



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
NUMBER

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**CHEMISTRY**

**0620/21**

Paper 2

**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 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.

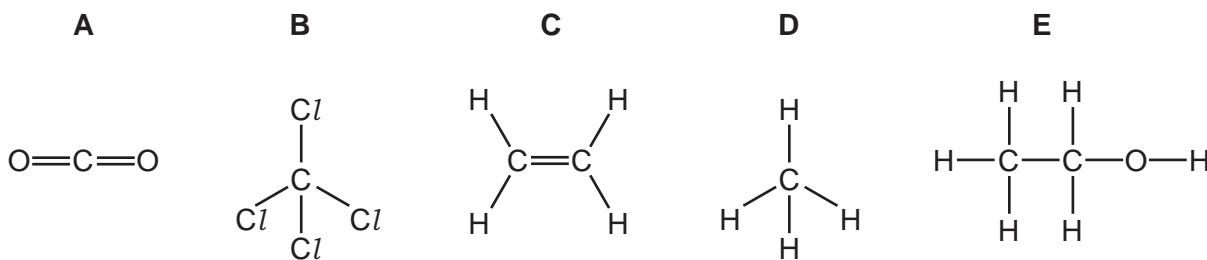
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
<b>Total</b>	

This document consists of **13** printed pages and **3** blank pages.



1 The diagram shows the structures of five compounds, **A**, **B**, **C**, **D** and **E**, containing carbon.



- (a) Answer these questions using the letters **A**, **B**, **C**, **D** or **E**.  
Each compound can be used once, more than once or not at all.

Which one of these compounds

- (i) is an unsaturated hydrocarbon, ..... [1]
- (ii) is a product of the complete combustion of a hydrocarbon, ..... [1]
- (iii) belongs to the alcohol homologous series, ..... [1]
- (iv) is an alkane, ..... [1]
- (v) is a product of respiration, ..... [1]
- (vi) is a product of fermentation? ..... [1]
- (b) Write the molecular formula of compound **C**. ..... [1]
- (c) Compound **B** is inert to most chemical reagents.  
It is made by reacting chlorine with carbon disulfide in the presence of an aluminium chloride catalyst.  
What do you understand by the following terms?

*compound* .....

..... [1]

*inert* .....

*catalyst* .....

[Total: 10]

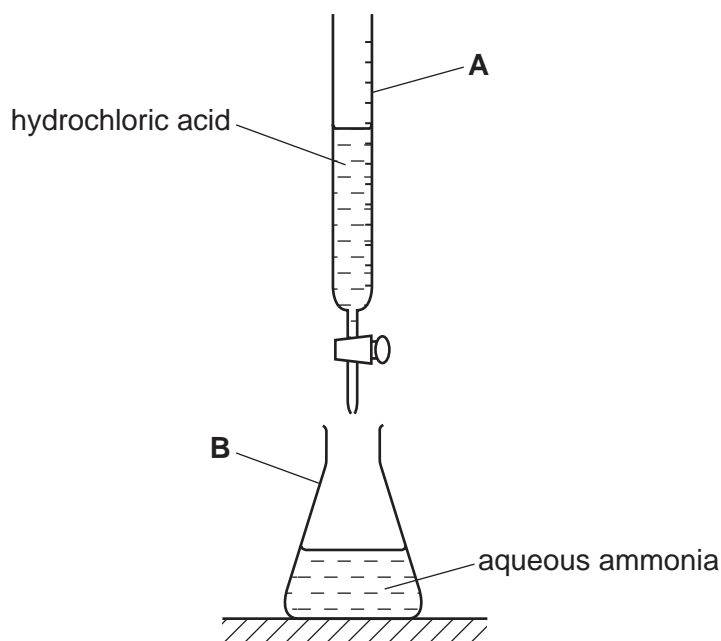
2 Hydrogen chloride,  $\text{HCl}$ , is an acidic gas.

