

Name: \_\_\_\_\_

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**CfE Higher Chemistry  
Unit Two - Nature's Chemistry  
Homework Booklet**

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For multiple choice questions circle your answer.

Reference may be made to the Chemistry Higher and Advanced Higher Data Booklet.

## 1) Esters, Fats and Oils

1. An ester has the following structural formula



The name of this ester is

- A propyl propanoate
- B ethyl butanoate
- C butyl ethanoate
- D ethyl propanoate.

[Q10. R2013]

2. Esters are formed by the reaction between which two functional groups?

- A A hydroxyl group and a carboxyl group
- B A hydroxyl group and a carbonyl group
- C A hydroxide group and a carboxyl group
- D A hydroxide group and a carbonyl group.

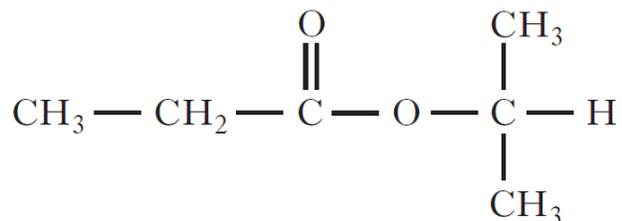
[Q11. R2013]

3. Which of the following consumer products is least likely to contain esters?

- A Solvents
- B Perfumes
- C Toothpastes
- D Flavourings.

[Q12.R2012]

4. An ester has the structural formula:



On hydrolysis, the ester would produce

- A ethanoic acid and propan-1-ol
- B ethanoic acid and propan-2-ol
- C propanoic acid and propan-1-ol
- D propanoic acid and propan-2-ol.

[Q10.RSQP]

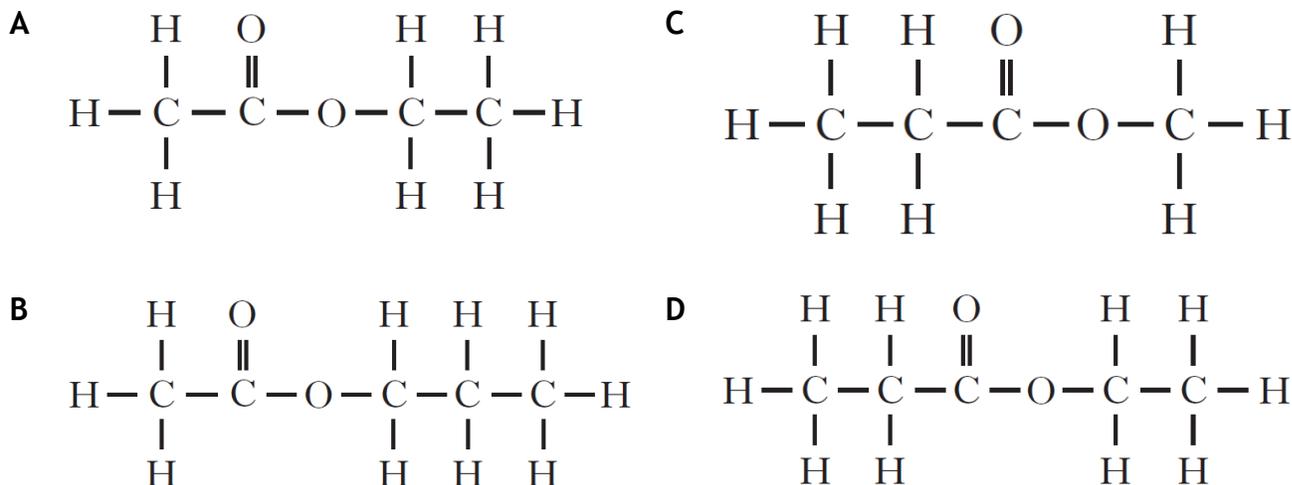
5. Fats have higher melting points than oils because comparing fats and oils

- A fats have more hydrogen bonds
- B fat molecules are more saturated
- C fat molecules are more loosely packed
- D fats have more cross-links between molecules.

[Q13. R2012]

6. Hydrolysis of an ester gave an alcohol and a carboxylic acid both of which had the same molecular mass of 60.

The structure of the ester was



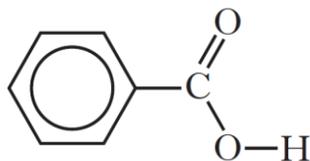
[Q11. R2012]

7. Oils are generally

- A solid at room temperature and contain a high proportion of unsaturated molecules
- B solid at room temperature and contain a high proportion of saturated molecules
- C liquid at room temperature and contain a high proportion of unsaturated molecules
- D liquid at room temperature and contain a high proportion of saturated molecules.

