Candidate forename		Candidate surname	

Centre number						Candidate number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

ADVANCED SUBSIDIARY GCE

F332/TEST

CHEMISTRY B (SALTERS)

Chemistry of Natural Resources

THURSDAY 20 JANUARY 2011: Afternoon
DURATION: 1 hour 45 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

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

READ INSTRUCTIONS OVERLEAF

DC (SM/CGW) 11MEP01079 39778/2

INSTRUCTIONS TO CANDIDATES

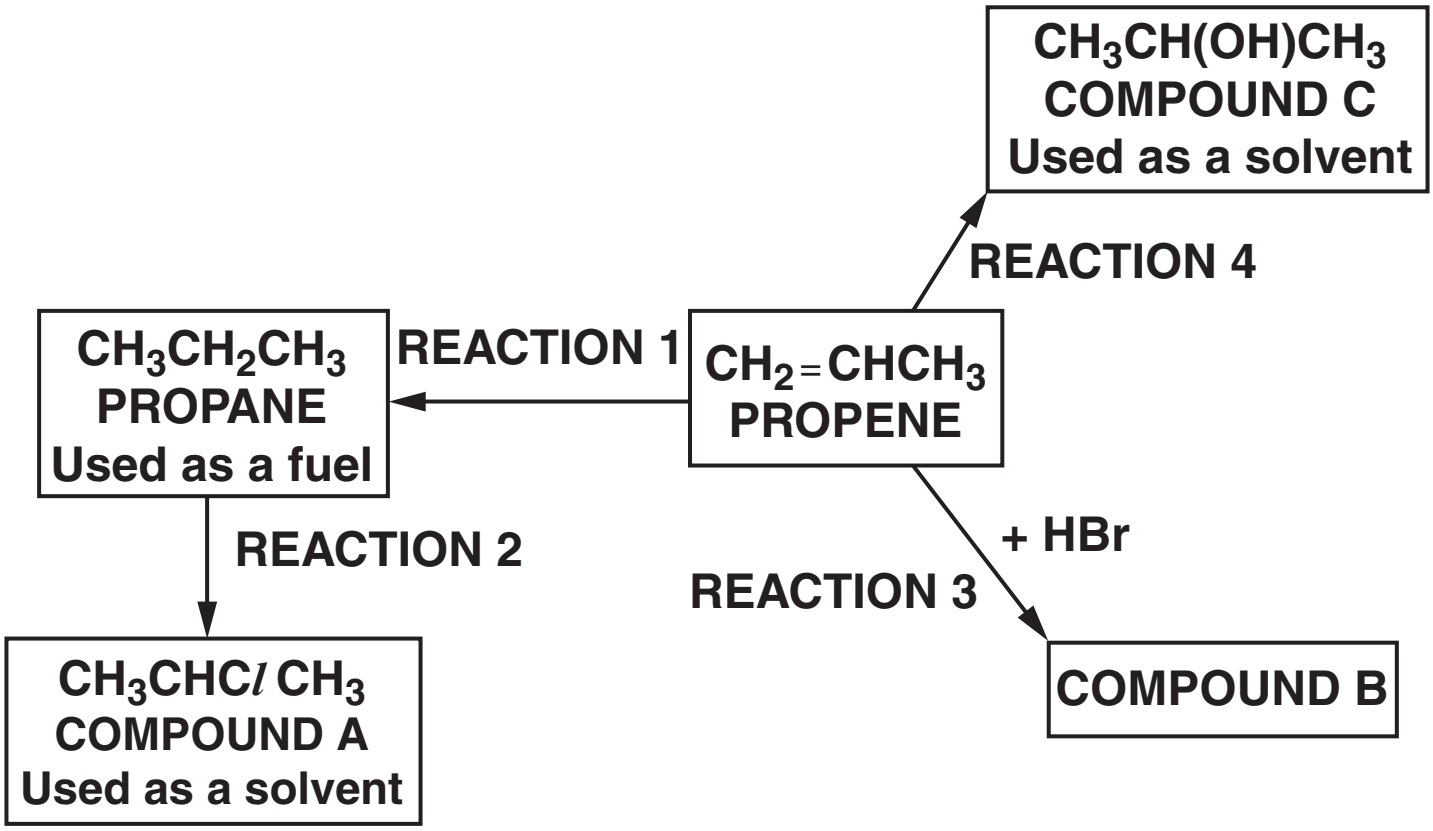
- **The inserts will be found in the centre of this document.**
- **Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.**
- **Use black ink. Pencil may be used for graphs and diagrams only.**
- **Read each question carefully. 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.**

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.**

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.