- (a) Draw a dot and cross diagram of a molecule of hydrogen chloride.  
Show only the outer electrons.

[2]

- (b) Hydrogen chloride dissolves in water to form a solution of hydrochloric acid.

A student titrated aqueous ammonia with hydrochloric acid using the apparatus shown below.



- (i) State the name of the pieces of apparatus labelled **A** and **B**.

**A** is a ..... [1]

**B** is a ..... [1]

- (ii) Describe how the pH value of the solution in **B** changes as hydrochloric acid is added until the acid is in excess.

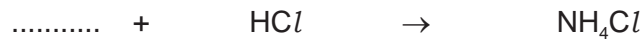
.....

.....

..... [3]

(iii) Complete the word and symbol equations for this reaction.

ammonia + hydrochloric acid → .....



[2]

(c) Aqueous ammonia is used to test for copper(II) ions.

Describe what happens when you add aqueous ammonia to a solution of copper(II) sulfate until the aqueous ammonia is in excess.

.....

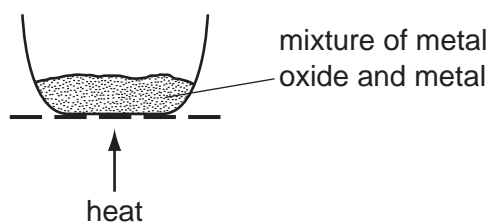
.....

.....

..... [4]

[Total: 13]

- 3 The reactivity of different metal oxides was compared by heating them with metals in a crucible.



The results are shown in the table below.

mixture	observations
iron oxide + zinc	reacts
lead oxide + iron	reacts
magnesium oxide + zinc	no reaction

- (a) (i) Use the results in the table to suggest the order of reactivity of the metals iron, lead, magnesium and zinc.

most reactive  $\xrightarrow{\hspace{15em}}$  least reactive

[2]

- (ii) Predict whether iron will react with zinc oxide.  
Explain your answer.

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

- (b) Which two of the following statements about metals are correct?  
Tick **two** boxes.

Metals conduct electricity and heat.

All Group IV elements show metallic properties.

Magnesium is extracted by heating its oxide with carbon.

All metals have high densities.

Iron is a transition element.

[2]

(c) Sand and salt (sodium chloride) are both solids.

(i) Describe the arrangement and movement of the particles in a solid.

arrangement .....

movement ..... [2]

(ii) Describe how you could separate the sand from a mixture of sand and salt. Give full details of how this is carried out.

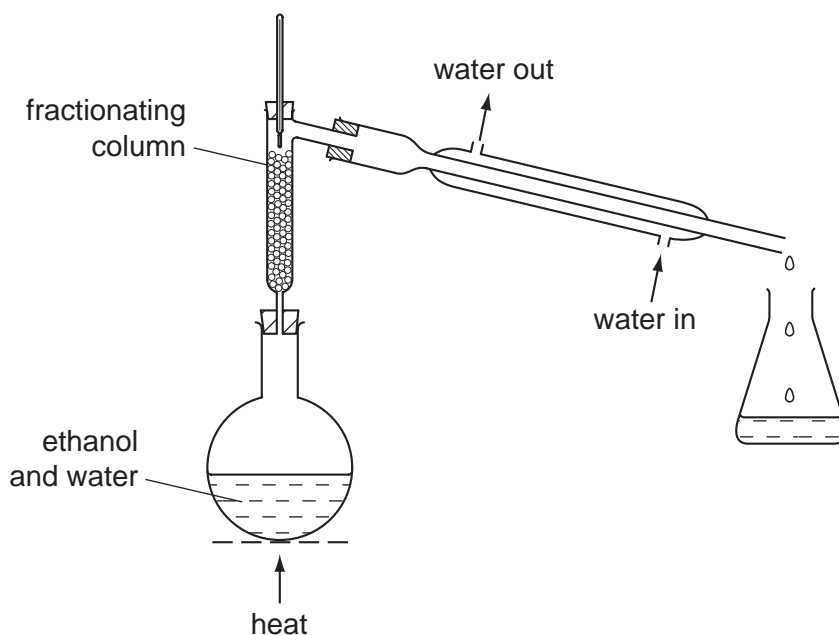
.....

