OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE **2848/01**

CHEMISTRY (SALTERS)

Chemistry of Natural Resources

WEDNESDAY 4 JUNE 2008 Morning

Time: 1 hour 30 minutes

Candidates answer on the question paper
Additional materials (enclosed): *Data Sheet for Chemistry (Salters)* (Inserted)

Additional materials (required):
Scientific calculator

CUP/T38935

Candidate Forename		Candidate Surname	
Centre Number		Candidate Number	

INSTRUCTIONS TO CANDIDATES

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

INFORMATION FOR CANDIDATES

- The number of marks for each question 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.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**19**	
2	**19**	
3	**13**	
4	**14**	
5	**25**	
TOTAL	**90**	

This document consists of **14** printed pages, **2** blank pages and a *Data Sheet for Chemistry (Salters)*.

  [Turn over

Answer **all** the questions.

1 Ethene can be made from a variety of chemicals. A large amount of ethene is used for the manufacture of plastics.

(a) Ethene can be produced by the dehydration of ethanol as shown in **equation 1.1**.

$$CH_3CH_2OH \rightarrow CH_2CH_2 + H_2O \qquad \textbf{equation 1.1}$$

(i) Underline the term below that describes the type of reaction occurring in **equation 1.1**.

addition **elimination** **hydrolysis** **substitution** [1]

(ii) What reagents and conditions would be required for the reaction shown in **equation 1.1**?

reagents .....

.....

conditions ..... [3]

(b) Gases from crude oil are currently used to produce most of the ethene for industry.

Suggest why making ethene from ethanol may become a more important method in the future.

.....

.....

..... [2]

(c) Ethene can be converted into low density poly(ethene), ldpe, by heating under pressure.

$$n CH_2{=}CH_2 \rightarrow -(-CH_2{-}CH_2-)_n-$$

What is the name of this type of polymerisation?

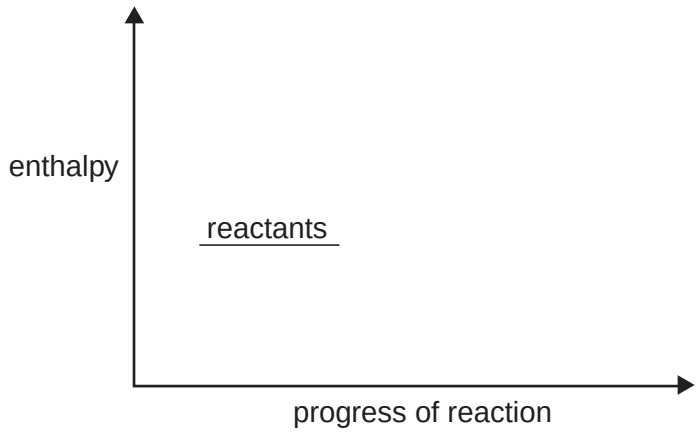
..... [1]

(d) Catalysts are used in the manufacture of polymers.

Complete the enthalpy profile diagram below to show the effect of a catalyst on an **endothermic** reaction that takes place in a single step.

Show and label on your diagram the:

- products
- activation enthalpy without a catalyst, labelled E_A
- activation enthalpy with a catalyst, labelled E_C
- enthalpy change for the reaction, labelled ΔH.



[5]

(e) Karl Ziegler discovered a method that allowed the polymerisation of ethene to produce high density poly(ethene), hdpe. The polymer hdpe has a higher density than ldpe and is more crystalline.

(i) Explain, in terms of their structures, why hdpe has a higher density than ldpe.

.....

.....

..... [2]

(ii) Explain the meaning of the term *crystalline* as applied to polymers.

.....

.....

..... [2]

(iii) Suggest and explain **one** difference in properties between these polymers apart from density and crystallinity.

.....

.....

..... [3]

[Total: 19]

2 Potassium chlorate(VII), $KClO_4$, is used in fireworks, for example in sparklers. A sparkler burns over a long period of time and produces a brilliant shower of sparks.

