

Tuesday 3 June 2014 – Afternoon

AS GCE CHEMISTRY B (SALTERS)

F332/01/TEST Chemistry of Natural Resources

Candidates answer on the Question Paper.

OCR supplied materials:

- *Data Sheet for Chemistry B (Salters)* (inserted)
- *Advance Notice: 'Chemistry of Wine'* (inserted)

Other materials required:

- Scientific calculator

Duration: 1 hour 45 minutes



Candidate
forename

Candidate
surname

Centre number

Candidate number

INSTRUCTIONS TO CANDIDATES

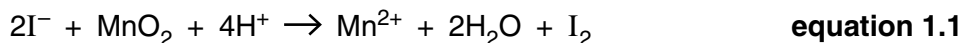
- The Inserts will be found inside this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- 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.
- The total number of marks for this paper is **100**.
-  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 '*Chemistry of Wine*' 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.
- This document consists of **20** pages. Any blank pages are indicated.

Answer **all** the questions.

- 1 Iodine can be extracted from the ash of burnt seaweed. The ash is washed with water. The remaining solid is heated with manganese(IV) oxide and concentrated sulfuric acid, forming iodine.

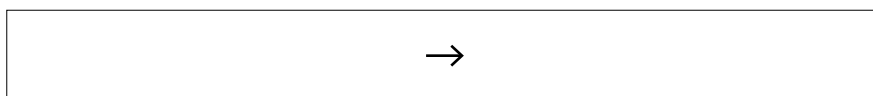


- (a) Complete the table below to show the oxidation states for manganese and iodine in the reaction shown in **equation 1.1**.

Element	Initial oxidation state	Final oxidation state
Mn		
I		

[2]

- (b) Write the half-equation for the conversion of iodide ions to iodine.



[1]

- (c) **Name** the reducing agent in the reaction in **equation 1.1**.

Explain your answer in terms of oxidation states.

.....
 [2]

- (d) Describe the appearance and physical state of iodine at room temperature.

.....
 [1]

- (e) Give **one** use for compounds of the iodine that is produced.

.....
 [1]

- (f) A student extracts iodine from seaweed ash. The student suspects that the water which has been used to wash the ash contains a mixture of salts, including sodium chloride.

The student tests this water to see if it contains chloride ions.

- (i) What reagent would the student need to add to the water?

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

- (ii) Give the result of the test for chloride ions and name the compound formed.

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

- (iii) Suggest why the student might not get the expected test result.

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

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

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

..... [1]

- (ii) Write the electron configuration for the highest energy sub-shell for an iodine atom.

..... [1]

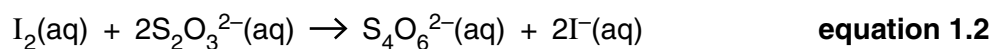
- (iii) Chlorine is more readily reduced than iodine.

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

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

- (h) The student collected 0.92 g of impure iodine, I_2 , and decided to determine its purity.

The student dissolved the impure iodine in potassium iodide solution. This iodine solution was then titrated with sodium thiosulfate solution. The equation for the reaction is shown below.



- (i) The titration required 28.40 cm^3 of $0.200 \text{ mol dm}^{-3}$ sodium thiosulfate solution.

Calculate the number of moles of thiosulfate ions, $S_2O_3^{2-}$, used.

moles thiosulfate = ... mol [1]

- (ii) Give the number of moles of iodine, I_2 , in the iodine solution.

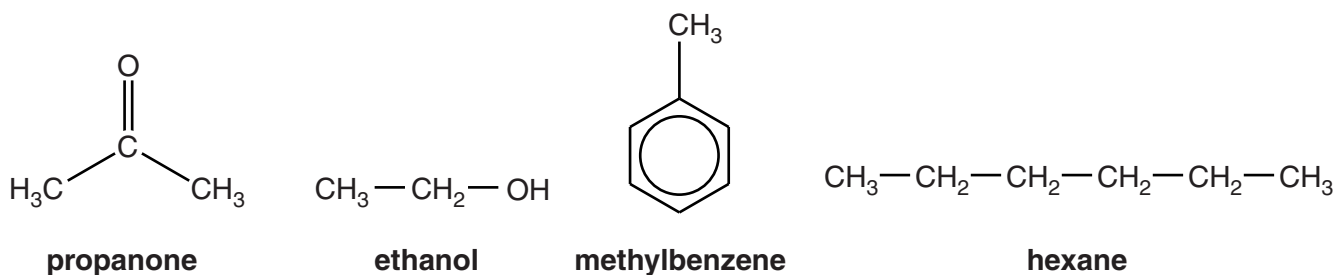
moles iodine = ... mol [1]

- (iii) Calculate the percentage purity of the iodine.

purity of iodine = ... % [2]

[Total: 19]