.....

.....

..... [3]

(d) The diagram below shows the apparatus used to separate ethanol and water from a mixture of ethanol and water.



Complete the following sentences about this separation using words from the list below.

**condenser    crystallisation    distillation    flask    heavy**  
**higher    lower    solid    volatile    vapour**

Fractional ..... is used to separate a mixture of water and ethanol. The temperature at the top of the fractionating column is ..... than the temperature at the bottom. The more ..... liquid evaporates and moves further up the column. It eventually reaches the ..... where the ..... changes to a liquid. [5]

[Total: 15]

4 Lithium has two naturally-occurring isotopes,  ${}^6_3\text{Li}$  and  ${}^7_3\text{Li}$ .

(a) What do you understand by the term *isotope*?

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

(b) Draw a **labelled** diagram to show the atomic structure of an atom of  ${}^7_3\text{Li}$ .

Show the particles in the nucleus as well as the electrons.

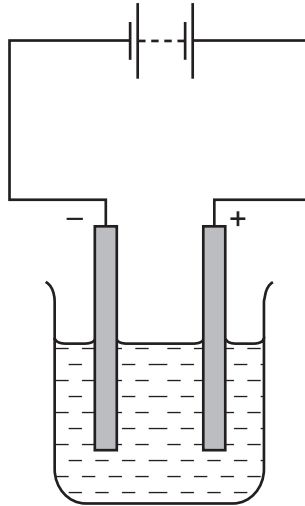
[5]

(c) Lithium reacts with oxygen to form lithium oxide,  $\text{Li}_2\text{O}$ .  
Complete the equation for this reaction.



[3]

(d) Aqueous lithium chloride is electrolysed using the apparatus shown below.



(i) On the diagram above, label:

- the electrolyte
- the anode.

[2]

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

..... [1]

(iii) Explain why aqueous lithium chloride is able to conduct electricity.

..... [1]

[Total: 13]

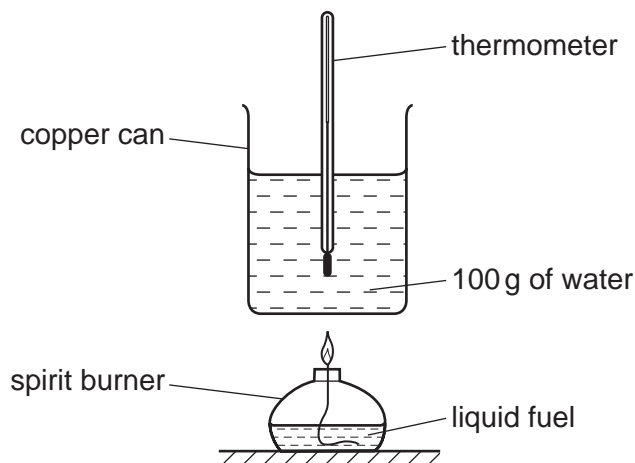


- 5 (a) Match the fuel on the left with the information on the right.  
The first one has been done for you.

uranium-236	a fuel with a relative molecular mass of 2
hydrogen	the main constituent of natural gas
methane	a nuclear 'fuel'
fuel oil	fuel for aircraft
kerosene	fuel for ships

[4]

- (b) Two students investigated some fuels to find which gave off the most energy. They tested four liquid fuels using the apparatus shown below.



- (i) In each experiment, the amount of fuel burnt was the same.  
Suggest **one** other factor that should be kept the same in each experiment.

..... [1]

- (ii) The students used the thermometer to stir the water.  
Suggest why it is important to keep the water stirred.

