

ADVANCED SUBSIDIARY GCE CHEMISTRY

2811/01

Foundation Chemistry

THURSDAY 11 JANUARY 2007

Morning

Time: 1 hour

Additional materials: Scientific calculator

Data Sheet for Chemistry (Inserted)

Candidate Name				 			
Centre				Candidate		-	į

Number

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer all the questions.

Number

- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do not write in the bar code.
- Do not write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- A copy of the Data Sheet for Chemistry is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE					
Qu.	Max.	Mark			
1	13				
2	15				
3	9				
4	7				
5	16				
TOTAL	60				

This document consists of 10 printed pages, 2 blank pages and a Data Sheet for Chemistry.

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Data Sheet for Chemistry

GCE Advanced level and Advanced Subsidiary

Chemistry 3882, 7882

Chemistry units 2811 - 2816

These data are for the use of candidates following Chemistry 3882 or 7882.

Clean copies of this sheet must be issued to candidates in the examination room, and must be given up to the invigilator at the end of the examination.

Copies of this sheet may be used for teaching.

Characteristic infra-red absorptions in organic molecules

bond	location	wavenumber
C-0	alcohols, esters	1000 - 1300 cm ⁻¹
C=O	aldehydes, ketones, carboxylic acids, esters	1680 - 1750 cm ⁻¹
0-н	hydrogen bonded in carboxylic acids	2500 - 3300 cm ⁻¹ (broad)
N-H	primary amines	3100 - 3500 cm ⁻¹
0-н	hydrogen bonded in alcohols, phenols	3230 ~ 3550 cm ⁻¹
о-н	free	3580 – 3670 cm ⁻¹

Chemical shifts for some types of protons in n.m.r. spectra

- Chemical shifts are for hydrogen relative to TMS (tetramethylsilane)
- Chemical shifts are typical values and can vary slightly depending on the solvent, concentration and substituents.

type of proton	chemical shift, δ
R-CH₃	0.7–1.6
R-CH₂-R	1.2–1.4
R₃CH	1.6–2.0
0 —С- сн, —С- сн ₂ -R	2.0-2.9
-CH₂-R	2.3–2.7
-O-CH ₃ -O-CH ₂ -R	3.3-4.3
R-OH	3.5–5.5
О -он	6.5–7.0
<u></u> —н	7.1–7.7
0 R-C-H	9.5–10
—с— он	11.0–11.7

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	_		19.0 F. F. 19.0	35.5 Cl	chlorine 17	79.9	bromine 35	127	odine 53	١₹	astatine 85		
	9			32.1 S	sulphur 16	79.0	selenium 34	128 Te	selfurium 52	ı 8	polonium 84	ı Ş	unumexium 116
	5	•	14.0 N nitrogen	31.0 P	phosphorus 15	74.9	AS argenic 33	122 Sb	antimony 51	703 203	bismuth 83		
	4		12.0 C C Briton	28.1 Si	silicon 14	72.6	Germankum 32	119 Sn	50 th	207 Ph	lead 82	, Dig	ununquadium 114
	3		10.8 B boron	27.0 Al	aluminium 13	69.7	gallium 3.1	115 In	indium 49	204 ⊏	thailtum 81		
							# 7		cadmium 48	201 Ho	mercury 80	qnn	unumbium 112
						63.5	2 gg C	20 A	salver .	197	plog 79	nnn Oun	unumunium 111
 §						58.7	Z jei Z	2 <u>2</u>	palladium 46	2 4	platinum 78	- Gnn	110 unumailium u
Group						i .	3 # S	5 E	modium 15	192	iridikum 77	1 ₹	meltnentun 109
		1.0 H hydrogen	_			55.8	전 6 년	5 2	ruthenium	190	20 Samilum 76	١ ਝ	hessium 108
			_			54.9	Min	ع ۱	technetium 43	186 5	£	۱ ڇ	bohrium 107
			mass			52.0	chromium	95.9 Mo	molybdenum	184	tungsten 74	- gg	n seaborgium 106
		Key	relative atomic mass atomic symbol			50.9	Vanedium	92.9	_	184	1 ar tambalum 73	ල	dubnium 105
			relative ator atomic s			47.9	ittanium 23	91.2	zirconium 40	178	hafinium 72	ا ک ت	rutherfordium 104
						45.0	Scandium	88.9	yttrium 39	139	La Ismthenum 57	- A	actinium * 89
	2		9.0 Be beryfflum	1''	Mg magnesium 12	40.1	Salcium Salcium	87.6 Sr	E	137	Seriem 56	ا اي ا	radium 88
	-		6.9 Li lithum	23.0	sodium 11	39.1	K potassium	85.5 95.5	rubidium 37	133	caestum 55	ı iž	francium 87

