GCE A LEVEL CHEMISTRY

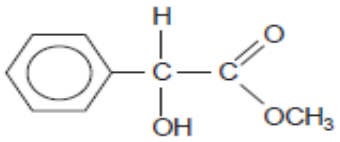
S21-A410

Assessment Resource H

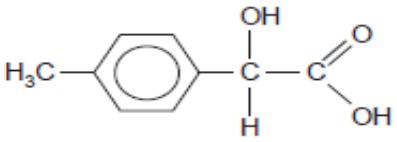
Organic Chemistry and Analysis

1. Give the structure of a compound containing four carbon atoms that will give a red precipitate with Fehling's reagent. [1]

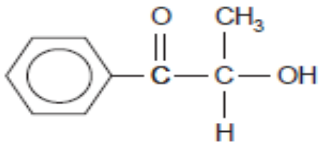
2. The formulae of three compounds are shown below.



compound **A**



compound **B**



compound **C**

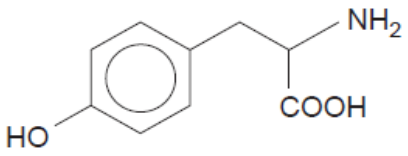
(a) State which one of the compounds can be reduced by sodium tetrahydridoborate(III). [1]

.....

(b) Complete each box in the table by giving an observation. If there is no observation, write 'no reaction'. [3]

Compound	Reagent added		
	Aqueous sodium hydrogencarbonate	Acidified potassium dichromate	Aqueous 2,4-dinitrophenylhydrazine
A			
B			
C			

3. *(a)* Tyrosine is an α-amino acid that occurs in many foods.



(i) In an aqueous solution tyrosine exists largely as the zwitterion.

Give the structure of this zwitterion. [1]

(ii) The melting temperature of tyrosine is 314 °C.

Explain how the structure of tyrosine contributes to this high melting temperature. [2]

.....

.....

.....

.....

(iii) Give the structure of **one** of the dipeptides formed between tyrosine and aminoethanoic acid. [1]

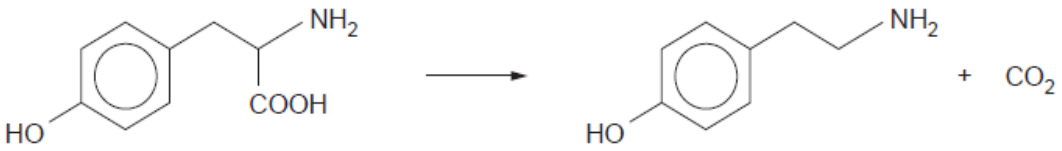
(iv) A few drops of aqueous iron(III) chloride are added to an aqueous solution of tyrosine.

State any observation made. [1]

.....

(v) In the body, tyrosine is converted by enzymes into tyramine.

One equation for this reaction is as follows.



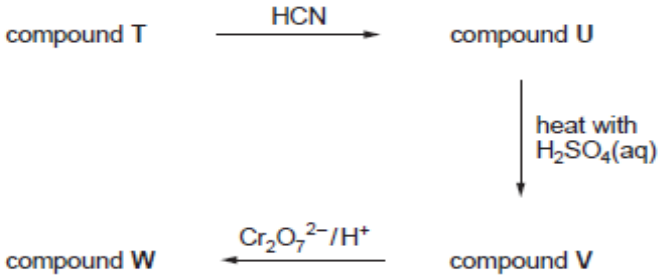
tyrosine tyramine

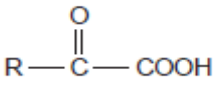
M_r 181

Calculate the atom economy of this reaction to make tyramine, giving your answer to an **appropriate** number of significant figures. [2]

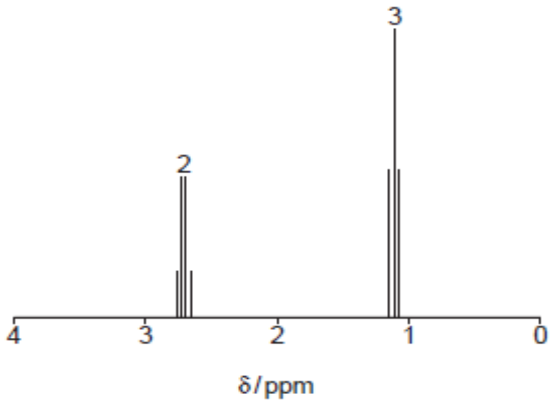
Atom economy = ... %

(b) The diagram below shows a scheme for the synthesis of compound **W**.



