THIS IS A LEGACY SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

CHEMISTRY (SALTERS)

Chemistry of Natural Resources

2848/01

Candidates answer on the question paper

OCR Supplied Materials:
- *Data Sheet for Chemistry (Salters)* (inserted)

Other Materials Required:
- Scientific calculator

Wednesday 3 June 2009
Morning

Duration: 1 hour 30 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, however additional paper may be used if necessary.

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 **90**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry (Salters)* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- This document consists of **16** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**27**	
2	**26**	
3	**17**	
4	**20**	
TOTAL	**90**	

This paper has been pre modified for carrier language

Answer **all** the questions.

1 The polymer poly(ethene) was discovered by accident.

(a) Give the name of another polymer that was discovered by accident.

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

(b) High density and low density poly(ethene) can be made by producing the polymer under different conditions. The high density form is more crystalline.

Give **two** other properties, apart from density, that would be different in high density poly(ethene) compared to the low density form.

.....

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

(c) Poly(ethene) is made from ethene, which can be produced from ethanol.

(i) Name the **type** of reaction that produces ethene from ethanol.

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

(ii) Give the reagents and conditions that would be required to form ethene from ethanol.

.....

.....

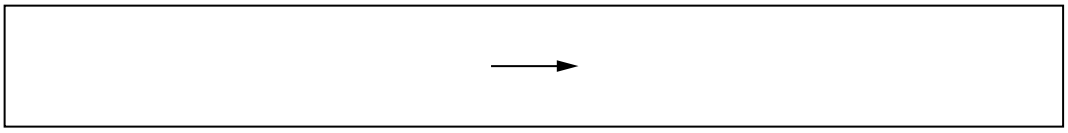
..... **[3]**

(d) Another polymer, PVC, is made by a process using methane and chlorine.
Chlorine is produced from an aqueous solution of sodium chloride by electrolysis. The overall equation for the reaction involved is shown below.

$$2NaCl\,(aq) + 2H_2O\,(l) \rightarrow 2NaOH\,(aq) + H_2\,(g) + Cl_2\,(g) \qquad \textbf{equation 1.1}$$

In the electrolysis of sodium chloride, chlorine molecules are produced from chloride ions at the anode.

Write the half-equation for this reaction.



[2]

(e) PVC, or poly(chloroethene), is a rigid polymer material.
Diagram 1 shows part of the polymer chain present in PVC.

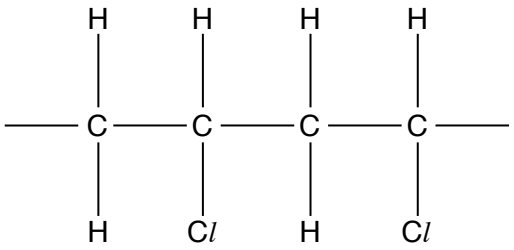


diagram 1

(i) Use **diagram 1** to help you draw the full structural formula of the chloroethene monomer.

[1]

(ii) Name the **type** of polymerisation that occurs when PVC is produced.

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

(f) The polymer is formed by a radical chain reaction.

(i) What is a radical?

.....

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

(ii) Name the **type** of bond breaking that causes a radical to form.

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

(iii) The first stage in the mechanism of the reaction, which produces the radicals, is called the initiation stage.

Name the other two stages.

second stage: .....

third stage: ..... **[2]**

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

Radical polymerisations are very rapid. One way to slow them down is to carry them out at lower temperatures. Using ideas about collision theory and activation enthalpy, explain how lowering the temperature reduces the rate of the reaction.

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.....

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

Quality of Written Communication **[1]**

(g) One way of making PVC more flexible is to copolymerise the chloroethene with a second monomer, such as ethenyl ethanoate.

(i) Name the functional group that is present in **both** chloroethene and ethenyl ethanoate.

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

(ii) **Diagram 2** shows part of the chain of the PVC – ethenyl ethanoate copolymer molecule.

