

**ADVANCED SUBSIDIARY GCE  
CHEMISTRY B (SALTERS)**  
Chemistry of Natural Resources

**F332/TEST**

Candidates answer on the question paper.

**OCR supplied materials:**

- *Data Sheet for Chemistry B (Salters)* (inserted)
- *Advance Notice: 'Understanding our Changing Atmosphere'* (inserted)

**Other materials required:**

- Scientific calculator

**Thursday 20 January 2011  
Afternoon**

**Duration: 1 hour 45 minutes**




Candidate forename		Candidate surname	
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Centre number						Candidate number				
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**INSTRUCTIONS TO CANDIDATES**

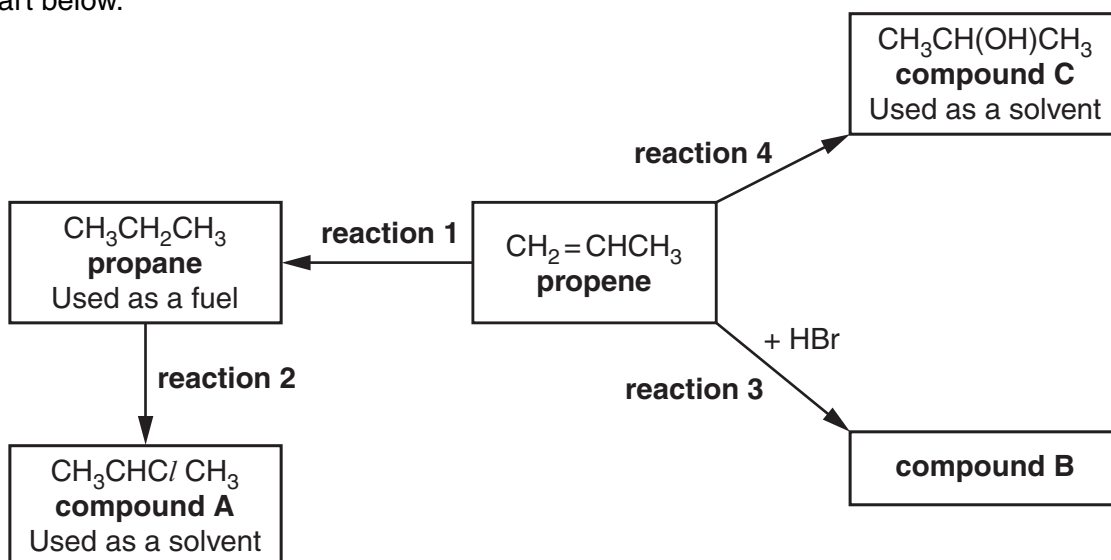
- The inserts will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- 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).
- Answer **all** the questions.
- Do **not** write in the bar codes.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- This means for example you should:
  - ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
  - organise information clearly and coherently, using specialist vocabulary when appropriate.
- You may use a scientific calculator.
- The insert '*Understanding our Changing Atmosphere*' is provided for use with question 5.
- A copy of the *Data Sheet for Chemistry B (Salters)* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **100**.
- This document consists of **16** pages. Any blank pages are indicated.

Answer **all** the questions.

- 1 Propene can be converted into a wide range of chemicals, some of which are shown in the flow chart below.



- (a) Name the homologous series that includes propene.  
 ..... [1]
- (b) Suggest a source for the propene used in industrial processes.  
 ..... [1]
- (c) It is possible to test propene, to show it is unsaturated, by reacting it with bromine water. Give the colour change of the bromine water during this test.  
 from ..... to ..... [1]
- (d) Underline **two** words that describe the mechanism of both **reaction 3** and **reaction 4**.  

<b>addition</b>	<b>electrophilic</b>	<b>elimination</b>	
<b>nucleophilic</b>	<b>radical</b>	<b>substitution</b>	[2]
- (e) **Reaction 4** produces an alcohol.
- (i) Classify the alcohol produced in **reaction 4** as primary, secondary or tertiary.  
 ..... [1]
- (ii) Explain your answer to (i).  
 .....  
 ..... [1]
- (iii) Give the reagents and conditions that would be required when **reaction 4** is carried out in industry.  
 .....  
 ..... [3]

(f) Give **two** possible structures for **compound B**.

