



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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CHEMISTRY

0620/21

Paper 2

May/June 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 in the spaces at the top of this page.

Write in dark blue or black pen.

You may need to use a pencil for any diagrams, graphs 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 16.

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.

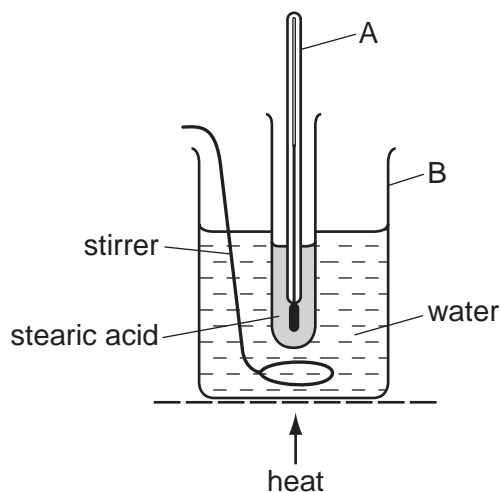
For Examiner's Use

1	
2	
3	
4	
5	
6	
7	
Total	

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



- 1 Stearic acid is a solid at room temperature.
The diagram below shows the apparatus used for finding the melting point of stearic acid.
The apparatus was heated at a steady rate and the temperature recorded every minute.



- (a) State the name of the piece of apparatus labelled

A,

B. [2]

- (b) (i) Suggest why the water needs to be kept stirred during this experiment.

.....

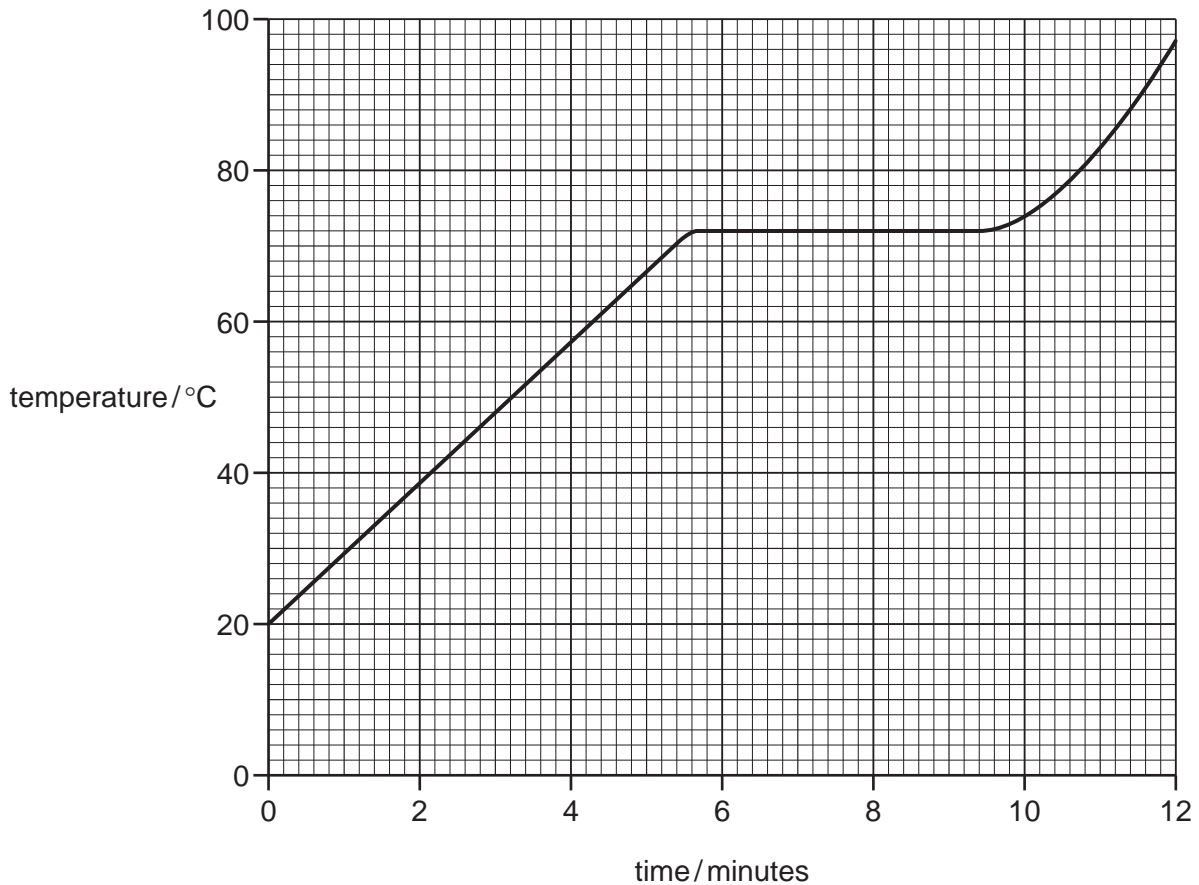
..... [1]