ADDITION

ELECTROPHILIC

ELIMINATION

NUCLEOPHILIC

RADICAL

SUBSTITUTION

[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.

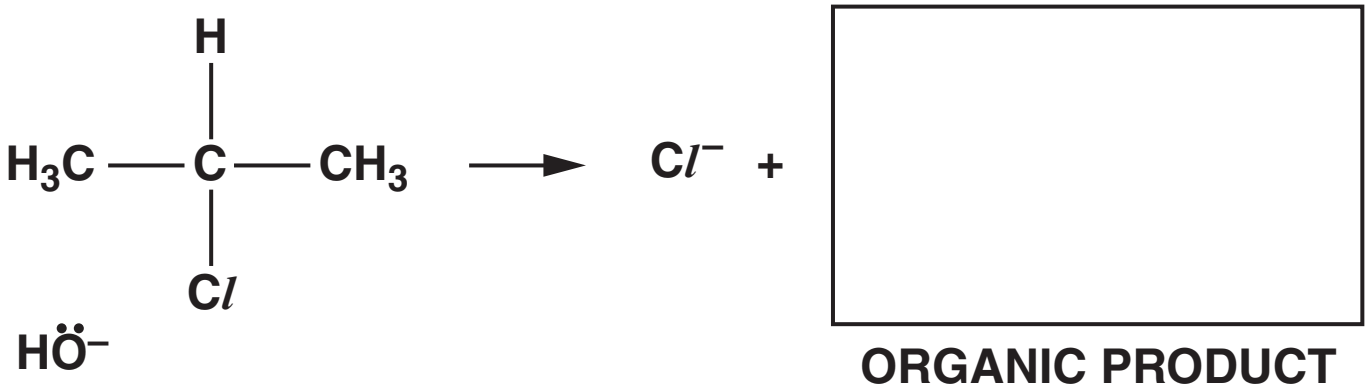
_____

_____

_____ **[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 $CH_3CHCl CH_3$ and the resulting electron pair movement within the molecule.



[2]

(ii) Draw, in the box on page 6, 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]**

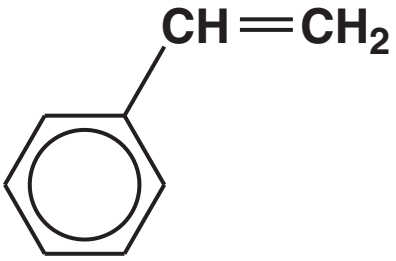
[Total: 19]

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.

EQUATION 2.1

$$C_6H_5CH_2CH_3(g) \rightleftharpoons C_6H_5CHCH_2(g) + H_2(g)$$

$$\Delta H = +117\,kJ\,mol^{-1}$$

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

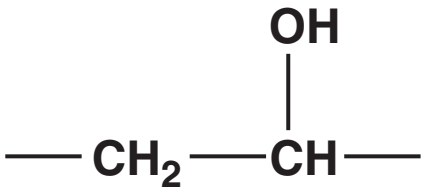
ELIMINATION

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]

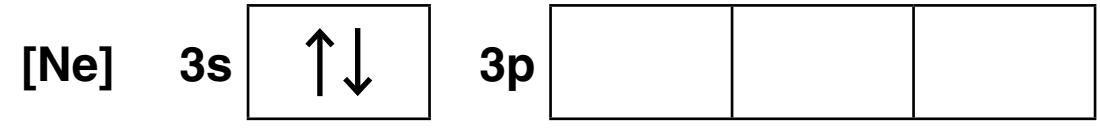
→

(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]

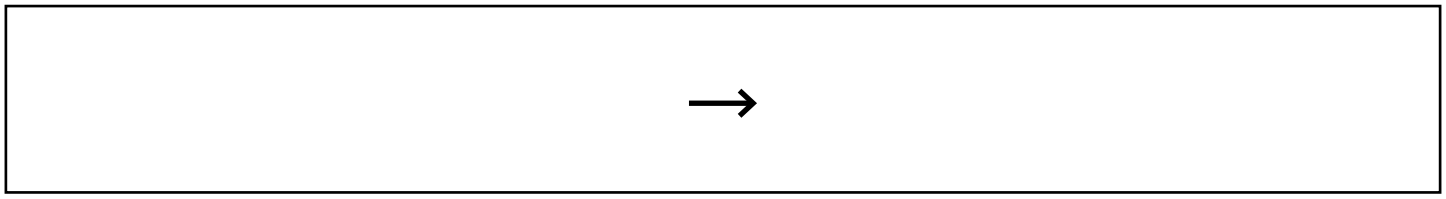


(d) Potassium atoms become potassium ions during the reaction of potassium with chlorine.

