

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

**A322/02**

Unit 2: Modules C4 C5 C6 (Higher Tier)

Candidates answer on the Question Paper  
A calculator may be used for this paper

**OCR Supplied Materials:**  
None

**Other Materials Required:**

- Pencil
- Ruler (cm/mm)

**Monday 28 June 2010  
Morning**

**Duration: 40 minutes**



Candidate Forename		Candidate Surname	
--------------------	--	-------------------	--

Centre Number						Candidate Number				
---------------	--	--	--	--	--	------------------	--	--	--	--

**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- 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).

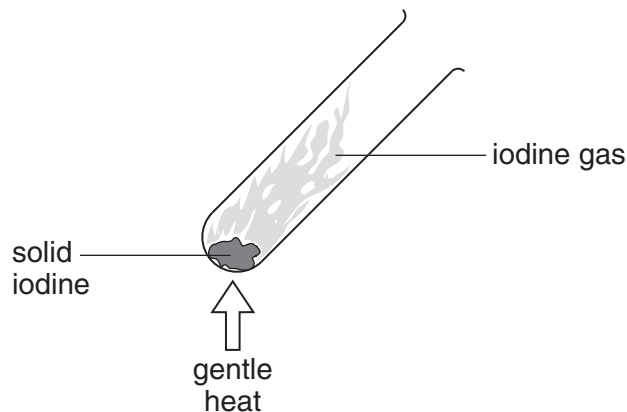
**INFORMATION FOR CANDIDATES**

- 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 **42**.
- This document consists of **16** pages. Any blank pages are indicated.
- The Periodic Table is printed on the back page.

Answer **all** the questions.

- 1 Iodine is a halogen in Group 7 of the Periodic Table.

Marty warms a small crystal of iodine in a test tube.



- (a) What colour change will Marty **see** when solid iodine changes into iodine gas?

Choose words from the list to complete the sentence.

**dark grey**

**orange**

**brown**

**purple**

**green**

The colour changes from ..... to ..... [1]

- (b) Iodine dissolves in water to form a dilute solution.

Give the **formula** and **state symbol** for iodine solution.

formula ..... state symbol ..... [1]

(c) Marty finds some information about other halogens in Group 7.

name of halogen	melting point in °C	boiling point in °C	reactivity	formula of potassium salt
fluorine	-220	-188	most reactive halogen	.....
chlorine	-101	-35	less reactive than fluorine more reactive than bromine	KCl
bromine	-7	59	less reactive than chlorine more reactive than iodine	KBr

(i) Fill in the missing formula for potassium fluoride. [1]

(ii) Use information from the table to describe the trends in properties of the elements down Group 7.

.....

.....

.....

.....

..... [3]

(d) Astatine is another halogen. It is below iodine in Group 7.

Marty makes some predictions about the properties of astatine based on its position in the Periodic Table.

Which of the following predictions about astatine are **likely to be true** and which are **likely to be false**?

Put a tick (✓) in the correct box in each row.

	likely to be true	likely to be false
Astatine is a gas at room temperature.		
Astatine has a lower melting point than bromine.		
Astatine has one electron in its outer shell.		
Astatine forms an ion with a single negative charge.		
Astatine reacts with iron more slowly than iodine does.		

[3]

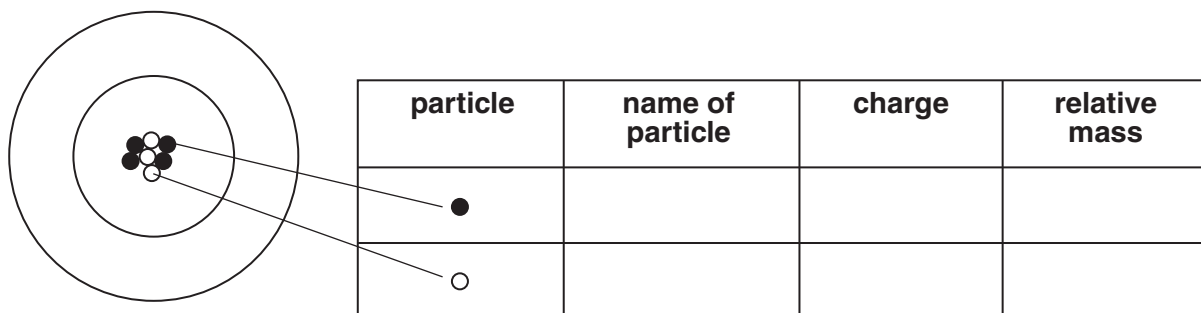
[Total: 9]

2 Lithium is in Group 1.

(a) The Periodic Table shows this information for lithium.

