

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

CHEMISTRY (SALTERS)

Chemistry of Natural Resources

2848

Thursday

10 JUNE 2004

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	19	
2	17	
3	14	
4	18	
5	22	
TOTAL	90	

This question paper consists of 16 printed pages.

Answer **all** the questions.

1 Chlorine, Cl_2 , can be used as a disinfectant for water. Chlorine is transported in pressurised containers.

(a) (i) In the event of an accident when chlorine is being transported, people living near the accident site are evacuated. What properties of chlorine make this necessary?

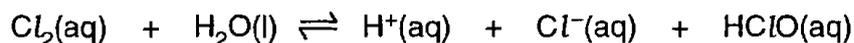
1.....

2.....[2]

(ii) Describe the appearance of water that has been saturated with chlorine.

.....[1]

(b) Chlorine reacts with water as shown below.



(i) The equilibrium position lies to the right. Explain why this solution is acidic.

.....

.....[1]

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

Some solid sodium chloride is added to a solution of chlorine in water. Use Le Chatelier's principle to explain what will happen to the concentration of $Cl_2(aq)$.

.....

.....

.....

.....

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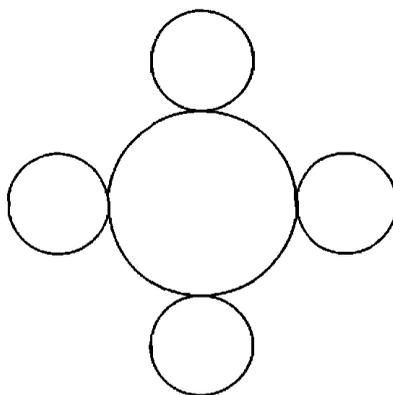
.....

.....[4]

Quality of Written Communication [1]

- (iii) The diagram below shows part of a layer of a sodium chloride lattice.

Label each type of particle and complete the diagram with enough particles to show the structure of the layer clearly.



[3]

- (c) (i) Give the oxidation states of chlorine in Cl_2 and HClO .

Cl_2 HClO [2]

- (ii) Give the name of the process in which Cl_2 is changed into HClO .

.....[1]

- (iii) Explain your choice of answer in (ii).

.....[1]

- (d) When a solution of chlorine in water behaves as a disinfectant, the active chemical is HClO .

The disinfecting power decreases when the solution is exposed to sunlight because HClO decomposes to form oxygen and a solution of hydrochloric acid.

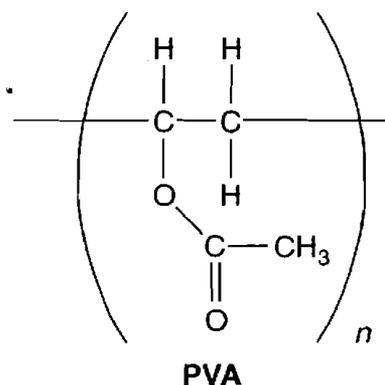
Complete the balanced chemical equation for this reaction below. Indicate that it is a photochemical reaction by writing the appropriate symbols over the arrow.



[3]

[Total: 19]

- 2 Glues contain substances that will bond to different surfaces. These substances are always polymers. Glues used for paper, fabric and card often contain the polymer polyvinyl acetate, PVA.



- (a) (i) Draw the structure of the monomer used to make PVA.

[1]

- (ii) PVA is a thermoplastic polymer. Explain the meaning of the term *thermoplastic*.

.....

[2]

- (iii) What **type** of polymerisation reaction is used to turn the monomer into PVA?

.....[1]

- (b) For a polymer to have good adhesive properties, it needs to have a high average relative molecular mass, M_r .

- (i) The average M_r of the molecules in a sample of PVA is 43 000. Calculate the average value of n in the formula of PVA given above.

A_r : H, 1.0; C, 12; O, 16

average value of $n =$ [2]

(ii) The longer the chains in a liquid polymer, the less easily the polymer flows.

Explain why.

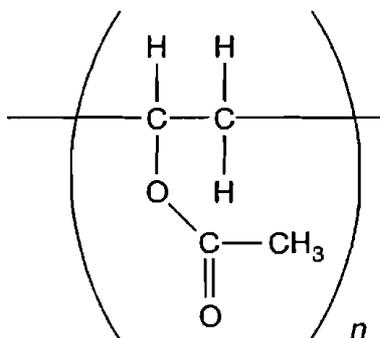
.....