- (ii) Describe a chemical test for water.

test

result [2]

(c) A graph of temperature of stearic acid against time of heating is shown below.



(i) What was the temperature of the stearic acid after 3 minutes heating?

..... [1]

(ii) Use the information on the graph to determine the melting point of stearic acid.

..... [1]

(d) Describe the arrangement and motion of the particles in liquid stearic acid.

arrangement

motion [2]

(e) A sample of stearic acid contained 1% of another compound with a higher relative molecular mass.

(i) Which one of the following statements about this sample of stearic acid is correct?
Tick **one** box.

Its density is exactly the same as that of pure stearic acid.

Its boiling point is the same as that of pure stearic acid.

Its melting point is different from pure stearic acid.

Its melting point is the same as that of pure stearic acid.

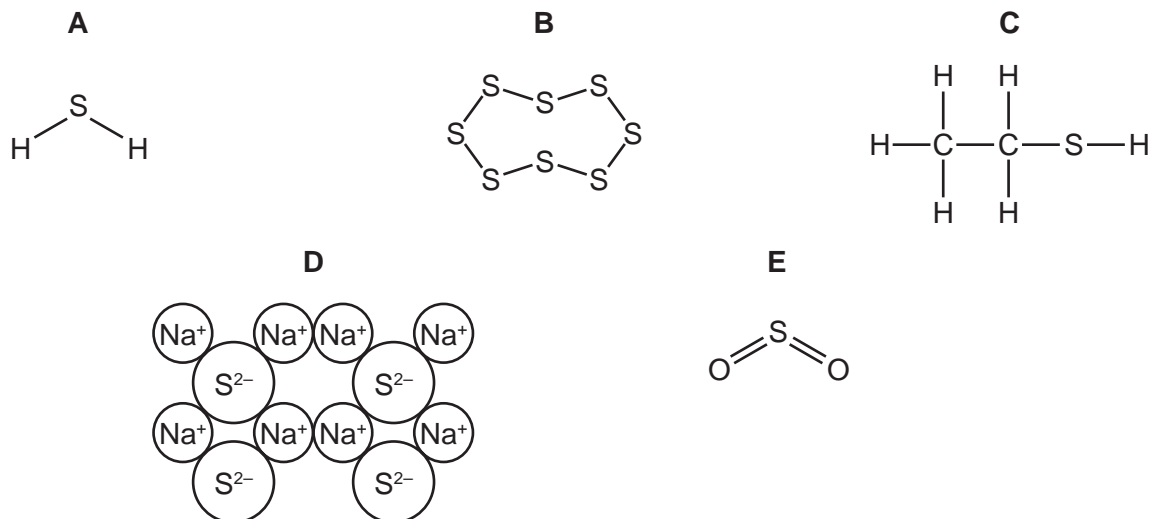
[1]

(ii) Describe **one** area of everyday life where the purity of substances is important.

..... [1]

[Total: 11]

2 The diagram below shows the structure of some substances, **A**, **B**, **C**, **D** and **E**.



(a) (i) Which **one** of these substances, **A**, **B**, **C**, **D** or **E**, is an element?

..... [1]

(ii) What do you understand by the term *element*?

..... [1]

(b) Calculate the relative molecular mass of **E**.

[1]

(c) Write the simplest formula for **D**.

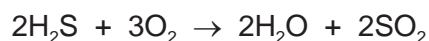
..... [1]

(d) Which substance, **A**, **B**, **C**, **D** or **E**, conducts electricity when it is molten?
Explain your answer.