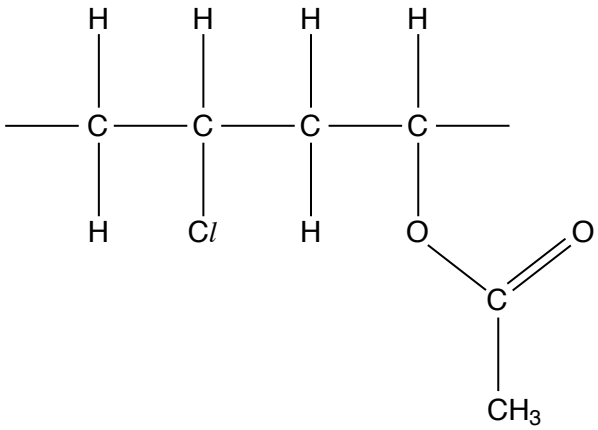


diagram 2

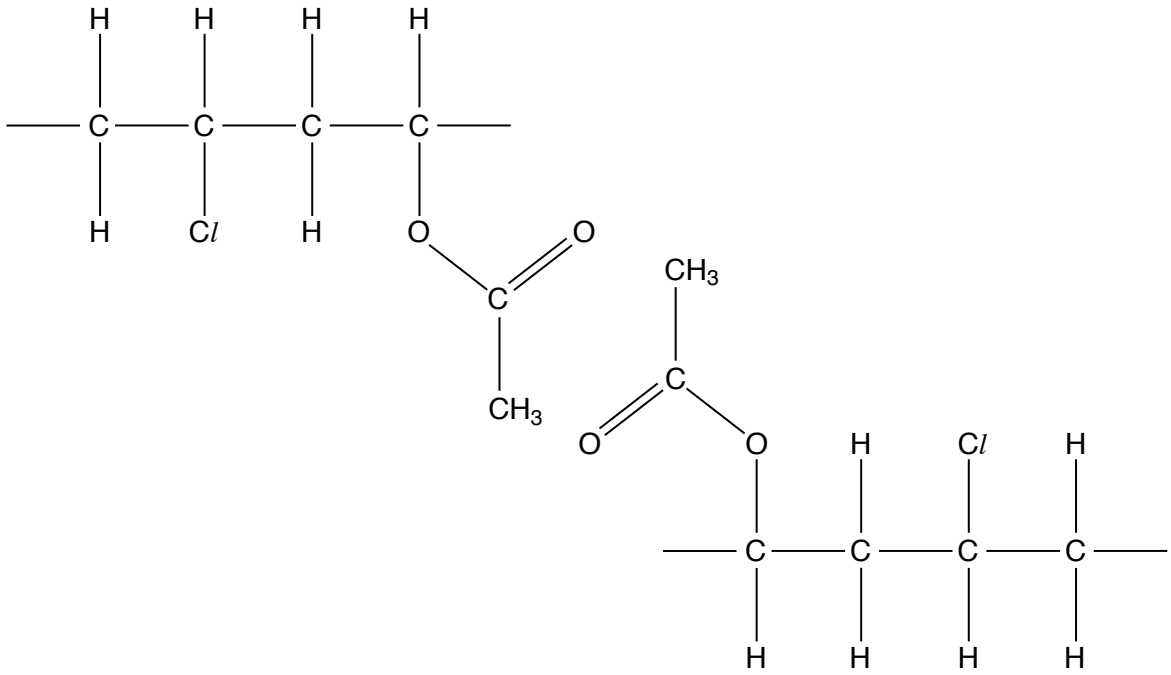
The copolymer form of PVC can be used to make cling film food wrap. The ability of cling film to stick to itself arises from its intermolecular forces.

Name the strongest type of intermolecular force that is present between chains of the copolymer form of PVC shown in **diagram 2**.

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

(iii) The diagram below shows two PVC copolymer chain sections.

On the diagram show the intermolecular force you have described in **(ii)**.
Show relevant partial charges.



[2]

(h) Explain why the PVC copolymer described in **diagram 2** is more flexible than ordinary PVC.

.....

.....

.....

.....

..... **[3]**

[Total: 27]

2 A range of methods has been used for the extraction of silver from metal ores. Some of these are outlined below.

method		outline of the process
1	Cyanide leaching	Highly toxic cyanide ions are used to leach silver ions rapidly from an ore sample.
2	Bacterial leaching	Bacteria convert silver(I) sulphide into a soluble complex. The process works on very low-grade ores. The process takes several weeks.
3	During copper refining	Impure copper is used as an anode. Pure copper is deposited onto the cathode and solid silver falls to the bottom of the electrolysis tank.

(a) A potential problem with the cyanide extraction process is loss of hydrogen cyanide gas into the atmosphere. This loss is minimised by using the cyanide under alkaline conditions.

$$CN^-\,(aq) + H_2O\,(l) \rightleftharpoons HCN\,(g) + OH^-\,(aq) \qquad \textbf{equation 2.1}$$

State Le Chatelier's Principle and use it and **equation 2.1** to explain why adding an alkali limits the loss of hydrogen cyanide gas from the reaction mixture.

Le Chatelier's Principle: .....

