

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

CHEMISTRY (SALTERS)

Chemistry of Natural Resources

2848

Tuesday

11 JANUARY 2005

Morning

1 hour 30 minutes

Candidates answer on the question paper.

Additional materials:

Data Sheet for Chemistry (Salters)

Scientific calculator

Candidate Name	Centre Number	Candidate Number												
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TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

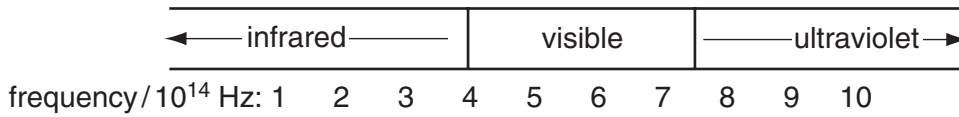
- The number of marks is given in brackets [] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry (Salters)*.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	21	
2	24	
3	24	
4	21	
TOTAL	90	

This question paper consists of 11 printed pages and 1 blank page.

Answer all the questions.

1 The temperature inside a glass greenhouse is usually higher than the temperature of the air outside. A similar effect occurs in the atmosphere and is called the 'greenhouse effect'. Glass is transparent to radiation of frequencies from about 1×10^{14} Hz to 10×10^{14} Hz. The relevant part of the electromagnetic spectrum is shown below.



(a) Give the main **type** of radiation which is described in each of the situations below.

(i) It enables us to see through glass.

.....[1]

(ii) It is radiated by plants and soil inside the greenhouse and absorbed by the glass.

.....[1]

(b) In the atmosphere, a major contributor to the greenhouse effect is carbon dioxide.

(i) Describe what happens to carbon dioxide molecules when they absorb the radiation emitted by plants and soil.

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

(ii) In this question, one mark is available for the quality of spelling, punctuation and grammar.

Describe **one** advantage of the greenhouse effect in the atmosphere and **one** disadvantage.

.....
.....
.....
.....
.....
.....
.....
.....[4]

Quality of Written Communication [1]

- (c) One way in which carbon dioxide is removed from the atmosphere is by dissolving in the oceans. When carbon dioxide dissolves in water, a dynamic equilibrium can be set up between carbon dioxide gas and dissolved carbon dioxide.

Describe, in terms of carbon dioxide molecules, what happens at the surface of the water when this dynamic equilibrium is set up.

.....

[2]

- (d) (i) Suggest why it is **not** possible to get a suntan inside a glass greenhouse.

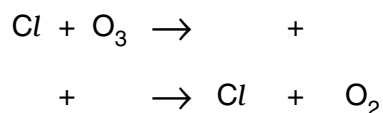
.....
[2]

- (ii) Ozone in the upper atmosphere protects us from the most harmful effects of the Sun's radiation. Write a balanced chemical equation for the reaction which is responsible for this, indicating the absorption of radiation in the usual way.

[2]

- (e) Chlorine atoms in the upper atmosphere catalyse the breakdown of ozone.

- (i) Complete the equations below to illustrate this.



[2]

- (ii) How can you tell from the equations in (i) that chlorine atoms are *catalysts* for the breakdown of ozone? Why is the process faster in the presence of a catalyst?

.....

[2]

- (iii) Name a source of chlorine atoms in the upper atmosphere.

.....[1]

- (iv) A chlorine atom contains an unpaired electron. What name is given to an atom, or molecule, with an unpaired electron?

.....[1]

[Total: 21]

[Turn over

2 Some copper-containing minerals are listed below.

tenorite	CuO
cuprite	Cu ₂ O
malachite	CuCO ₃ ·Cu(OH) ₂
chalcopyrite	CuFeS ₂

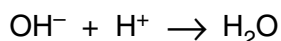
(a) Give the systematic names for

tenorite

cuprite[2]

(b) Malachite reacts with hydrochloric acid. A green solution is formed and carbon dioxide is given off.

The reaction of the OH⁻ ions can be represented by the following ionic equation.



(i) Write an **ionic** equation for the reaction of carbonate ions with acid.

[2]

(ii) Explain why the reaction in (i) is described as an *acid/base* reaction. Identify the base in this reaction.

.....

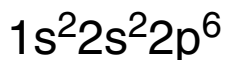
[2]

(iii) Suggest what happens to the Cu²⁺ ions when malachite reacts with hydrochloric acid.

.....

[2]

(c) Complete the electron configuration of a copper **atom**.



[2]

(d) In the modern process for extracting copper, ore containing chalcopyrite is concentrated and then smelted.

(i) An ore contains 2.0% by mass of chalcopyrite. Calculate the percentage of copper in this ore.

Give your answer to **two** significant figures.

A_r: Cu, 64; Fe, 56; S, 32

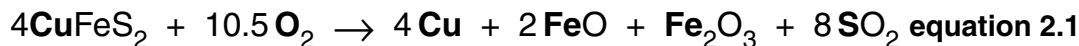
% Cu = [3]

- (ii) Suggest a method by which chalcopyrite is concentrated from the crushed ore.

.....[1]

- (e) An overall equation for the smelting reaction is given below with some of the oxidation states shown.

- (i) Give the oxidation states of the atoms shown in **bold**. Write your answers on the dotted lines below each atom.



.....+2 -2

[3]

- (ii) Suggest and explain **one** environmental hazard of operating the smelting process shown in **equation 2.1**.

.....

.....

.....[2]

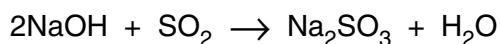
- (f) A pilot plant produces 320 g of sulphur dioxide.

- (i) Calculate the number of moles of SO_2 in this mass.

