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

MONDAY 7 JUNE 2010: Morning
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: 'Earth-Venus-Mars' **(inserted)**

OTHER MATERIALS REQUIRED:

Scientific calculator

READ INSTRUCTIONS OVERLEAF

DC (CW/SW) MEP60169 28446/1

INSTRUCTIONS TO CANDIDATES

- **Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.**

- **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.**

- **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).**

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 *'Earth-Venus-Mars'* 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 Iodine can be extracted from some types of seaweed which have taken up iodine compounds from the seawater. Iodine is present in seawater, as both iodide, I^-, and iodate, IO_3^-, ions.

(a) Give the oxidation state of iodine in I^- and IO_3^-.

I^- _____

IO_3^- _____ **[2]**

(b) Iodate ions can be converted to iodide ions by reacting them with a solution of sulfur dioxide. The reaction that occurs is represented by EQUATION 1.1.

$$IO_3^- + 3SO_2 + 3H_2O \rightarrow 6H^+ + 3SO_4^{2-} + I^-$$

EQUATION 1.1

(i) Which element has been oxidised in the reaction represented by EQUATION 1.1?

_____ **[1]**

(ii) A solution contains IO_3^- ions at a concentration of 0.15 mol dm^{-3}.

Calculate the concentration of IO_3^- ions in the solution in g dm^{-3}.

Give your answer to <u>TWO</u> significant figures.

M_r: IO_3^-, 174.9

concentration = _____ g dm^{-3} [2]

(iii) <u>EQUATION 1.2</u> is the incomplete half-equation for the conversion of iodate ions to iodide ions. Complete and balance <u>EQUATION 1.2</u>.

IO_3^- + _____ H^+ + _____ → I^- + $3H_2O$

<u>EQUATION 1.2</u> [2]

(c) When silver nitrate solution is added to a solution containing iodide ions, a reaction occurs.

(i) What would be <u>SEEN</u> when this reaction occurs?

_____

_____ **[2]**

(ii) Write the ionic equation for the reaction, including state symbols.

→

[2]

(d) Iodine, I_2, can be obtained by burning seaweed. The intermolecular bond between the iodine molecules is instantaneous dipole–induced dipole.

Explain how this type of intermolecular bond forms.

_____

_____

_____

_____

_____

_____

_____ **[3]**

(e) Iodine and chlorine are both members of the halogen group.

(i) Write the electron configuration for chlorine in terms of s and p sub-shells.

_____ **[2]**

(ii) Write the electron configuration for the highest energy sub-shell for iodine.
(For example, for lead it would be $6p^2$).

_____ **[1]**

(iii) Chlorine atoms are more readily reduced than iodine atoms.

State what is meant by *reduction* in terms of electrons.

_____ **[1]**

(iv) Using your answers to (i), (ii) and (iii), suggest why chlorine atoms are more readily reduced than iodine atoms.

_____

_____

_____

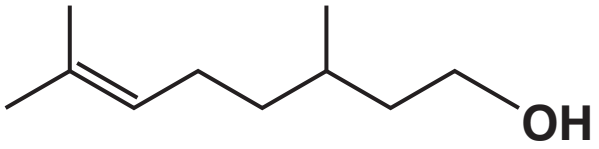
_____

_____

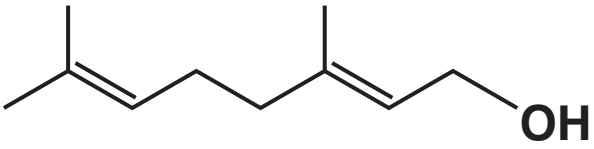
_____ **[2]**

[Total: 20]

2 Rose oil, which is extracted from rose petals to use in perfumes, consists of a mixture of chemicals. The skeletal formulae of two of the chemicals, citronellol and geraniol, are shown below.



CITRONELLOL



GERANIOL

(a) Give the molecular formula of CITRONELLOL.

_____ **[2]**

(b) Name the TWO functional groups that are present in BOTH citronellol and geraniol.

_____

_____ **[2]**

(c) Classify the OH groups in citronellol and geraniol as primary, secondary or tertiary.

Explain your answer.

_____

_____

_____ **[2]**

(d) The OH group in geraniol can be oxidised by heating the geraniol under reflux with appropriate reagents.

(i) Give the reagents that would be required in order for this oxidation to occur.

_____

_____ **[2]**

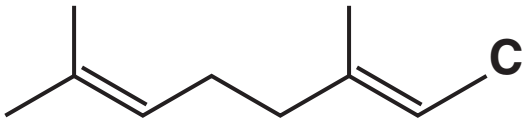
(ii) Describe the colour change you would see during the reaction.

from _____ **to** _____ **[2]**

(iii) <u>NAME</u> the new functional group that forms.

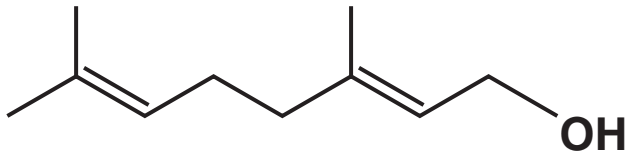
_____ **[1]**

(iv) Complete the diagram below to show the full structural formula of the oxidised group that would form from geraniol.



