



## **Cambridge International Examinations**

Cambridge International General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	
CHEMISTRY			0620/22
Paper 2		Oct	ober/November 2014
			1 hour 15 minutes
Candidates ans	swer on the Question Paper.		
No Additional M	Naterials 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 use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer all questions.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 20.

You may lose marks if you do not show your working or if you do not use appropriate units.

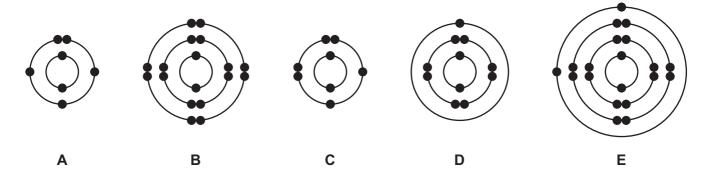
At the end of the examination, fasten all your work securely together.

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

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.



1 (a) The electronic structure of five atoms, A, B, C, D and E, are shown below.



Answer the following questions about these structures. Each structure can be used once, more than once or not at all.

## Which structure:

	(i)	represents an atom of an element in Group V of the Periodic Table,							
	(ii)	has a complete outer shell of electrons,							
	(iii)	represents a	an oxygen	atom,				[1]	
(	(iv)	has a protor	number o	of 20,				[1]	
	(v)	is an atom of an element in Period 4 of the Periodic Table,							
	(vi)	has a single	valency e	lectron?				[1]	
(b)	(b) Complete the following sentences about isotopes using words from the list below.  atoms ions molecules neutrons nuclei protons								
	Isot	opes are		of the same	element with t	he same nu	mber of		
	but	different num	nbers of					[3]	

[Total: 9]

2 The table below shows some nutritional information on a bottle of apple juice.

contents	mass present in g / 100 cm <sup>3</sup>
protein	0.10
sugars	10.40
unsaturated fat	0.10
saturated fat	0.06
chloride ions, Cl-	0.04
magnesium ions, Mg <sup>2+</sup>	0.01
nitrate ions, NO <sub>3</sub> <sup>-</sup>	0.01
potassium ions, K <sup>+</sup>	0.02
sodium ions, Na <sup>+</sup>	0.05
<b>X</b> , SO <sub>4</sub> <sup>2-</sup>	0.01

(a)	Ans	swer these questions using information from the table.	
	(i)	Which negatively charged ion is present in the highest concentration?	
			[1]
	(ii)	State the name of the ion, $\mathbf{X}$ , whose formula is $SO_4^{2-}$ .	
			[1]
(	(iii)	The formulae for some chlorides are shown below.	
		aluminium chloride, $AlCl_3$ calcium chloride, $CaCl_2$ lead(IV) chloride, $PbCl_4$ potassium chloride, $KCl$ Deduce the formula for magnesium chloride.	
			[1]
(	(iv)	Calculate the mass of sugars in 250 cm³ of this apple juice.	

.....g [1]

(b)	The fats in the apple juice are both saturated and unsaturated.
	Describe a test to distinguish between saturated and unsaturated compounds

test	
result with saturated compound	
result with unsaturated compound	
•	[3]

- (c) Apple juice is slightly acidic.
  - (i) Which **one** of the following pH values is slightly acidic? Put a ring around the correct answer.

(ii) One of the acids found in apple juice is malic acid. The structure of malic acid is shown below.

On the structure of malic acid above, put a ring around a carboxylic acid functional group. [1]

[Total: 9]

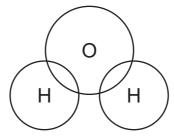
**3** Hydrogen chloride gas can be prepared by the action of concentrated sulfuric acid on sodium chloride.

$$H_2SO_4 + 2NaCl \rightarrow Na_2SO_4 + 2HCl$$

(a) Write the word equation for this reaction.

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- (b) Hydrogen chloride dissolves in water to form hydrochloric acid.
  - (i) Complete the dot-and-cross diagram to show the arrangement of the outer shell electrons in water.