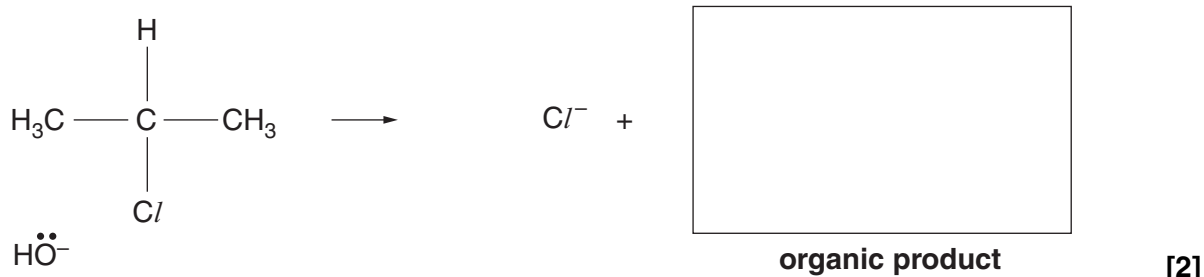
[2]

(g) Give the reagent and condition required for **reaction 2**.

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

(h) **Compound A** takes part in a substitution reaction with hydroxide ions.

(i) Add 'curly arrows' to the diagram below to show the attack of one hydroxide ion on  $\text{CH}_3\text{CHClCH}_3$  and the resulting electron pair movement within the molecule.



(ii) Draw, in the box above, the structure of the organic product that forms in the reaction in (i). [1]

(iii) Draw a 'dot-and-cross' diagram to represent the bonding in an hydroxide ion.

[1]

(iv) Explain why the hydroxide ion is classified as a nucleophile in the reaction shown in (i).

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

[Total: 19]

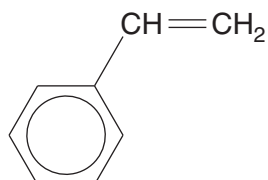
Turn over

2 Scientists have investigated the use of 'expanded' poly(phenylethene) for building houses in countries with cold climates and countries prone to earthquakes. 'Expanded' poly(phenylethene) is an insoluble polymer with a honeycomb structure containing air.

(a) Suggest a property of 'expanded' poly(phenylethene), other than its insolubility, which makes it suitable for building houses in these countries.

..... [1]

(b) The poly(phenylethene) monomer has the structure shown below.



**phenylethene**

Draw the structure of the repeating unit of poly(phenylethene).

[1]

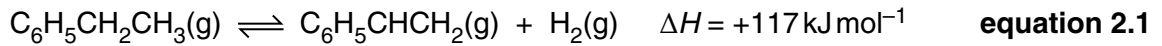
(c) Poly(phenylethene) is a thermoplastic.

Explain the meaning of the term *thermoplastic*.

.....

..... [1]

- (d) The phenylethene monomer is made by passing ethylbenzene vapour over a heated catalyst at a low pressure. **Equation 2.1** represents the reaction that occurs.



Describe and explain the effect of the following changes on the **yield** of phenylethene produced in the equilibrium represented by **equation 2.1**.

- (i) Carrying out the reaction at a higher temperature.



*In your answer, you should use technical terms, spelled correctly.*

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

- (ii) Carrying out the reaction at a higher pressure.

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

- (e) The catalyst used in the manufacture of phenylethene is in the form of a finely divided powder.

- (i) Explain why the use of a finely divided powder increases the reaction rate.

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

- (ii) Explain how the use of a catalyst increases the reaction rate.

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

- (f) Underline the word that best describes the type of reaction to produce phenylethene occurring in **equation 2.1**.

**addition**

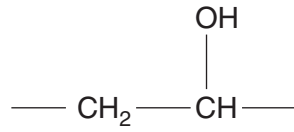
**elimination**

**reduction**

**substitution**

[1]

**(g)** Poly(phenylethene) is insoluble in water. Other polymers, such as poly(ethenol), can dissolve in water.



repeating unit of **poly(ethenol)**

Poly(ethenol) forms hydrogen bonds between its chains.

Poly(phenylethene) forms instantaneous dipole–induced dipole bonds between its chains.

- Explain how hydrogen bonds and instantaneous dipole–induced dipole bonds are formed.
- Explain why poly(ethenol) is slightly soluble in water, but poly(phenylethene) is insoluble.



*In your answer, you should make it clear how the structure of a polymer links to its solubility in water.*

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[7]  
[Total: 19]

3 Some people are advised to reduce the amount of sodium chloride in their diet, as sodium salts can contribute to high blood pressure. One method for making this dietary change is to use a 'low salt' alternative, which contains a mixture of sodium and potassium chlorides.

