



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



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.

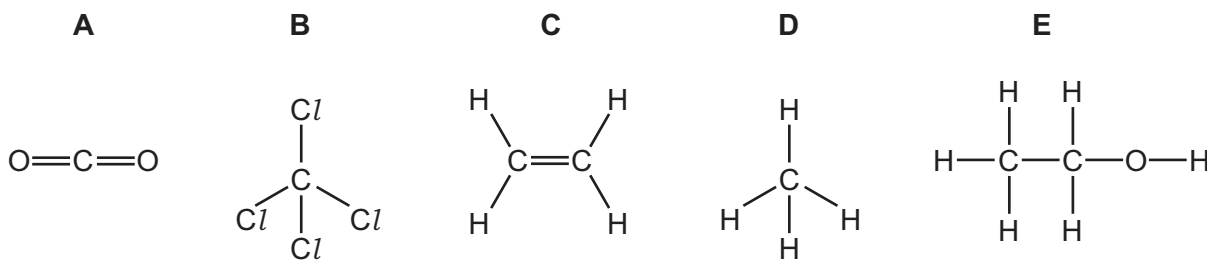
The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

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

..... [1]

[Total: 10]

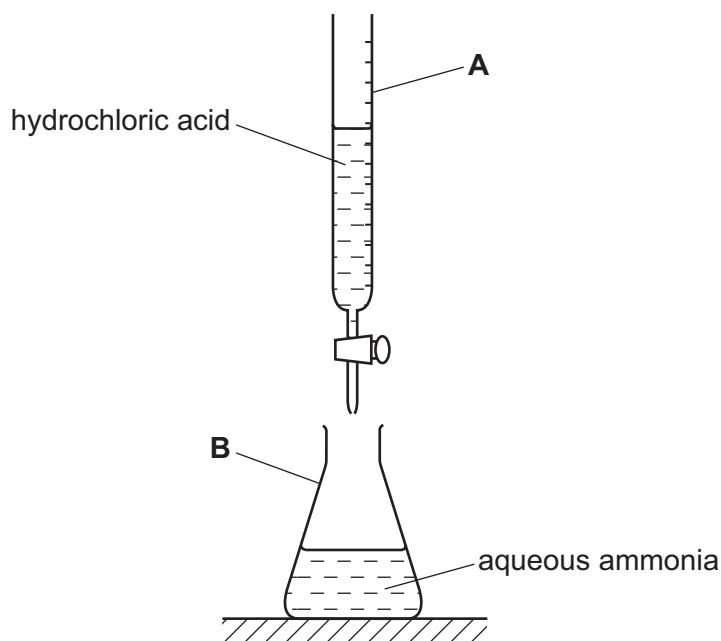
2 Hydrogen chloride, HCl , is an acidic gas.

- (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 →

..... + HCl → NH₄Cl

[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.

.....

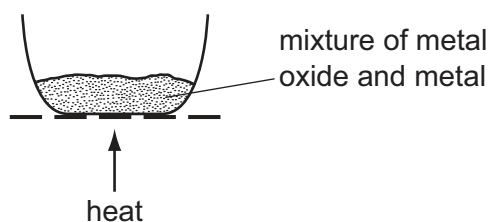
.....

.....

..... [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.

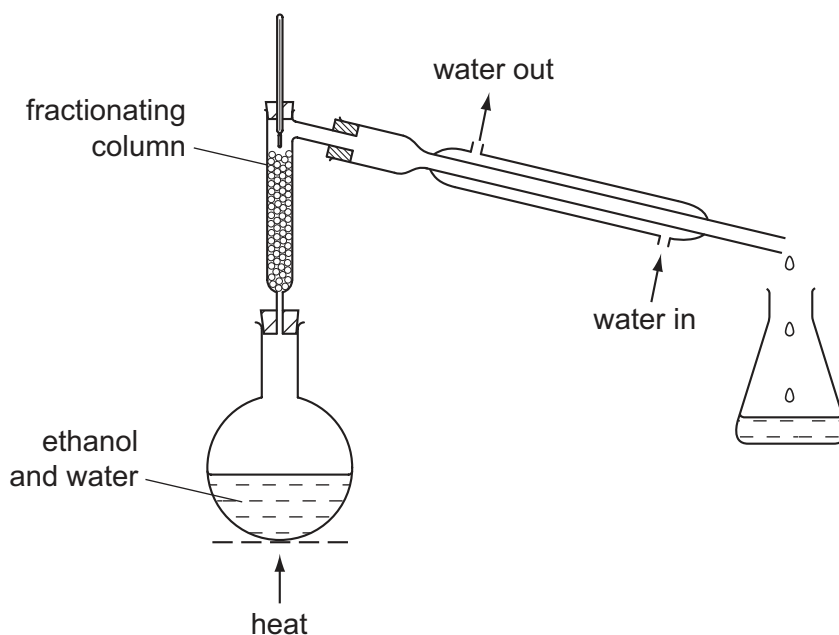
.....

.....

.....

..... [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.