[Q12. R2013]

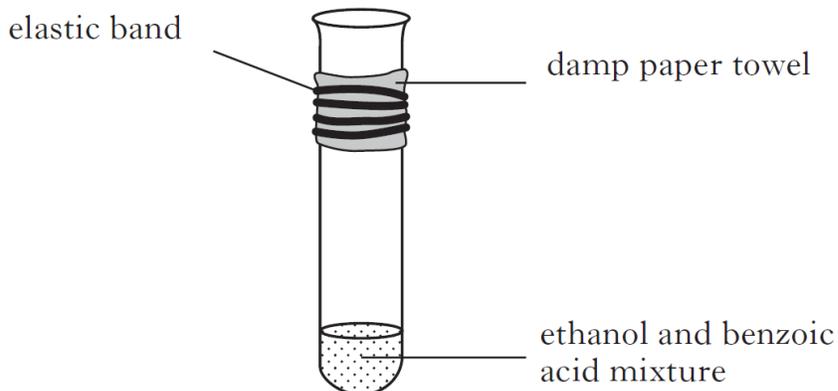
8. Benzoic acid,  $C_6H_5COOH$ , is an important feedstock in the manufacture of chemicals used in the food industry.



benzoic acid

The ester ethyl benzoate is used as food flavouring.

Ethyl benzoate can be prepared in the laboratory by an esterification reaction. A mixture of ethanol and benzoic acid is heated, with a few drops of concentrated sulfuric acid added to catalyse the reaction.



- (a) Suggest a suitable method for heating the reaction mixture.

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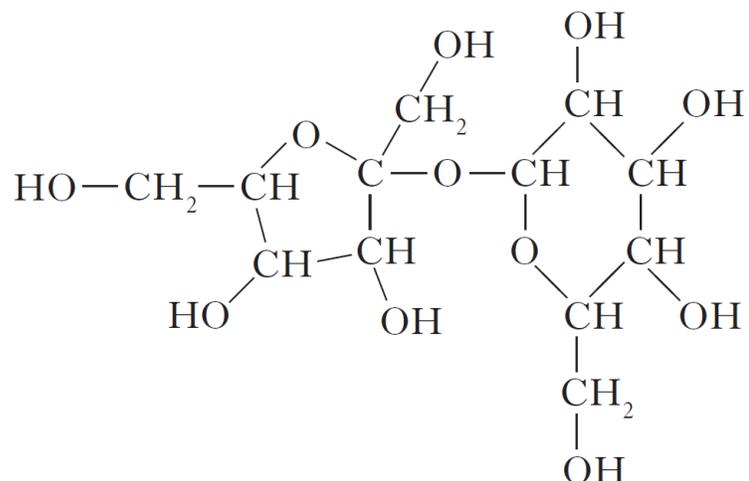
- (b) During esterification the reactant molecules join by eliminating a small molecule. What name is given to this type of chemical reaction?

1

- (c) Draw a structural formula for ethyl benzoate.

1

10. A calorie-free replacement for fat can be made by reacting fatty acids with the hydroxyl groups on a molecule of sucrose. A structural formula for sucrose is shown.



How many fatty acid molecules can react with one molecule of sucrose?

1  
[1b.R2013]

## 2) Proteins

1. Which type of bond is broken when a protein is denatured?

- A Ionic
- B Polar covalent
- C Hydrogen
- D Non-polar covalent.

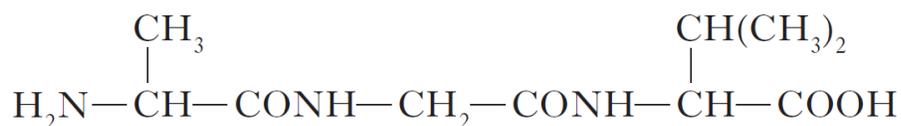
[Q13. R2014]

2. When a protein is denatured

- A its overall shape is distorted
- B its amide links are hydrolysed
- C it is broken into separate peptide fragments
- D it decomposes into amino acids.

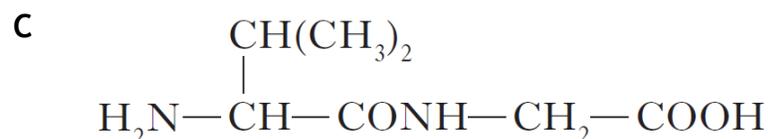
[Q13. R2013]

3. A tripeptide X has the structure



Partial hydrolysis of X yields a mixture of dipeptides.

Which of the following dipeptides could be produced on hydrolysing X?



[Q13.R2013]

4. The arrangement of amino acids in a peptide is



where the letters V, W, X, Y and Z represent amino acids.

On partial hydrolysis of the peptide, which of the following sets of dipeptides is possible?

