Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Organic analysis

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Name of the Student:_____
Max. Marks : 29 Marks **Time : 29 Minutes**

Q1.

The reaction of butane-1,4-diol with butanedioic acid produces the polymer PBS used in biodegradable packaging and disposable cutlery.
Butanedioic acid is produced by two different processes.

Process 1

- Aqueous sodium hydroxide reacts with 1,4-dibromobutane to make butane-1,4-diol.
- Butane-1,4-diol is oxidised to butanedioic acid.

Process 2

- Glucose reacts with carbon dioxide in the presence of microorganisms to produce butanedioic acid directly.
- The carbon dioxide used in this process is obtained from a local factory that produces bioethanol.

(a) Deduce **one** safety reason and one environmental reason why **Process 2** is preferred to **Process 1**.

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(2)

(b) (i) Name and outline a mechanism for the following reaction that occurs in **Process 1**.

$BrCH_2CH_2CH_2CH_2Br + NaOH \longrightarrow BrCH_2CH_2CH_2CH_2OH + NaBr$

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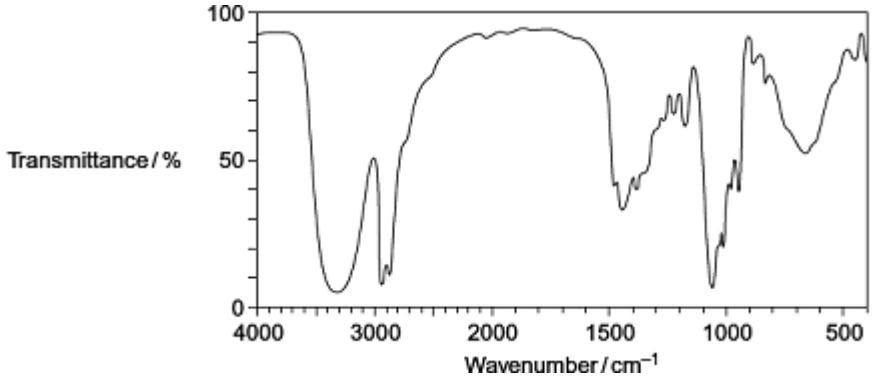
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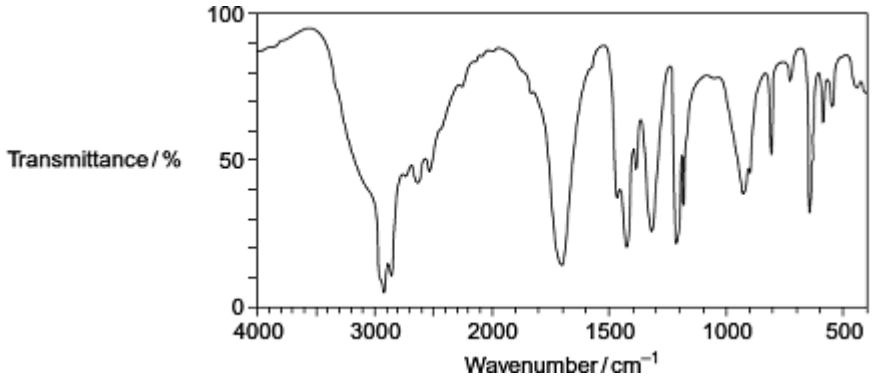
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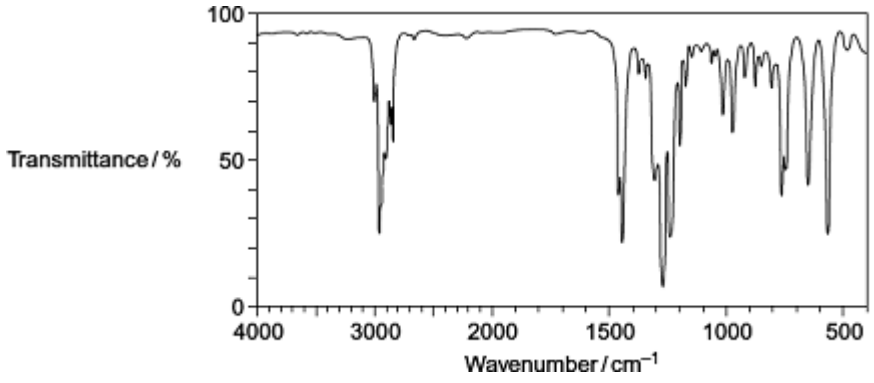
(ii) The infrared spectra shown are those of three compounds.