175 Lu Iuteritum 7.1	LW tawnencium
173 Yb ytterblum 70	No nobelium 102
169 Tm thulium 69	Md mendelevium 101
167 Er erbium 68	Fm fermium 100
165 Ho holmium 67	Es ekretekrium 99
163 Dy dysproeium 66	Cf Californium 98
159 Tb Berblum 65	Bk berkellum 97
157 Gd gadolinium 64	Carriera Seuriera 96
152 Eu europkum 63	Am americium 95
150 Sm semartum 62	Pu phrtonium 94
Pm promethium 61	Np neptunkum 93
144 Nd neodymium 60	U urankum 92
141 Pr presendymium 59	Pa protectinium 91
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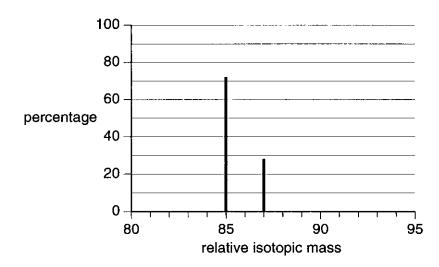
Answer all the questions.

1 Rubidium, atomic number 37, was discovered in 1861 by Bunsen and Kirchoff. Rubidium is in Group 1 of the Periodic Table and the element has two natural isotopes, ⁸⁵Rb and ⁸⁷Rb.

(a) Explain the term isotopes.

 •	 	***************************************	•••••

(b) A sample of rubidium was analysed in a mass spectrometer to produce the mass spectrum below.



(i) Use this mass spectrum to help you complete the table below.

inatana	norcontogo	number of					
isotope	percentage	protons	neutrons	electrons			
⁸⁵ Rb							
⁸⁷ Rb							

[3]

(ii) Calculate the relative atomic mass of this rubidium sample. Give your answer to three significant figures.

(c) Which isotope is used as the standard against which the masses of the two rubidium isotopes are measured?

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3

(d)	In a mass spectrometer, gaseous atoms are ionised.
	Explain why less energy is needed to ionise gaseous atoms of rubidium than gaseous atoms of sodium.
	[3]
(e)	Rubidium forms an ionic compound with silver and iodine. This compound has a potential use in miniaturised batteries because of its high electrical conductivity.
	The empirical formula of this ionic compound can be calculated from its percentage composition by mass: Rb, 7.42%; Ag, 37.48%; I, 55.10%.
	(i) Define the term empirical formula.
	[1]
	(ii) Calculate the empirical formula of the compound.
	[2]
	[Total: 13]

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			-
2			cium hydroxide, $Ca(OH)_2$, is commonly known as 'slaked lime'. Over one million tonnes lime are produced annually in the UK.
	(a)		water is an aqueous solution of calcium hydroxide, $Ca(OH)_2$. Lime water is commonly in the laboratory as a test for carbon dioxide.
		(i)	Suggest a value for the pH of lime water.
			[1]
		(ii)	Write an equation, including state symbols, for the precipitation reaction that takes place in the lime water test for carbon dioxide.
			[2]
		(iii)	When an excess of carbon dioxide is bubbled through lime water, a further reaction takes place.
			State what you would see as this further reaction takes place and also state the formula of the product of the reaction.
			observation
			formula of product[2]
	(b)	The	ions present in Ca(OH) ₂ are Ca ²⁺ and OH ⁻ .
		(i)	Complete the electronic configuration of a Ca ²⁺ ion.
			1s ² [1]
		(ii)	How many moles of ions are in one mole of Ca(OH) ₂ ?
			moles of ions =[1]
		(iii)	How many moles of electrons are in one mole of OH ⁻ ions?
			moles of electrons =[1]

5

(iv)	Draw a	'dot-and-cross'	diagram	of Ca(OH) ₂ .	Show outer	electron	shells only.
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(c)	Slaked lime (solid calcium hydroxide) can be prepared from calcium carbonate, ${\rm CaCO_3}$, in two stages.
	Outline how this could be done in the laboratory. Include an equation for each stage.
	[4]
(d)	The production of lime water is a small-scale use of calcium hydroxide.
	State a large-scale use of calcium hydroxide outside of the laboratory.
	[1]
	[Total: 15]

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[2]

4	
1	

3 Although compounds are usually classified as having ionic or covalent bonding, oft is somewhere in between these two extremes.			compounds are usually classified as having ionic or covalent bonding, often the bonding where in between these two extremes.			
	(a)	Stat	State what is meant by the terms			
		(i)	ionic bond,			
			[1]			
		(ii)	covalent bond.			
			[2]			
	(b)		npounds with covalent bonding often have polar bonds. Polarity can be explained in terms lectronegativity.			
		(i)	Explain the term <i>electronegativity</i> .			
			[2]			
		(ii)	Use a suitable example to show how the presence of a polar bond can be explained in terms of electronegativity.			
			You may find it useful to draw a diagram in your answer.			
			[2]			
	(c)	Soi Dra	me polar molecules are able to form hydrogen bonds. w a diagram to show an example of hydrogen bonding.			