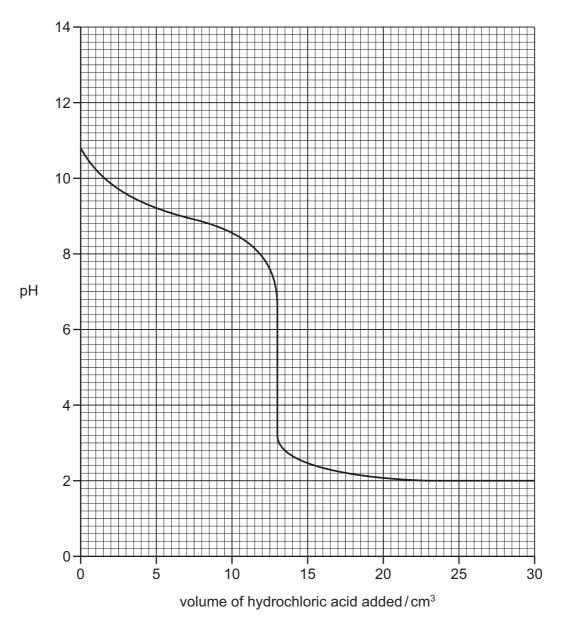


[2]

(ii) Describe what you would observe when a few drops of silver nitrate solution are added to hydrochloric acid.

r/	`
I'z	71
	-1

(c) The graph below shows how pH changes when aqueous ammonia is neutralised by hydrochloric acid.



(i)	What is the pH of the aqueous ammonia at the start of the experiment?	
		[1]
(ii)	What volume of hydrochloric acid has been added when the pH is 10?	

(iii) What volume of hydrochloric acid has been added when the pH is changing most quickly?

(d)	Concentrated	hydrochloric	acid	reduces	manganese(IV)	oxide,	MnO <sub>2</sub> ,	to	manganese(II)
	chloride.								

$$\mathrm{4HC}\mathit{l} + \mathrm{MnO_2} \rightarrow \mathrm{MnC}\mathit{l}_2 + \mathrm{C}\mathit{l}_2 + \mathrm{2H_2O}$$

How does this equation show that manganese(IV) oxide gets reduced?

(e) The table shows some properties of four metals, A, B, C and D, and their oxides.

metal	density in g/cm³	boiling point /°C	colour of oxide	charge on the metal ion
Α	2.99	2831	white	3+
В	0.53	1342	white	1+
С	7.86	2750	black or red-brown	2+ or 3+
D	7.14	907	white	2+

Which <b>one</b> of these metals is a transition metal? Use the information in the table to explain your answer.	
	[2]

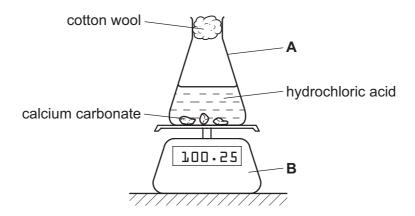
[Total: 11]

<b>4</b> Calcium carbonate reacts with dilute hydrochloric	acia	ocnioric a	s wit	reacts	carbonate	Calcium	4
--	------	------------	-------	--------	-----------	---------	---

(a) Complete the symbol equation for this reaction.

$$\mathsf{CaCO_3} \ + \ .....\mathsf{HC}{\it l} \ \rightarrow \ \mathsf{CaC}{\it l}_{\it 2} \ + \ \mathsf{CO_2} \ + \ ......$$

(b) The rate of this reaction can be followed using the apparatus shown below.

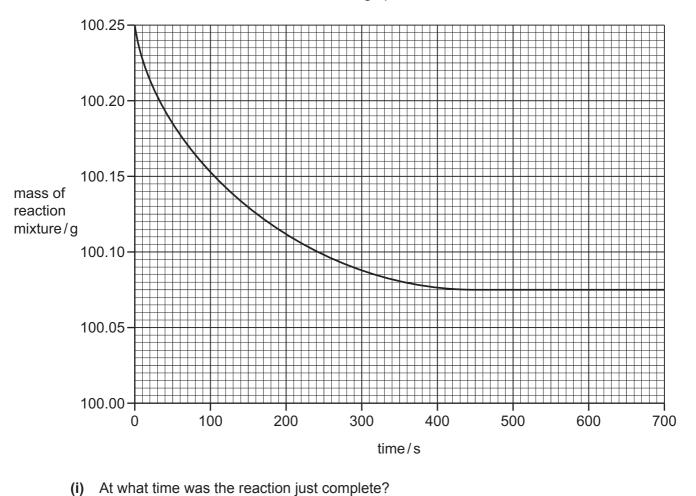


(i)	State the names	of the	pieces	of a	pparatus	labelled	A	and	В.
-----	-----------------	--------	--------	------	----------	----------	---	-----	----

Α					
В					
					[2
Evolain	why the mass of the	roaction mixt	uro docroacos	with time	

......[1]

**(c)** The graph below shows how the mass of the reaction mixture changes with time. The calcium carbonate was in excess and large pieces of calcium carbonate were used.