.....

.....[2]

Turn over for the rest of Question 2

- (c) The surfaces of paper, card and fabric contain many -OH groups. PVA is able to 'stick' these surfaces together by interacting with these groups.

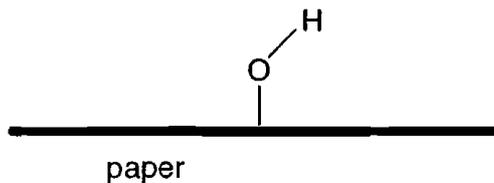


PVA or polyvinyl acetate

- (i) Name the strongest type of attractive force between paper and PVA.

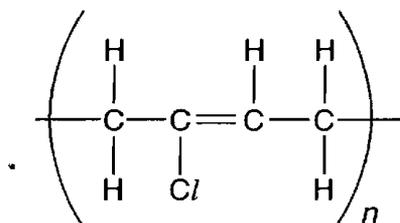
.....
[1]

- (ii) On the diagram below, show how an -OH group on the paper surface can interact with **part** of a PVA molecule. Include any relevant partial charges.



[3]

(d) Another adhesive, *Bostick*, contains a polymer commonly called polychloroprene.



polychloroprene

(i) Describe a chemical test to show that C=C bonds are present in *Bostick*.

Describe the colour change that occurs.

test

colour change from..... to.....

[3]

(ii) Explain why the C=C bond in polychloroprene can show geometric (*cis-trans*) isomerism.

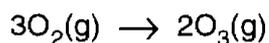
.....

.....[2]

[Total: 17]

- 3 Chemists have detected increases in the concentration of ozone in the troposphere (the lower atmosphere) during large firework displays. They believe the reactions involved in the formation of ozone in the troposphere are similar to those that take place in the stratosphere (the upper atmosphere).

(a) (i) The overall equation for the formation of ozone is shown below.



Complete **two** balanced equations to show how oxygen is converted into ozone in the stratosphere.

equation 1	O_2	$\xrightarrow{h\nu}$	
equation 2		\rightarrow	

[2]

(ii) Explain why the process you have described in (i) takes place in the stratosphere, but **not** usually in the troposphere.

.....
 [2]

(iii) Why might firework displays result in ozone formation?

..... [1]

(b) In the troposphere, ozone acts as a **greenhouse** gas.

(i) What effect would an increased ozone concentration have on the troposphere?

..... [1]

(ii) What **type** of radiation is absorbed by ozone when it acts as a greenhouse gas?

..... [1]

(iii) What effect does this radiation have on the ozone molecule?

..... [1]

(c) In the stratosphere, ozone acts as a sunscreen by absorbing radiation.

(i) What happens to molecules of ozone that have absorbed the radiation?

..... [1]

- (ii) The bond enthalpy of an oxygen-oxygen bond in ozone is $+302 \text{ kJ mol}^{-1}$. Calculate the energy in **joules** to break **one** oxygen-oxygen bond in ozone.

$$\text{Avogadro constant} = 6.02 \times 10^{23} \text{ mol}^{-1}$$

energy = J [3]

- (iii) Using the equation $E = h\nu$, calculate the minimum frequency of radiation needed to break a bond in an ozone molecule. **Give your answer to three significant figures.**

$$h = 6.63 \times 10^{-34} \text{ J Hz}^{-1}$$

frequency = Hz [2]

[Total: 14]

4 Platinum has been used as a jewellery metal for over 4000 years. In recent times, it has become important in a wider range of applications. For example, it is an essential constituent of steel used in blades for slicing bread.

(a) Rock containing the highest concentration of platinum is found in South Africa. 1 000 kg of rock contains 3 g of platinum.

(i) Calculate the percentage by mass of platinum in the rock.

% = [1]

(ii) The platinum-containing rock is crushed, made into a slurry and then mixed with a detergent containing 'collector' molecules. Air is then blown through the mixture. This enables the grains of metal minerals to be separated from the rest of the mixture.

Name the separation process and briefly explain how it works.

name of process

how it works

.....

.....

.....[3]

(b) The grains of metal minerals also contain copper(I) sulphide and copper(II) sulphide.