(a) Solid potassium chlorate(VII) produces oxygen when heated, which helps the sparkler to burn. Potassium chloride also forms.

Complete **equation 2.1** to show the products of this reaction. Include state symbols.

$KClO_4$ ( ) $\rightarrow$ …… ( ) + …… ( ) **equation 2.1**

[2]

(b) Underline the term below that describes the type of reaction occurring in **equation 2.1**.

acid-base **combustion** **precipitation** **redox** [1]

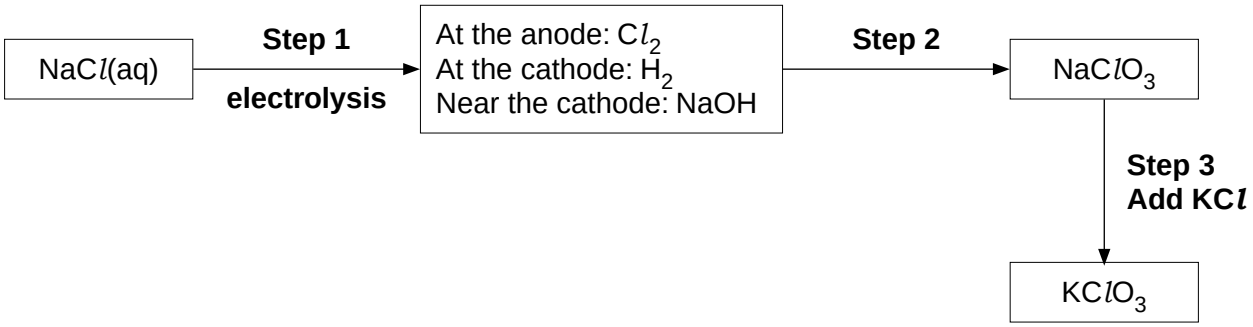
(c) Another chlorate of potassium, $KClO_3$, is also used in fireworks to produce oxygen, as shown in **equation 2.2**.

$$2KClO_3 \rightarrow 2KCl + 3O_2 \quad \textbf{equation 2.2}$$

Give the oxidation state of the chlorine in:

$KClO_3$ ..... KCl ..... [2]

(d) $KClO_3$ can be made by the steps outlined in the flow chart below.



(i) In **step 1** chlorine molecules are produced from chloride ions at the anode.

Write the half-equation for this reaction.

[2]

(ii) Explain why the conversion of chloride to chlorine is classified as oxidation.

.....

..... [1]

(iii) Give **one** large-scale use of chlorine, other than for making chlorates.

..... [1]

(e) **Step 2** occurs if the electrodes are placed close together.

(i) Complete the chemical equation for the reaction in **step 2**.

$$3Cl_2 + 6NaOH \longrightarrow NaClO_3 + 5NaCl + \ldots\ldots\ldots$$ [1]

(ii) Use the flow chart to suggest why the electrodes need to be close to each other for this reaction to happen.

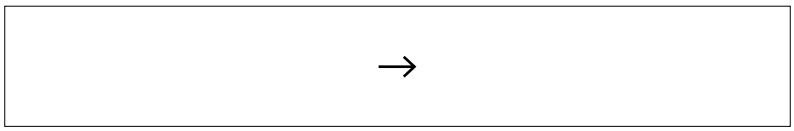
.....

..... [1]

(f) In **Step 3** potassium chloride is added to the reaction mixture. The $KClO_3$ precipitate that forms is filtered off, leaving a solution of sodium chloride.

(i) Adding silver nitrate solution to the filtrate can show the presence of chloride ions.

Write the ionic equation for the precipitation of the silver chloride, $AgCl$, showing state symbols.



