

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Secondary Education
June 2008

CHEMISTRY
Unit Chemistry C3
Higher Tier

CHY3H
H



Thursday 5 June 2008 9.00 am to 9.45 am

<p>For this paper you must have:</p> <ul style="list-style-type: none"> the Data Sheet (enclosed) a pencil and a ruler. <p>You may use a calculator.</p>

Time allowed: 45 minutes

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice

- In all calculations, show clearly how you work out your answer.

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Question	Mark	Question	Mark
1		3	
2		4	
		5	
		6	
		7	
		8	
Total (Column 1)		→	
Total (Column 2)		→	
TOTAL			
Examiner's Initials			



Answer **all** questions in the spaces provided.

1 (a) Nicotinic acid is a weak acid. It has the formula C_5H_4NCOOH .

Hydrochloric acid is a strong acid. It has the formula HCl.

1 (a) (i) Give the name or formula of the ion that makes solutions acidic.

.....
(1 mark)

1 (a) (ii) Weak acids contain fewer of these ions than strong acids of the same concentration.

Describe and give the results of an experiment to show that nicotinic acid is a weaker acid than hydrochloric acid of the same concentration.

.....
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(2 marks)

1 (b) Read the following information.

It's all in a name

Nicotinic acid is an important chemical. It is also known as niacin or vitamin B₃. It is found in many foods, including eggs, meat, poultry, fish, leafy vegetables, carrots and cereals. It is also in tea and coffee.

A lack of nicotinic acid in our diet causes the disease pellagra. The symptoms of pellagra include diarrhoea, dermatitis and dementia. People can die. Pellagra is a common disease of malnutrition in Africa.

Nicotinic acid can be made by oxidising nicotine.

Nicotine is found in tobacco, tomatoes and potatoes. Smoking tobacco is said to cause the death of millions of people each year from cancer.

DC/AC (Dedicated Citizens Against Chemicals) is a pressure group that wants the government to ban nicotine and chemicals made from nicotine. Many people oppose such a ban and there is to be a televised debate.



In the television programme, DC/AC and their opponents gave their reasons. You have to suggest what they were.

- 1 (b) (i) DC/AC said that nicotine and chemicals made from nicotine should be banned because

.....
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(2 marks)

- 1 (b) (ii) Their opponents said that nicotine and chemicals made from nicotine should **not** be banned because

.....
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(2 marks)

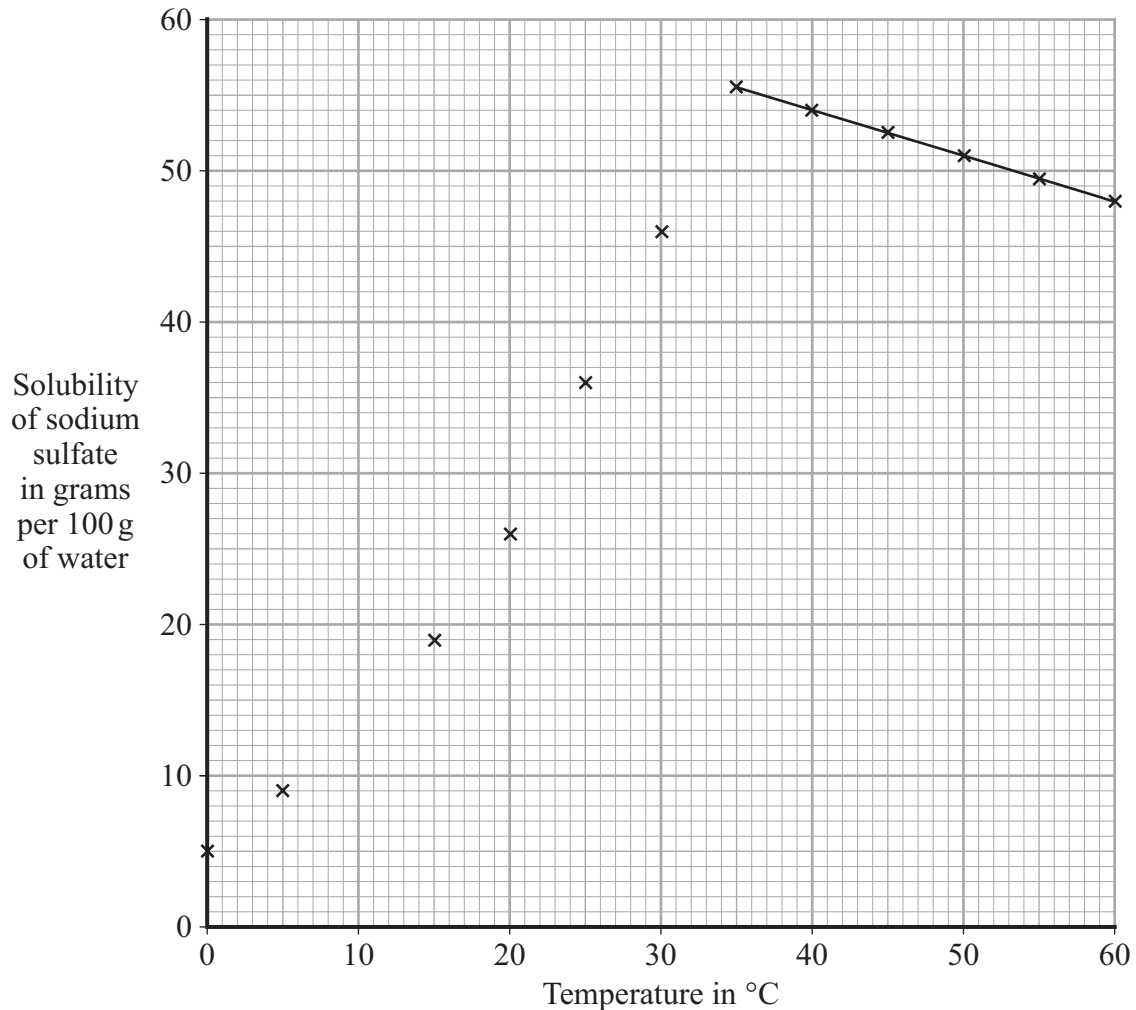
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- 2 A student did experiments to find the maximum amount of sodium sulfate that dissolves in 100 g of water at different temperatures. Each experiment was repeated several times. The points on the graph show the student's average results.



