

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS International General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	
CHEMISTRY			0620/21
Paper 2		Octo	ober/November 2012
			1 hour 15 minutes
Candidates ans	wer on the Question Paper.		

READ THESE INSTRUCTIONS FIRST

No Additional Materials are required.

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.



For Examiner's Use

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

Α	В	С	D	E
o=c=o		C = C	H 	H H H—C—C—O—H H H

(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)	Wri	te the molecular formula of compound C .	[1]
(c)	It is	mpound B is inert to most chemical reagents. s made by reacting chlorine with carbon disulfide in the presence of an aluminitaride catalyst. at do you understand by the following terms?	um
	con	npound	
			[1]
	iner	<i>t</i>	[1]
	cata	alyst	[1]

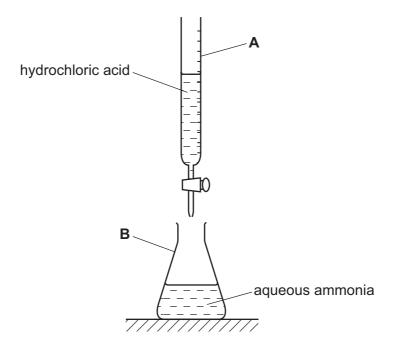
[Total: 10]

- **2** Hydrogen chloride, HC*l*, 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]

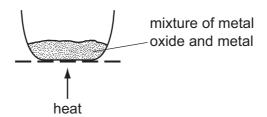
(ii) Describe how the pH value of the solution in **B** changes as hydrochloric acid is added until the acid is in excess.

 	 	 131

	(iii)	Con	nplet	e the	WO	rd and	d syn	nbol e	quati	ons f	or th	nis rea	action			
			am	moni	a +	hydi	rochlo	oric a	cid -	·				 		
					+		НС	Cl	_	>		NH₄	Cl			[2]
(c)	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.							er(II)								
														 	 	[4]
															[Total	l: 13]

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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

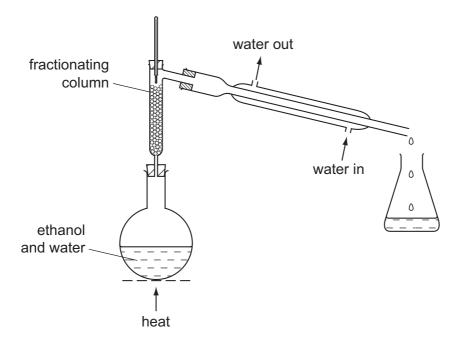
(a) (i) Use the results in the table to suggest the order of reactivity of the metals iron, lead, magnesium and zinc.

most reactive —	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]

1) Sand an	d calt (c	odium	chlorida)	aro	hoth	colide
ı	C) Sanu an	u saii (s	oululli	Cilionae)	are	DOLLI	Sullus.

(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	tlask	heavy			
higher	lower	solid	volatile	vapour			
Fractional	is used	d 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 eventua	ally reaches the	V	where the	changes			
to a liquid.				[5]			

[Total: 15]

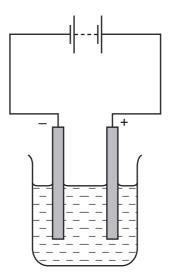
4

[3]

Lith	ium has two naturally-occurring isotopes, 6_3 Li and 7_3 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.	
		1
		[5]
(c)	Lithium reacts with oxygen to form lithium oxide, Li ₂ O. Complete the equation for this reaction.	
	Li +Li₂O	

For Examiner's Use

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



(i) On the diagram above, label:

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

• the electrolyte

• the anode. [2]

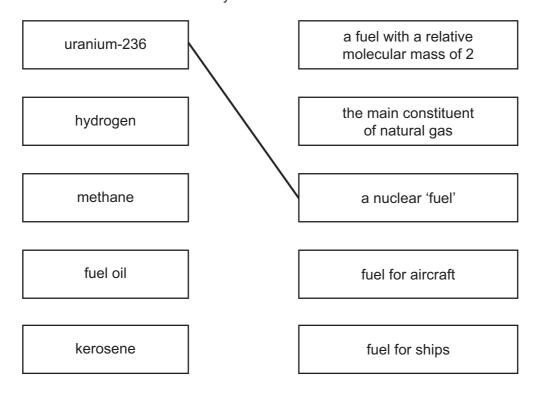
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-[1]

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

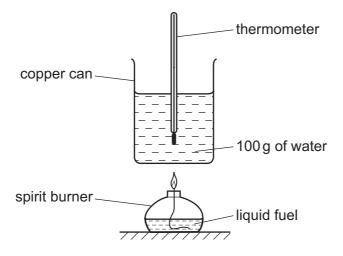
[Total: 13]

[4]

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



(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.

