 3 Fig. 3.1 shows a non-uniform beam of length 2.4 m and mass 0.80 kg. The beam is pivoted at its centre. Point C marks the centre of mass of the beam.

A weight of 4.5 N is hung on the beam. The distance x of the weight from the pivot is adjusted until the beam balances.

[$g = 10 \text{ N/kg}$]

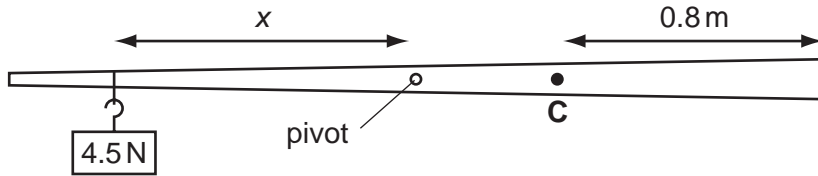


Fig. 3.1

- (a) Explain what is meant by the term *centre of mass*.

.....

 [2]

- (b) (i) Calculate the weight of the beam.

..... N [1]

- (ii) Calculate the distance of the centre of mass from the pivot.

distance = m

Now calculate the moment produced by the weight of the beam about the pivot.

moment = Nm [2]

(iii) State the moment that the 4.5 N weight produces about the pivot.

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moment = [1]

(iv) Calculate the distance x .

$x =$ m [2]

- 4 Calcium sulfate is a salt that is insoluble in water.

It can be made in the laboratory from solid calcium nitrate, $\text{Ca}(\text{NO}_3)_2$, and solid sodium sulfate, Na_2SO_4 . Both of these solids are soluble in water.

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- (a) Describe how you would make a pure dry sample of calcium sulfate starting from these solid materials.

.....

 [4]

- (b) Write a balanced equation for the reaction between calcium nitrate and sodium sulfate. Include state symbols in your equation.

..... [3]

- (c) Calcium sulfate can also be made by reacting calcium chloride with sodium sulfate.



What is the maximum mass of calcium sulfate that could be made from 5.0 g calcium chloride?

[Relative atomic masses: A_r : Ca,40; Na,23; Cl,35.5; O,16; S,32.]

Show your working in the box.

mass of calcium sulfate = g [3]

- 5 Fig. 5.1 shows blue light entering a triangular prism. The prism is made of a transparent plastic.

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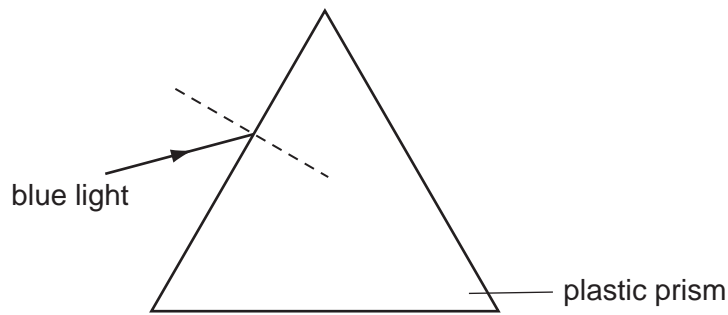


Fig. 5.1

The blue light enters at an angle of incidence 45° . The light is refracted so that the angle of refraction is 30° .

- (a) (i) On Fig. 5.1, draw the path of the blue light inside the plastic prism. [1]
- (ii) Calculate the refractive index n of the plastic for blue light.

$$n = \dots\dots\dots [3]$$

- (iii) On Fig. 5.1, complete the path of the light after it leaves the prism. Label this line **blue**. [1]

- (b) The refractive index of the plastic for red light is slightly less than for blue light.

Red light is shone along the same incident path as the blue light.

On Fig. 5.1, draw the path of the red light as it passes through and out of the prism.

Label this line **red**. [2]

- 6 A student investigates the reaction of four metal powders with 100 cm^3 dilute hydrochloric acid using the apparatus in Fig. 6.1.

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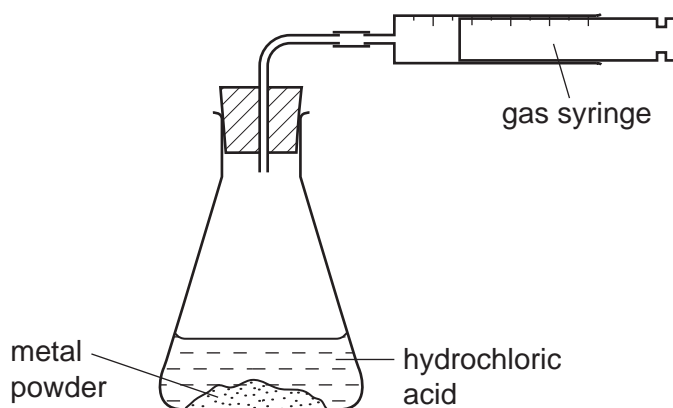


Fig. 6.1

The student measures the time taken to collect 100 cm^3 of hydrogen for each metal. Results of this investigation are shown in Fig. 6.2.

