



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

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CANDIDATE NUMBER

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PHYSICAL SCIENCE

0652/31

Paper 3 (Extended)

October/November 2011

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	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **19** printed pages and **1** blank page.

1 Two cars are being tested on a straight level track.

Fig. 1.1 shows the speed-time graphs for the two cars, each of mass 1500 kg.

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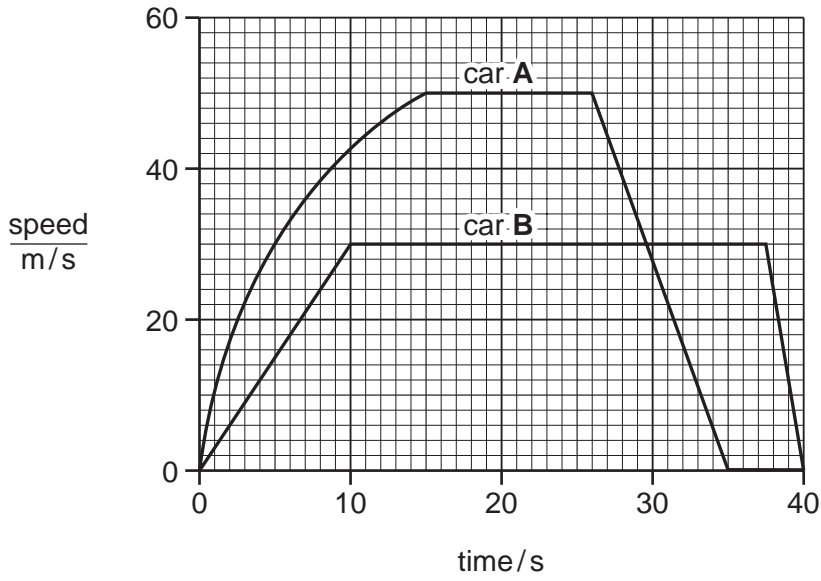


Fig. 1.1

(a) Determine the maximum velocity of car A.

velocity = m/s [1]

(b) Describe the motion of car A after 26 s.

.....

 [2]

(c) (i) Use the graph to calculate the acceleration of car **B** during the first 10 s of the test.

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acceleration = [2]

(ii) Calculate the resultant force on car **B** during this period.

force = [2]

(iii) Explain why the engine must provide a greater force than that given in your answer to (c)(ii).

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

(d) As the two cars approach the end of the track they brake and come to rest.

Explain which car produces the greater braking force.

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

- 2 Fig. 2.1 shows a catalytic converter, which is part of a car exhaust system.

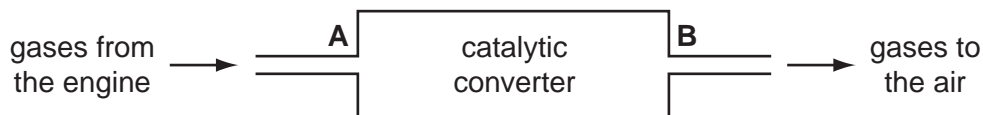


Fig. 2.1

Scientists analyse the gases at **A** and at **B**. Their results are shown in Table 2.1.

Table 2.1

gas	percentage at A	percentage at B
carbon dioxide	8.0	9.2
carbon monoxide	5.0	3.8
hydrogen	2.0	0.8
nitrogen	71.0	71.3
nitrogen monoxide	0.3	0.0
oxygen	4.0	2.8
water vapour	9.0	10.7

- (a) The scientists conclude that in the catalytic converter nitrogen monoxide is converted to nitrogen by reaction with carbon monoxide.

- (i) Write a balanced equation for this reaction. Use the data in Table 2.1 to help you.

..... [2]

- (ii) Use this reaction to explain the meaning of the terms *reduced* and *oxidised*.

.....

 [2]

- (iii) Explain how the results in Table 2.1 support the conclusion that this reaction takes place in the catalytic converter.

.....

 [2]

(iv) Use data from Table 2.1 to suggest another reaction that takes place in the catalytic converter.

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

(b) Parts of the car exhaust system are made from galvanised steel.

(i) Explain how galvanising prevents steel from rusting.

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

(ii) Suggest why galvanising is a better method of rust prevention than painting.

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

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- 3 A student experiments with a rubber band. She stretches it between two retort stands and notices that it produces a sound when she plucks it. The apparatus is shown in Fig. 3.1.

