UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

3940916627

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.

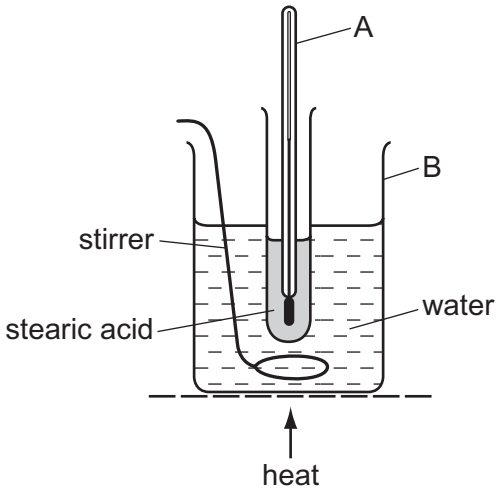
Answer **all** questions.
A copy of the Periodic Table is printed on page 16.

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]

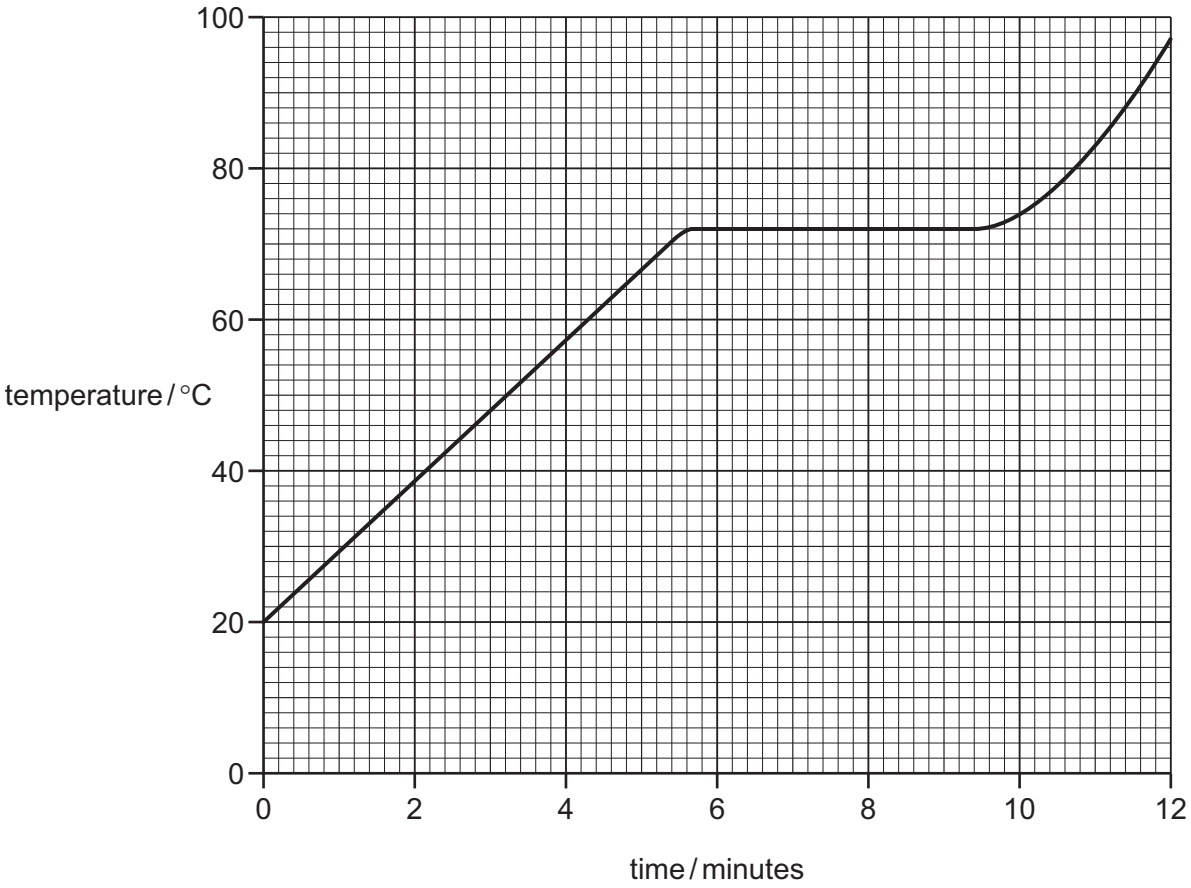
(ii) Describe a chemical test for water.

test .....

result ..... [2]

For Examiner's Use

(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]

[Turn over

(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]

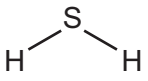
(ii) Describe **one** area of everyday life where the purity of substances is important.