Use the graph to answer the following questions.

- 2 (a) Complete the graph by drawing a smooth curve through the points. (1 mark)

- 2 (b) The student was surprised by the shape of this solubility graph.

Suggest why.

.....
(1 mark)

- 2 (c) Suggest why the student was sure that the results were reliable.

.....
(1 mark)



2 (d) At what temperature is the solubility of sodium sulfate greatest? °C
(1 mark)

2 (e) Use your graph to find the maximum mass of sodium sulfate that dissolves in 100 g of water at 10°C.

Mass = g
(1 mark)

2 (f) A *saturated solution* of sodium sulfate in 100 g of water is made at 30°C. It is then cooled to 15°C.

What mass of sodium sulfate crystallises from the solution?

.....
.....

Mass = g
(2 marks)

2 (g) At a given temperature what is meant by a *saturated solution*?

.....
.....
(1 mark)

8

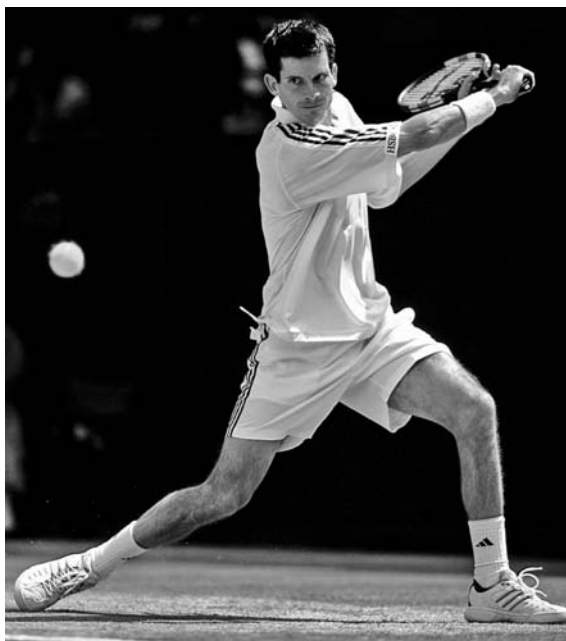
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- 3 The information in the box was on the internet.

Breathtaking Finish



Tim Henman used *smelling salts* to help revive his fortunes at Wimbledon yesterday.

The active chemical in *smelling salts* is ammonium carbonate, $(\text{NH}_4)_2\text{CO}_3$.

Describe how *smelling salts* can be tested to show that they contain ammonium ions and carbonate ions. Give the results of the tests.

- 3 (a) Test and result for ammonium ions

.....

(2 marks)

- 3 (b) Test and result for carbonate ions

.....

(2 marks)

4



- 4 The following article appeared recently in the *Manchester Gazette*.

Sodium Drum Blaze Scare

A 20 litre drum containing sodium burst into flames when it reacted violently with rainwater at a Manchester factory. It is believed that the sodium, which is normally stored under oil, had been accidentally left outside with the lid off.