7
<b>Li</b>
lithium
3

The diagram shows the particles in the nucleus of a lithium atom and two electron shells.



particle	name of particle	charge	relative mass
●			
○			

(i) Complete the table of information about the particles in the nucleus. [2]

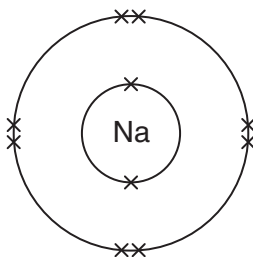
(ii) On the diagram, show the arrangement of electrons.

Use an **x** for each electron.

[1]

(b) Sodium is another element in Group 1.

The diagram shows the arrangement of electrons in a sodium **ion**.



Which of the following statements about a sodium ion are **true** and which are **false**?

Put a tick (✓) in the correct box in each row.

	<b>true</b>	<b>false</b>
A sodium ion has a larger relative mass than a sodium atom.	<input type="checkbox"/>	<input type="checkbox"/>
The total charge on the nucleus of a sodium ion is greater than the total charge on the electrons.	<input type="checkbox"/>	<input type="checkbox"/>
Sodium ions have more protons and electrons than sodium atoms.	<input type="checkbox"/>	<input type="checkbox"/>
A sodium atom forms a sodium ion by gaining one electron.	<input type="checkbox"/>	<input type="checkbox"/>
A sodium ion has fewer shells of electrons than a sodium atom.	<input type="checkbox"/>	<input type="checkbox"/>

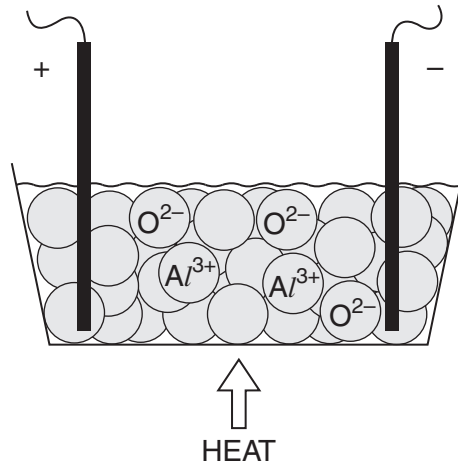
[2]

[Total: 5]

3 Bauxite is an ore of aluminium.

Bauxite contains the ionic compound, aluminium oxide.

Aluminium is extracted from aluminium oxide by electrolysis.



(a) Describe what happens to the oxide ions during the electrolysis.

.....

.....

..... [2]

(b) The formula for aluminium oxide is  $Al_2O_3$ .

The relative formula mass of aluminium oxide can be worked out like this.

relative atomic masses:  $Al = 27$        $O = 16$

relative formula mass of  $Al_2O_3$ :  $(2 \times 27) + (3 \times 16) = 102$

(i) What is the maximum mass of aluminium that can be made from 204 tonnes of aluminium oxide,  $Al_2O_3$ ?

mass = ..... tonnes [1]

(ii) Which one of the following statements about the electrolysis of aluminium oxide is true?

Put a tick (✓) in the box next to the correct statement.

Aluminium ions give up electrons during the electrolysis.

More atoms of aluminium are formed than atoms of oxygen.

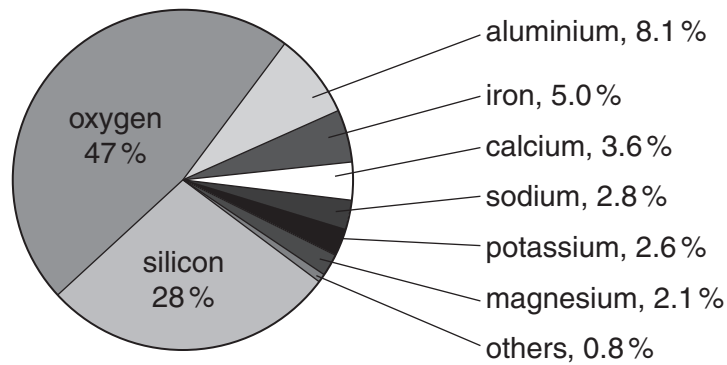
The same total number of electrons is involved in the reaction at each electrode.

Aluminium forms at the positive electrode.

[1]

[Total: 4]

- 4 The pie chart shows the percentages of common elements found in the Earth's crust.

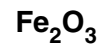
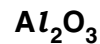


- (a) Three elements make up most of the Earth's crust.

The list below shows compounds found in the Earth's crust.

Which two compounds, when taken together, contain **all three** of these most common elements?