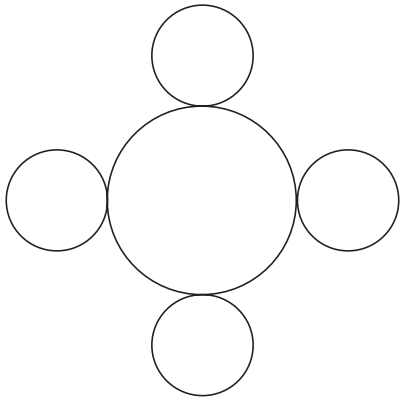
[2]

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

..... [1]

(iii) Solid $AgCl$ has a lattice structure similar to that of $NaCl$. The diagram below shows part of a layer of the $AgCl$ lattice.

Label each type of particle.



[1]

(iv) Complete the diagram in **f(iii)** by drawing in enough particles to show the structure of the layer clearly. [1]

(g) Small pieces of metal, rather than a fine powder, are added to produce the sparks as the sparkler burns.

Explain, in terms of the reacting particles, why the reaction is slower if small metal pieces are used, rather than finely powdered metal.

.....

.....

.....

.....

.....

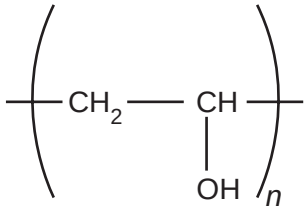
..... [3]

[Total: 19]

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

3 Hospitals use plastic laundry bags made from a copolymer containing mainly units of poly(ethenol). The bags dissolve during washing, which means that hospital workers do not need to handle the dirty linen and run the risk of infection.



poly(ethenol)

(a) Draw the structure of the monomer, ethenol, from which the polymer poly(ethenol) gets its name.

[1]

(b) Poly(ethenol) is not made directly from the monomer ethenol. This is because ethenol is an unstable isomer of ethanal, CH_3CHO.

(i) Draw the **full structural** formula of ethanal.

[1]

(ii) Name the homologous series to which ethanal belongs.

..... [1]

(iii) Ethanal can be made by oxidising ethanol.

Give the reagents and conditions required for the oxidation of ethanol to ethanal in the laboratory.

.....

.....

..... [3]

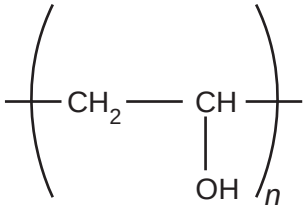
(iv) When another alcohol, propan-2-ol, is oxidised, the product that forms is in a different homologous series from that of ethanal.

Name the homologous series to which this product would belong.

..... [1]

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

Pure poly(ethenol) is only slightly soluble in hot water.



poly(ethenol)

Explain the low solubility of pure poly(ethenol), in terms of intermolecular forces.

In your answer you should refer to:

- the strongest type of intermolecular force that is present between molecules of poly(ethenol)
- how these intermolecular forces form
- how these forces can be used to account for the low solubility of the pure poly(ethenol) in water.

.....

.....

.....

.....

.....

.....

.....

..... [5]

Quality of Written Communication [1]

[Total: 13]

4 Industrial demand for the metal tin, Sn, has risen in recent years because it is used to make a variety of modern electrical components.

(a) Tin ore can be mined by spraying high-pressure jets of water onto rocks containing tin ore. The rocks break up and a mixture of water, waste rock and tin ore is collected. The water and waste rock are separated from the tin ore.

(i) Suggest **two** possible environmental problems that could arise from obtaining tin ore by this method.

.....

.....

.....

..... [2]

(ii) Suggest a possible method of overcoming **one** of the problems you have mentioned in **(i)**.

.....

.....

..... [1]

(b) (i) Name the 'block' of the Periodic Table in which tin is found.

..... [1]

(ii) Write the electron configuration for the highest energy subshell of a tin, Sn, atom. For example that for oxygen is $2p^4$.

..... [2]

(iii) Tin forms many compounds in which the oxidation state is +2.

Suggest another oxidation state that tin might show in its compounds.

Explain how you arrived at your answer.

.....

.....

.....