*For
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Use*

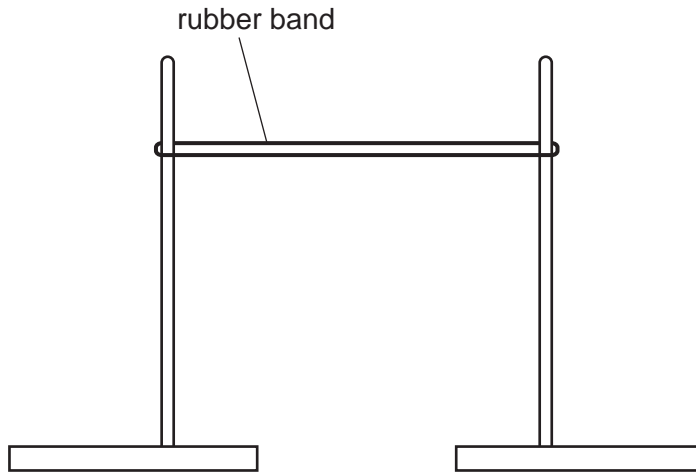


Fig. 3.1

- (a) Explain why the sound is produced.

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

- (b) The student sets up a cathode ray oscilloscope and a microphone, as shown in Fig. 3.2, to display the sound trace produced by the apparatus in Fig. 3.1.

For
Examiner's
Use

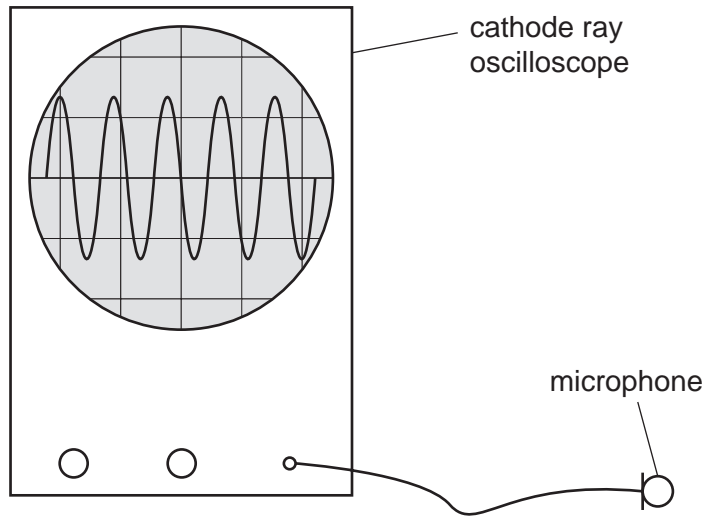


Fig. 3.2

The time base is set to 2.5 ms/division.

Calculate the frequency of the sound wave.

Show your working in the box.

frequency = Hz [3]

4 Silver salts are used in photography.

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Use

(a) The action of light on silver bromide releases an electron.



(i) How does light enable this reaction to take place?

..... [1]

(ii) The silver ion is converted into a silver atom.

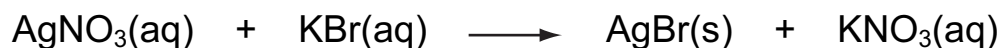
Why is this said to be a reduction reaction?

..... [1]

(iii) Write an ionic equation to show this reduction of a silver ion.

..... [1]

(b) Silver bromide can be made from the reaction between silver nitrate and potassium bromide.



(i) Describe how you would prepare a pure, dry sample of silver bromide from solutions of silver nitrate and potassium bromide.

.....

 [4]

(ii) What mass of silver bromide could be made from 5.0 g of silver nitrate?

[relative atomic masses, A_r : Ag, 108; Br, 80; N, 14; O, 16]

Show your working in the box.

mass of silver bromide = g [3]

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- 5 Fig. 5.1 shows an electric circuit. The e.m.f. of the battery is 6.0 V. The total resistance of the variable resistor 48 Ω .

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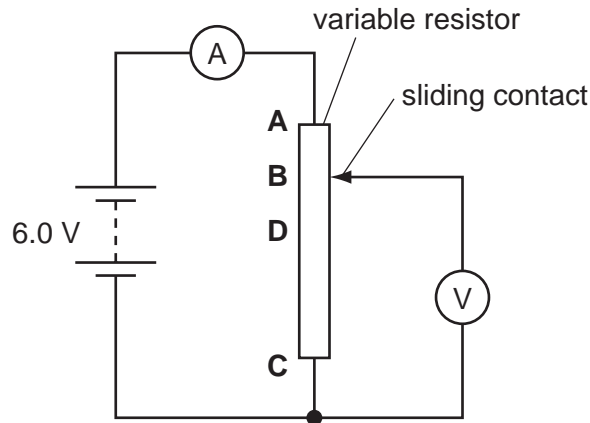


Fig. 5.1

- (a) (i) Calculate the current measured by the ammeter.

current = [2]

- (ii) When the sliding contact is at point **B** the voltmeter reading is 4.5 V.