Put a ring around the **two** correct answers.



[2]

- (b) Sodium chloride,  $\text{NaCl}$ , is found in some parts of the Earth's crust. It is left behind when sea water evaporates.

Sodium appears in the pie chart of common elements in the Earth's crust but chlorine does not.

Which of the following statements explain why?

Put ticks (✓) in the boxes next to the **two** best answers.

There is much less chlorine than sodium in the Earth's crust.

Chlorine is a gas.

Sodium occurs in other compounds, not only sodium chloride.

The pie chart only shows metals.

There is only a very small amount of chlorine in the sea.


[2]

[Total: 4]



- 5 The information describes part of the nitrogen cycle in a garden pond.

**Nitrogen cycle in a garden pond**

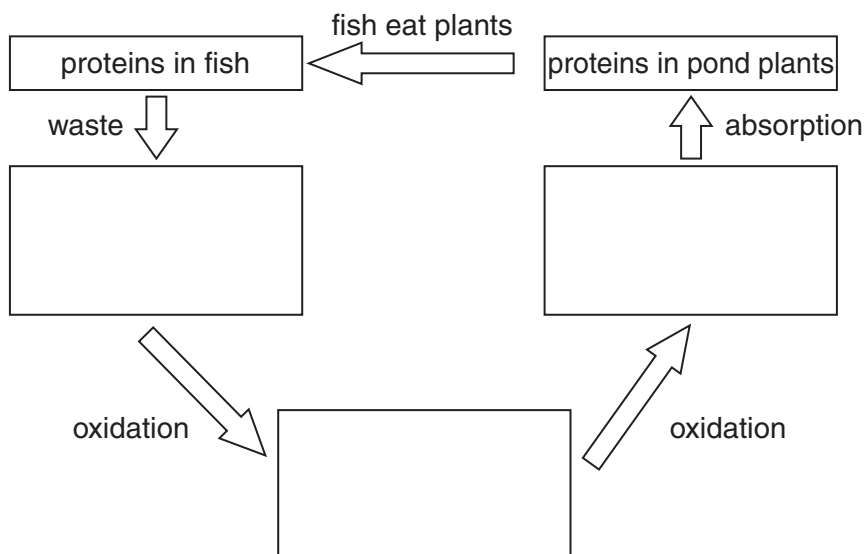


Nitrogen compounds in plants and fish are part of a cycle of changes. Plants in the pond take in (absorb) nitrate ions ( $\text{NO}_3^-$ ) from the water and use them to produce plant proteins. The nitrate ions are formed by the oxidation of nitrite ions ( $\text{NO}_2^-$ ) in the water. Fish eat plant proteins and convert them into proteins in their bodies. They pass out waste nitrogen compounds that contain ammonium ions ( $\text{NH}_4^+$ ) that are easily oxidised to nitrite ions in the water.

- (a) The chemical changes in the nitrogen cycle in the pond can be represented in a flow chart.

Use the information to complete the flow chart.

In each box write the **name** and the **formula** of the correct nitrogen ion.



[2]

(b) Proteins are made from amino acids.

The table shows some information about the amino acid, alanine.

<b>alanine</b>	
name of atom	percentage by mass in formula
carbon	40%
hydrogen	8%

(i) Explain how and why the **percentage by mass** of hydrogen and carbon in alanine seems to disagree with the **number of atoms** of these elements in the formula.

Your answer should include

- how the number of atoms of carbon and of hydrogen in the molecule are different
- how the percentage by mass of carbon and of hydrogen are different
- the reasons why these seem to disagree.

.....

.....

.....

.....

.....

..... [3]

(ii) Alanine is typical of molecules found in living things.

Which statement is the best reason why?

Put a tick (✓) in the box next to the **best** answer.

Alanine has a low melting point.

Alanine is soluble in water.

Alanine contains carbon, hydrogen and oxygen.

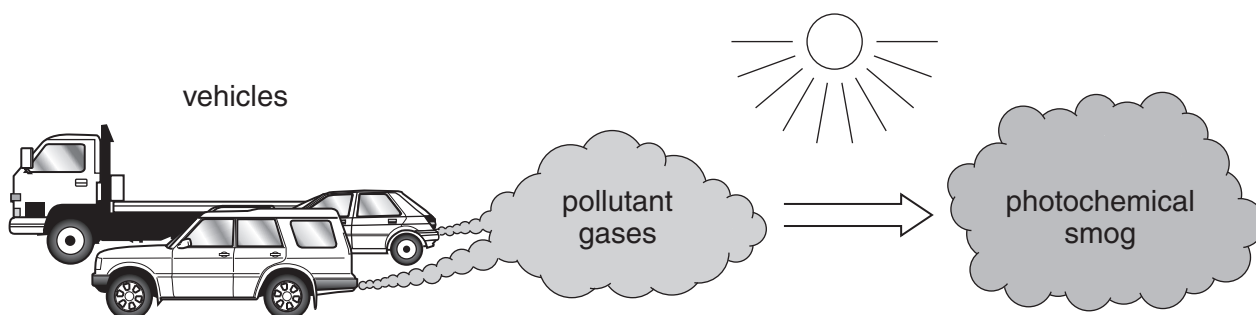
Alanine is non-toxic.