.....

..... [2]

(e) The equation for the combustion of substance **A** is shown below.



What type of chemical reaction is this?
Put a ring around the correct answer.

decomposition **neutralisation** **oxidation** **reversible**

[1]

[Total: 7]

3 Hydrochloric acid and ethanoic acid are both acidic in nature.

(a) Which **one** of the following is a pH value for an acidic solution.
Put a ring around the correct answer.

pH3

pH7

pH9

pH13

[1]

(b) Describe how you would use litmus to test if a solution is acidic.

.....

 [3]

(c) Acids react with metal carbonates.

(i) Write a word equation for the reaction of calcium carbonate with hydrochloric acid.

[3]

(ii) Calcium carbonate can be used to treat acidic soil.
State **one** other use of calcium carbonate.

..... [1]

(iii) Name **one** other compound that can be used to treat acidic soil.

..... [1]

(d) Hydrochloric acid reacts with iron to form iron(II) chloride and hydrogen.
Complete the equation for this reaction.



[2]

(e) (i) Complete the table below to show:

- the molecular formula for ethanoic acid
- the full structural formula for ethanol.

	ethanoic acid	ethanol
full structural formula		
molecular formula		C ₂ H ₆ O

[2]

(ii) Ethanol can be manufactured by the catalytic addition of steam to ethene. Complete the equation for this reaction.



[1]

[Total: 14]

- 4 Fractional distillation is used to separate petroleum into different fractions. Each fraction has a particular use.

- (a) Match the fractions on the left with their uses on the right.
The first one has been done for you.

gas oil	heating
bitumen	fuel for ships
lubricating fraction	surfacing roads
refinery gases	waxes and polishes
naphtha	making chemicals

[4]

- (b) Petroleum fractions contain hydrocarbons.
What do you understand by the term *hydrocarbon*?

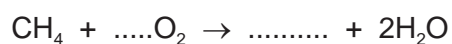
..... [1]

- (c) Methane, CH₄, is a hydrocarbon.

- (i) Draw the structure of methane, showing all atoms and bonds.

[1]

- (ii) Complete the following equation for the burning of methane in excess oxygen.



[2]

- (iii) Methane belongs to a homologous series called the alkanes.
What do you understand by the term *homologous series*?

.....

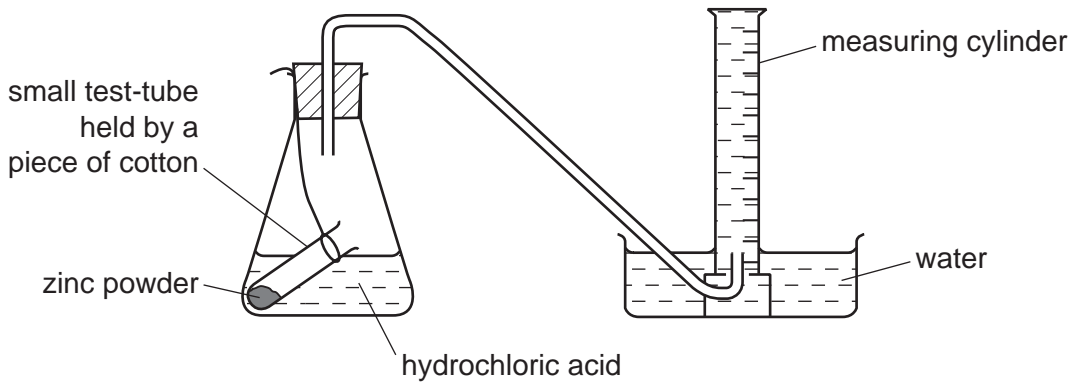
..... [2]

- (iv) Name the second member of the alkane homologous series.

..... [1]

[Total: 11]

- 5 A student investigated the reaction between zinc and hydrochloric acid using the apparatus shown below. The zinc was in excess.