..... [1]

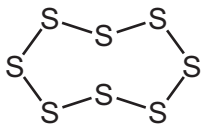
[Total: 11]

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

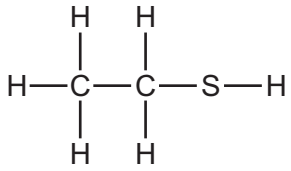
A



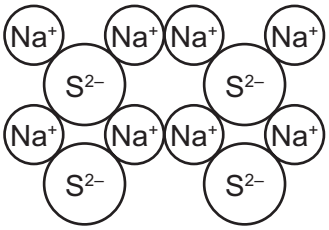
B



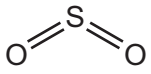
C



D



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.

$$2H_2S + 3O_2 \rightarrow 2H_2O + 2SO_2$$

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.

pH 3 **pH 7** **pH 9** **pH 13**

[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]

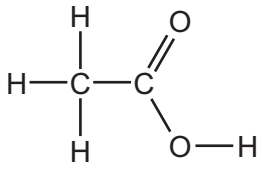
(d) Hydrochloric acid reacts with iron to form iron(II) chloride and hydrogen.
Complete the equation for this reaction.

$$Fe + ...HCl \rightarrow FeCl_2 + ...$$

[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_2H_6O

[2]

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

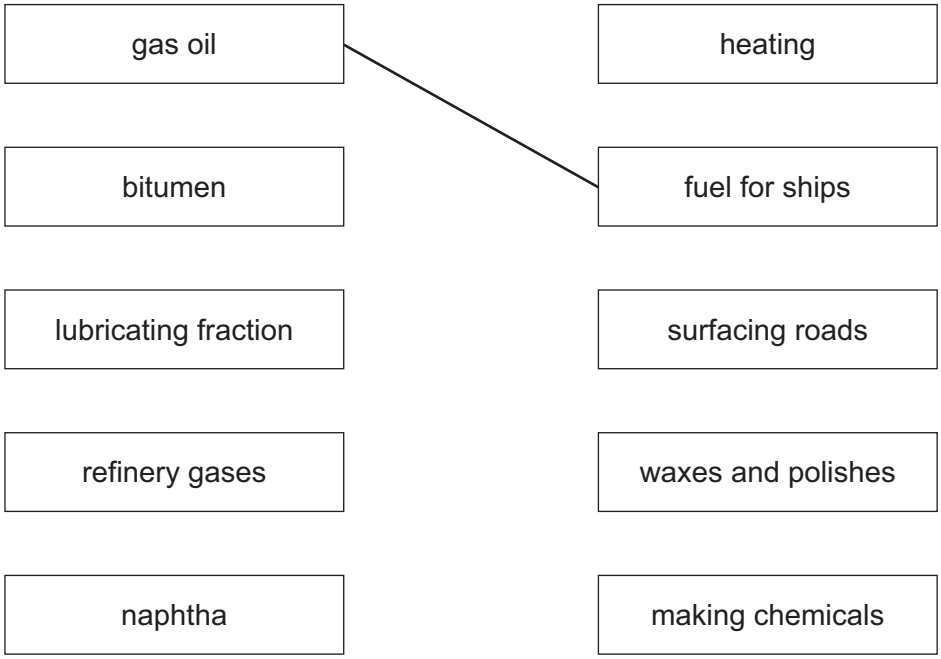
..... + ... $\rightarrow$ C_2H_5OH

[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.



[4]

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

..... [1]

(c) Methane, CH_4, 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.

$$CH_4 + ...O_2 \rightarrow ..... + 2H_2O$$

[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.

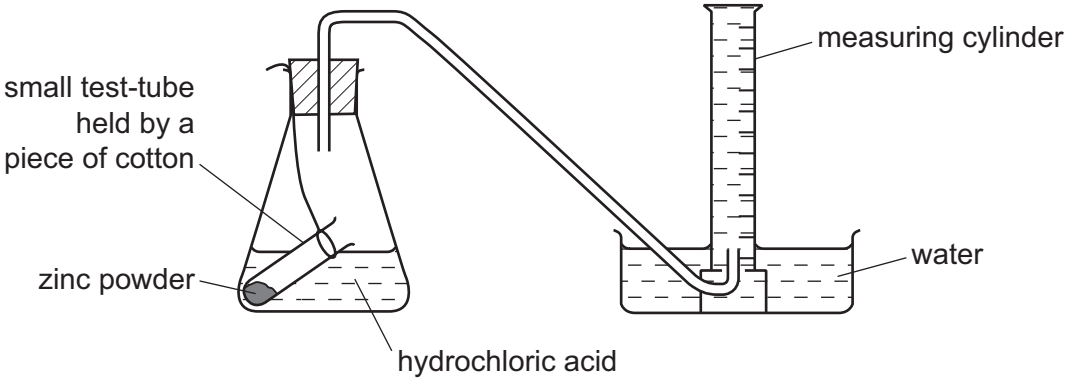
..... [1]

[Total: 11]