[1]

[Total: 6]

6 Photochemical smog forms when pollutant gases react together in strong sunlight.

The pollutant gases build up in cities where there are a large number of vehicles.



(a) When the concentration of pollutant gases increases, the rate of the reactions that form the smog changes.

What effect does an increase in concentration have on rate of reaction?

Use ideas about colliding particles to explain your answer.

.....

.....

.....

..... [3]

(b) A new type of city pavement has a catalyst coating.

The pollutant gases break down when they are in contact with the coating to form less harmful products.

The new pavements are expensive, but the coating keeps working for a very long time.

Explain why the catalyst keeps on working.

..... [1]

- (c) One of the pollutant gases is nitrogen dioxide.

Nitrogen dioxide makes nitric acid when it dissolves in water. Nitric acid is very acidic.

How does the pH of the water change if a large volume of nitrogen dioxide is bubbled through it?

Put a (ring) around the correct answer in **each row**.

Pure water has a pH of 1 5 7 9 14

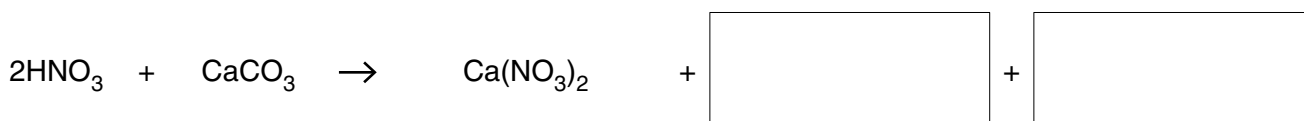
When a large volume of nitrogen dioxide is bubbled through water the pH changes to 1 5 7 9 14

[1]

- (d) Concrete contains calcium carbonate.

Nitric acid in rain water damages concrete because it reacts with calcium carbonate.

Complete the **word** and **symbol** equations for this reaction by filling in the empty boxes.

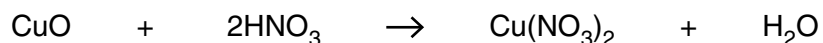


[3]

[Total: 8]

7 Copper nitrate is a salt that is used to give green colours in fireworks.

Eve makes some copper nitrate by reacting copper oxide with nitric acid.



(a) Eve carries out some calculations on her experiment.

The box shows some of her working.

(i) Fill in the missing relative formula mass of copper nitrate,  $\text{Cu}(\text{NO}_3)_2$ .

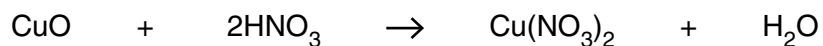
<b>relative atomic mass:</b>	Cu = 64	O = 16	H = 1	N = 14
<b>relative formula mass:</b>	CuO = 80			
	HNO <sub>3</sub> = 63			
	Cu(NO <sub>3</sub> ) <sub>2</sub> = .....			
	H <sub>2</sub> O = 18			

[1]

(ii) Eve weighs out 0.8g of copper oxide.

She uses the equation and the relative formula masses to work out the mass of nitric acid that will react exactly with 0.8g copper oxide.

Complete Eve's working by calculating the mass of nitric acid she needs.



0.8g CuO reacts with ..... g HNO<sub>3</sub> [2]

(b) The formula for copper nitrate is  $\text{Cu}(\text{NO}_3)_2$ .

The symbol for a nitrate ion is  $\text{NO}_3^-$

(i) What is the symbol for a copper ion?

answer ..... [1]

(ii) Some fireworks also contain copper sulfate.

Which acid would Eve need to add to copper oxide to make copper sulfate?

answer .....acid [1]

(iii) Lithium nitrate is added to some fireworks to give a red colour.

The symbol for a lithium ion is  $\text{Li}^+$ .

What is the formula for lithium nitrate?

answer ..... [1]

[Total: 6]

**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, is given to all schools that receive assessment material and is freely available to download from our public website ([www.ocr.org.uk](http://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.