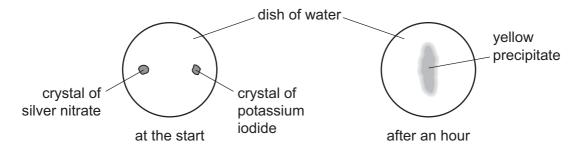
.....[1]

(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)		is needed for fuels to burn. e pie chart below shows the composition of the air.	
		A B mainly argon	
	Stat	te the name of	
	gas	A,	
	gas	В	[2]
(d)	Arg	on 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]

- 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 these observations.								
	[4								

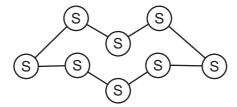
(b) Potassium iodide reacts with aqueous chlorine. Complete the equation for this reaction.

2KI +
$$\rightarrow$$
KC l + I_2

[2]

[Total: 6]

7 The diagram shows one molecule of sulfur.



(a)	How many atoms are there in three molecules of sulfur?
(b)	Calculate the relative molecular mass of sulfur.
	[1]
(c)	[1] 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]

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DATA SHEET
The Periodic Table of the Elements

	0	[₽] H	Helium 2	20	Ne	10	40	Ā	18	84	궃	Krypton 36	131	Xe	Xenon 54			Radon 86						n Lutetium 71		בֿ	
	=			19	ш	Fluorine 9		CI	17	80	Ā	Bromine 35	127	H	lodine 53		¥	Astatine 85						Ytterbium 70	_	Š	
	>			16	0	Oxygen 8	32	တ	Sulfur 16	62	Se	Selenium 34	128	Te	Tellurium 52		Ъ	Polonium 84				169	F	Thulium 69		Md	
	>			14	z	Nitrogen 7	31	۵	Phosphorus 15	75	As	Arsenic 33	122	Sb	Antimony 51	209	ā	Bismuth 83						Erbium 68		Fm	
	2			12		_	28	Si	Silicon 14	73	Ge	Ε		Sn	Tin 50			Lead 82					우	Holmium 67		Es	
	≡			11	Ω	Boron 5	27	Ν	Aluminium 13	02	Ga	31	115	I n	Indium 49	204	11	. 18				162	Dy	Dysprosium 66		ర	
										65	Zn	Zinc 30	112		Cadmium 48	201	Hg	Mercury 80					₽	Terbium 65		æ	
										64	C	Copper 29	108	Ag	Silver 47	197	Αn	Gold 79				157		Gadolinium 64		Cm	
Group										59	Z	Nickel 28	106	Pd	Palladium 46			_				152	Eu	Europium 63		Am	
S										59	ပိ	Cobalt 27	103	格	Rhodium 45		ĭ	Iridium 77				150		Samarium 62		Pu	
		- I	Hydrogen 1							99	Fe	Iron 26	101	Ru	Ruthenium 44	190	Os	Osmium 76					Pm	Promethium 61		Q N	
												Manganese 25		ဥ	n Technetium 43	186	Re	Rhenium 75				144	N	Neodymium 60	238	_	
										52	ပ်	Chromium 24	96	W	Molybdenum 42	184	≥					141	P	Praseodymium 59		Ра	
										51	>	Vanadium 23	93	qN	Niobium 41	181	Та	Tantalum 73				140	င္မ	Cerium 58	232	Т	
										48	F	Titanium 22	91	Zr	Zirconium 40	178	Ŧ	Hafnium 72							nic mass	lod	
										45	သွင	Scandium 21	88	>	Yttrium 39	139	La	Lanthanum 57 *	227	Ac	Actinium 89 †	corios	Pripo	2	a = relative atomic mass	X = atomic symbol	
	=			6	Be	Beryllium 4	24	M	Magnesium 12	40	Ca	Calcium 20	88	ഗ്	Strontium 38	137	Ва	Barium 56	226	Ra	Radium 88	*58_71 anthanoid series	90-7 1 Eantinailoid seine 190-103 Actinoid series		а	×	
	_			7	=	Lithium 3	23	Na	Sodium 11	39	¥	Potassium 19	85	Rb	Rubidium 37	133	Cs	Caesium 55		ቷ	Francium 87	58-711	90-1037			Key	,

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

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