

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS International General Certificate of Secondary Education

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	
CHEMISTRY			0620/31
Paper 3 (Extend	ded)	Octo	ber/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 on all the work you hand in.

Write in dark blue or black pen.

You may 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 12.

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 Exam	iner's Use
1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of 12 printed pages.



1 A list of techniques used to separate mixtures is given below.

filtration
diffusion
fractional distillation
simple distillation
crystallisation

chromatography

From this list, choose the most suitable technique to separate the following mixtures. A technique may be used once, more than once or not at all.

(a)	butane from a mixture of propane and butane	[1]
(b)	oxygen from liquid air	[1]
(c)	water from aqueous magnesium sulfate	[1]
(d)	potassium chloride from aqueous potassium chloride	[1]
(e)	silver chloride from a mixture of silver chloride and water	[1]
(f)	glucose from a mixture of glucose and maltose	[1]
	[Total	: 6]

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2 Three of the halogens in Group VII are listed below.

chlorine bromine iodine

(a)	(i)	How does their colour change down the Group?	
	(ii)	How do their melting points and boiling points change down the Group?	_
((iii)	Predict the colour and physical state (solid, liquid or gas) of astatine, At.	
		physical state[2	2]
(b)	A ra	adioactive isotope of iodine, $^{131}_{53}$ I, is used to treat cancer.	
	(i)	Define the term isotope.	
	(ii)	How many protons, electrons and neutrons are there in one atom of $^{131}_{53}$ I?	··· <u>'</u>]
		number of protons	
		number of electrons	<u>?]</u>
((iii)	When this isotope, $^{131}_{53}\mathrm{I}$, emits radiation, a different element with a proton number of 54 is formed. What is the name of this element?	of
		[1]
(c)	two	orine, the most reactive halogen, forms compounds with the other halogens. It forms compounds with bromine. duce their formulae from the following information.	S
		npound 1 emass of one mole of this compound is 137 g.	
		formula is[1]
	0.02	npound 2 2 moles of this compound contain 0.02 moles of bromine atoms and 0.1 moles or rine atoms.	of
	Its f	formula is[1]
		[Total: 11	1

- 3 The speed (rate) of a chemical reaction depends on a number of factors which include temperature and the presence of a catalyst.
 - (a) Reaction speed increases as the temperature increases.

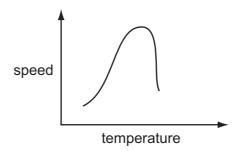
(i) Explain why reaction speed increases with temperature

('')	Explain with reaction opera increased with temperature.

•••••	 	

(ii) Reactions involving enzymes do not follow the above pattern.

The following graph shows how the speed of such a reaction varies with temperature.



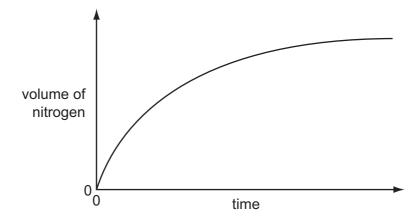
Suggest an explanation why initially the reaction speed increases then above a certain temperature the speed decreases.

 [2]

(b) An organic compound decomposes to give off nitrogen.

$$\mathrm{C_6H_5N_2C}\mathit{l}(\mathrm{aq}) \ \to \ \mathrm{C_6H_5C}\mathit{l}(\mathrm{I}) \ + \ \mathrm{N_2(g)}$$

The speed of this reaction can be determined by measuring the volume of nitrogen formed at regular intervals. Typical results are shown in the graph below.



(i) The reaction is catalysed by copper.

Sketch the graph for the catalysed reaction on the diagram above.

[2]

(ii)	How does the speed of this reaction vary with time? [1]
(iii)	Why does the speed of reaction vary with time?
	[2]
(c) Cat	alytic converters reduce the pollution from motor vehicles.
	des of nitrogen bon monoxide less harmful gases to atmosphere
	catalysts: rhodium, platinum, palladium
(i)	Describe how carbon monoxide and the oxides of nitrogen are formed in car engines.
	[4]
(ii)	Describe the reaction(s) inside the catalytic converter which change these pollutants into less harmful gases. Include at least one equation in your description.
	[3]
	[Total: 17]

4	Silicon(IV) oxide, SiO ₂ , and zirconium(IV) oxide, ZrO ₂ , are both macromolecules.
	They have similar physical properties but $silicon(IV)$ oxide is acidic and $zirconium(IV)$ oxide
	is amphoteric.