2 The structures of some common organic solvents are shown below.

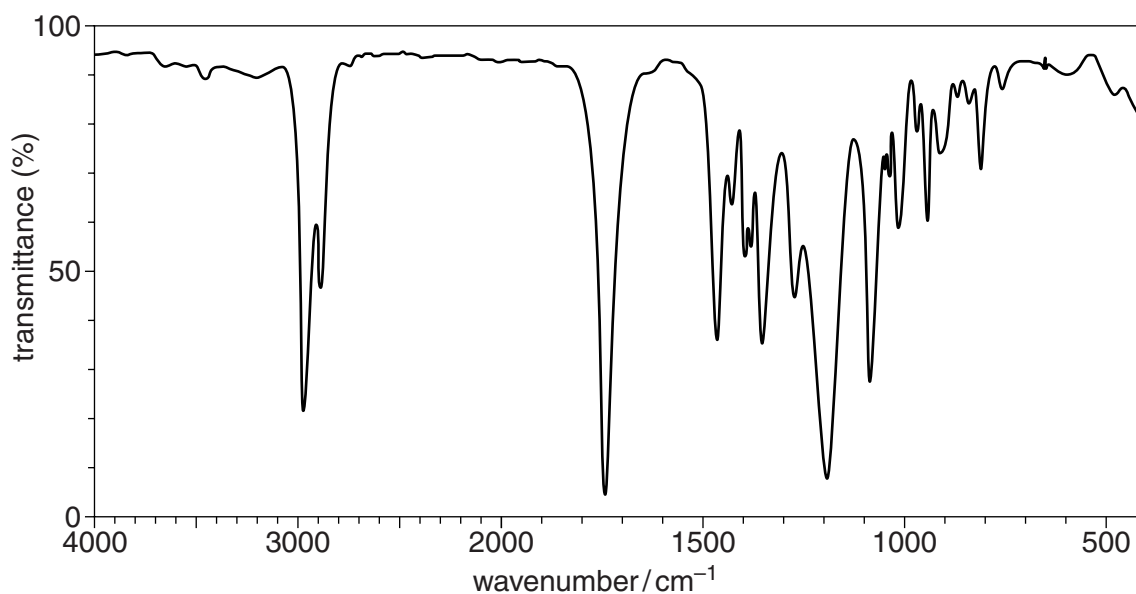


(a) Propanone can be made by the oxidation of an alcohol.

(i) **Name** the alcohol from which propanone can be made.

..... [1]

(ii) A student carries out the oxidation of **ethanol**, which can form two different oxidation products. The infrared spectrum of the compound the student obtained is given below.



Use the spectrum to identify the compound formed.

..... [1]

(iii) Explain how the spectrum in (ii) shows that no ethanol remains.

.....

 [2]

..... [3]

Name the strongest type of intermolecular bond formed between:

- propanone and ethanol
- methylbenzene and hexane.

Explain how the intermolecular bonds you have named are produced.



..... [7]

- (d) Another common solvent, ethyl ethanoate, can be made by reacting ethanol with ethanoic acid, as shown in the equation below.



- (i) The reaction in **equation 2.1** is allowed to reach dynamic equilibrium.

Explain what is meant by the term *dynamic equilibrium*.

.....

 [2]

- (ii) Some ethanoic acid is added to the equilibrium mixture. The mixture is allowed to reach equilibrium again.

Describe the effect on the amount of ethyl ethanoate formed.

Use le Chatelier's principle to explain this effect.

.....

 [2]

[Total: 18]

3 The halogenoalkanes CBr_4 , CF_3Cl and CBrClF_2 have been used in fire extinguishers.

(a) CF_3Cl is a chlorofluorocarbon.

(i) Give the systematic name for CF_3Cl .

..... [1]

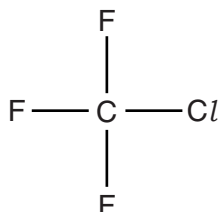
(ii) Draw a 3D diagram to show the shape of a CF_3Cl molecule.

Include the bond angle.

[2]

(iii) The molecules of CF_3Cl contain polar bonds.

Mark **all** the partial charges on the atoms in the diagram of the CF_3Cl molecule shown below.



[1]

(iv) Explain why the molecule CF_3Cl has the partial charges you have shown in (iii).



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

.....

 [2]

(v) Explain whether or not the molecule of CF_3Cl is polar.

.....

 [2]

- (b) When a different halogenoalkane, CBrClF_2 , is exposed to high temperatures in a fire, one of the bonds in the molecule breaks.

Suggest which bond is most likely to break.

..... [1]

- (c) When CBr_4 vapour gets into the Earth's atmosphere, a C–Br bond can be broken by UV radiation from the Sun.

- (i) Name the **type** of bond breaking that occurs.

Explain what happens during this process.

.....

.....

..... [2]

- (ii) The minimum frequency of radiation needed to break one C–Br bond is $7.14 \times 10^{14} \text{ Hz}$.

Calculate the minimum energy, in J, required to break one C–Br bond.

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

minimum energy = ... J [2]

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

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

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

bond enthalpy = + ... kJ mol^{-1} [3]

- (d) 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 why the evidence was originally overlooked.

.....

.....

.....

.....

.....

.....

..... [3]

- (e) 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: 22]

- 4 Natural processes in the air can control some types of atmospheric pollutants, such as carbon monoxide and ozone. Although carbon monoxide emissions increased in the twentieth century, the percentage of carbon monoxide in the troposphere has remained almost constant.