A_r : S, 32; O, 16

number =mol [2]

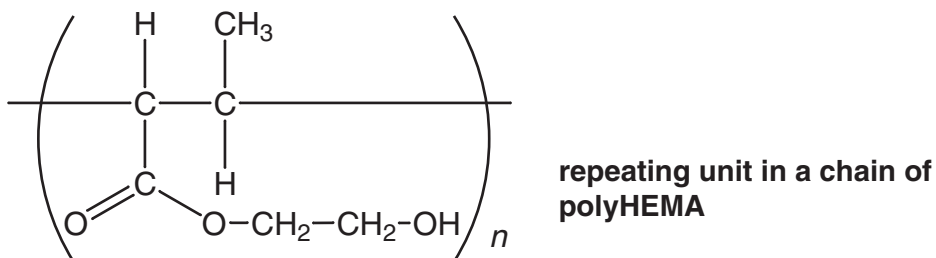
- (ii) Use the equation below to calculate the volume (in dm^3) of 0.5 mol dm^{-3} sodium hydroxide solution that reacts exactly with this number of moles of sulphur dioxide.



volume = dm^3 [3]

[Total: 24]

- 3 Contact lenses are now made from *hydrogels*. These are cross-linked polymer structures that are able to absorb water readily. PolyHEMA is an example of a hydrogel polymer.



- (a) The chains in polyHEMA are made by addition polymerisation. Draw the structure of the monomer from which they are made.

[2]

- (b) PolyHEMA is described as a *cross-linked polymer*. Suggest the **type** of bonding that holds the chains together in the cross-links.

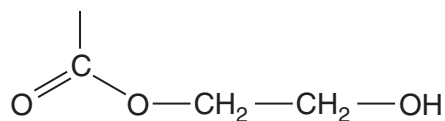
.....[1]

- (c) PolyHEMA is able to absorb water because hydrogen bonding can occur between water molecules and -OH groups on the polyHEMA structure.

Draw a diagram of a hydrogen bond formed between a water molecule and an -OH group, showing lone pairs and partial charges.

[4]

- (d) Alcohol groups are described as *primary*, *secondary*, and *tertiary*. Which name describes the alcohol group in the side-chain of polyHEMA shown below? Explain your answer.



type of alcohol group

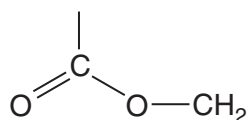
explanation

.....

.....[2]

- (e) The alcohol group in the side-chain can be oxidised to a carboxylic acid.

- (i) Complete the incomplete structure of the side-chain to show the carboxylic acid that is formed.



[2]

- (ii) Give the reactants and conditions needed to carry out this oxidation reaction in a laboratory.

.....

.....

.....[3]

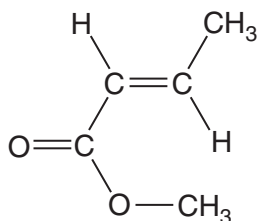
- (f) Formerly, contact lenses were made from PMMA (*perspex*). This polymer does not absorb water to any great extent.

Suggest why contact lenses containing absorbed water are an advantage over those that do not contain water.

.....

.....[1]

(g) The monomer of PMMA is shown below.



PMMA monomer

- (i) This compound shows geometric isomerism. Describe how this kind of isomerism arises and give the name that describes the geometric isomer shown above.

.....

[3]

- (ii) Suggest the strongest type of intermolecular force formed between chains of PMMA.

.....[1]

- (iii) In this question, one mark is available for the quality of use and organisation of scientific terms.

By comparing the intermolecular forces between the chains in PMMA and between the chains in **poly(ethene)**, describe and explain which of these two polymers you would expect to be the more flexible.

.....

[4]

Quality of Written Communication [1]

[Total: 24]

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4 Bromine is made by passing chlorine through a solution derived from sea water containing bromide ions. The resulting bromine is dangerous to transport but it has several important uses.

(a) (i) Describe the appearance of the element bromine at room temperature.

.....[2]

(ii) What can be deduced about the relative reactivities of bromine and chlorine from the way bromine is made? Explain your answer.

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

(iii) Write a half-equation showing what happens to bromide ions when they are converted to molecules of the element bromine.

[2]

(iv) Name the process taking place in this half-equation.

.....[1]

(b) Give **two** reasons why bromine is dangerous if spilt while being transported.

1.
.....

2.
.....[2]

(c) One use of bromine involves making silver bromide for use in photography.

Write an ionic equation, with state symbols, for the reaction between a solution of silver ions and a solution of bromide ions to form silver bromide.

[3]

(d) Bromine reacts with an alkene to form a dibromoalkane.

(i) What is **seen** when this reaction occurs?

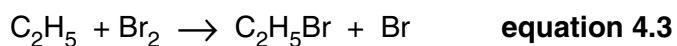
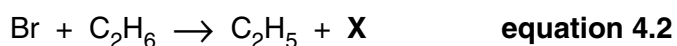
.....[1]

(ii) The mechanism of this reaction is described as electrophilic addition. Complete the reaction mechanism below, including relevant charges.



[4]

(e) Bromine also reacts with alkanes, as shown in the example below.



(i) What conditions are necessary for the reaction in **equation 4.1** to occur?

.....[1]

(ii) Name the **type** of bond fission that occurs in **equation 4.1**.

.....[1]

(iii) Circle the term that is used to describe the reaction in **equation 4.1**.

initiation **ionisation** **propagation** **termination** [1]

(iv) Name the product **X** in **equation 4.2**.

.....[1]

(v) Name the product $\text{C}_2\text{H}_5\text{Br}$ in **equation 4.3**.

.....[1]

[Total: 21]

END OF QUESTION PAPER