(a)	Def	Define the term <i>macromolecule</i> .					
(b)		Predict three physical properties of these two oxides.					
	(ii)	Name an element which has the same physical properties as these two oxides.					
(c)	(i)	Name a reagent that reacts with the oxides of both elements.					
	(ii)	Name a reagent that reacts with only one of the oxides. reagent					
		oxide which reacts[Tota	[2]				

5	Carbonyl chloride,	$COCl_2$,	is	widely	used	in	industry	to	make	polymers,	dyes	and
	pharmaceuticals.											

(a) Carbonyl chloride was first made in 1812 by exposing a mixture of carbon monoxide and chlorine to bright sunlight. This is a photochemical reaction.

$$CO(g) + Cl_2(g) \rightarrow COCl_2(g)$$

		$CO(g) + Cl_2(g) \rightarrow COCl_2(g)$
	(i)	Explain the phrase photochemical reaction.
		[2]
	(ii)	Give another example of a photochemical reaction and explain why it is important either to the environment or in industry.
		[3]
(b)	Car	bonyl chloride is now made by the reversible reaction given below.
		$CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$
		e forward reaction is exothermic. e reaction is catalysed by carbon within a temperature range of 50 to 150 °C.
	(i)	Predict the effect on the yield of carbonyl chloride of increasing the pressure. Explain your answer.
		[2]
	(ii)	If the temperature is allowed to increase to above 200 $^{\circ}\text{C},$ very little carbonyl chloride is formed. Explain why.
		[2]
	(iii)	Explain why a catalyst is used.
		[1]

(c) The structural formula of carbonyl chloride is given below.

For Examiner's Use

Draw a diagram showing the arrangement of the outer (valency) electrons in one molecule of this covalent compound.

Use o to represent an electron from a carbon atom.

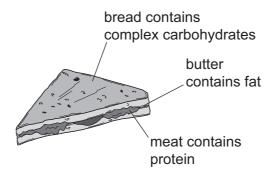
Use x to represent an electron from a chlorine atom.

Use ● to represent an electron from an oxygen atom.

[3]

[Total: 13]

6 A sandwich contains three of the main constituents of food.



(a) (i) These constituents of food can be hydrolysed by boiling with acid or alkali. Complete the table.

constituent of food	product of hydrolysis
protein	
fat	
complex carbohydrate	

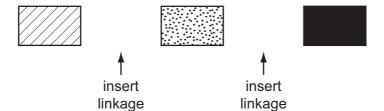
	I <
- 1	
- 1	

(ii) What type of synthetic polymer contains the same linkage as

fats,		
-------	--	--

proteins?

(b) An incomplete structural formula of a protein is given below. Complete this diagram by inserting the linkages.



[2]

(c) Butter contains mainly saturated fats. Fats based on vegetable oils, such as olive oil, contain mainly unsaturated fats.

A small amount of fat was dissolved in an organic solvent. Describe how you could determine if the fat was saturated or unsaturated.

.....[3]

[Total: 10]

7 Both strontium and sulfur have chlorides of the type XCl_2 . The table below compares some of their properties.

	strontium chloride	sulfur chloride		
appearance	white crystals	red liquid		
formula	$\mathrm{SrC}l_2$	SCl ₂		
melting point/°C	874	-120		
boiling point/°C	1250	59		
conductivity of liquid	good	poor		
solubility in water	dissolves to form a neutral solution	reacts to form a solution of pH1		

) (1)	25 °C.
	[2]
(ii)	Strontium is a metal and sulfur is a non-metal. Explain why both have chlorides of the type XCl_2 .
	The electron distribution of a strontium atom is 2 + 8 + 18 + 8 + 2.
	[2]
(iii)	Deduce the name of the acidic compound formed when sulfur chloride reacts with water.
	[1]
(iv)	Explain the difference in the electrical conductivity of liquid strontium chloride and liquid sulfur chloride.
	[3]

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(b)	Strontium	chloride-6-water	can	be	made	from	the	insoluble	compound,	strontium
	carbonate,	by the following i	eacti	ons						

$$SrCO_3(s) \ + \ 2HC\mathit{l}(aq) \ \rightarrow \ SrC\mathit{l}_2(aq) \ + \ CO_2(g) \ + \ H_2O(I)$$

$$SrCl_2(aq) + 6H_2O(I) \rightarrow SrCl_2.6H_2O(s)$$

The following method was used to prepare the crystals.