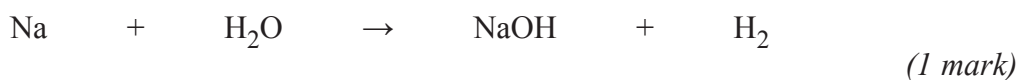
A factory worker put out the blaze before the fire services arrived, and a leading fire fighter said, "It was fortunate that potassium wasn't involved as it would have reacted more violently and exploded. These Group 1 *alkali metals* can be very dangerous".

- 4 (a) Group 1 metals are stored under oil.

Suggest why.

.....
(1 mark)

- 4 (b) Balance the equation which represents the reaction between sodium and water.



- 4 (c) Explain why the Group 1 metals are called the *alkali metals*.

.....
.....
(1 mark)

- 4 (d) Explain, in terms of electrons, why potassium reacts more violently than sodium.

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(3 marks)

6

Turn over ►



- 5 The picture shows an old Spanish coin. It is called a piece of eight.

Photograph of old Spanish coin is not reproduced here due to third party copyright constraints.

The full copy of this paper can be obtained by ordering from AQA Publications.
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- 5 (a) A piece of eight has a mass of 27.06 g, and is 90% silver.

- 5 (a) (i) Calculate the number of moles of silver in a piece of eight.

Relative atomic mass: $A_r = 108$.

.....
.....
.....

Moles of silver =
(2 marks)

- 5 (a) (ii) Suggest why the actual mass of a piece of eight may be less than this.

.....
.....
(1 mark)

- 5 (b) Analysis can be used to find out whether a coin is genuine or fake.

- 5 (b) (i) It is possible to prove that the coin is genuine by identifying the elements in the coin.

Name an instrumental method of analysis that could be used to identify the elements in the coin.

.....
(1 mark)



5 (b) (ii) Chemical analysis would damage the coin.

Suggest why using an instrumental method would cause less damage than chemical analysis.

.....
.....

(1 mark)

5

Turn over for the next question

Turn over ►



- 6 Read the information about the development of the periodic table and answer the questions that follow.

Photograph of John Newlands is not reproduced here due to third party copyright constraints.

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John Newlands was one of the first chemists to arrange the known elements in order of increasing atomic mass. In 1866, he put forward the Law of Octaves. He suggested that there was a repeating pattern of elements with similar chemical properties every eighth element, just like the eighth note of an octave of music. A version of his periodic table is shown below.

H	Li	G	Bo	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co, Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce, La	Zr	Di, Mo	Ro, Ru
Pd	Ag	Cd	U	Sn	Sb	Te
I	Cs	Ba, V	Ta	W	Nb	Au
Pt, Ir	Os	Hg	Tl	Pb	Bi	Th

However, other chemists did not accept Newlands' ideas. It was not until much later that his contribution to the development of the modern periodic table was recognised.

The modern periodic table on the Data Sheet may help you to answer these questions.

- 6 (a) What is the modern symbol for the element 'Bo'?
(1 mark)

- 6 (b) Describe **one** piece of evidence to support the Law of Octaves.

.....

(2 marks)



6 (c) Suggest **two** reasons why other chemists did not accept Newlands' ideas.

1

.....

.....

2

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.....

(2 marks)

6 (d) The alkanes are a series of hydrocarbons with similar chemical properties. They have the general formula C_nH_{2n+2} .

Suggest why the alkanes do not appear in the periodic table.

.....

.....

(1 mark)

6

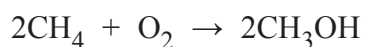
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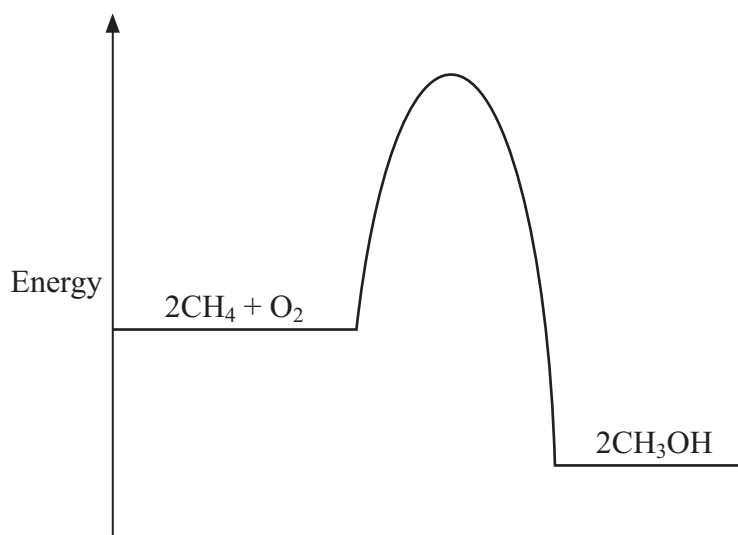


- 7 Methanol (CH_3OH) can be made by reacting methane (CH_4) and oxygen (O_2) in the presence of a platinum catalyst. The reaction is exothermic.