- (a) The increased use of cars in the twentieth century is one reason for the increase in carbon monoxide emissions.

Explain the origin of these carbon monoxide emissions.

.....
 [1]

- (b) Give **two** reasons why carbon monoxide is classed as a polluting gas.

.....

 [2]

- (c) The reaction of carbon monoxide with hydroxyl radicals helps control atmospheric carbon monoxide concentrations. Hydroxyl radicals form by the breakdown of water molecules.

Equation 4.1 represents the reaction of carbon monoxide with hydroxyl radicals to produce carbon dioxide.



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

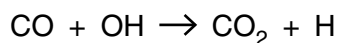
.....
 [1]

- (ii) Classify the reaction represented by **equation 4.1** as initiation, propagation or termination.

Explain your choice.

.....

 [2]



equation 4.1

- (iii) Suggest why OH radicals are not produced in the **troposphere** by the action of sunlight on water molecules.

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

- (iv) The reaction represented by **equation 4.1** has a low activation enthalpy.

Suggest why the reaction represented by **equation 4.1** still occurs slowly in the atmosphere.

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

- (d) The reaction represented by **equation 4.1** produces carbon dioxide, which is a gas at room temperature. Silicon dioxide, another Group 4 oxide, is a solid at room temperature.

Explain this difference in physical state in terms of bonding and structure.

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

- (e) Scientists monitor the composition of the Earth's atmosphere. They have found that the concentration of carbon dioxide in dry, unpolluted tropospheric air has increased from 300 ppm in 1900 to around 380 ppm today.
- (i) Calculate the percentage **increase** in carbon dioxide in the air between 1900 and the present day. Take the present day value to be 380 ppm.

increase in carbon dioxide concentration = ... % [1]

- (ii) A sample of air is analysed and found to contain $1.20 \times 10^{-5}\%$ carbon monoxide by volume.

How much more abundant is carbon dioxide than carbon monoxide in this sample of air?
Take the value for carbon dioxide to be 380 ppm.

carbon dioxide concentration = ... times more [2]

- (f) Tropospheric ozone is a pollutant, but the presence of ozone in the stratosphere is important to humans.
- (i) Give one problem caused by **tropospheric** ozone and one benefit to humans of **stratospheric** ozone.

problem caused by tropospheric ozone

.....

.....

benefit of stratospheric ozone

.....

.....

.....

[2]

- (ii) Describe **one natural** process that causes ozone to be **broken down** in the stratosphere.

.....

.....

.....

..... [2]

- (iii) Describe **one natural** process that causes ozone to be **formed** from O_2 in the stratosphere.

.....

.....

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.....

.....

.....

.....

..... [3]

[Total: 21]

- 5 This question is based on the Advance Notice article '**Chemistry of Wine**' which is provided as an insert to this paper.

- (a) During wine production, ethanol forms from sugars in grape juice. If the wine is left open to the air, the ethanol reacts with oxygen and the taste of the wine becomes sharp and acidic.

Suggest the name of the organic compound that gives the wine this sharp taste.

..... [1]

- (b) **Box 1** in the article shows the structures of molecules that can make wine undrinkable because it is 'corked'.

- (i) Give the molecular formula of oct-1-en-3-one.

..... [2]

- (ii) Name the **two** functional groups in oct-1-en-3-one.

.....
 [2]

- (iii) Draw a circle around the term from the list below which describes the type of reaction that occurs when oct-1-en-3-ol is converted to oct-1-en-3-one.

addition dehydration redox substitution

[1]

- (iv) Name a functional group, other than arene, that is in molecules of both 2,4,6-trichloroanisole and 2-methoxyphenol.

..... [1]

- (c) **Fig. 1** in the article shows some of the organic compounds found in grape juice.

- (i) Retinol can exhibit *E/Z* isomerism. One part of the molecule responsible for this isomerism is the structure around the C=C nearest to the OH group.

One isomer is shown in **Fig. 1**.

Draw the skeletal formula of the other isomer caused by this C=C bond.

[2]

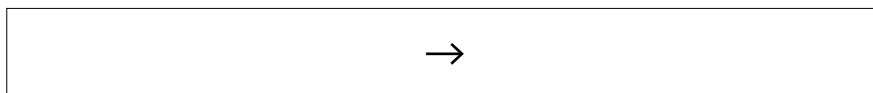
- (ii) Retinol reacts with bromine at room temperature and pressure.

Describe the colour change when retinol reacts with liquid bromine.

..... [1]

- (iii) Write the equation for the reaction of retinol with excess bromine.

Represent retinol by its molecular formula, $C_{20}H_{30}O$.



[2]

- (iv) **Fig. 1** in the article shows some of the compounds found in grape juice.

Give **two** compounds in **Fig. 1** that contain a **primary** alcohol group.

.....

..... [2]

Comment on how the taste of the wine is affected.



In your answer, you should link the change in taste of the wine to the chemical process involved.

..... [6]

[Total: 20]

END OF QUESTION PAPER

[illegible]

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