Compound **A** 1,4-dibromobutane
Compound **B** butane-1,4-diol
Compound **C** butanedioic acid

Identify the compound responsible for each spectrum by writing the correct letter, **A**, **B** or **C**, in the box next to each spectrum.
You may find it helpful to refer to **Table 1** on the Data Sheet.







(3)

(c) In the production of bioethanol, glucose ($C_6H_{12}O_6$) is converted into a dilute aqueous solution of ethanol and carbon dioxide.

Give the name of this process and state **three** essential conditions necessary to produce a good yield of ethanol.

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(4)

(d) State the class of alcohols to which the diol butane-1,4-diol belongs.

Identify a suitable reagent or combination of reagents for the conversion of butane-1,4-diol into butanedioic acid ($HOOCCH_2CH_2COOH$).

Write an equation for this oxidation reaction using [O] to represent the oxidising agent.

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(3)

(Total 15 marks)

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Q2.

Chloromethanes, such as dichloromethane and trichloromethane, are produced in industry as they have many uses.
Trichloromethane has been used in the manufacture of the refrigerant chlorodifluoromethane.

(a) Chlorine can react with dichloromethane (CH_2Cl_2) to form trichloromethane ($CHCl_3$).

(i) Write an equation for each of the following steps in the mechanism for this reaction.

Initiation step

_____

First propagation step

_____

Second propagation step

_____

(3)

(ii) Give **one** essential condition for this reaction and name the type of mechanism.

Essential condition _____

Type of mechanism _____

(2)

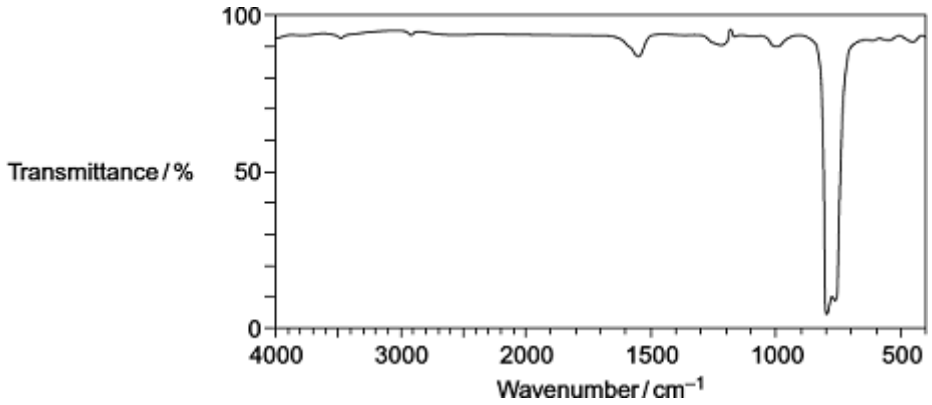
(b) An organic product, **X**, with M_r = 154.0 is obtained when chlorine reacts with trichloromethane.

(i) Write an equation for the overall reaction of chlorine with trichloromethane to form **X**, by the same mechanism as that outlined in part (a)(i).

_____

(1)

(ii) The following infrared spectrum was obtained for a sample of **X** produced in this reaction.



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Use this infrared spectrum to explain why it is possible to deduce that this sample of **X** contains no trichloromethane.
You may find it helpful to refer to **Table 1** on the Data Sheet.

(2)

(c) Explain, with the aid of equations and the intermediates that form in the ozone layer, why the European Union has banned the use of chlorodifluoromethane ($CHClF_2$) as a refrigerant.

(4)

(d) The compound 2,3,3,3-tetrafluoropropene is the refrigerant used in all new car air conditioners.

(i) Draw the displayed formula for 2,3,3,3-tetrafluoropropene.

(1)

(ii) Give **one** reason why 2,3,3,3-tetrafluoropropene is a more **environmentally** acceptable refrigerant than chlorodifluoromethane.

(1)

(Total 14 marks)

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