

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

A323/01

Unit 3: Ideas in Context plus C7 (Foundation 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	
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Centre number						Candidate number				
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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) (i) Why are lithium-ion batteries better than nickel-metal hydride batteries for powering cars?

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

(ii) Use information from the article to work out the price of one tonne of lithium metal.

price of one tonne of lithium metal = £ [1]

(iii) 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) Lithium metal is obtained by electrolysis of the ionic compound lithium chloride.

Solid lithium chloride is made of ions held in a giant structure.

Describe what happens to the **lithium ions** in lithium chloride

(i) as the solid is melted

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

(ii) during the electrolysis.

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

(d) Care has to be taken in the way that lithium metal is stored during transport.

(i) Why is this care necessary?

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

(ii) Suggest what precautions should be taken.

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

(e) Describe an investigation to show the trend in reactivity of the elements lithium, sodium and potassium.

Include in your answer

- what you would do
- what you would look for.

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

[Total: 13]

2 The alkanes are a family of chemical compounds.

(a) Use words from the list to complete the sentences about alkanes.

amino acids carbohydrates explosive hydrocarbons
polymers reactive unreactive volatile

Alkanes are called because they contain the elements hydrogen and carbon only.

They are because the bonds between their atoms need a lot of energy to break them. [2]

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

name of alkane	molecular formula	structural formula
methane	CH ₄	<pre> H H — C — H H </pre>
ethane		
	C ₃ H ₈	

[4]

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

Complete this word equation for the burning of butane.

butane + oxygen → + [2]

(d) Butane is used as a fuel in camping stoves because heat energy is given out as it burns.

What scientific term can be used to describe a reaction that gives out heat energy?

Put a (ring) around the correct answer.

decomposition endothermic exothermic neutralisation synthesis [1]

[Total: 9]

3 Most esters have sweet, fruity smells.

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



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 and octanol.

A little sulfuric acid is added to the reaction mixture.

(a) In this reaction mixture to make octyl ethanoate, name the chemical which is ...

... a carboxylic acid.

answer

... an alcohol.

answer

... a catalyst.

answer

[2]

(b) Complete the word equation for the reaction to make octyl ethanoate.

..... + \rightleftharpoons octyl ethanoate + water [1]

(c) What does the sign \rightleftharpoons tell you about the reactions that produce esters?

.....

..... [1]

(d) Esters are used to give some foods their smell and flavour.

Give **two** other common uses of esters.

1

2

[2]

[Total: 6]

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 and removes the lime scale.

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

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

.....
 [1]

- (b) The sentences below describe the procedure used to test each batch of the lime scale remover, but they are in the wrong order.

- A** measure out a 10.0g sample of lime scale remover
B use the best estimate to calculate the mass of phosphoric acid
C dissolve the sample in water and add a few drops of indicator
D repeat with several other samples of lime scale remover and find the best estimate
E measure the volume of standard sodium hydroxide solution that exactly reacts with the lime scale remover solution
F estimate the degree of uncertainty in the results

- (i) Write the letter for a statement in each of the blank boxes below to give the correct order.

The first and last have already been done for you.

A					F
----------	--	--	--	--	----------

[3]

- (ii) 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]

- (iii) Step **E** is carried out using a burette.

Explain why a burette is used to measure the volume of sodium hydroxide solution instead of a measuring cylinder.

.....
 [1]

- (iv) A few drops of an indicator are added to the solution in step **C**.

What is the job of this indicator?



One mark is for the correct use of scientific terms.

.....

 [2+1]

- (c) 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) 100.0cm^3 of the standard solution contains 6.0g sodium hydroxide.

How much sodium hydroxide is in 25.0cm^3 of this solution?

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) Calculate the mass of phosphoric acid in 10.0 g of lime scale remover.

You will need to use your answers from parts (i) and (ii).

The formula to use is given below.

$$\text{mass of phosphoric acid in 10.0 g of lime scale remover} = \frac{\boxed{\text{mass of sodium hydroxide in 25.0 cm}^3 \text{ standard solution}} \times \boxed{\text{relative formula mass of phosphoric acid}}}{40 \times 3}$$

mass = g [1]

[Total: 14]

5 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) Which method, 1, 2 or 3, uses a non-renewable starting material?

method [1]

(ii) Why is this starting material non-renewable?

.....

 [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: 5]

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

(a) (i) Which of these chemicals is classed as a fine chemical?

Put a **ring** around the correct answer.

ammonia aspirin phosphoric acid sodium hydroxide sulfuric acid [1]

(ii) Explain why this is classed as a fine chemical.

.....
 [1]

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

Step 1 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 word equation for the formation of sulfur dioxide in **Step 1**.