[1]

(e) Geraniol can exhibit *E/Z* isomerism due to the structure of the molecule around the C=C nearest to the OH group. One isomer is shown below.



(i) Draw the skeletal formula of the other isomer.

[2]

(ii) Explain why there are no *E/Z* isomers arising from the C=C at the other end of the molecule.

_____

_____

_____ **[1]**

(f) A student adds bromine water drop by drop to 1 cm^3 of geraniol in a test tube. The tube is shaken after each addition. The addition of bromine water is continued until no further change occurs. In a second experiment, the student repeats the process with an equal volume of citronellol.

(i) Describe and explain the <u>SIMILARITIES</u> the student would observe between the two experiments.

_____

_____

_____

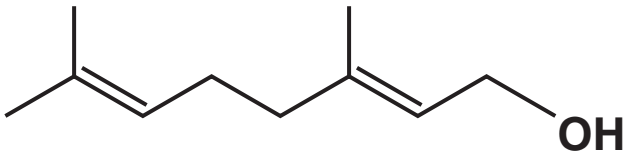
_____ **[3]**

(ii) Describe and explain the <u>DIFFERENCE</u> the student would observe between the two experiments.

_____

_____

_____ **[2]**



GERANIOL

(iii) Give the SKELETAL formula of the product that forms from the reaction of geraniol with bromine.

[2]

(iv) Classify the reaction of bromine with citronellol by underlining TWO words from the following list.

ADDITION ELECTROPHILIC NUCLEOPHILIC

RADICAL SUBSTITUTION

[2]

[Total: 24]

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PLEASE TURN OVER FOR QUESTIONS 3, 4 AND 5.

3 A lightning strike provides energy to start reactions between chemicals present in the atmosphere. One possible reaction sequence involving gaseous substances is shown below.

$N_2 + 4O_2 \rightarrow 2NO + 2O_3$ **EQUATION 3.1**

$NO + O_3 \rightarrow NO_2 + O_2$ **EQUATION 3.2**

$NO_2 + O \rightarrow NO + O_2$ **EQUATION 3.3**

$NO_2 + OH \rightarrow HNO_3$ **EQUATION 3.4**

(a) The reactions represented by EQUATIONS 3.1 and 3.2 involve the formation of oxides of nitrogen.

Give an example of a human activity that gives rise to oxides of nitrogen.

_____

_____ **[1]**

(b) Some of the species involved in the reactions shown in the equations above are radicals.

(i) Circle ONE substance in the list below that represents the formula of a radical.

HNO_3 N_2 NO [1]

(ii) Explain your answer to (i).

_____

_____ **[1]**

(iii) NO_2 and OH are also radicals. Give the name that is used to describe the type of radical reaction illustrated by EQUATION 3.4.

_____ **[1]**

(c) The reaction represented by EQUATION 3.4 has a low activation enthalpy.

(i) Suggest why this reaction has a low activation enthalpy.

_____

_____ **[1]**

(ii) Suggest why, even though this reaction has a low activation enthalpy, it still occurs slowly in the atmosphere.

_____

_____ **[1]**

(iii) Describe and explain how the rate of a reaction varies under different temperature conditions.

In your answer, you should make clear how the points you make are linked to one another.

_____

_____

_____

_____

_____

_____

_____ **[5]**

(d) <u>EQUATIONS 3.2</u> and <u>3.3</u> represent the process in which NO reacts with ozone in the stratosphere.

$NO + O_3 \rightarrow NO_2 + O_2$ **<u>EQUATION 3.2</u>**

$NO_2 + O \rightarrow NO + O_2$ **<u>EQUATION 3.3</u>**

(i) Combine <u>EQUATIONS 3.2</u> and <u>3.3</u> to produce the overall equation for the process.

[1]

(ii) Explain how EQUATIONS 3.2 and 3.3 show that NO could be a catalyst for the breakdown of ozone.

_____

_____ **[1]**

(iii) In this process NO is a homogeneous catalyst.

Explain what is meant by the term *homogeneous*.

_____

_____

_____ **[1]**

(iv) Explain why a reaction is faster in the presence of a catalyst.

_____

_____

_____ **[2]**

(e) Ozone is present in both the stratosphere and the troposphere.

(i) Explain how the presence of ozone in the <u>STRATOSPHERE</u> benefits us.

_____

_____

_____

_____

_____ **[3]**

(ii) Give <u>ONE</u> disadvantage of a build-up of <u>TROPOSPHERIC</u> ozone.

_____

_____ **[1]**

[Total: 20]

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PLEASE TURN OVER FOR QUESTIONS 4 AND 5.

4 Chlorofluorocarbons, CFCs, have been used for a variety of applications, including as blowing agents for plastics. Since the discovery that CFCs cause environmental damage, alternative compounds have been used.

