

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A**

A323/02

Unit 3: Ideas in Context plus C7 (Higher Tier)

**Friday 27 May 2011
Morning**

Duration: 60 minutes

Candidates answer on the question paper.
A calculator may be used for this paper.

OCR supplied materials:

- Insert (inserted)

Other materials required:

- Pencil
- Ruler (cm/mm)



Candidate forename		Candidate surname	
-----------------------	--	----------------------	--


Centre number						Candidate number				
---------------	--	--	--	--	--	------------------	--	--	--	--

MODIFIED LANGUAGE

INSTRUCTIONS TO CANDIDATES

- The insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Answer **all** the questions.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **55**.
-  Where you see this icon you will be awarded a mark for the quality of written communication in your answer.
- The Periodic Table is printed on the back page.
- This document consists of **12** pages. Any blank pages are indicated.

Answer **all** the questions.

1 This question is based on the article “**Bolivian Bonanza**”.

(a) The article says ‘the green-car revolution could make lithium one of the planet’s most sought after elements’.

Explain why the demand for lithium will increase greatly.

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

(b) **Describe and explain** one impact on the environment that may be caused by the extraction, use or disposal of lithium used in lithium-ion batteries.

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

(c) (i) Vehicles powered by petrol or diesel release carbon dioxide into the air. This causes global warming.

Cars powered using lithium-ion batteries do not release carbon dioxide.

However, large scale use of cars powered by lithium-ion batteries would still result in global warming.

Explain why.

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

(ii) What further developments would be needed to prevent cars powered by lithium-ion batteries contributing to global warming?

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

- (d) (i) Lithium is extracted from lithium chloride, LiCl , by electrolysis, but iron is extracted from iron oxide by reduction with carbon.

What is the reason for this difference?

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

- (ii) During the electrolysis, lithium metal is formed at the negative electrode (cathode) and chlorine gas is released at the positive electrode (anode).

Write equations to show how the ions react at the electrodes.

Use e^- to represent an electron.

cathode

.....

anode

..... [2]

- (iii) A factory produces 50 tonnes of lithium from lithium chloride, LiCl .

What mass of lithium chloride would be used to produce this lithium?

Give your answer to the nearest tonne.

(Relative atomic masses: Cl , 35.5; Li , 7.)

Show your working.

mass of lithium chloride = tonnes [2]

[Total: 13]

2 The alkanes are a family of chemical compounds.

(a) Complete the table to show names, molecular formulae and structural formulae of three alkanes.

name of alkane	molecular formula	structural formula
methane	CH ₄	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{H} \end{array} $
ethane		
	C ₃ H ₈	

[4]

(b) Alkanes burn in a plentiful supply of air to give two products.

Balance this equation for the burning of an alkane.



[1]

(c) The burning of an alkane in air is an exothermic reaction.

Use ideas about the energy involved in the making and breaking of bonds to explain this.



One mark is for a clear ordered answer.

.....

.....

.....

.....

..... [3+1]

[Total: 9]

- 3 Most esters have sweet, fruity smells.

Esters can be made by reacting a carboxylic acid with an alcohol.



- (a) The reaction to make an ester takes place in the presence of sulfuric acid.

State and explain the job of the sulfuric acid.

.....

 [2]

- (b) Octyl ethanoate, $\text{CH}_3\text{COOC}_8\text{H}_{17}$, has the smell of oranges.

Octyl ethanoate can be made by heating a mixture of ethanoic acid, CH_3COOH , and octanol, $\text{C}_8\text{H}_{17}\text{OH}$.

Write a balanced equation for the reaction used to make octyl ethanoate.

..... \rightleftharpoons [1]

- (c) The \rightleftharpoons sign shows that this is a reversible reaction that reaches a state of equilibrium.

At equilibrium the concentrations of each of the reactants and the products are constant.

Use ideas about dynamic equilibrium to explain how the reaction mixture reaches a state of equilibrium.

.....

 [4]

[Total: 7]

4 Lime scale can build up in kettles.

A company makes a lime scale remover that contains solid phosphoric acid, H_3PO_4 , together with other ingredients. When dissolved in water the phosphoric acid reacts with the lime scale and removes it.

The batch of lime scale remover that is made each day is analysed to measure how much phosphoric acid it contains.

- (a) The amount of phosphoric acid in 10.0g samples of the lime scale remover is measured using titration against standard sodium hydroxide solution.