	[1]
Calculate the total loss in mass of the reaction mixture in this experiment	

		[1]
(iii)	How does the rate of reaction change when:	

smaller pieces of calcium carbonate are used,

(ii)

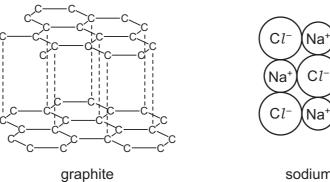
the temperature is decreased,

the concentration of hydrochloric acid is decreased?

[3]

(d)	When heated, calcium carbonate breaks down to form calcium oxide and carbon dioxide.					
		Which <b>two</b> words from the list below describe this reaction? ick <b>two</b> boxes.				
			combustion decomposition endothermic			
			exothermic oxidation		[2]	
(e)	Cal	cium oxide is used in flue	-gas desulfurisati	on.		
	(i)	Explain how flue-gas de	sulfurisation work	S.		
					[2]	
	(ii)	Give <b>one</b> other use of ca	alcium oxide.			
				[	[1]	
				[Total: 1	5]	

The structures of graphite and sodium chloride are shown below. 5



sodium chloride

Cl-

Na⁺

(a)	Des	scribe the similarity and differences in these structures.
		[4
(b)		phite is a form of carbon. bon is an element.
	(i)	What is meant by the term <i>element</i> ?
		[1
	(ii)	Write a symbol equation for the complete combustion of carbon.

[2]

## (c) The table shows some properties of four substances, A, B, C and D.

substance	melting point /°C	boiling point /°C	electrical conductivity	
Α	<b>–</b> 7	+59	does not conduct	
В	<b>B</b> –157 –152		does not conduct	
С	<b>C</b> +769		conducts when molten but not when solid	
D	+1410	+2355	does not conduct	

Which one of these substances, A, B, C or D,

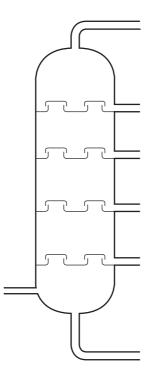
(i)	is a liquid at room temperature,	[1]
(ii)	is a giant ionic structure,	[1]
(iii)	is a noble gas,	[1]
(iv)	is a giant covalent structure?	[1]
	[Total:	11]

6 The table below shows some properties of the first five members of the alkane homologous series.

alkane	molecular formula	boiling point /°C	density of the liquid alkane in g/cm³
methane	CH <sub>4</sub>	-164	0.47
ethane	C <sub>2</sub> H <sub>6</sub>	-88	
propane	C <sub>3</sub> H <sub>8</sub>	-42	0.59
butane	C <sub>4</sub> H <sub>10</sub>	0	0.60
pentane		+36	0.63

(a)	(i)	What do you understand by the term <i>homologous series</i> ?	
			[2]
	(ii)	Deduce the molecular formula for pentane.	
			[1]
	(iii)	Describe how the boiling points of these alkanes change as the number of carbon ato increases.	ms
			[1]
	(iv)	Deduce the density of liquid ethane.	
			[1]
(b)		thane is a fuel which is a gas at room temperature. te the name of a fuel which is:	
	a s	olid at room temperature,	
	a lid	quid at room temperature.	
			[2]

(c) The diagram below shows a distillation column used to separate petroleum into different fractions.



- (i) On the diagram above:
  - put a letter **X** to show where the temperature in the column is lowest,
  - put a letter **F** to show where the fraction containing the largest molecules is collected,
  - put a letter **M** to show where petroleum enters the distillation column.

[3]

(ii) The refinery gas fraction contains ethane.

Hydrogen is one of the products formed when ethane is cracked.

Complete the symbol equation for the cracking of ethane.

$C_2H_6$	$\rightarrow$	 +	
			[2]

(iii) State the conditions needed for cracking.

	121
·····	

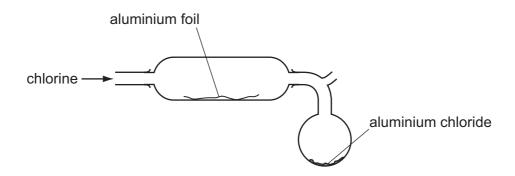
[Total: 14]

(a)	The melting point of gallium is 30 °C.
	Use the kinetic particle theory to explain what happens when a spoon made of gallium is put
	into a cup of tea at 40 °C.