..... [2]

(c) Tin can be used to make alloys. The amount of tin present in an alloy was found using a titration method.

A weighed sample of tin alloy was reacted with hydrochloric acid to form exactly 250 cm^3 of a solution containing Sn^{2+} ions. 25.0 cm^3 of this Sn^{2+} solution was titrated with iodine solution.

(i) The 25.0 cm^3 of Sn^{2+} solution reacted exactly with 9.70 cm^3 of I_2(aq) that had a concentration of 0.050 mol dm^{-3}.

Calculate the number of moles of iodine, I_2, used in the reaction.

number of moles of I_2 = ... [2]

(ii) The left-hand side of the balanced ionic equation for the reaction between iodine and Sn^{2+} ions is given below.

$$Sn^{2+}(aq) + I_2(aq) \rightarrow$$

Use your answer to **c(i)** and the information above to write down the number of moles of Sn^{2+} that took part in the reaction.

number of moles of Sn^{2+} = ... [1]

(iii) 0.95 g of the tin alloy was used in this experiment to make the original 250 cm^3 of solution. Your answer to **c(ii)** is the number of moles of tin in 25.0 cm^3 of this solution.

Calculate the percentage by mass of tin in the alloy being analysed.

A_r: Sn, 119

% by mass of tin = ... [3]

[Total: 14]

5 During the last century, large amounts of CFCs were manufactured for a range of uses, for example as a propellant in aerosol cans.

(a) What does CFC stand for?

..... [1]

(b) Give **one** large-scale use for CFCs during the last century, other than as aerosol propellants.

.....

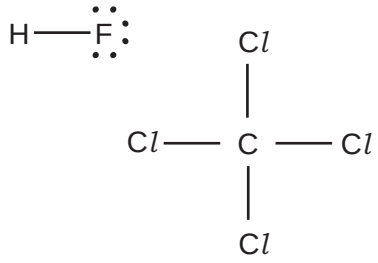
..... [1]

(c) The CFC with formula CCl_2F_2 was made from tetrachloromethane, CCl_4, by reacting it with hydrogen fluoride.

(i) Give the systematic name for CCl_2F_2.

..... [1]

(ii) Add 'curly arrows' to the diagram below to show the attack of one hydrogen fluoride molecule on tetrachloromethane and the resulting electron pair movement within the molecule.



[2]

(d) The use of CFCs has now almost stopped because it was found that CFC emissions were making a large contribution to stratospheric ozone depletion.

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

Describe why CFCs do **not** tend to react in the troposphere and how they contribute to the breakdown of ozone in the stratosphere.

.....

.....

.....

.....

.....

..... [4]

Quality of Written Communication [1]

(ii) The presence of ozone in the stratosphere is important for humans.

Explain why.

.....

.....

.....

..... [3]

(e) CFCs contain both C–F bonds and C–Cl bonds.

(i) Suggest why C–F bonds are much less likely than C–Cl bonds to be broken in the stratosphere.

.....

.....

..... [2]

(ii) The bond enthalpy of the C–F bond is +467 kJ mol^{-1}.

Calculate the minimum energy (in Joules) needed to break a **single** C–F bond.

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

minimum energy = ... J [2]

(iii) Calculate the frequency of radiation that is needed to break one C–F bond.

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

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

frequency = ... Hz [3]

(f) Even if the production of CFCs stopped today, their damaging effects on stratospheric ozone levels would continue for a long time.

Suggest **two** reasons for this.

.....

.....

.....

..... [2]

(g) Hydrofluorocarbons, HFCs, and hydrocarbons can be used as replacements for CFCs.

(i) Give **one** property that these compounds would need to have, if they were to replace a CFC as an aerosol propellant.

.....

..... [1]

(ii) Suggest why an HFC would be more expensive to produce than a hydrocarbon.

.....

.....

..... [2]

[Total: 25]

END OF QUESTION PAPER

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

PLEASE DO NOT WRITE ON THIS PAGE