- 1 Add excess strontium carbonate to hot hydrochloric acid.
- 2 Filter the resulting mixture.
- 3 Partially evaporate the filtrate and allow to cool.
- 4 Filter off the crystals of SrCl₂.6H₂O.
- 5 Dry the crystals between filter papers.

	(i)	How would you know when excess strontium carbonate had been added in step	1?
			[1]
	(ii)	Why is it necessary to filter the mixture in step 2?	
			[1]
((iii)	In step 3, why partially evaporate the filtrate rather than evaporate to dryness?	
			[1]
(c)	use	he above experiment, $50.0\mathrm{cm^3}$ of hydrochloric acid of concentration $2.0\mathrm{mol/dm^3}$ w d. $6.4\mathrm{g}$ of $\mathrm{SrC}l_2.6\mathrm{H_2O}$ was made. culate the percentage yield.	as
	nun	nber of moles of HCl used =	
	nun	ober of moles of $SrCl_2.6H_2O$ which could be formed =	
	mas	ss of one mole of $SrCl_2.6H_2O$ is 267 g	
	thed	pretical yield of SrCl ₂ .6H ₂ O =g	
	per	centage yield =%	[4]

[Total: 15]

DATA SHEET
The Periodic Table of the Elements

	0	Helium	20 Ne Neon	40 Ar Argon	8 Ā	Krypton 36	131 Xe	Xenon 54	Rn	Radon 86		Lutetium 7.1	Lr Lawrendur 103
	II/		19 Fluorine	35.5 C1 Chlorine	® ऴ			lodine 53	At	Astatine 85		173 Yb Ytterbium 70	Nobelium
			16 O Oxygen 8	32 S Sulfur 16	Se Se	Selenium 34	128 Te	Tellurium 52	Ро	Polonium 84		169 Tm Thulium	Md Mendelevium 101
	>		14 N itrogen 7	31 P Phosphorus 15	75 As	Arsenic 33	122 Sb	Antimony 51	209 Bi	Bismuth 83		167 Er Erbium 68	Fm Fermium 100
	>		12 Carbon	28 Si iicon 14		Ε	Sn Sn	Tin 50	207 Pb			165 Ho Holmium 67	Esinsteinium 99
	=		11 Boron 5	27 A1 Aluminium 13	⁷⁰ Ga	Gallium 31	115 In	Indium 49	204 T î	Thallium 81		162 Dy Dysprosium 66	Californium
					65 Zn	Zinc 30	112 Cd	Cadmium 48	201 Hg	Mercury 80		159 Tb Terbium 65	BK Berkelium
					64 Cu	Copper 29	108 Ag	Silver 47	197 Au	Gold 79		157 Gd Gadolinium 64	Cm Curium 96
Group					65 Z	Nickel 28	106 Pd	Palladium 46	195 Pt	Platinum 78		152 Eu Europium 63	Am Americium 95
Gre					င်း	Cobalt 27	103 Rh	Rhodium 45	192 I r	Iridium 77		Sm Samarium 62	Pu Plutonium 94
		1 Hydrogen			.56 Fe	Iron 26	101 Ru	Ruthenium 44	0 S	Osmium 76		Pm Promethium 61	Neptunium
					SS Mn	Manganese 25	ဥ	n Technetium 43	186 Re			Neodymium 60	238 U Uranium 92
					ن و25	Chromium 24	96 W	Molybdenum 42	184 W	Tungsten 74		Pr Praseodymium 59	Pa Protactinium 91
					51	Vanadium 23	es Np	Niobium 41	181 Ta	Tantalum 73		140 Ce Cerium	232 Th Thorium
					48 E	Titanium 22	91 Z	Zirconium 40	178 Hf	Hafnium 72			nic mass bol nic) number
					Sc Sc	Scandium 21	® >	Yttrium 39	139 La	Lanthanum 57 *	227 Ac Actinium	series eries	a = relative atomic massX = atomic symbolb = proton (atomic) number
	=		Berylium	Magnesium	0 9	Calcium 20	∞ స	Strontium 38	137 Ba	Barium 56	226 Ra Radium 88	*58-71 Lanthanoid series	e × a
	_		7 L.i Lithium	23 Na Sodium	® ×	Potassium 19	85 5	Rubidium 37	133 Cs	Caesium 55	Fr Francium 87	*58-71 L:	Key

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

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