

CANDIDATE

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS International General Certificate of Secondary Education

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NAME		
CENTRE NUMBER	CANDIDATE NUMBER	

CHEMISTRY 0620/31

Paper 3 (Extended)

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 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.



For miner's e

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]

[Total: 11]

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

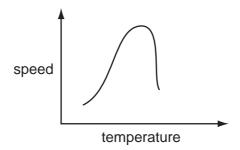
		the state of the s	
		3	1
Thr	ee o	f the halogens in Group VII are listed below.	Co
		f the halogens in Group VII are listed below. chlorine bromine iodine	1
(a)	(i)	How does their colour change down the Group?	
	(ii)	How do their melting points and boiling points change down the Group?	[1]
	(iii)	Predict the colour and physical state (solid, liquid or gas) of astatine, At.	[1]
		physical state	[2]
(b)	A ra	idioactive isotope of iodine, ¹³¹ ₅₃ I, is used to treat cancer.	
	(i)	Define the term isotope.	
			[2]
	(ii)	How many protons, electrons and neutrons are there in one atom of $^{131}_{53}$ I?	
		number of protons	
			[2]
	(iii)	When this isotope, $^{131}_{53}I$, emits radiation, a different element with a proton number 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 for compounds with bromine. duce their formulae from the following information.	ms
		npound 1 mass of one mole of this compound is 137 g.	
	Its f	ormula is	[1]
	0.02	npound 2 2 moles of this compound contain 0.02 moles of bromine atoms and 0.1 moles rine atoms.	of
	Its f	ormula is	[1]

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

(i)	Explain why reaction speed increases with temperature.
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4	
ed (rate) of a chemical reaction depends on a number of factors which ure and the presence of a catalyst.	For miner's e
ction speed increases as the temperature increases.	Wridge C
Explain why reaction speed increases with temperature.	COM
[3]	į k

(ii) Reactions involving enzymes do not follow the above pattern. The following graph shows how the speed of such a reaction varies with temperature.



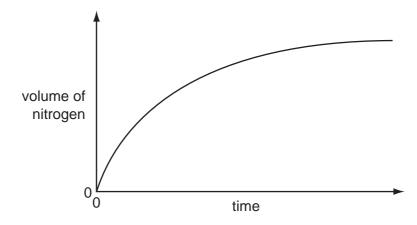
Suggest an explanation why initially the reaction speed increases then above a certain temperature the speed decreases.

 	[2]

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

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

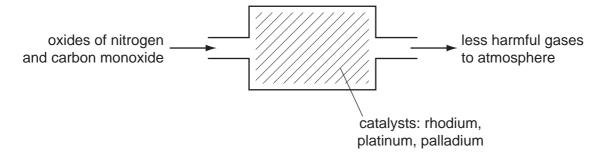
The speed of this reaction can be determined by measuring the volume of nitrogen formed at regular intervals. Typical results are shown in the graph below.



(i) The reaction is catalysed by copper. Sketch the graph for the catalysed reaction on the diagram above.

(ii)	How does the speed of this reaction vary with time?	>
(iii)	Why does the speed of reaction vary with time?	
	[2]	

(c) Catalytic converters reduce the pollution from motor vehicles.



[2
 i) Describe the reaction(s) inside the catalytic converter which change these pollutant into less harmful gases. Include at least one equation in your description.
[3

(i) Describe how carbon monoxide and the oxides of nitrogen are formed in car engines.

[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(I	(VI
	is amphoteric.	

The	ey ha	6 IV) oxide, SiO_2 , and $\mathrm{zirconium}(\mathrm{IV})$ oxide, ZrO_2 , are both macromolecules. ave similar physical properties but $\mathrm{silicon}(\mathrm{IV})$ oxide is acidic and $\mathrm{zirconium}(\mathrm{IV})$ otheric. fine the term $\mathit{macromolecule}$.
		interic. fine the term <i>macromolecule</i> .
(b)	(i)	Predict three physical properties of these two oxides.
		[3]
	(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.
	(;:\	Name a reagent that reagts with only one of the syides
	(ii)	Name a reagent that reacts with only one of the oxides. reagent
		oxide which reacts[2]
		[Total: 8]

- Carbonyl chloride, $COCl_2$, is widely used in industry to make polymers, dy 5 pharmaceuticals.
- www.PapaCambridge.com (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.

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

	(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.
(b)	Car	bonyl chloride is now made by the reversible reaction given below.
		$CO(g) + Cl_2(g) \iff COCl_2(g)$
		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 $^{\circ}$ C, very little carbonyl chloride is formed. Explain why.
		[2]
	(iii)	Explain why a catalyst is used.
		[1]

www.PapaCambridge.com 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.

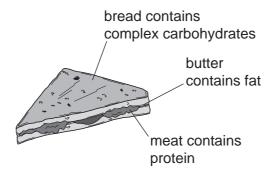
Use x to represent an electron from a chlorine atom.

Use • to represent an electron from an oxygen atom.

[3]

[Total: 13]

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.

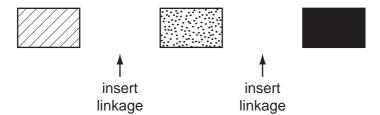
constituent of food	product of hydrolysis
protein	
fat	
complex carbohydrate	

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1 3	
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(ii) What type of synthetic polymer contains the same linkage as

fats,																																																									,										•																																,	,	,								,			,			,		,		,		,					,		,		,	•		•	,				,		,						
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(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.
l.