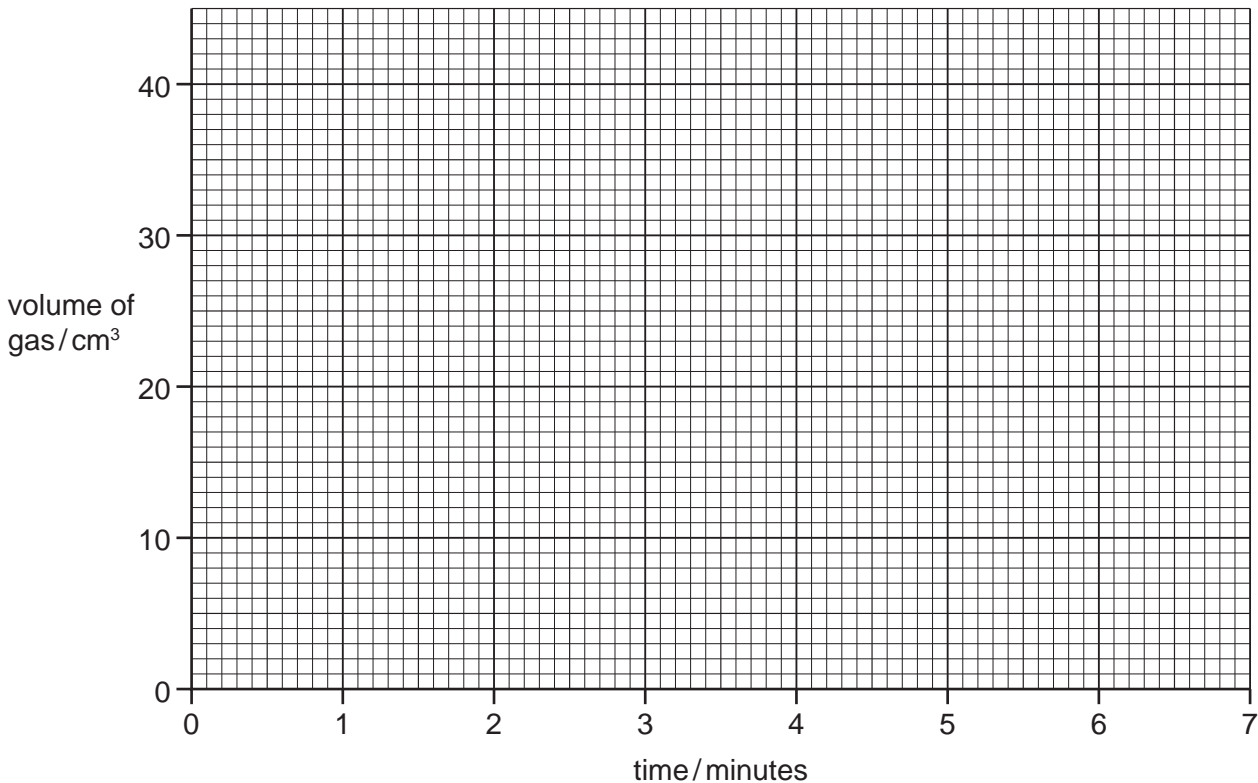
- (a) What should the student do to start the reaction?

..... [1]

- (b) The student measured the volume of gas in the measuring cylinder at minute intervals. The results are shown in the table.

time/minutes	0	1	2	3	4	5	6	7
volume of gas/cm ³	0	15	23	30	33	35	35	35

- (i) Plot the results on the grid below and draw the best curve through the points.



[3]

(ii) Explain why the volume of gas stays the same after 5 minutes.

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

(c) Complete the following sentences about this reaction using words or phrases from the list below.

- | | | |
|----------------------|-----------------------|------------------|
| concentration | decreases | increases |
| speed | stays the same | volume |

When the of hydrochloric acid is increased, the volume of gas given off in the first two minutes Decreasing the temperature of the reaction mixture the of the reaction. [4]

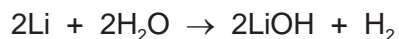
(d) When the reaction is complete, the flask contains a mixture of zinc and aqueous zinc chloride. Describe how you can obtain pure dry crystals of zinc chloride from this reaction mixture.

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

[Total: 13]

6 Lithium, sodium and potassium are in Group I of the Periodic Table.

(a) The equation for the reaction of lithium with water is



(i) Write a word equation for this reaction.