Calculate the value of the resistance of the section of the variable resistor **BC**.

resistance = [2]

- (b) The sliding contact is moved to point **D**. The reading on the voltmeter is now 3.0 V.

Show that the resistance of the section **CD** of the variable resistor is 24 Ω . You may assume that the current through the circuit remains the same.

[1]

(c) The student realises that he could use this circuit as a variable voltage supply. He leaves the sliding contact at point **D** and connects a 3.0 V bulb of resistance 8Ω in place of the voltmeter.

(i) Show that the resistance of the parallel combination of the bulb and the section **CD** of the variable resistor is 6Ω .

[2]

(ii) Calculate the total resistance in the circuit.

resistance = [1]

(iii) Calculate the potential drop across the section **CD** of the variable resistor.

p.d. = [2]

(iv) Comment on the brightness of the bulb.

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

- 6 When calcium carbonate is heated strongly it decomposes to form calcium oxide and carbon dioxide.

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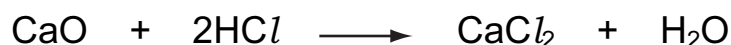
- (a) Calculate the volume of carbon dioxide, measured at room temperature and pressure, produced when 2.5 g of calcium carbonate is decomposed.

[The volume of one mole of any gas is 24 dm^3 at room temperature and pressure.]

Show your working in the box.

volume of carbon dioxide = dm^3 [3]

- (b) Calcium oxide reacts with hydrochloric acid to form a salt.



In this reaction calcium oxide is acting as a base.

- (i) Use this reaction to define the terms *acid* and *base* in terms of proton transfer.

acid

.....

base

..... [2]

(ii) Calcium oxide reacts with acids but not with alkalis. It is classified as a basic oxide.

Complete Table 6.1 to classify three other oxides.

Table 6.1

name	formula	property	type of oxide
calcium oxide	CaO	reacts with acids but not alkalis	basic
aluminium oxide	Al ₂ O ₃	reacts with both acids and alkalis	
carbon dioxide	CO ₂	reacts with alkalis but not acids	
nitrogen monoxide	NO	reacts with neither acids nor alkalis	

[3]

*For
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7 Fig. 7.1 shows a magnet and a coil which is connected to a sensitive voltmeter.

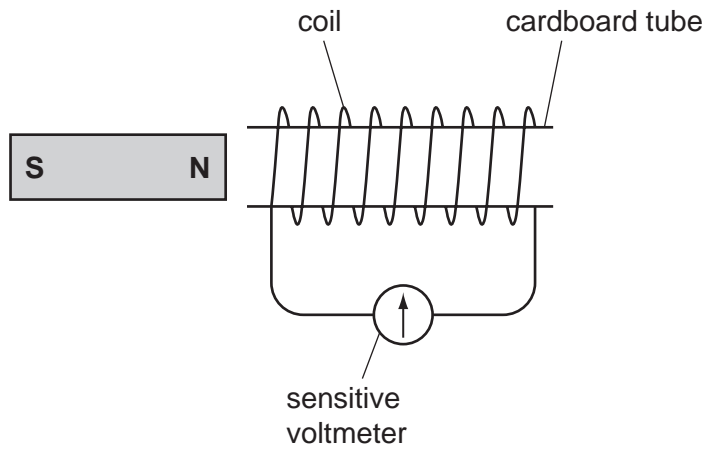


Fig. 7.1

(a) (i) Describe what you would observe as the magnet is moved away from the coil.

.....

 [2]

(ii) Explain this observation using the theory of electromagnetic induction.

.....

 [2]

(b) The magnet is now moved towards the coil.

Describe what you would observe.

.....
 [1]

(c) The magnet is now replaced with a similar coil connected to an alternating supply. The original coil is connected to a cathode ray oscilloscope. This is shown in Fig. 7.2.