[Total: 10]

www.PapaCa Both strontium and sulfur have chlorides of the type ${
m XC}\,l_2$. The table below compared 7 of their properties.

The same	e	13
1	A	
	10	
	.0.	

strontium chloride	sulfur chloride
white crystals	red liquid
$\mathrm{SrC}l_2$	SCl_2
874	-120
1250	59
good	poor
dissolves to form a neutral solution	reacts to form a solution of pH1
	white crystals

(a) (i)	Use the data in the table to explain why sulfur chloride is a liquid at room temperature, $25^{\circ}\text{C}.$
	[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 $2 + 8 + 18 + 8 + 2$.
	The electron distribution of a strontium atom is 2 + 6 + 16 + 6 + 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]

[Total: 15]

www.PapaCambridge.com (b) Strontium chloride-6-water can be made from the insoluble compound, st. carbonate, by the following reactions.

$$SrCO_3(s) + 2HCl(aq) \rightarrow SrCl_2(aq) + CO_2(g) + H_2O(l)$$

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

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.
- Filter off the crystals of $SrCl_2.6H_2O$. 4
- 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	ne above experiment, $50.0\mathrm{cm^3}$ of hydrochloric acid of concentration $2.0\mathrm{mol/dm^3}$ wad. $6.4\mathrm{g}$ of $\mathrm{SrC}l_2.6\mathrm{H_2O}$ was made. culate the percentage yield.	as
	num	nber of moles of HCl used =	
	nun	nber of moles of SrC1 ₂ .6H ₂ O which could be formed =	
	mas	ss of one mole of SrC1 ₂ .6H ₂ O is 267 g	
	thed	pretical yield of $SrCl_2.6H_2O = \dots$ g	
	per	centage yield =%	[4]

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

	0	4 He Helium	20 Neon 10	40 Ar Argon	84 K Krypton 36	Xe Xenon 554	Rn Radon 86		175 Lu Lutetium
	II/		19 Fluorine	35.5 C1 Chlorine	80 Br Bromine	127 	At Astatine 85		173 Yb Ytterbium
	IN		16 Oxygen 8	32 S Suffur 16	79 Se Selenium 34	128 Te Tellurium 52	Po Polonium 84		169 Tm Thullum
	Λ		14 N Nitrogen 7	31 Phosphorus 15	75 AS Arsenic 33	Sb Antimony 51	209 Bi Bismuth		167 Er Erbium
	ΛΙ		12 Carbon 6	28 Si Silicon	73 Ge Germanium	Sn Tnn 50	207 Pb Lead 82		165 Ho Holmium
	Ш		11 Boron 5	27 A1 Aluminium 13	70 Ga Gallium 31	115 n Indium 49	204 T t Thallium 81		162 Dy Dysprosium
					65 Zn Zinc 30	112 Cd Cadmium 48	201 Hg Mercury 80		159 Tb Terbium
					64 Copper 29	108 Ag Silver 47	197 Au Gold 79		Gd Gadolinium
Group					59 Nickel	106 Pd Palladium 46	195 Pt Platinum 78		152 Eu Europium
Gre					59 Co Cobalt	103 Rh Rhodium 45	192 F		Sm Samarium
		1 T Hydrogen			56 Fe Iron	Ruthenium 44	190 Os Osmium 76		Pm Promethium
					Manganese	Tc Technetium 43	186 Re Rhenium 75		144 Neodymium
					Chromium	96 Mo Molybdenum 42	184 W Tungsten 74		Praseodymium
					51 V Vanadium 23	93 Nb Niobium 41	181 Ta Tantalum 73		140 Ce
					48 T Titanium	2 r Zirconium 40	178 Hafnium * 72		1
					Scandium 21	89 Y	139 La Lanthanum 57 *	227 Ac Actinium 89	Series
	=		Be Beryllium	Mg Magnesium	40 Ca Calcium	Strontium	137 Ba Barium 56	226 Ra Radium 88	*58-71 Lanthanoid series 190-103 Actinoid series
	_		7 Lithium 3	23 Na Sodium	39 K Potassium 19	Rb Rubidium 37	133 Cs Caesium 55	Fr Francium 87	*58-71 Li

anoid series oid series	140 Ce	141 Pr seodymium		Pm	Samarium	152 Eu Europium	157 Gd Gadolinium	159 Tb Ferbium	162 Dy Dysprosium	165 5 Holmium	167 Er Erbium	169 Tm Thulium	Yb Ytterbium	175 Lu Lutetium	
	28	59	09	61	62	63	64	65	99	29	89	69	70	7.1	
a = relative atomic mass	232	ć	238		ć		(ā	č	i	Ĺ		ž		4
X = atomic symbol	_	J B	>	Q Z	J D	Am	<u>ج</u>	ğ	ל	ES	Ē	Ø	o Z	ב	2
b = proton (atomic) number	Thorium 90	Protactinium 91	Uranium 92	Neptunium 93	Plutonium 94	Americium 95	Curium 96	Berkelium 97	Californium 98	Einsteinium 99	Fermium 100	Mendelevium 101	Nobelium 102	Lawrendum 103	n.
	The v	The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).	one mole	of any ga	s is 24 dr	n³ at roor	n tempera	ature and	pressure	(r.t.p.).		13	Ste. Co.	Cambric	Sana Cambridge Com

Key

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