(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.

_____

_____

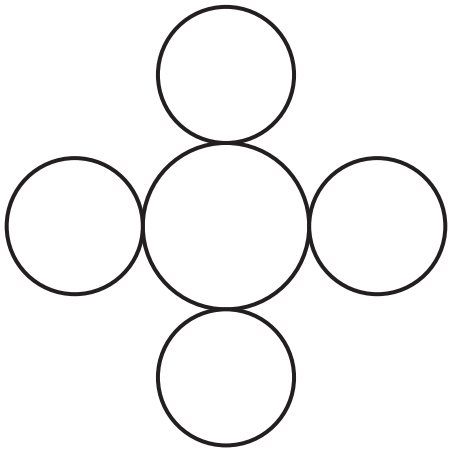
_____

_____

_____ **[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 cm^3 of a 0.100 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.

EQUATION 3.1

$$KOH(aq) + HCl(aq) \rightarrow KCl(aq) + H_2O(l)$$

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 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 = _____ mol dm^{-3} [3]

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

METHOD 1:

$$2K(g) + Cl_2(g) \rightarrow 2KCl(s)$$

METHOD 2:

$$KOH(aq) + HCl(aq) \rightarrow KCl(aq) + H_2O(l)$$

(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 CCl_4, CF_3Br and $CBrClF_2$ have been used in fire extinguishers.

(a) Give the systematic name for CF_3Br.

_____ **[1]**

(b) Draw a diagram of the shape of a CF_3Br molecule. Give a value for the bond angle.

[2]

(c) When $CBrClF_2$ is exposed to high temperatures in a fire, one of the bonds breaks.

Suggest which bond is most likely to break.

_____ **[1]**

(d) When CCl_4 vapour gets into Earth's stratosphere, a C–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 C–Cl bond is 8.67×10^{14} Hz. Calculate the minimum energy, in J, required to break one C–Cl bond.

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

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

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

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

bond enthalpy = + _____ **kJ mol^{-1} [2]**

(e) The production of $CBrClF_2$ 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.

_____

_____

_____ **[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]**

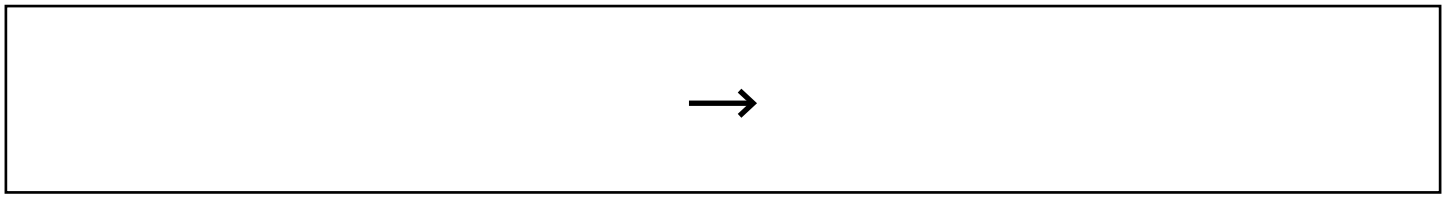
(b) Hydroxyl radicals form in the troposphere.

(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_3CHO.

[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.

_____

_____

_____

_____

_____ **[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_2 concentration during the day. Describe this variation and explain it using the other graph in Fig. 1 and the diagram in SCHEME 1.

_____

_____

_____

_____

_____

_____

_____ **[3]**

(f) There are competing processes that cause the formation and removal of ozone in the troposphere. These processes are summarised in the SCHEME 1 diagram and elsewhere in the article.

- **Describe the processes that occur in the troposphere that cause the formation and removal of ozone.**

- **Describe the evidence that has been used to predict a significant rise in tropospheric ozone levels over the next century.**

- **Explain why a rise in tropospheric ozone levels is a cause for concern.**

In this question, you should make it clear how the steps you describe are linked to one another.

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_____

_____ **[7]**

[Total: 20]

END OF QUESTION PAPER