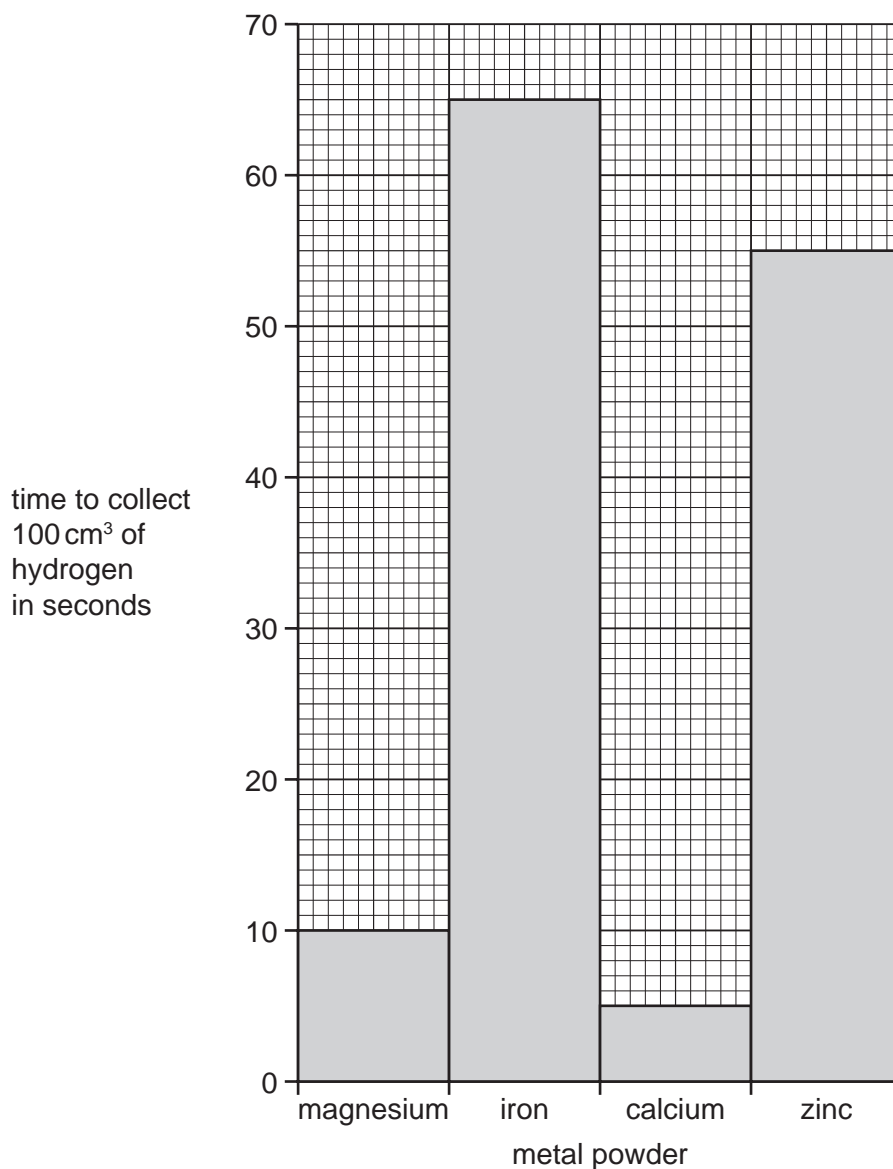


Fig. 6.2

- (a) (i) Place the four metals in order of reactivity, from most reactive to least reactive.

1 most reactive

2

3

4 least reactive

[1]

- (ii) The student repeats the experiment using copper powder.

Predict what the student will observe.

..... [1]

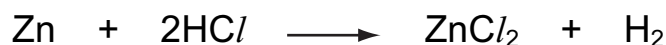
- (iii) The student then does the experiment with magnesium ribbon instead of magnesium powder. The same mass of magnesium is used.

Predict what the student will observe.

..... [1]

- (b) The student repeats the experiment with zinc. This time it is allowed to continue until it stops. When the reaction stops some of the zinc powder is left unreacted.

The total volume of hydrogen given off, measured at room temperature and pressure, is 180 cm³. The reaction takes place according to this equation.



- (i) Calculate the mass of hydrogen chloride in the hydrochloric acid used in the reaction. [Relative atomic masses: A_r: H,1; Cl,35.5; Zn,65.]

The volume of one mole of any gas is 24 dm³ at room temperature and pressure.

Show your working in the box.

mass of hydrogen chloride = g [3]

(ii) Work out the concentration of the 100 cm^3 hydrochloric acid in mol/dm^3 .

Show your working in the box.

concentration of hydrochloric acid = mol/dm^3 [2]

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7 Fig. 7.1 shows a battery for a mobile telephone.



Fig. 7.1

The battery has an e.m.f. of 3.7V. When fully charged the battery can provide a steady current of 0.020A for 51 hours.