For Examiner's Use

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

zinc + hydrochloric acid → zinc chloride + hydrogen



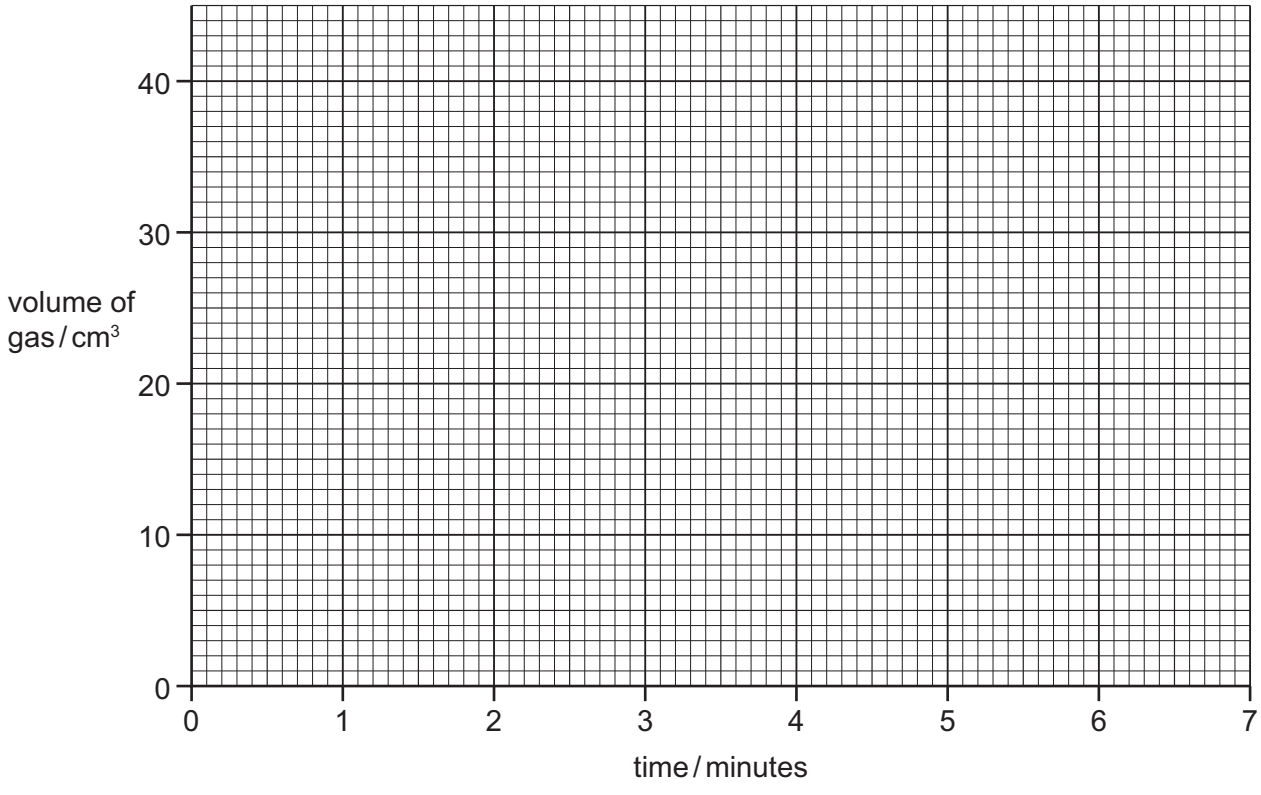
(a) What should the student do to start the reaction?

..... [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

$$2Li + 2H_2O \rightarrow 2LiOH + H_2$$

(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.

.....

.....

.....

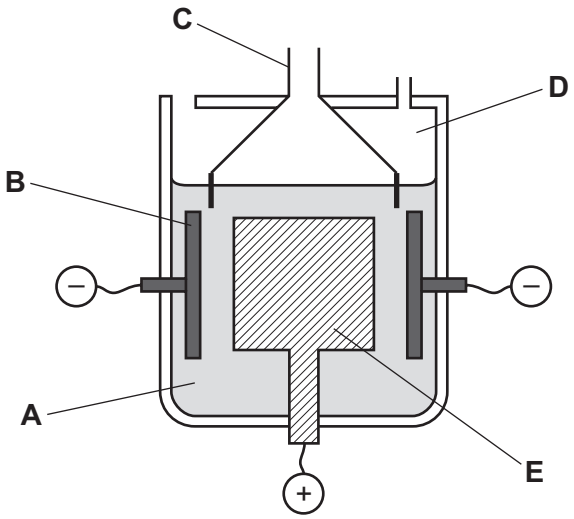
.....

.....

.....

..... [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.

A $S + O_2 \rightarrow SO_2$

B $SO_2 + O_3 \rightarrow SO_3 + O_2$

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

..... [2]

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

SO_2 is oxidised to SO_3	☐
SO_2 is reduced to SO_3	☐
O_3 is reduced to O_2	☐
O_3 is oxidised to O_2	☐

[2]

(iii) Complete the equation to show how an aqueous solution of sulfuric acid, H_2SO_4, is formed from SO_3.

$$SO_3 + \text{.....} \rightarrow H_2SO_4$$

[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]

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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 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	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 = 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.).