..... [2]

(ii) Sodium reacts with water in a similar way to lithium.
Write a symbol equation for the reaction of sodium with water.

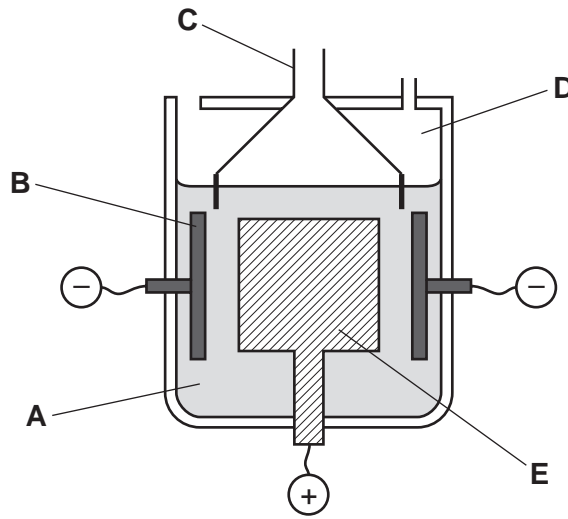
[1]

(b) Describe the reactions of lithium, sodium and potassium with water.
In your description, write about:

- the difference in the reactivity of the metals
- the observations you would make when these metals react with water.

.....
.....
.....
.....
.....
.....
..... [5]

(c) The diagram below shows an electrolysis cell used to manufacture sodium from molten sodium chloride.



(i) Which letter in the diagram above represents
the anode?

the electrolyte? [2]

(ii) State the name of the product formed
at the positive electrode,

at the negative electrode. [2]

(iii) Which one of the following substances is most likely to be used for the anode?
Put a ring around the correct answer.

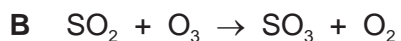
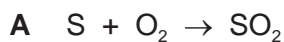
- graphite** **iodine** **magnesium** **sodium** [1]

(d) Lithium, sodium and potassium are metals with a low density.
State **two** other physical properties of these metals.

1.
2. [2]

[Total: 15]

7 (a) The equations **A** and **B** below show two reactions which lead to the formation of acid rain.



(i) Write a word equation for reaction **A**.

..... [2]

(ii) Which two of the following statements about reaction **B** are correct?
Tick **two** boxes.

SO₂ is oxidised to SO₃

SO₂ is reduced to SO₃

O₃ is reduced to O₂

O₃ is oxidised to O₂

[2]

(iii) Complete the equation to show how an aqueous solution of sulfuric acid, H₂SO₄, is formed from SO₃.



[1]

(b) Describe and explain the effect of sulfuric acid on buildings made from limestone (calcium carbonate).

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

(c) State **one** effect of acid rain other than on buildings.

..... [1]

[Total: 9]

DATA SHEET
The Periodic Table of the Elements

		Group																																																																																													
I	II	III	IV	V	VI	VII	0					0																																																																																			
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10	18 Ar Argon 18	19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	104 Rf Rutherfordium 104	105 Db Dubnium 105	106 Sg Seaborgium 106	107 Bh Bohrium 107	108 Hs Hassium 108	109 Mt Meitnerium 109	110 Ds Darmstadtium 110	111 Rg Roentgenium 111	112 Cn Copernicium 112	113 Nh Nihonium 113	114 Fl Flerovium 114	115 Lv Livermorium 115	116 Ts Tennessine 116	117 Og Oganesson 117
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	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	181 La Lanthanum 89	182 Ce Cerium 90	183 Pr Praseodymium 91	184 Nd Neodymium 92	185 Pm Promethium 93	187 Sm Samarium 94	188 Eu Europium 95	189 Gd Gadolinium 96	190 Tb Terbium 97	191 Dy Dysprosium 98	192 Ho Holmium 99	193 Er Erbium 100	194 Tm Thulium 101	195 Yb Ytterbium 102	196 Lu Lutetium 103	226 Fr Francium 87	227 Ra Radium 88	228 Ac Actinium 89	232 Th Thorium 90	238 U Uranium 92	238 Pa Protactinium 91	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	261 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 dm³ at room temperature and pressure (r.t.p.).

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