(a) A certain brand of 'low salt' contains one third potassium chloride,  $KCl$ , and two thirds sodium chloride,  $NaCl$ , by mass. Calculate the mole ratio of sodium to potassium in the mixture.

mole ratio Na : K = 1 : ..... [2]

(b) A student tests the 'low salt' for the presence of chloride ions. A sample of 'low salt' is dissolved in water and silver nitrate solution is added. A precipitate forms confirming the presence of chloride ions.

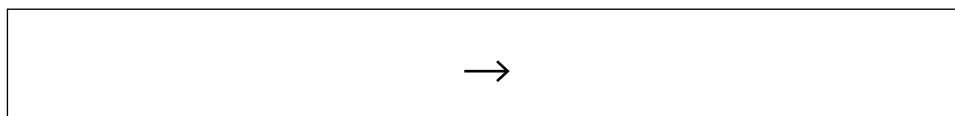
(i) Give the colour of the precipitate that the student would see.

..... [1]

(ii) Give the chemical name of the precipitate.

..... [1]

(iii) Write an ionic equation for the reaction that takes place to form the precipitate.



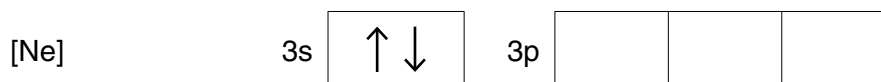
[1]

(c) Potassium chloride can be made by burning potassium in chlorine.

(i) Give the appearance and physical state of chlorine at room temperature.

..... [1]

(ii) Complete the diagram below, showing the arrangement of electrons in atomic orbitals for a chlorine atom.



[1]

(d) Potassium atoms become potassium ions during the reaction of potassium with chlorine.

(i) Write the electronic sub-shell arrangement for electrons in an **atom** of potassium.

..... [1]

(ii) Write an equation representing the first ionisation enthalpy of potassium.  
Include state symbols.



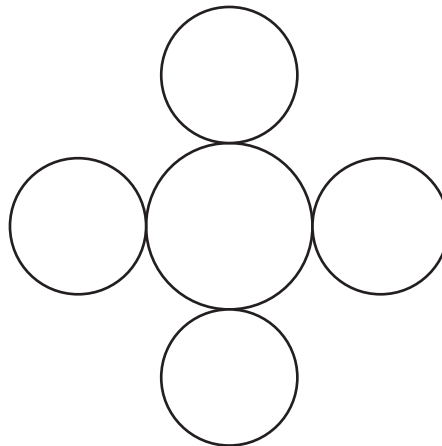
[2]

(iii) The first ionisation enthalpy for potassium is less than that for sodium. Explain why.

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

(e) Solid potassium chloride has a lattice structure similar to that of sodium chloride. The diagram below shows part of a layer of the potassium chloride lattice.

Label each type of particle and complete the diagram by drawing in enough particles to show the structure of the **layer** clearly.



[2]



- (f) Another method for making potassium chloride is to neutralise a solution of potassium hydroxide with hydrochloric acid. A student carries out a titration to find out how much hydrochloric acid is needed to neutralise a known volume of potassium hydroxide solution using methyl orange as the indicator.
- (i) The student measures out exactly  $25.0\text{cm}^3$  of a  $0.100\text{mol dm}^{-3}$  solution of potassium hydroxide using a volumetric pipette.

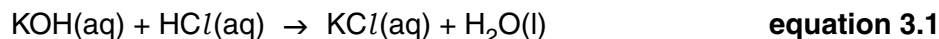
Calculate the number of moles of potassium hydroxide in the sample.

moles KOH = .....mol [1]

- (ii) Name a suitable piece of equipment for the student to use to add the hydrochloric acid to the potassium hydroxide solution.

..... [1]

- (iii) The equation for the reaction between potassium hydroxide and hydrochloric acid is shown in **equation 3.1**.



State the number of moles of hydrochloric acid that would be needed to react exactly with the amount of potassium hydroxide calculated in (i).

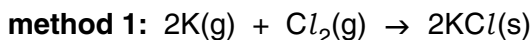
moles = ..... mol [1]

- (iv) The student used  $20.10\text{cm}^3$  of the acid to neutralise the potassium hydroxide solution. Calculate the concentration of the hydrochloric acid that was used.

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

concentration = .....  $\text{mol dm}^{-3}$  [3]

(g) Two methods for making potassium chloride are shown below.



