



**ADVANCED SUBSIDIARY GCE
CHEMISTRY**

Foundation Chemistry

THURSDAY 11 JANUARY 2007

2811/01

Morning

Time: 1 hour

Additional materials: Scientific calculator
Data Sheet for Chemistry (Inserted)



Candidate
Name

Centre
Number

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Candidate
Number

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INSTRUCTIONS TO CANDIDATES

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





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.

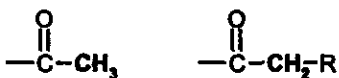
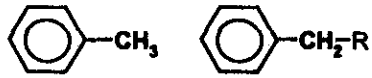

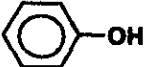
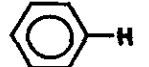
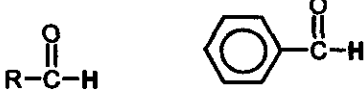
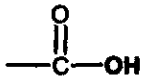
Copies of this sheet may be used for teaching.

Characteristic infra-red absorptions in organic molecules

bond	location	wavenumber
C-O	alcohols, esters	1000 – 1300 cm^{-1}
C=O	aldehydes, ketones, carboxylic acids, esters	1680 – 1750 cm^{-1}
O-H	hydrogen bonded in carboxylic acids	2500 – 3300 cm^{-1} (broad)
N-H	primary amines	3100 – 3500 cm^{-1}
O-H	hydrogen bonded in alcohols, phenols	3230 – 3550 cm^{-1}
O-H	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-CH ₃	0.7–1.6
R-CH ₂ -R	1.2–1.4
R ₃ CH	1.6–2.0
	2.0–2.9
	2.3–2.7
	3.3–4.3
R-OH	3.5–5.5
	6.5–7.0
	7.1–7.7
	9.5–10
	11.0–11.7

2

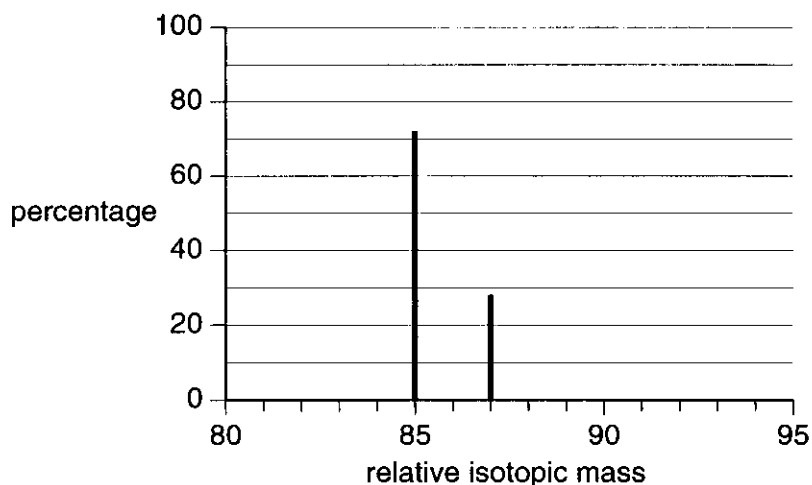
Answer **all** the questions.

- 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, ^{85}Rb and ^{87}Rb .

(a) Explain the term *isotopes*.

.....
 [1]

(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.

isotope	percentage	number of		
		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.

$A_r = \dots\dots\dots$ [2]

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

..... [1]



(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]



2 Solid calcium hydroxide, $\text{Ca}(\text{OH})_2$, is commonly known as 'slaked lime'. Over one million tonnes of slaked lime are produced annually in the UK.

(a) Lime water is an aqueous solution of calcium hydroxide, $\text{Ca}(\text{OH})_2$. Lime water is commonly used 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 $\text{Ca}(\text{OH})_2$ 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 $\text{Ca}(\text{OH})_2$?

moles of ions = [1]

(iii) How many moles of electrons are in one mole of OH^- ions?

moles of electrons = [1]



3 Although compounds are usually classified as having ionic or covalent bonding, often the bonding is somewhere in between these two extremes.

(a) State what is meant by the terms

(i) *ionic bond*,

.....
.....[1]

(ii) *covalent bond*.

.....
.....[2]

(b) Compounds with covalent bonding often have polar bonds. Polarity can be explained in terms of electronegativity.

(i) Explain the term *electronegativity*.

.....
.....
.....[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]

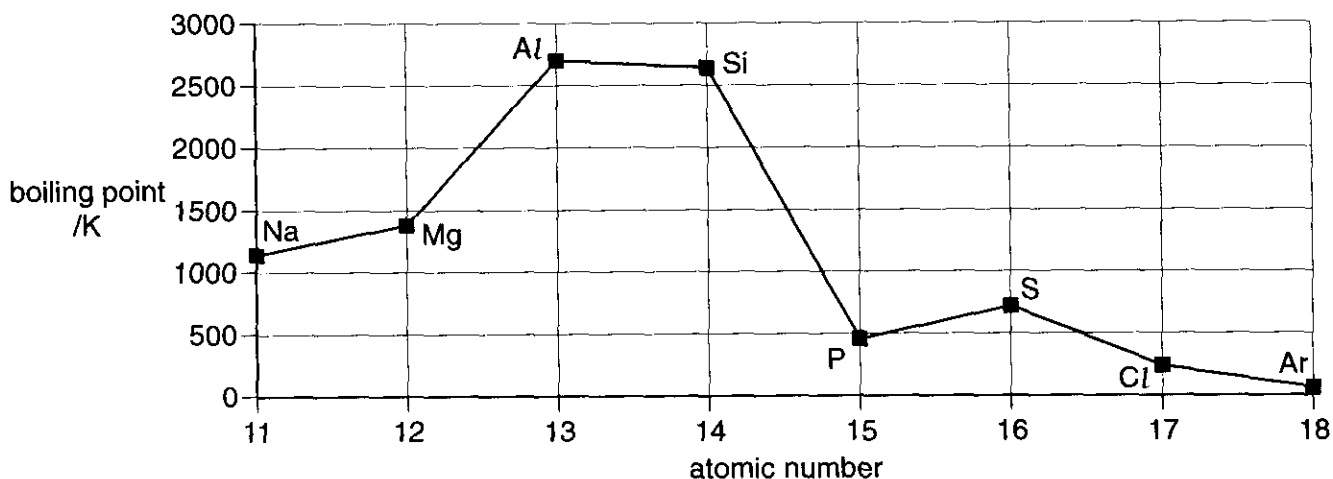
(c) Some polar molecules are able to form hydrogen bonds.
Draw a diagram to show an example of hydrogen bonding.

[2]

[Total: 9]



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.

.....

 [2]

(c) Explain why the boiling point **increases** from sodium to aluminium.

.....

 [2]

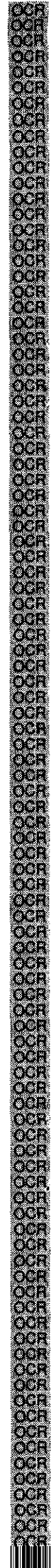
[Total: 7]



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