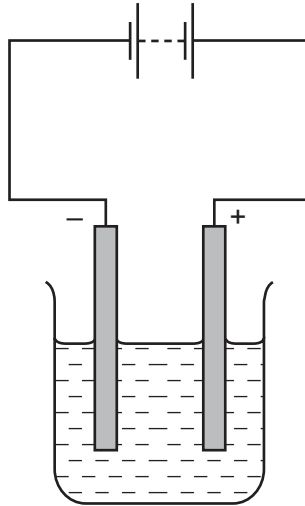
[5]

(c) Lithium reacts with oxygen to form lithium oxide, Li_2O .
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]

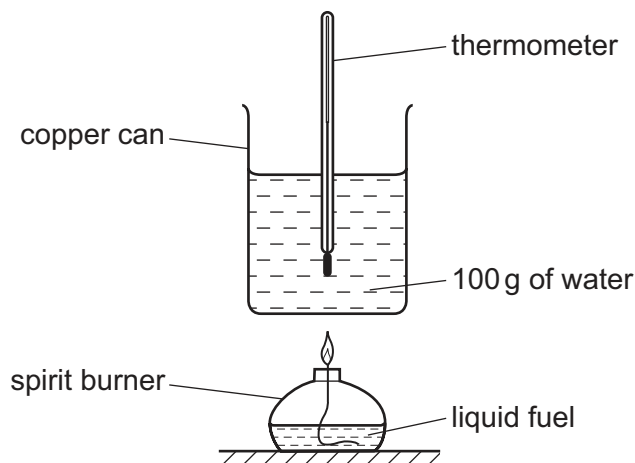
[Total: 13]

- 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]

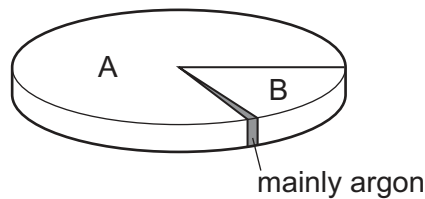
(iii) The results are shown in the table below.

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]

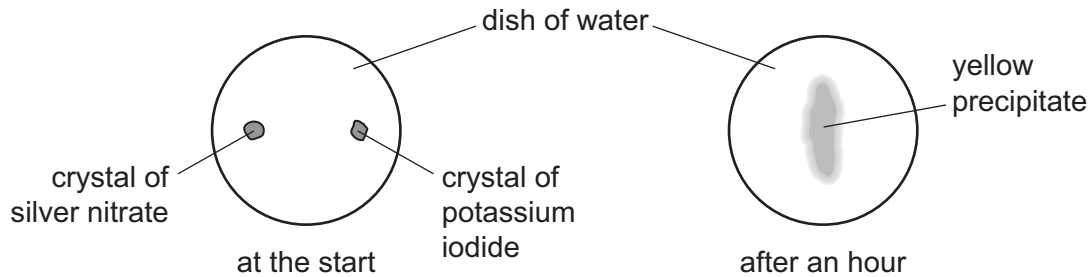
(iii) Describe the chemical properties of argon.

..... [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]

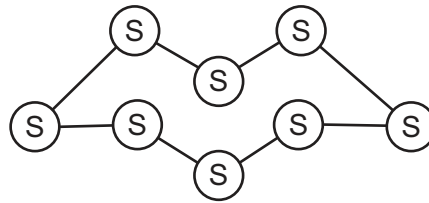
(b) Potassium iodide reacts with aqueous chlorine. Complete the equation for this reaction.



[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																																																																																								
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
												140 Ce Cerium 58	141 Pr Praseodymium 59	142 Nd Neodymium 60	143 Pm Promethium 61	144 Sm Samarium 62	145 Eu Europium 63	146 Gd Gadolinium 64	147 Tb Terbium 65	148 Dy Dysprosium 66	149 Ho Holmium 67	150 Er Erbium 68	151 Tm Thulium 69	152 Yb Ytterbium 70	153 Lu Lutetium 71	154 Yt Ytterbium 70	155 La Lanthanum 57	156 Ce Cerium 58	157 Pr Praseodymium 59	158 Nd Neodymium 60	159 Pm Promethium 61	160 Sm Samarium 62	161 Eu Europium 63	162 Gd Gadolinium 64	163 Tb Terbium 65	164 Dy Dysprosium 66	165 Ho Holmium 67	166 Er Erbium 68	167 Tm Thulium 69	168 Yb Ytterbium 70	169 Lu Lutetium 71	170 Yt Ytterbium 70	171 La Lanthanum 57	172 Ce Cerium 58	173 Pr Praseodymium 59	174 Nd Neodymium 60	175 Pm Promethium 61	176 Sm Samarium 62	177 Eu Europium 63	178 Gd Gadolinium 64	179 Tb Terbium 65	180 Dy Dysprosium 66	181 Ho Holmium 67	182 Er Erbium 68	183 Tm Thulium 69	184 Yb Ytterbium 70	185 Lu Lutetium 71																																						

*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.).

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.