

3

June 2011

8

- 3 Mandelic acid (2-phenyl-2-hydroxyethanoic acid), $\text{C}_6\text{H}_5\text{CH}(\text{OH})\text{COOH}$, is used in some skin creams and can be converted into a condensation polymer.

The addition polymer of ethyl methacrylate (ethyl 2-methyl-2-propenoate), $\text{CH}_2\text{C}(\text{CH}_3)\text{COOC}_2\text{H}_5$, is used to make some artificial fingernails.

- (a) Explain what is meant by the term *condensation polymerisation*.



Your answer should use appropriate technical terms, spelled correctly.

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.....

..... [1]

- (b) Draw **two** repeat units of a polymer that is formed when,

(i) mandelic acid, $\text{C}_6\text{H}_5\text{CH}(\text{OH})\text{COOH}$, polymerises

[2]

(ii) ethyl methacrylate, $\text{CH}_2\text{C}(\text{CH}_3)\text{COOC}_2\text{H}_5$, polymerises.

[1]

137

- (c) When ethyl methacrylate, $\text{CH}_2\text{C}(\text{CH}_3)\text{COOC}_2\text{H}_5$, is heated under reflux with aqueous dilute acid, a hydrolysis reaction takes place forming compound **C** and ethanol.

When compound **C** is heated with steam in the presence of an acid catalyst, an addition reaction takes place forming two organic products **D** and **E**.

Compounds **D** and **E** are structural isomers with the molecular formula $\text{C}_4\text{H}_8\text{O}_3$.

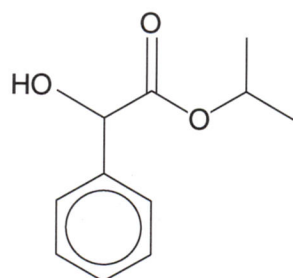
Draw the structures of compounds **C**, **D** and **E**.

compound C
compound D
compound E

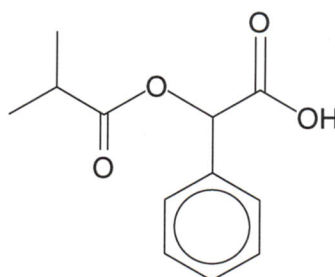
[3]

TURN OVER FOR PART (d)

- (d) Mandelic acid has anti-bacterial properties and is used in some skin creams. A cosmetic chemist used mandelic acid to prepare two different esters that might be suitable for new skin creams. The structures of the two esters are shown below.



ester 1



ester 2

- (i) Draw the structure of an organic compound that could react with mandelic acid, $\text{C}_6\text{H}_5\text{CH}(\text{OH})\text{COOH}$, to produce **ester 1**.

[1]

- (ii) Identify an organic compound that could react with mandelic acid to produce **ester 2**.

[1]

- (iii) **Ester 1** is less soluble in water than mandelic acid, $\text{C}_6\text{H}_5\text{CH}(\text{OH})\text{COOH}$.

Explain the difference in water solubility of mandelic acid and **ester 1**.

You may use a labelled diagram in your answer.

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..... [3]

- (iv) Before any skin cream can be sold to the public, it must be tested to ensure it is safe to use.

Suggest why.

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..... [1]

[Total: 13]

Your answer should include reagents, equations and observations, if any.

[5]

[Total: 5]

5

- 2 Hydroxyethanal, HOCH_2CHO , is sometimes referred to as the 'first sugar' as it is the simplest possible molecule that contains both an aldehyde group and an alcohol group.

A biochemist investigated some redox reactions of hydroxyethanal and found that several different products were produced.

- (a) The biochemist reacted hydroxyethanal with Tollens' reagent.

- (i) State what the biochemist would see when hydroxyethanal reacts with Tollens' reagent.

..... [1]

- (ii) Write the structural formula of the organic product formed when hydroxyethanal reacts with Tollens' reagent.

[1]

- (b) The biochemist also reacted hydroxyethanal with acidified dichromate by heating under reflux.

Write an equation for this oxidation.

Use [O] to represent the oxidising agent.

[2]

- (c) The biochemist then reduced hydroxyethanal using aqueous NaBH_4 .

- (i) Write the structural formula of the organic product.

..... [1]

- (ii) Outline the mechanism for this reduction.

Use curly arrows and show any relevant dipoles.

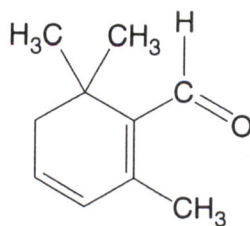
[4]

[Total: 9]
Turn over

3

Jan 2011

- 3 Safranal, shown below, is an aldehyde which contributes to the aroma of saffron.



safranal

An undergraduate chemist investigated some reactions of safranal.

- (a) She prepared a solution of Tollens' reagent and added a few drops of safranal. She then warmed the mixture for about 5 minutes in a water bath.

Describe what you would expect the chemist to see.

State the type of reaction that the safranal undergoes.

Draw the structure of the organic product formed in this reaction.

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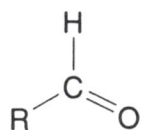
[3]



- (b) The chemist then reduced safranal using an aqueous solution of NaBH_4 .

Outline the mechanism for this reaction.

Use curly arrows and show any relevant dipoles.



can be used to represent safranal.

[4]

- (c) Suggest one reaction of safranal that does **not** involve the aldehyde group.

State the reagent, observation (if any) and draw the organic product.

reagent

observation

organic product

[3]

[Total: 10]