.....

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

explanation: .....

.....

.....

.....

..... **[3]**

(b) Using information from the table opposite, suggest **two** advantages and **one** disadvantage of bacterial leaching compared to cyanide leaching for obtaining silver.

advantages: .....

.....

.....

disadvantage: .....

..... **[3]**

(c) The copper that forms from **method 3** is 99.55% pure.

(i) Calculate the number of parts per million of **impurity** in the copper.

ppm = ... **[2]**

(ii) The impure copper is produced in a furnace from copper matte, Cu_2S, by smelting.

Explain how smelting is carried out.
Name the gas that forms during smelting that is a cause of acid rain.

smelting: .....

.....

name of gas: ..... **[3]**

(d) A new method for silver extraction has been investigated using ores containing silver(I) sulphide, Ag_2S. The ore is reacted with thiosulphate ions, $S_2O_3^{2-}$, under acidic conditions to produce a solution containing Ag^+ ions.

(i) What is the oxidation state of sulphur in silver(I) sulphide and in thiosulphate ions?

Ag_2S: ..... $S_2O_3^{2-}$: ..... **[2]**

(ii) Silver is obtained by electrolysis of the aqueous solution containing Ag^+ ions.

$$Ag^+(aq) + e^- \longrightarrow Ag(s) \qquad \textbf{equation 2.2}$$

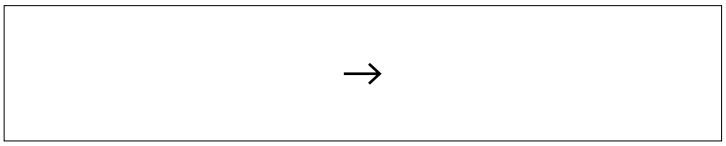
Explain why the process represented by **equation 2.2** is classed as reduction.

.....

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

(e) Silver chloride is used in lenses for photochromic spectacles. Silver chloride can be made from a solution containing silver ions by adding a solution that contains chloride ions.

(i) Write an **ionic** equation that describes the precipitation of silver chloride, showing state symbols.



[2]

(ii) Give the colour of the precipitate of silver chloride formed.

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

(iii) Solid silver chloride has a cubic lattice structure similar to that of sodium chloride.

Sketch and label a diagram that shows the arrangement of ions in a layer of the silver chloride lattice.

[2]

(iv) The silver chloride can be separated from the mixture by vacuum filtration.

Draw a diagram of the apparatus you would use, labelling the parts of the apparatus and where the silver chloride would be found.

[3]

(v) The presence of silver chloride in the photochromic lenses makes them turn grey and darken when the glasses are worn in bright sunlight.

Suggest what happens to the silver chloride to cause the darkening effect to occur.

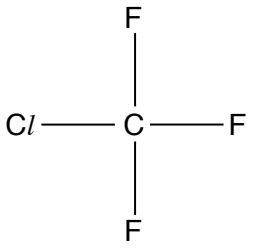
.....

.....

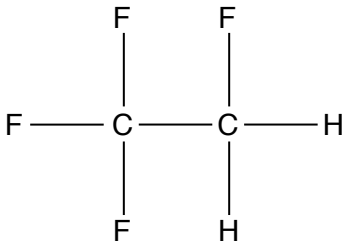
..... **[2]**

[Total: 26]

3 CFCs, such as CFC 11, were used as refrigerants. More recently, HFCs have taken over from CFCs because HFCs have a much lower ozone depletion potential. One example of an HFC is shown below.



CFC 11



HFC 134a

(a) Give the systematic name for HFC 134a.

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

(b) CFCs cause ozone depletion because their C−C*l* bonds break in the stratosphere to produce chlorine atoms, which catalyse the breakdown of ozone.

(i) Write equations for the reactions in the cycle in which chlorine atoms catalyse the breakdown of ozone.

[2]

(ii) Suggest why C−F bonds are much less likely than C−C*l* bonds to be broken in the stratosphere.

.....

.....

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

(iii) The bond enthalpy of the C−C*l* bond is +346 kJ mol^{-1}.
Calculate the minimum energy (in Joules) needed to break a **single** C−C*l* bond.

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

minimum energy = ... J **[2]**

(iv) Calculate the frequency of radiation that is needed to break one C−C*l* bond.
Give your answer to **three** significant figures.

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

frequency = ... Hz **[3]**

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

HFC 134a is also a powerful greenhouse gas.

Explain how the Greenhouse Effect transfers energy from the Sun to heat energy that warms the Earth's atmosphere.