(a) Explain what is meant by the term *e.m.f.*

.....
 [1]

(b) (i) Calculate the power of the battery when it supplies a current of 0.020A.

power = [2]

(ii) Calculate the charge which will flow through the circuit if there is a steady current of 0.020A for 51 hours.

charge = [2]

(iii) Calculate the energy the battery will supply in this time.

energy = [2]

(c) Mobile telephones send signals by use of microwaves.

Describe the nature of microwaves.

.....

 [2]

8 (a) Aluminium is more reactive than iron.

Aluminium is used for food containers but steel is not unless it is first coated with a thin layer of tin.

Explain these facts.

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

(b) Duralumin is an aluminium alloy. It contains copper, manganese and magnesium. This alloy is widely used to make parts of aircraft.

(i) The main component of duralumin is aluminium.

What property of aluminium makes this aluminium alloy a good choice for aircraft parts?

..... [1]

(ii) Duralumin is used rather than pure aluminium because it is much stronger.

Explain why duralumin is stronger than pure aluminium.

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

Please turn over for Question 9.

9 Fig. 9.1 shows an a.c. generator.

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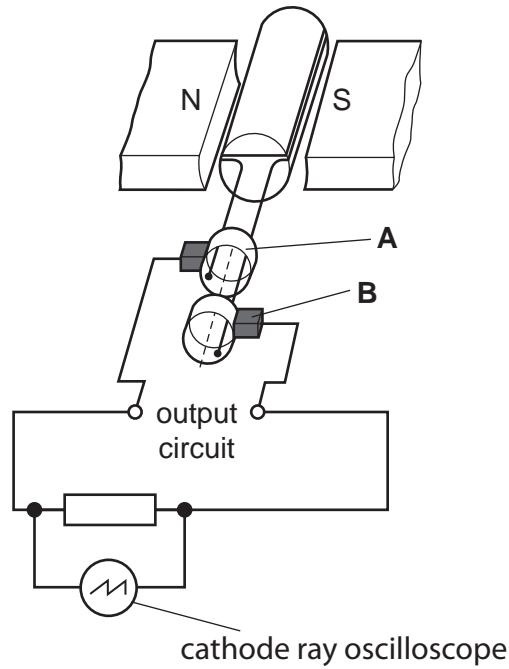


Fig. 9.1

The output from the generator is connected to a resistor and a cathode ray oscilloscope (c.r.o.).

(a) (i) Name part **A**. [1]

(ii) Name part **B**. [1]

(b) The generator works by electromagnetic induction.

Explain how this produces a current in the output circuit.

.....

 [3]

(c) Fig. 9.2 shows the trace on the c.r.o. shown in Fig. 9.1.

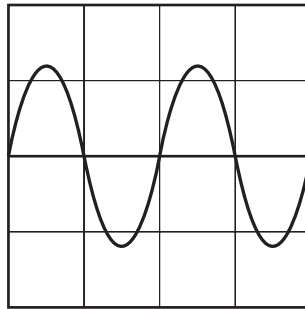


Fig. 9.2

Fig. 9.3a shows a similar circuit to the one shown in Fig. 9.1 but with a diode included.

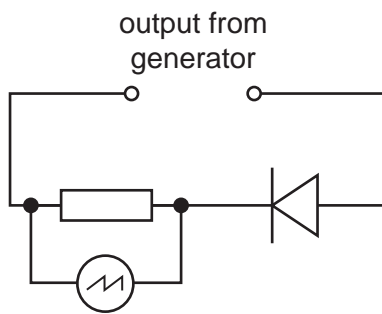


Fig. 9.3a

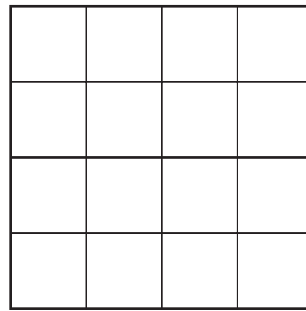


Fig. 9.3b

(i) Explain the purpose of the diode in this circuit.

.....
 [1]

(ii) On Fig. 9.3b, draw the trace that is seen on the c.r.o. when the circuit of Fig. 9.3a is connected to the a.c. generator output of Fig. 9.1. [1]

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10 Ethanol is used as a fuel.

It burns according to this equation.



(a) The burning of ethanol is an exothermic reaction.

Use ideas of energy, bond making and bond breaking to explain what this means.

.....

.....

.....

.....

.....

..... [3]

(b) State how ethanol can be made on an industrial scale.

..... [1]

(c) State one use of ethanol, other than as a fuel.

..... [1]

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DATA SHEET
The Periodic Table of the Elements

		Group																						
		I	II	III	IV	V	VI	VII	VIII	IX	X													
		1 H Hydrogen 1																						
7	9	Li Lithium 3	Be Beryllium 4																					
23	24	Na Sodium 11	Mg Magnesium 12																					
39	40	K Potassium 19	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	88	Rb Rubidium 37	Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	101 Ru Ruthenium 44	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	137	Cs Caesium 55	Ba Barium 56	139 La Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	190 Os Osmium 76	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	210 Rn Radon 86							
	226	Fr Francium 87	Ra Radium 88	227 Ac Actinium 89									140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	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	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103								

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

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

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

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