Compound **W** is a carboxylic acid of general formula 

Its ^{1}H NMR spectrum is shown below with the peak for the O—H group omitted.



(i) Use the NMR spectrum to deduce the formula of the R group in compound **W**. Give your reasoning.

The numbers 2 and 3 represent relative peak areas. [3]

.....

.....

.....

.....

.....

.....

(ii) Use your answer to part (i) to deduce the structures of compounds T, U and V. [3]

Compound	Structure
T	
U	
V	

4. *(a)* Phenol reacts with bromine to give 2,4,6-tribromophenol.

(i) Give the equation for this reaction. [1]

(ii) State what is seen during this reaction. [2]

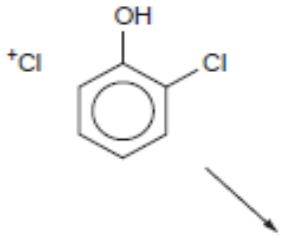
.....

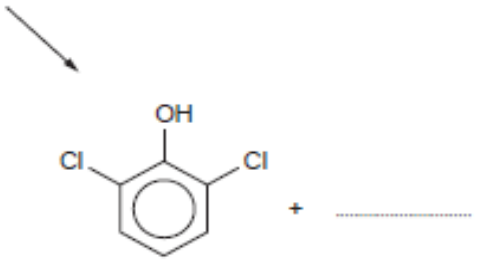
.....

(b) Under suitable conditions 2-chlorophenol can be chlorinated giving 2,6-dichlorophenol.

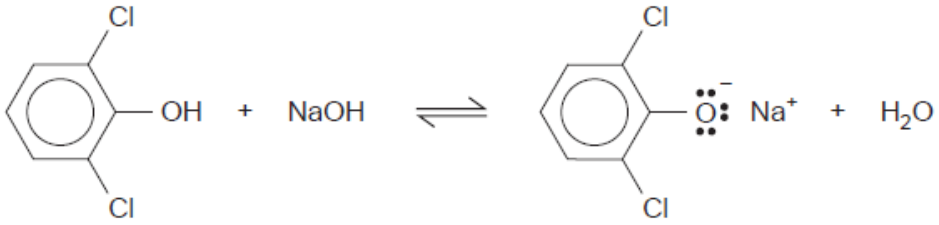
Complete the mechanism for this reaction showing appropriate charges, curly arrows, the structure of the intermediate and the other product.

For simplicity the electrophile is shown as Cl^+. [3]





(c) 2,6-Dichlorophenol is an acidic substance and will react with aqueous sodium hydroxide to give the corresponding anion, whereas ethanol does not react.



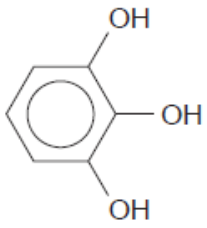
(i) Use this information to explain why 2,6-dichlorophenol is a stronger acid than ethanol. [2]

.....

.....

.....

(ii) Explain why 2,6-dichlorophenol does **not** react with aqueous sodium hydroxide to give compounds such as benzene-1,2,3-triol. [1]



.....

.....

(d) Some information about a sample of 2,6-dichlorophenol produced by the chlorination of 2-chlorophenol is given below.

Calculated percentage of chlorine in 2,6-dichlorophenol	43.6 %
Percentage of chlorine in the sample of 2,6-dichlorophenol	43.7 %
Melting temperature of 2,6-dichlorophenol	65 °C
Melting temperature of the sample of 2,6-dichlorophenol	53-55 °C

The melting temperature of the sample of 2,6-dichlorophenol indicates that the sample is impure.

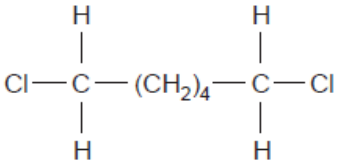
Suggest **two** reasons why the percentage of chlorine is however, close to the calculated value. [2]

.....

.....

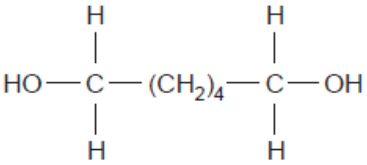
.....

(e) The flow chart shows a route for the preparation of a polyester.