..... [1]

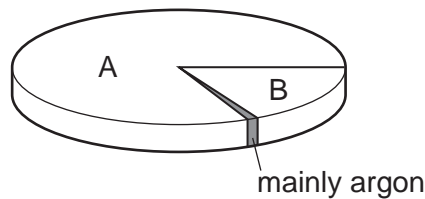
(iii) The results are shown in the table below.

fuel	initial temperature of the water / °C	final temperature of the water / °C
ethanol	24	40
propanol	24	42
paraffin	22	33
petroleum spirit	20	40

Which fuel transfers the most energy to the water?  
Explain your answer.

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

(c) Air is needed for fuels to burn.  
The pie chart below shows the composition of the air.



State the name of

gas A, .....

gas B. .... [2]

(d) Argon is a noble gas.

(i) State **one** use for argon.

..... [1]

(ii) To which period in the Periodic Table does argon belong?

..... [1]

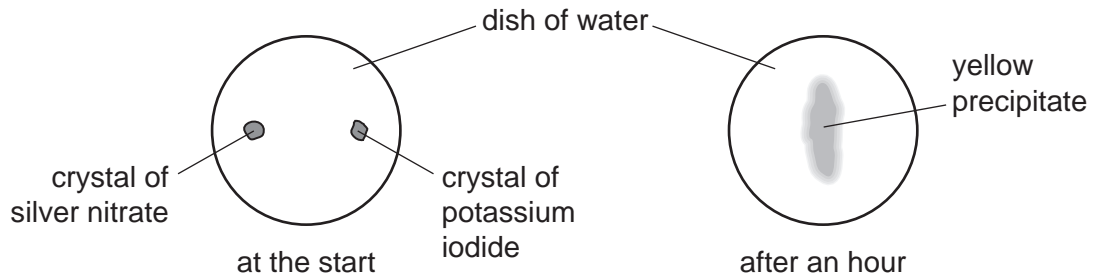
(iii) Describe the chemical properties of argon.

..... [1]

[Total: 13]

- 6 A student placed a crystal of silver nitrate and a crystal of potassium iodide in a dish of water. After an hour she observed that

- the crystals had disappeared,
- a yellow precipitate had appeared near the middle of the dish.



- (a) Use your knowledge of the kinetic particle theory and reactions between ions to explain these observations.

.....

.....

.....

.....

..... [4]

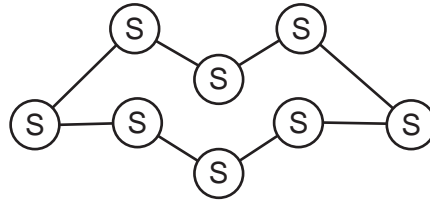
- (b) Potassium iodide reacts with aqueous chlorine. Complete the equation for this reaction.



[2]

[Total: 6]

7 The diagram shows one molecule of sulfur.



(a) How many atoms are there in **three** molecules of sulfur?

..... [1]

(b) Calculate the relative molecular mass of sulfur.

[1]

(c) Explain how acid rain is formed when fossil fuels containing sulfur are burnt.  
In your answer, include

- the name of a fossil fuel which contains sulfur,
- the gas formed when sulfur burns,
- the reactions which lead to the formation of acid rain.

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

(d) Potassium sulfate can be used as a fertiliser.  
The potassium in this fertiliser is an important element for plant growth.  
Name **two** other **elements**, important for plant growth, which are present in most fertilisers.