(i) State which method has the greater atom economy and explain your answer.

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

(ii) Explain why the reaction with the greater atom economy is not the more economical method to use for making potassium chloride.

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

(h) Magnesium carbonate can be added to salt to keep it free-flowing. This is because the magnesium and carbonate ions attract water molecules and absorb them into the crystal, where they become bonded to the ions.

(i) Explain the link between the charge on a magnesium ion and the position of magnesium in the Periodic Table.

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

(ii) Give the formula of magnesium carbonate.

..... [1]

(iii) Minerals such as diamond have a different type of crystal structure.

Describe the structure and bonding of diamond.

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

[Total: 27]

4 The halogenoalkanes  $\text{CCl}_4$ ,  $\text{CF}_3\text{Br}$  and  $\text{CBrClF}_2$  have been used in fire extinguishers.

(a) Give the systematic name for  $\text{CF}_3\text{Br}$ .

..... [1]

(b) Draw a diagram of the shape of a  $\text{CF}_3\text{Br}$  molecule. Give a value for the bond angle.

[2]

(c) When  $\text{CBrClF}_2$  is exposed to high temperatures in a fire, one of the bonds breaks.

Suggest which bond is most likely to break.

..... [1]

(d) When  $\text{CCl}_4$  vapour gets into Earth's stratosphere, a  $\text{C}-\text{Cl}$  bond can be broken by UV radiation from the Sun.

(i) Name the **type** of bond breaking that would occur.

..... [1]

(ii) The minimum frequency of radiation needed to break one  $\text{C}-\text{Cl}$  bond is  $8.67 \times 10^{14}$  Hz. Calculate the minimum energy, in J, required to break one  $\text{C}-\text{Cl}$  bond.

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

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

(iii) Calculate the bond enthalpy of the  $\text{C}-\text{Cl}$  bond, in  $\text{kJ mol}^{-1}$ .

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

bond enthalpy = + .....  $\text{kJ mol}^{-1}$  [2]

- (e) The production of  $\text{CBrClF}_2$  has been banned in most countries since 1994, because it contributes to ozone depletion.

Describe the theoretical work and research that led to the discovery of ozone depletion in the stratosphere and how the evidence was originally overlooked.

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..... [3]

- (f) Some halogenoalkanes also contribute to global warming.

- (i) Explain how an increase in the concentration of a greenhouse gas leads to an enhanced greenhouse effect.

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..... [2]

- (ii) Describe the evidence for the relationship between the increased concentration of greenhouse gases and global warming.

.....

.....

..... [1]

[Total: 15]

5 This question is based on the Advance Notice article ‘**Understanding our Changing Atmosphere**’ which is provided as an insert to this paper.

- (a) The article explains that, in the atmosphere, ‘hydrocarbons are oxidised as part of a propagating chain’. Explain what is meant by the term *propagating chain*. Give an example from the article of a propagating chain.

Explanation: .....

.....

..... [2]

Example: .....

.....

..... [1]

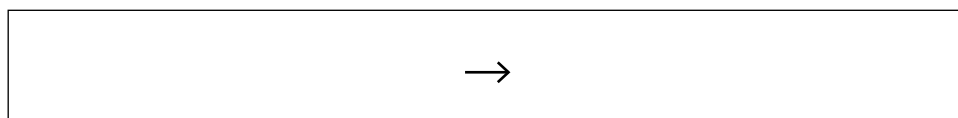
- (b) Hydroxyl radicals form in the troposphere.

- (i) Explain what is meant by the term *radical*.

.....

..... [1]

- (ii) Write the equation for the formation of hydroxyl radicals from an oxygen atom and a water molecule in the troposphere.



[1]

- (c) Ethanal can form during radical reactions that occur in the troposphere.

- (i) Draw the full structural formula of ethanal, CH<sub>3</sub>CHO.

[1]

- (ii) Explain how infrared spectroscopy could be used on a sample of gas from a simulation chamber to show the presence of ethanal. Indicate how the infrared spectrum would show the presence of aldehydes and then how ethanal itself could be detected.

.....

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..... [2]

- (d) Describe how hydroxyl radicals remove HCFCs from the troposphere.

.....

.....

..... [2]

- (e) One of the graphs in **Fig. 1** shows the variation of NO<sub>2</sub> concentration during the day. Describe this variation and explain it using the other graph in **Fig. 1** and the diagram in **Scheme 1**.

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..... [3]



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