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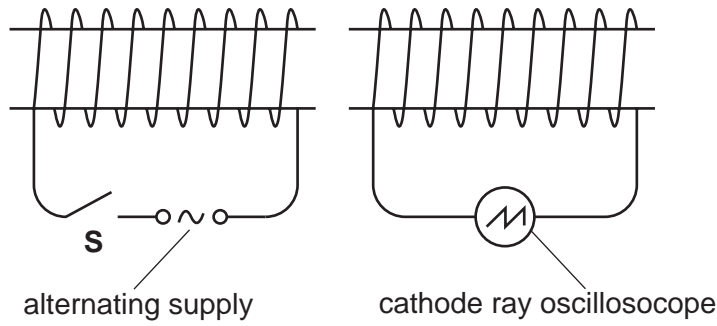


Fig. 7.2

State and explain what is observed when the switch **S** is closed.

.....

.....

..... [2]

- 8 Table 8.1 contains data about elements in Group 0 of the Periodic Table.

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Table 8.1

element	symbol	proton number	boiling point / °C	density of gas in kg/m ³
helium	He	2	-269	0.17
neon	Ne	10	-246	0.84
argon	Ar	18	-186	1.67
krypton	Kr	36	-152	3.50

- (a) (i) What name is given to the elements in Group 0?

..... [1]

- (ii) Use information from Table 8.1 to describe a trend in **one** physical property shown by this group of elements.

.....

 [2]

- (iii) Describe a chemical property common to all elements in this group.

..... [1]

- (iv) Xenon is the next member of Group 0 after krypton.

Predict the density of xenon.

density = kg/ m³ [1]

(b) (i) Draw a diagram to show the electron arrangement in an atom of argon.

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[2]

(ii) A calcium ion has the same electron arrangement as an argon atom.

Give the **name** of, and the **charge** on, another ion apart from calcium that has the same electron arrangement as an argon atom.

name charge [2]

(iii) State how a calcium ion is formed from a calcium atom.

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

9 A student is investigating the cooling of a cup of tea.

She makes the tea using water first boiled in a kettle. As the tea cools she notices that some of it evaporates.

(a) (i) State **one** similarity between evaporation and boiling.

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

(ii) Explain the difference between evaporation and boiling.

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

(b) The graph in Fig. 9.1 shows how the temperature of the tea changes with time.

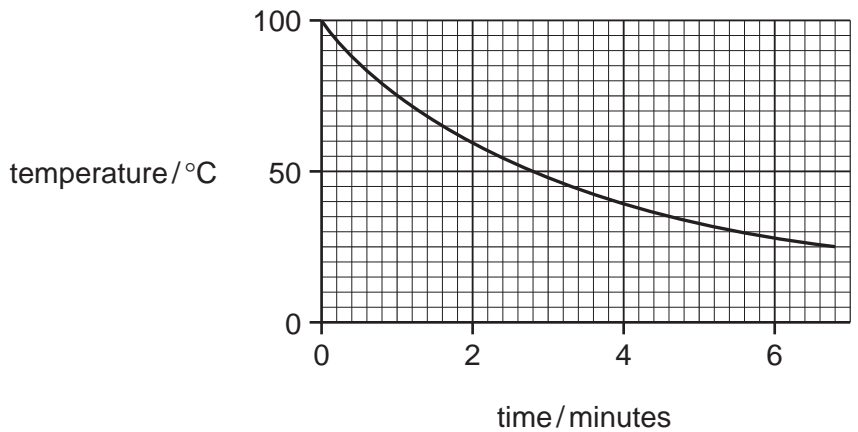


Fig. 9.1

Use the graph to estimate room temperature.

room temperature = °C [1]

(c) Explain, in terms of the molecular kinetic theory, what happens to the tea as it cools.

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

DATA SHEET
The Periodic Table of the Elements

		Group																																					
		I	II	III	IV	V	VI	VII	0																														
		<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center;">1</td> <td style="width: 10%; text-align: center;">H Hydrogen 1</td> <td colspan="8"></td> <td style="width: 10%; text-align: center;">4 He Helium 2</td> </tr> </table>										1	H Hydrogen 1									4 He Helium 2																	
1	H Hydrogen 1									4 He Helium 2																													
7	Li Lithium 3	9	Be Beryllium 4											19	F Fluorine 9	20	Ne Neon 10																						
23	Na Sodium 11	24	Mg Magnesium 12											32	S Sulfur 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	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	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	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	210	Po Polonium 84	210	At Astatine 85	210	Rn Radon 86						
226	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	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	238	U Uranium 92	232	Th Thorium 90	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92	238	U Uranium 92		

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

a = relative atomic mass

X = atomic symbol

b = proton (atomic) number

Key

a

X

b

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

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