A rough titration is carried out first, then several accurate titrations.

Describe the key stages of an accurate titration.

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

- (b) The titration is repeated with several other samples of the lime scale remover.

Give **two** reasons for analysing several samples of the lime scale remover.

1
.....
2
..... [2]

- (c) A best estimate from the analysed samples is used to work out the phosphoric acid content of the lime scale remover.

How can the degree of uncertainty of this result be assessed?

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

- (d) Why is it important for the company to know how much phosphoric acid the lime scale remover contains?

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

(e) The result of the analysis shows that 25.0cm^3 of standard sodium hydroxide solution reacts with the phosphoric acid in 10.0g of the lime scale remover.

(i) The standard sodium hydroxide solution contains $60.0\text{g}/\text{dm}^3$ of sodium hydroxide.

What is the mass of sodium hydroxide in 25.0cm^3 of this standard solution?

(1dm^3 contains 1000cm^3)

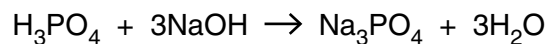
mass of sodium hydroxide in 25.0cm^3 standard solution = g [1]

(ii) Work out the relative formula mass of phosphoric acid, H_3PO_4 .

(relative atomic masses: H, 1; O, 16; P, 31.)

relative formula mass of phosphoric acid = [2]

(iii) Phosphoric acid reacts with sodium hydroxide according to this equation.



The relative formula mass of sodium hydroxide is 40.

Work out the mass of phosphoric acid in 10.0g of lime scale remover.

Show your working.

mass of phosphoric acid H_3PO_4 in 10.0g lime scale remover = g [3]

[Total: 12]

5 The chemical industry produces thousands of different chemicals. Some of these are classed as bulk chemicals and others as fine chemicals.

(a) Steps in the production of sulfuric acid, H_2SO_4 , are shown below.

Step 1 Liquid sulfur is burned in air to produce sulfur dioxide.

Step 2 Sulfur dioxide is reacted with more oxygen to make sulfur trioxide.

Step 3 Sulfur trioxide is dissolved in concentrated sulfuric acid.

Step 4 Water is added to produce sulfuric acid of the required concentration.

(i) Write a symbol equation with state symbols for the formation of sulfur dioxide in **Step 1**.
..... [3]

(ii) Vanadium oxide speeds up the reaction in **Step 2**.
This vanadium oxide is not used up in the reaction.
Explain how vanadium oxide speeds up this reaction.
Use ideas about activation energy in your answer.
.....
.....
..... [2]

(b) The Government has strict regulations to control the manufacture, transport and storage of sulfuric acid.

What is the purpose of these regulations?
.....
.....
..... [2]

[Total: 7]

6 Details of three methods used to produce ethanol are given below.

method	starting material (feedstock)	process
1	ethene	react with steam
2	corn starch	ferment with yeast
3	waste biomass	ferment with E. coli bacteria

(a) (i) In terms of feedstock, which of these three methods is least sustainable?

Explain why this method is less sustainable than the other two.

.....

.....

.....

.....

..... [3]

(ii) The sustainability of a chemical process depends on a number of factors.

Choose one of these factors, other than the type of feedstock, and explain how it may affect the sustainability of a chemical process.

.....

.....

.....

..... [2]

(b) Ethanol can be used instead of petrol as a fuel in cars. This would greatly increase the demand for ethanol.

Producing much larger amounts of ethanol could result in an increase in food prices.

Using **method 3** rather than **method 2** may overcome this problem.

Explain why.

.....

.....

.....

..... [2]

[Total: 7]

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

The Periodic Table of the Elements

1	2	3	4	5	6	7	0										
7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 P phosphorus 15	16 O oxygen 8	17 F fluorine 9	18 Ne neon 10								
19 K potassium 19	20 Ca calcium 20	23 Sc scandium 21	24 Ti titanium 22	25 V vanadium 23	26 Cr chromium 24	27 Mn manganese 25	28 Fe iron 26	29 Co cobalt 27	30 Ni nickel 28	31 Cu copper 29	32 Zn zinc 30	33 Ga gallium 31	34 Ge germanium 32	35 As arsenic 33	36 Se selenium 34	37 Br bromine 35	38 Kr krypton 36
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium [98]	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

1 H hydrogen 1

relative atomic mass atomic symbol name atomic (proton) number

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.