(a) The table below gives data for some compounds that could be used in place of CFCs. ODP is the Ozone Depletion Potential.

COMPOUND	FORMULA	BOILING POINT /K	FLAMMABLE	ODP	PRICE
A	$CFCl_3$	297	no	1.0	medium
B	CF_2Cl_2	243	no	1.0	medium
C	CF_3CCl_2H	302	no	0.02	high
D	CF_3CH_2F	247	no	0.0	very high
E	$CH_3CH_2CH_3$	231	yes	0.0	low

(i) Give the systematic name of <u>COMPOUND D</u>.

_____ **[2]**

(ii) CFCs were used as blowing agents for plastics like expanded polystyrene. The CFC was incorporated into the plastic as it was being produced. The CFC vaporised during the polymerisation reaction, so it 'blew' tiny bubbles in the plastic.

Use data from the table to suggest ONE advantage and ONE disadvantage of COMPOUND C as a replacement for COMPOUND A as a blowing agent.

advantage: _____

_____

disadvantage: _____

_____ **[2]**

(iii) Chemicals used as refrigerants need to be volatile. COMPOUND B has been used as a refrigerant because it has a suitable volatility.

Suggest from the list in the table, ONE substance of similar volatility to be a suitable replacement for COMPOUND B as a refrigerant.

_____ **[1]**

(b) A student decided to make the halogenoalkane 1-bromobutane, C_4H_9Br, by reacting butan-1-ol, C_4H_9OH, with hydrobromic acid.

$$C_4H_9OH + HBr \longrightarrow C_4H_9Br + H_2O$$

The student wanted to make at least 5 g of 1-bromobutane. Research shows that the reaction typically produces a 45% yield.

(i) Calculate the relative molecular masses of butan-1-ol and 1-bromobutane.

***M*r: C_4H_9OH = _____**

***M*$_r$: C_4H_9Br = _____ [1]**

(ii) Calculate the mass of butan-1-ol that would be needed to produce 5.0 g of 1-bromobutane if the reaction produces a 100% yield.

mass of butan-1-ol = _____ g [2]

(iii) Calculate the mass of butan-1-ol that would be needed to produce 5.0 g of 1-bromobutane if the reaction produces a 45% yield.

mass of butan-1-ol = _____ g [1]

(c) The reaction was carried out by heating the mixture of butan-1-ol and hydrobromic acid under reflux for 30 minutes.

(i) Describe how you would carry out the process of heating under reflux in the laboratory.

_____

_____ **[1]**

(ii) Suggest <u>TWO</u> reasons why *heating under reflux* is used for this reaction.

_____

_____

_____ **[2]**

(d) After heating under reflux, the mixture was allowed to cool. The 1-bromobutane was separated from the mixture and dried. 1-Bromobutane is a liquid that is more dense than water and immiscible in water.

(i) Describe how the 1-bromobutane layer can be separated from the aqueous layer.

_____

_____

_____ **[2]**

(ii) Give the name of a suitable drying agent for the 1-bromobutane.

_____

_____ **[1]**

(iii) The 1-bromobutane is contaminated with another organic liquid.

Name the process you would use to separate these two liquids.

_____ **[1]**

[Total: 16]

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PLEASE TURN OVER FOR QUESTION 5.

5 This question is based on the Advance Notice article *'EARTH-VENUS-MARS'* which is provided as an insert to this paper.

(a) Explain what is meant by *ultraviolet dissociation* of a molecule and how it occurs. Give an example from the article to support your explanation. Name the TYPE of bond fission that is occurring.

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

_____

_____

_____

_____

_____ **[4]**

(b) Calculate how many times as much nitrogen gas there is near the surface of Venus than there is near the surface of the Earth.

answer = _____ times as much [2]

(c) The article says that, on Venus, some of the carbon dioxide was 'baked out of the rocks'.

Suggest an explanation, in chemical terms, of the meaning of 'baking carbon dioxide out of the rocks'.

_____

_____

_____

_____ **[2]**

(d) Explain how carbon dioxide in the atmosphere absorbs infrared radiation.

_____

_____

_____

_____ **[2]**

(e) Infrared spectroscopy can be used to show that a sample of air contains water vapour.

Suggest what the main feature of the infrared spectrum of water would be, giving an appropriate wavenumber range.

_____

_____

_____ **[2]**

(f) A sample of Earth's air contains 0.0014% water vapour. Calculate the proportion, in ppm, of the Earth's air sample that is made from water vapour containing a deuterium atom.

answer = _____ ppm [2]

(g) Discuss factors that account for differences in the temperature on Mars compared to the temperature on Earth. In your answer you should:

- **explain why there is less water vapour and carbon dioxide in the atmosphere of Mars than there is in Earth's atmosphere.**
- **explain how this reduction in the amounts of water vapour and carbon dioxide in the atmosphere of Mars has contributed to much lower temperatures on Mars than on Earth.**

In your answer, you should make clear how the steps you describe are linked to one another.

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_____

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_____

_____ **[6]**

[Total: 20]

END OF QUESTION PAPER