In your answer you should include:

- what happens to the radiation from the Sun that enters the Earth's troposphere;
- what happens to a molecule of HFC 134a and how this results in the warming of the troposphere.

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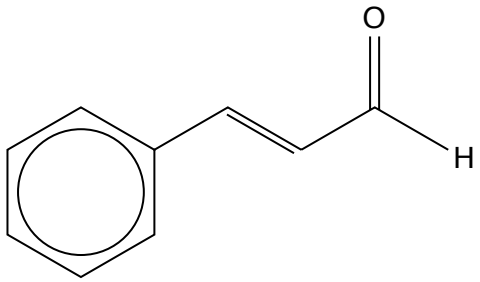
..... **[5]**

Quality of Written Communication **[1]**

[Total: 17]

4 Cinnamon is obtained from the bark of a tree. It is used in cooking to provide a spicy scent and flavour to food. The spicy smell is caused by the presence of an oil called cinnamaldehyde.



cinnamaldehyde

(a) Cinnamaldehyde is one geometric (*cis-trans*) isomer of $C_6H_5CH{=}CHCHO$.

(i) Draw the skeletal formula of the other geometric isomer of $C_6H_5CH{=}CHCHO$.

[2]

(ii) Explain why $C_6H_5CH{=}CHCHO$ exhibits geometric isomerism.

.....

.....

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

(b) Cinnamaldehyde reacts with liquid bromine.

(i) Name the functional group present in cinnamaldehyde that reacts with the bromine.

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

(ii) State the colour change you would see when bromine reacts with cinnamaldehyde.

From: ..... to: ..... **[2]**

(iii) Underline **two** of the following words to describe the reaction mechanism between cinnamaldehyde and bromine.

addition **electrophilic** **elimination**

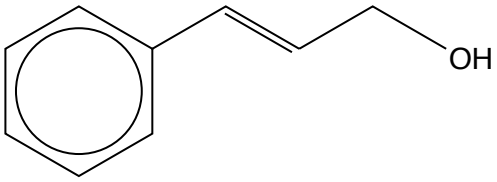
nucleophilic **radical** **substitution**

[2]

(c) Cinnamaldehyde takes part in an addition reaction with hydrogen bromide. Draw two possible structures for the product of this reaction.

[2]

(d) Cinnamaldehyde can be made from cinnamyl alcohol by an oxidation reaction.



cinnamyl alcohol

Give the reagents and conditions for the formation of cinnamaldehyde from cinnamyl alcohol.

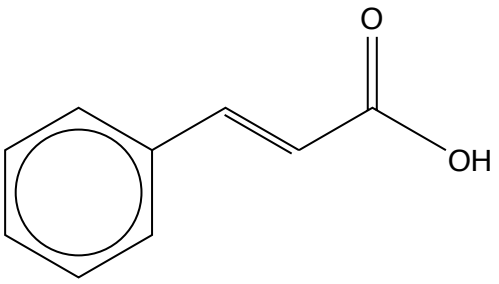
.....

.....

..... **[3]**

QUESTION 4 CONTINUES ON PAGE 14

The aldehyde group in cinnamaldehyde can be further oxidised to produce cinnamic acid. Cinnamic acid is acidic because it contains the carboxylic acid, COOH, functional group.



cinnamic acid

A solution of cinnamic acid reacts with sodium hydroxide solution. The reaction that occurs is represented by **equation 4.1**. The formula of cinnamic acid is shown as RCOOH.

$$RCOOH(aq) + NaOH(aq) \longrightarrow RCOO^{-}Na^{+}(aq) + H_2O(l) \qquad \textbf{equation 4.1}$$

(e) Underline **one** of the following words to describe the type of reaction that occurs between cinnamic acid and sodium hydroxide solution.

acid–base **precipitation** **redox** **[1]**

(f) In order to establish its purity, a 0.0400 g sample of impure cinnamic acid was dissolved in water and analysed by titrating it with sodium hydroxide solution. It was found that 26.10 cm^3 of 0.0100 mol dm^{-3} sodium hydroxide solution were required.

(i) Calculate the number of moles of sodium hydroxide used in the reaction.

moles of sodium hydroxide = ... **[2]**

(ii) Use **equation 4.1** and your answer to **(i)** to give the number of moles of cinnamic acid that took part in the reaction.

moles of cinnamic acid = ... **[1]**

(iii) Calculate the percentage of cinnamic acid in the 0.0400 g sample.

M_r of cinnamic acid = 148

% of cinnamic acid = ... **[2]**

[Total: 20]

END OF QUESTION PAPER

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