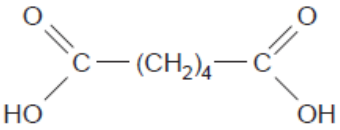
1,6-dichlorohexane

stage **1**



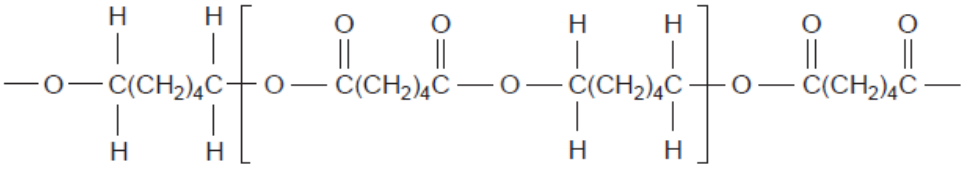
hexane-1,6-diol

stage **2**



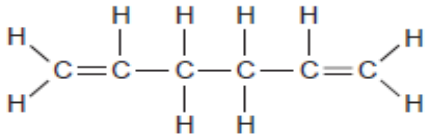
hexane-1,6-dioic acid

stage **3**



(i) The starting point for the preparation of the polyester is 1,6-dichlorohexane.

David said that this could be prepared by reacting hexa-1,5-diene with hydrogen chloride.



hexa-1,5-diene

Explain why the yield of 1,6-dichlorohexane is small if this method is used. [2]

.....

.....

.....

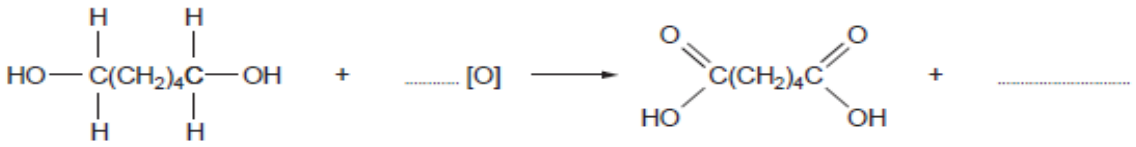
.....

(ii) State a reagent that will react with 1,6-dichlorohexane to give hexane-1,6-diol in stage **1**. [1]

.....

(iii) Stage **2** is an oxidation reaction.

Using [O] to represent the formula of the oxidising agent, complete the equation below. [2]

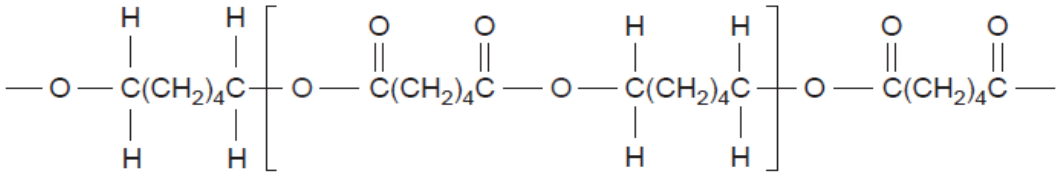


(iv) In stage **3**, hexane-1,6-diol reacts with hexane-1,6-dioic acid to give the polyester.

I. State why this is a condensation reaction. [1]

.....

II. Draw a ring around the part of the polymer structure that is an ester linkage. [1]



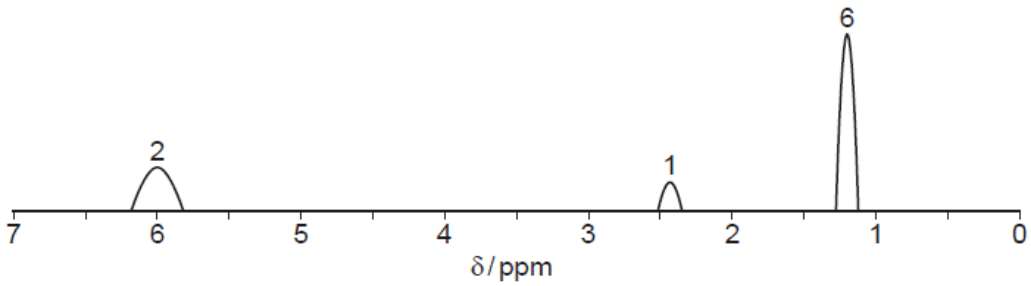
(v) If a polyamide were to be made instead of a polyester, 1,6-dichlorohexane would need to be converted to 1,6-diaminohexane.

State a reagent that would react with 1,6-dichlorohexane to give this diamine. [1]

.....

(f) The low resolution ^{1}H NMR spectrum of an aliphatic amide, R—C(=O)—NH_2 is shown below.

The numbers indicate the relative peak areas for the protons.



The signal at 6 ppm is given by the $-NH_2$ protons.

Use the spectrum and the **Data Booklet** to deduce a structure for this amide. Give your reasoning. [3]

.....

.....

.....

.....

.....

Structure