An equation that represents the reaction is:



- 7 (a) The energy level diagram for this reaction is given below.



- 7 (a) (i) Use the diagram to explain how you know that this reaction is exothermic.

.....

.....

.....

(1 mark)

- 7 (a) (ii) Explain, in terms of the energy level diagram, how the platinum catalyst increases the rate of this reaction.

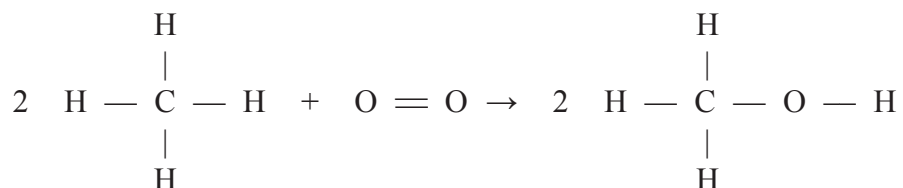
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(1 mark)



- 7 (b) The equation can also be written showing the structural formulae of the reactants and the product.



- 7 (b) (i) Use the bond energies given in the table to help you to calculate the energy change for this reaction.

Bond	Bond energy in kJ
C — H	435
O = O	498
C — O	805
O — H	464

.....

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Energy change = kJ
(3 marks)

- 7 (b) (ii) In terms of the bond energies, explain why this reaction is exothermic.

.....

.....

(1 mark)

6

Turn over ►



8 Good quality water is needed for a healthy life.

In the United Kingdom, obtaining safe water for drinking is as simple as turning on a tap. The water is made safe to drink by water companies.

However, in many parts of Africa and Asia, water used for drinking is contaminated and untreated. It is estimated that 2.2 million people die each year as a result of drinking contaminated water.



Efforts are being made to solve this problem and more water is being treated.

Describe how water in the United Kingdom is treated.
Explain how this makes it safe to drink.

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(3 marks)

3

END OF QUESTIONS



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Question 8 Photo: DADA DANESHANANDA, Man with filtered water from the Mafi-Zongo water project,
www.amurt.net/africa/ghana/2005

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Data Sheet

1. Reactivity Series of Metals

Potassium	most reactive
Sodium	↑
Calcium	
Magnesium	
Aluminium	
<i>Carbon</i>	
Zinc	
Iron	
Tin	
Lead	
<i>Hydrogen</i>	
Copper	
Silver	
Gold	
Platinum	↓
	least reactive

(elements in italics, though non-metals, have been included for comparison)

2. Formulae of Some Common Ions

Positive ions		Negative ions	
Name	Formula	Name	Formula
Hydrogen	H^+	Chloride	Cl^-
Sodium	Na^+	Bromide	Br^-
Silver	Ag^+	Fluoride	F^-
Potassium	K^+	Iodide	I^-
Lithium	Li^+	Hydroxide	OH^-
Ammonium	NH_4^+	Nitrate	NO_3^-
Barium	Ba^{2+}	Oxide	O^{2-}
Calcium	Ca^{2+}	Sulfide	S^{2-}
Copper(II)	Cu^{2+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}	Carbonate	CO_3^{2-}
Zinc	Zn^{2+}		
Lead	Pb^{2+}		
Iron(II)	Fe^{2+}		
Iron(III)	Fe^{3+}		
Aluminium	Al^{3+}		

Turn over ►

3. The Periodic Table of Elements

	1	2	3	4	5	6	7	0																									
	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 1 H hydrogen 1 </div>							<div style="border: 1px solid black; padding: 2px; display: inline-block;"> 4 He helium 2 </div>																									
	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> Key relative atomic mass atomic symbol name atomic (proton) number </div>																																
7 Li lithium 3	9 Be beryllium 4	23 Na sodium 11	24 Mg magnesium 12	39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	63.5 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36												
85 Rb rubidium 37	88 Sr strontium 38	133 Cs caesium 55	137 Ba barium 56	89 Y yttrium 39	89 La* lanthanum 57	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	112 Cd cadmium 48	112 Cd cadmium 48	108 Ag silver 47	106 Pd palladium 46	103 Rh rhodium 45	101 Ru ruthenium 44	106 Pd palladium 46	112 Cd cadmium 48	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54	204 Tl thallium 81	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[261] Rf rutherfordium 104	[262] Db dubnium 105	[262] Db dubnium 105	[262] Sg seaborgium 106	[264] Bh bohrium 107	[264] Bh bohrium 107	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	[272] Rg roentgenium 111	Elements with atomic numbers 112 – 116 have been reported but not fully authenticated																		

* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

Cu and **Cl** have not been rounded to the nearest whole number.