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

(e) Describe a test for sulfate ions.

test .....

result ..... [2]

[Total: 10]







**DATA SHEET**  
**The Periodic Table of the Elements**

Group		I	II	III	IV	V	VI	VII	0																																					
		1 <b>H</b> Hydrogen 1							4 <b>He</b> Helium 2																																					
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4				11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>Si</b> Silicon 14	15 <b>P</b> Phosphorus 15	16 <b>S</b> Sulfur 16	17 <b>Cl</b> Chlorine 17	18 <b>Ar</b> Argon 18	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10																																
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12				27 <b>Fe</b> Iron 26	28 <b>Mn</b> Manganese 25	29 <b>Co</b> Cobalt 27	30 <b>Ni</b> Nickel 28	31 <b>Cu</b> Copper 29	32 <b>Zn</b> Zinc 30	33 <b>Ga</b> Gallium 31	34 <b>Ge</b> Germanium 32	35 <b>As</b> Arsenic 33	36 <b>Se</b> Selenium 34	37 <b>Br</b> Bromine 35	38 <b>Kr</b> Krypton 36																														
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20				44 <b>Ru</b> Ruthenium 44	45 <b>Rh</b> Rhodium 45	46 <b>Pd</b> Palladium 46	47 <b>Ag</b> Silver 47	48 <b>Cd</b> Cadmium 48	49 <b>In</b> Indium 49	50 <b>Sn</b> Tin 50	51 <b>Sb</b> Antimony 51	52 <b>Te</b> Tellurium 52	53 <b>I</b> Iodine 53	54 <b>Xe</b> Xenon 54	55 <b>Cs</b> Caesium 55	56 <b>Ba</b> Barium 56	57 <b>La</b> Lanthanum 57	58-71 <b>Lanthanoid series</b>	59-103 <b>Actinoid series</b>	60 <b>Th</b> Thorium 90	61 <b>Pa</b> Protactinium 91	62 <b>U</b> Uranium 92	63 <b>Np</b> Neptunium 93	64 <b>Pu</b> Plutonium 94	65 <b>Am</b> Americium 95	66 <b>Cm</b> Curium 96	67 <b>Bk</b> Berkelium 97	68 <b>Cf</b> Californium 98	69 <b>Es</b> Einsteinium 99	70 <b>Fm</b> Fermium 100	71 <b>Md</b> Mendelevium 101	72 <b>No</b> Nobelium 102	73 <b>Lr</b> Lawrencium 103												
87 <b>Fr</b> Francium 87	88 <b>Ra</b> Radium 88	89 <b>Ac</b> Actinium 89	90 <b>Th</b> Thorium 90	91 <b>Pa</b> Protactinium 91	92 <b>U</b> Uranium 92	93 <b>Np</b> Neptunium 93	94 <b>Pu</b> Plutonium 94	95 <b>Am</b> Americium 95	96 <b>Cm</b> Curium 96	97 <b>Bk</b> Berkelium 97	98 <b>Cf</b> Californium 98	99 <b>Es</b> Einsteinium 99	100 <b>Fm</b> Fermium 100	101 <b>Md</b> Mendelevium 101	102 <b>No</b> Nobelium 102	103 <b>Lr</b> Lawrencium 103	104 <b>Rn</b> Radon 86	105 <b>At</b> Astatine 85	106 <b>Po</b> Polonium 84	107 <b>Bi</b> Bismuth 83	108 <b>Pb</b> Lead 82	109 <b>Tl</b> Thallium 81	110 <b>Hg</b> Mercury 80	111 <b>Ir</b> Iridium 77	112 <b>Rh</b> Rhodium 45	113 <b>Pt</b> Platinum 78	114 <b>Au</b> Gold 79	115 <b>Pd</b> Palladium 46	116 <b>Ag</b> Silver 47	117 <b>Cd</b> Cadmium 48	118 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	120 <b>Sb</b> Antimony 51	121 <b>Te</b> Tellurium 52	122 <b>I</b> Iodine 53	123 <b>Xe</b> Xenon 54	124 <b>Br</b> Bromine 35	125 <b>Se</b> Selenium 34	126 <b>As</b> Arsenic 33	127 <b>S</b> Sulfur 16	128 <b>P</b> Phosphorus 15	129 <b>N</b> Nitrogen 7	130 <b>O</b> Oxygen 8	131 <b>F</b> Fluorine 9	132 <b>Ne</b> Neon 10	133 <b>He</b> Helium 2

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).

a	X
b	X

Key

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

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