(i) Write the formula of copper(I) sulphide.

..... [1]

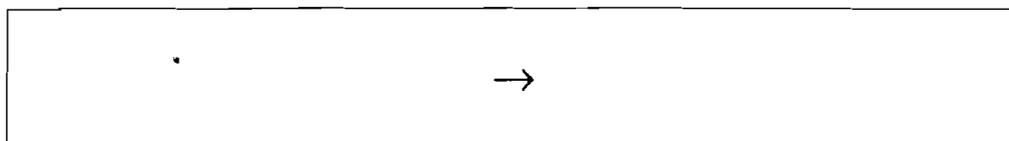
(ii) Use your Periodic Table to help you to complete the electron structure for a sulphur atom.

$1s^22s^2$

[2]

- (iii) During smelting, some copper(I) sulphide is converted into metallic copper and sulphur dioxide.

Write a balanced equation for this process. State symbols are not required.



[2]

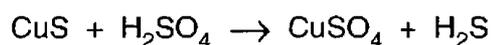
- (iv) The sulphur dioxide is collected and converted into sulphuric acid for use in the chemical industry.

Explain the environmental reasons why sulphur dioxide is not released into the atmosphere.

.....

[2]

- (c) Any remaining copper(II) sulphide is removed as shown below.



This is an acid-base reaction.

- (i) In an acid-base reaction, what is gained by the base?

.....[1]

- (ii) Give the formula of the ion that is acting as the base.

..... [1]

(d) One of the most important uses of platinum is as a catalyst.

Complete the enthalpy profile diagram below to show how a catalyst speeds up an exothermic reaction. The uncatalysed reaction takes place in a single step.