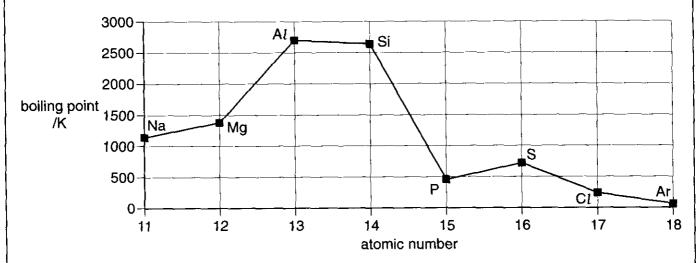
[2]

[Total: 9]



7

4 The diagram below shows the variation in the boiling points of elements across Period 3 of the Periodic Table.



- (a) In the table below for the elements Mg, Si and S,
 - complete the structure column using the word giant or simple.
 - complete the bonding column using the word metallic, ionic or covalent.

element	structure	bonding
Mg		
Si		
S		

[3]

(b)	Explain why silicon has a much higher boiling point than phosphorus.
(c)	Explain why the boiling point increases from sodium to aluminium.
(C)	Explain why the boning point increases non-social to ald mindin.
	[2]
	[Total: 7]



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5 Chlorine can be prepared by reacting concentrated hydrochloric acid with manganese(IV) oxide.

$$4HCl(aq) + MnO_2(s) \rightarrow Cl_2(g) + MnCl_2(aq) + 2H_2O(l)$$

- (a) A student reacted 50.0 cm³ of 12.0 mol dm⁻³ hydrochloric acid with an excess of manganese(IV) oxide.
 - (i) Calculate how many moles of HCl were reacted.

answer = mol [1]

(ii) Calculate the volume of $Cl_2(g)$ produced, in dm³. Under the experimental conditions, one mole of $Cl_2(g)$ occupies 24.0 dm³.

answer =dm³ [2]

(b) In this reaction, chlorine is oxidised.

Use oxidation numbers to determine what is reduced.

.....[2]

(c) Sodium reacts with chlorine forming the ionic compound sodium chloride, NaCl.

(i) Write an equation, including state symbols, for this reaction.

.....[2]

ii) Describe the structure of sodium chloride in the solid state. You may find it useful to draw a diagram.

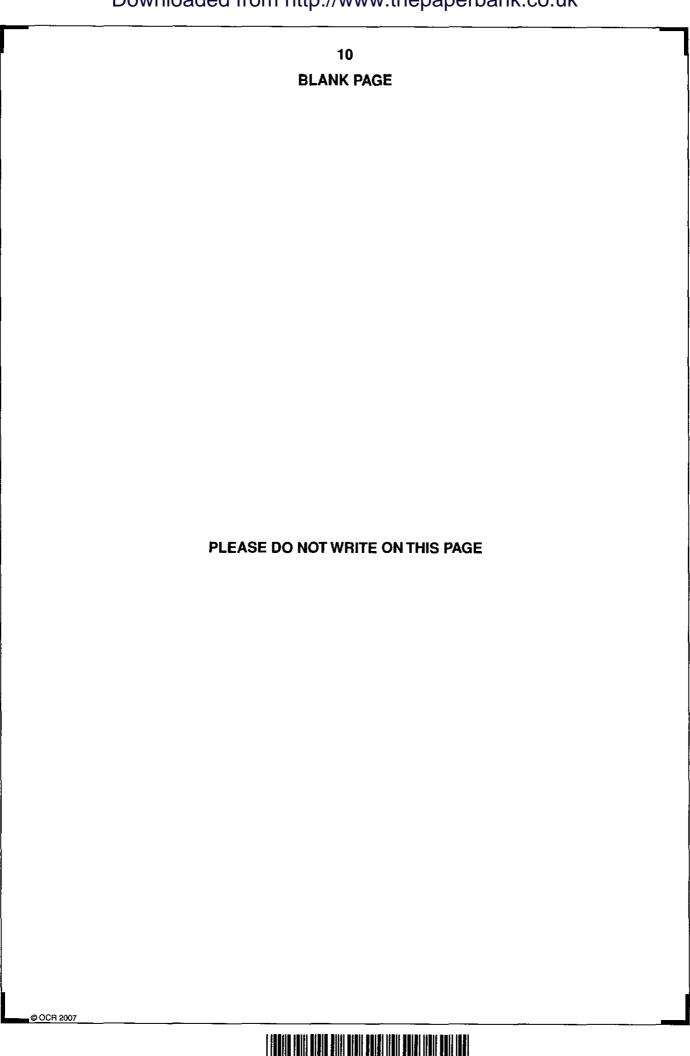
.....[2]



	9
(d)	In this question one mark is available for the quality of spelling, punctuation and grammar.
	Chlorine gas was bubbled through an aqueous solution of bromide ions and also through an aqueous solution of iodide ions. An organic solvent was then added and each mixture was shaken.
	State what you would see in each case.
	Write equations for any chemical reactions that take place.
	State and explain the trend in reactivity shown by these observations.
	······································
	[6]
	Quality of Written Communication [1]
	[Total: 16]

END OF QUESTION PAPER







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