..... [1]

(ii) Vanadium oxide speeds up the reaction in **Step 2**.

This vanadium oxide is not used up in the reaction.

What type of chemical is vanadium oxide?

Put a **ring** around the correct answer.

by-product catalyst product reactant solvent [1]

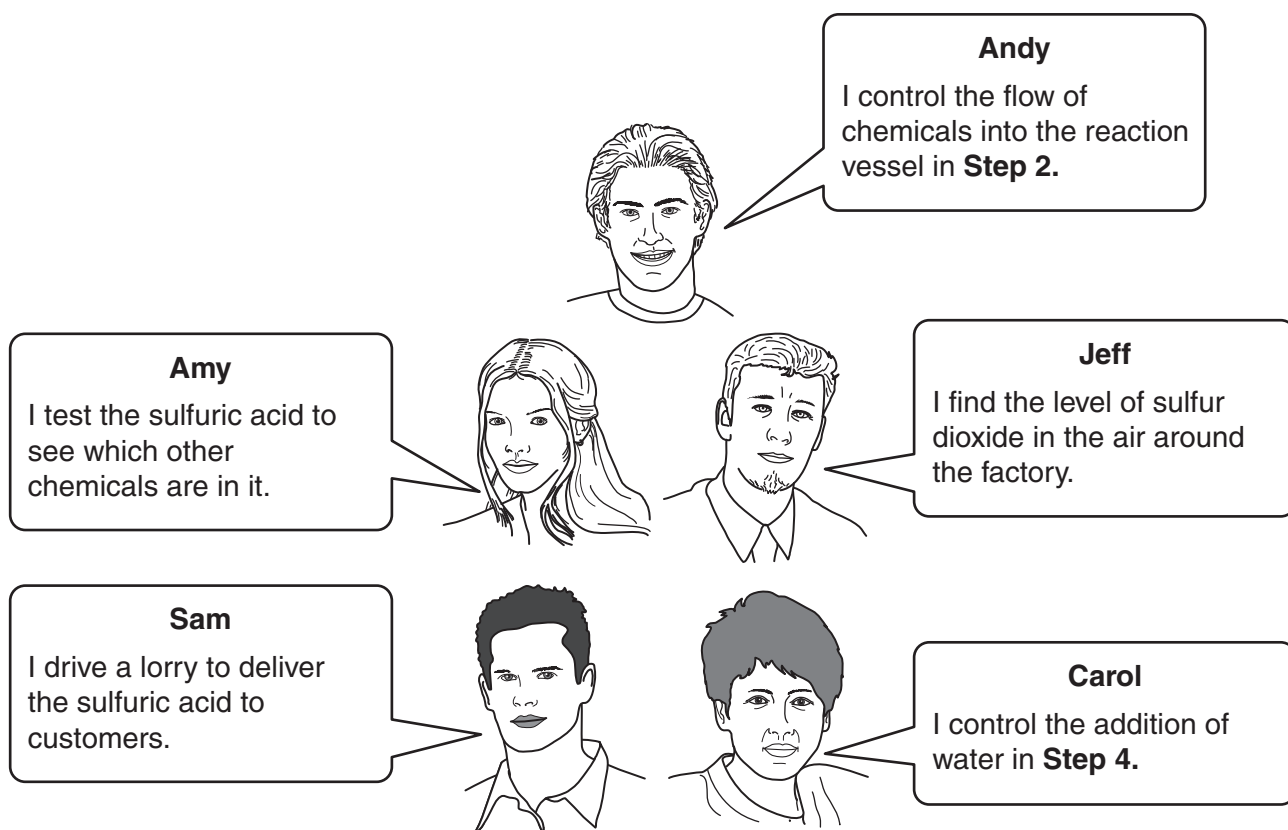
(iii) Explain how vanadium oxide speeds up this reaction.

Use ideas about activation energy in your answer.

.....

 [2]

- (c) The diagram shows workers involved in the manufacture and supply of sulfuric acid talking about their jobs.



- (i) Which person is involved in the **analysis** of the product?

Put a **(ring)** around the correct answer.

Amy **Andy** **Carol** **Jeff** **Sam** [1]

- (ii) Which person measures the **environmental impact** of the process?

Put a **(ring)** around the correct answer.

Amy **Andy** **Carol** **Jeff** **Sam** [1]

[Total: 8]

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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 Ar argon 18								
	19 K potassium 19	20 Ca calcium 20	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36		
	37 Rb rubidium 37	38 Sr strontium 38	40 Ca calcium 20	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	1
	hydrogen	

relative atomic mass
atomic symbol
name
atomic (proton) number

Key

* 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.