Candidate forename		Candidate surname	

Centre number						Candidate number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A323/01

TWENTY FIRST CENTURY SCIENCE

CHEMISTRY A

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

FRIDAY 27 MAY 2011: Morning
DURATION: 60 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

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)

READ INSTRUCTIONS OVERLEAF

DC (LEO) 11MEP06225 46946/1

INSTRUCTIONS TO CANDIDATES

- **Write your name, centre number and candidate number in the boxes on the first page. 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.**

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 provided.**

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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]

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QUESTION 2 BEGINS ON THE NEXT PAGE

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

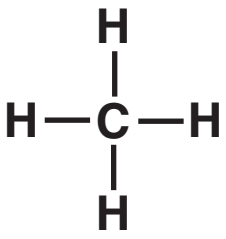
HYDROCARBONS POLYMERS REACTIVE

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	
ethane		
	C_3H_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]

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QUESTION 3 BEGINS ON THE NEXT PAGE

3 Most esters have sweet, fruity smells.

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

carboxylic acid + alcohol $\rightleftharpoons$ ester + water

Octyl ethanoate, $CH_3COOC_8H_{17}$, 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 10.0 g 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 25.0 cm^3 of standard sodium hydroxide solution reacts with the phosphoric acid in 10.0 g of the lime scale remover.

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

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

mass of sodium hydroxide in 25.0 cm^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]

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QUESTION 5 BEGINS ON THE NEXT PAGE

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.

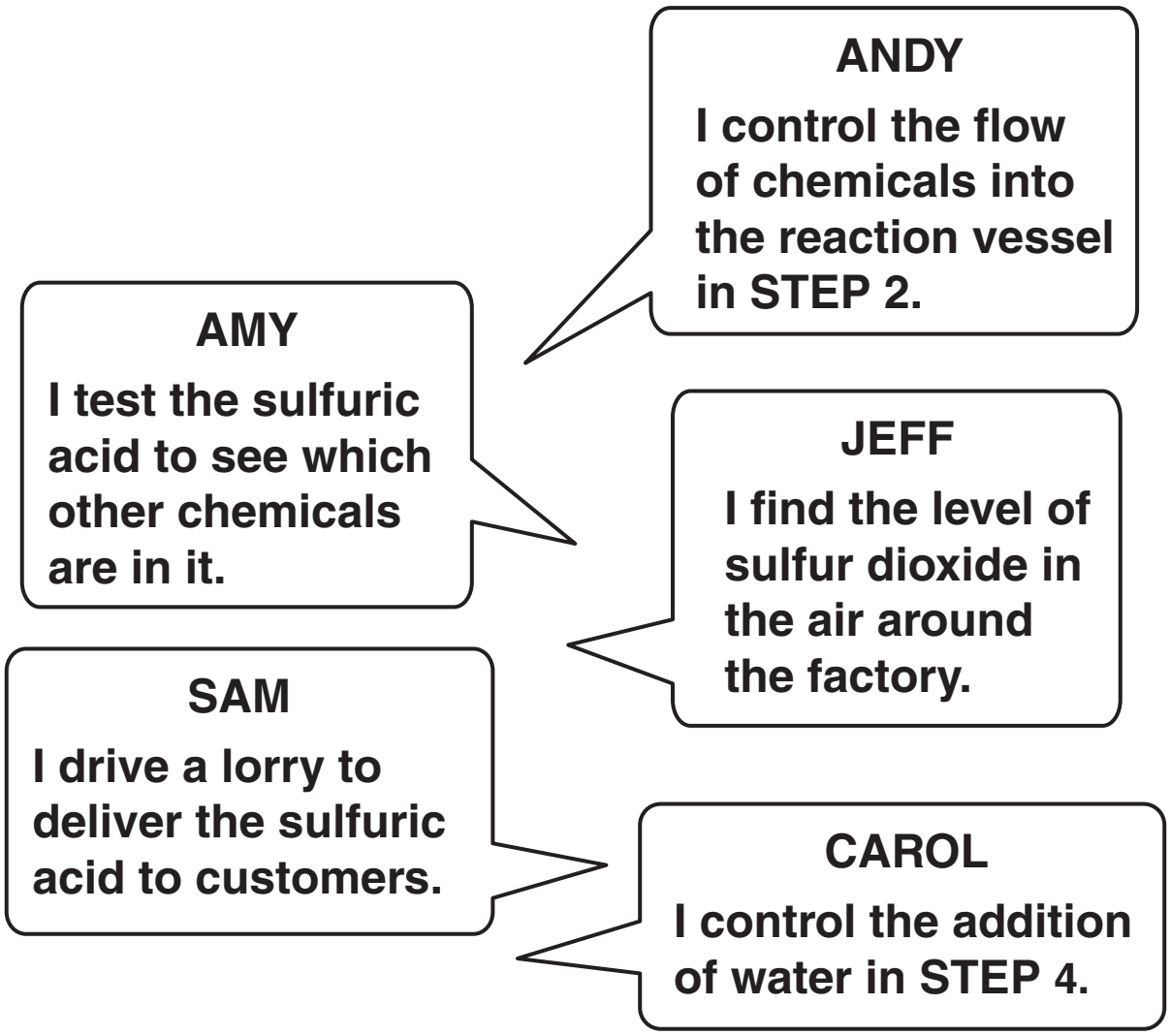
Use ideas about activation energy in your answer.

_____

_____

_____ **[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]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
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	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	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	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	[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						

Key

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.