Show and label in your diagram the

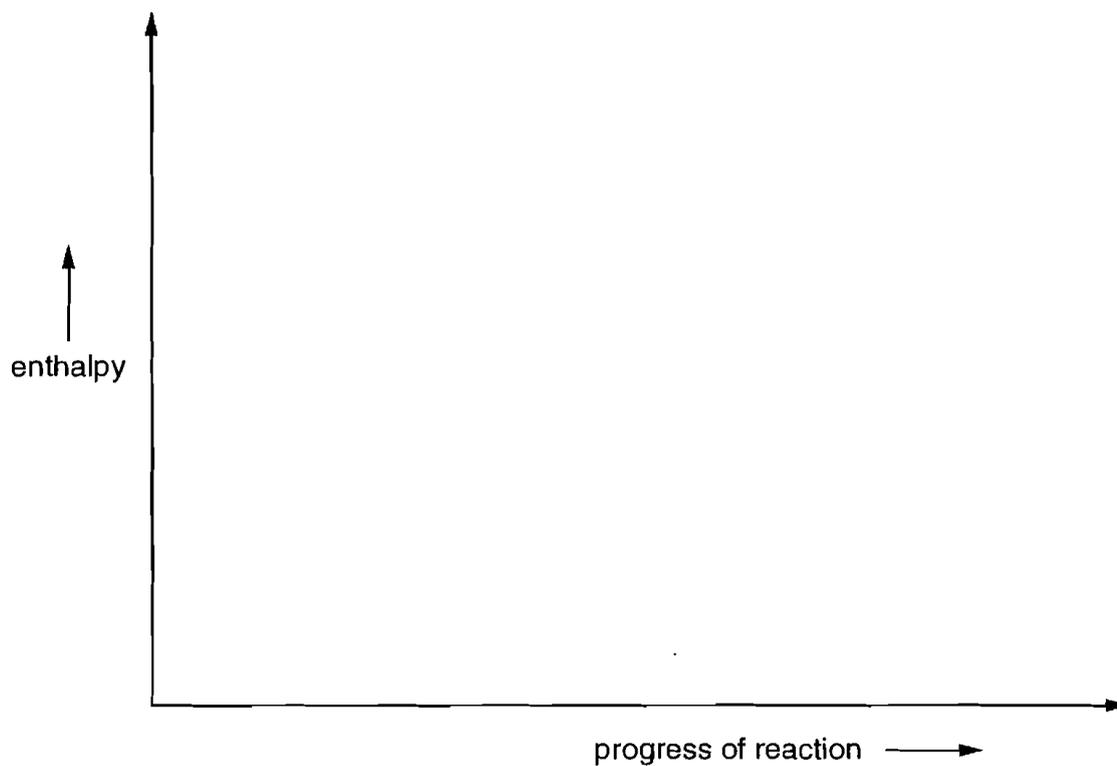
reactants

products

activation enthalpy without a catalyst

activation enthalpy with a catalyst

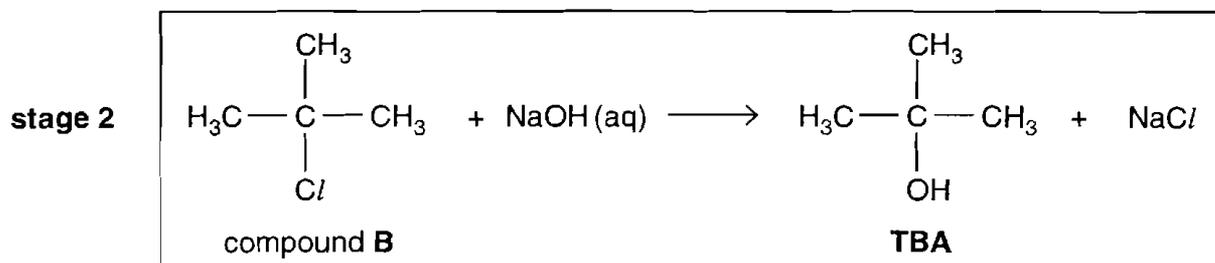
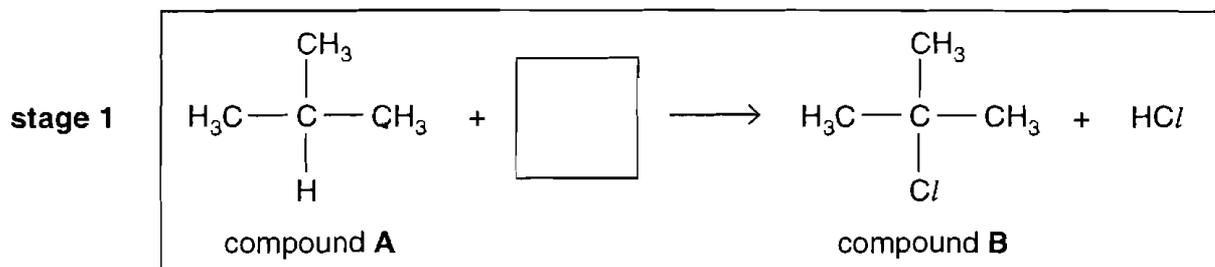
enthalpy change of reaction.



[5]

[Total: 18]

- 5 An additive sometimes used in petrol is TBA. TBA can be made from compound **A** in two stages.



- (a) (i) In the box in **stage 1**, write the formula of the reagent needed to make compound **B**. [1]

- (ii) Give the systematic name of compound **B**.

.....[2]

- (iii) Give the conditions used to carry out **stage 2** in the laboratory.

.....[1]

- (b) **Stage 2** is a nucleophilic substitution reaction.

- (i) Give the **formula** of the nucleophile in the reaction.

.....[1]

- (ii) Explain why a carbon atom in compound **B** is attacked by a nucleophile.

.....

.....[2]

(c) To carry out the reaction in **stage 2**, a student needs to make up 100 cm³ of 2.0 mol dm⁻³ aqueous sodium hydroxide.

(i) Calculate the number of moles of sodium hydroxide needed to make up the solution.

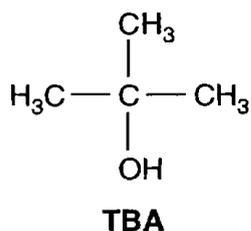
number of moles = mol [2]

(ii) Calculate the mass of solid sodium hydroxide the student should weigh out.

A_r : H, 1.0; O, 16; Na, 23

mass = g [2]

(d) (i) State whether TBA is a primary, secondary or tertiary alcohol. Give a reason for your choice.



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

(ii) Alcohols can be dehydrated to form alkenes. Give the structure of the alkene formed when TBA is dehydrated.

[2]

(iii) What **type** of reaction is dehydration? Choose your answer by circling **one** of the words in the list below.

acid-base addition condensation elimination hydrolysis substitution
[1]