In your answer, refer to:

	<ul> <li>the change of state which occurs,</li> <li>the change in the arrangement of the particles,</li> <li>the change in the motion of the particles.</li> </ul>	
(b)	Gallium burns in air at a high temperature to form gallium(III) oxide. Complete the symbol equation for this reaction.	
	Ga + $3O_2 \rightarrow \dots Ga_2O_3$	[2]
(c)	Explain why aluminium is often used in containers for food and drinks.	

(d) Aluminium chloride can be made by heating aluminium foil in a stream of chlorine.



- (i) On the diagram above, draw an arrow to show where heat should be applied. [1]
- (ii) At temperatures between 178 °C and 400 °C, aluminium chloride has the structure shown below.

$$Cl$$
  $Cl$   $Cl$   $Cl$ 

Deduce the molecular formula of this structure.

.....[1]

(iii) Some properties of aluminium and silver are shown in the table below.

	cost	density in g/cm³	electrical conductivity	melting point /°C					
aluminium	high	2.7	good	660					
silver	very high	10.5	very good	962					

Use the information in the table to suggest why aluminium rather than silver is used in overhead power cables.

[Total: 11]

DATA SHEET
The Periodic Table of the Elements

	0	4 <b>T</b>	Helium 2	20	Ne	Neon 10	40	Ā	Argon 18	84	첫	Krypton 36	131	Xe	Xenon 54		R	Radon 86				175	Ľ	Lutetium 71		בֿ	Lawrendur 103	
	II/			19	ш	Fluorine 9	35.5	CI	Chlorine 17	80			1	н	lodine 53		Αt	Astatine 85						Ytterbium 70		No	Nobelium 102	
				16	0	Oxygen 8	32	တ	Sulfur 16	79		_			E		Ро	Polonium 84				169	Ε	Thulium 69		Md	Mendelevium 101	
	>			14	Z	Nitrogen 7			Phosphorus 15						_		Ξ	Bismuth 83					ш			Fm	Fermium 100	
	<u>&gt;</u>			12	ပ				Silicon 14		Ge	Ε		Sn		207	Pb	Lead 82				165	우	Holmium 67		Es	Einsteinium 99	
	Ш			11	Ω	Boron 5	27	Ν	Aluminium 13	70	Ga	Gallium 31	115	In	Indium 49	204	11	Thallium 81				162	Dy	Dysprosium 66		ర్	Californium 98	
										65	Zn	Zinc 30	112	ဦ	Cadmium 48	201	Hg	Mercury 80				159	Q P	Terbium 65		Ř	Berkelium 97	
										64	C	Copper 29	108	Ag	Silver 47	197	Αn	Gold 79				157		Gadolinium 64			Curium 96	
Group									59	Z	Nickel 28	106	Pd	Palladium 46	195	풉	Platinum 78				152	En	Europium 63		Am	Americium 95		
Ω				1						29	ပိ	Cobalt 27	103	格	Rhodium 45	192	ĭ	lridium 77				150	Sm	Samarium 62			Plutonium 94	
		- <b>I</b>	Hydrogen 1							26	Ъ	Iron 26		Ru	Ruthenium 44		SO	Osmium 76						Promethium 61		ď	Neptunium 93	
											M	2 10		ည	n Technetium 43	186	Re	Rhenium 75					PN	Neodymium 60	238	_	Uranium 92	
										52	ပ်	Chromium 2	96	Mo	Molybdenum 42	184	>	Tungsten 74				141	P	Praseodymium 59		Ра	Protactinium 91	
											51	>	Vanadium 23	93	qN	Niobium 41	181	Та	Tantalum 73				140	S	Cerium 58	232	T	Thorium 90
										48	F	Titanium 22	91	Z	Zirconium 40	178	Ξ	* Hafnium				1			nic mass	loqi	nic) number	
										45	လွ	Scandium 21	88	>	Yttrium 39	139	Гa	Lanthanum 57 *	227	Ac	Actinium 89	00100	d selice	20100	a = relative atomic mass	X = atomic symbol	b = proton (atomic) number	
	=			6	Be	Beryllium 4	24	Mg	Magnesium 12	40	Ca	Calcium 20	88	Š	Strontium 38	137	Ba	Barium 56	226	Ra	Radium 88	*58 71 Lonthonoid corios	30-7 1 Lantinariold series	י שניווסע	a	× ×		
	_			7	=	Ulthium 3	23	Na	Sodium 11	39	×	Potassium 19	85	Rb	Rubidium 37	133	S	Caesium 55		Ť.	Francium 87	*58 71 I	100-103			Key	Q	

The volume of one mole of any gas is 24  $\mathrm{dm}^3$  at room temperature and pressure (r.t.p.).

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