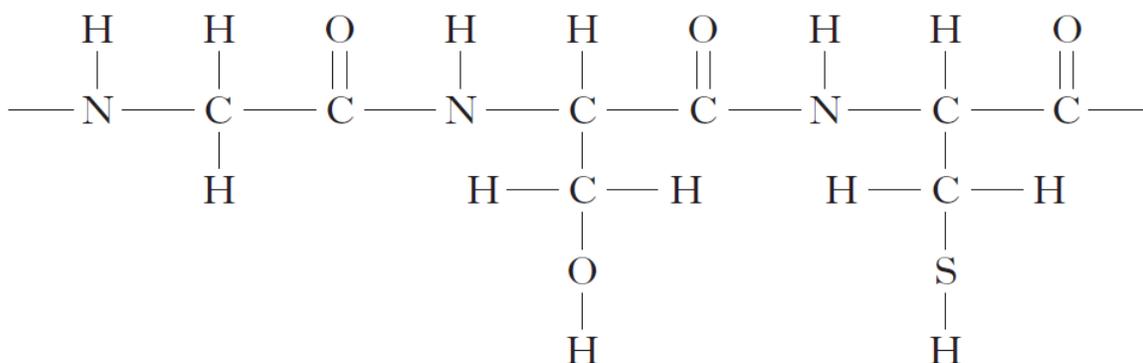
- A V-Y, Z-X, W-Y, X-W
- B Z-X, V-Y, W-V, X-W
- C Z-X, X-V, W-V, V-Y
- D X-W, X-Z, Z-W, Y-V

[Q15. R2012]

5. Proteins are made from monomers called amino acids.

Human hair is composed of long strands of a protein called keratin.

Part of the structure of a keratin molecule is shown.



- (a) Circle a peptide link in the structure.
- (b) Draw a structural formula for the three amino acids formed when this section of protein is hydrolysed.

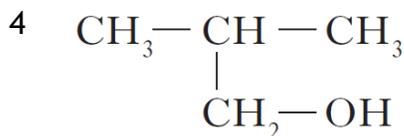
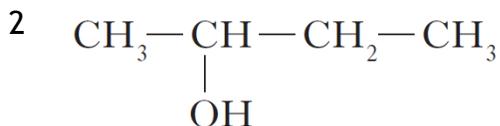
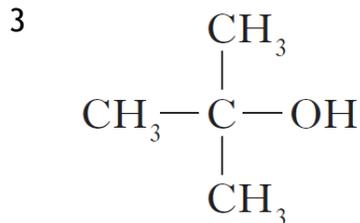
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[Q7a.2014]  
[Q8bii.RSQP\*]

### 3) Oxidation of Food

1. Which two isomers would each produce an acid when warmed with acidified potassium dichromate solution?



- A 1 and 2  
B 2 and 3  
C 1 and 4  
D 3 and 4.

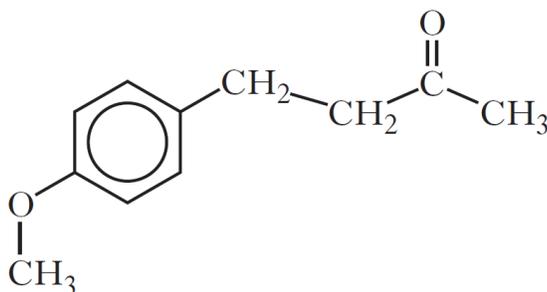
[Q16. R2013]

2. Which process is used to convert ethanal to ethanoic acid?

- A Hydrogenation  
B Condensation  
C Hydration  
D Oxidation.

[Q17. RSQP]

3. A compound with the following structure is used in perfumes to help provide a sweet, fruity fragrance.



This compound could be classified as

- A an aldehyde  
B a carboxylic acid  
C an ester  
D a ketone.

[Q15. R2014]

4. Which of the following organic compounds is an isomer of hexanal?

- A 2-Methylbutanal
- B 3-Methylpentan-2-one
- C 2,2-Dimethylbutan-1-ol
- D 3-Ethylpentanal.

[Q17. R2013]

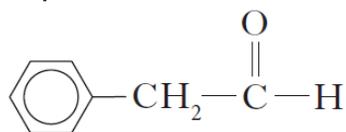
5. Cooking involves many chemical reactions. Proteins, fats, oils and esters are some examples of compounds found in food. A chemist suggested that cooking food could change compounds from being fat-soluble to water-soluble.

**Use your knowledge of chemistry** to comment on the accuracy of this statement.

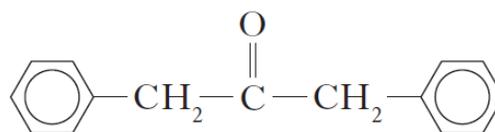
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[Q12.R2013]

6. Chocolate contains various compounds. Many of the flavour and aroma molecules found in chocolate are aldehydes and ketones. Two examples are shown below.



phenylethanal



1,3-diphenylpropan-2-one

Phenylethanal can be easily oxidised but 1,3-diphenylpropan-2-one cannot.

- (a) Name a chemical that could be used to distinguish between these two compounds.

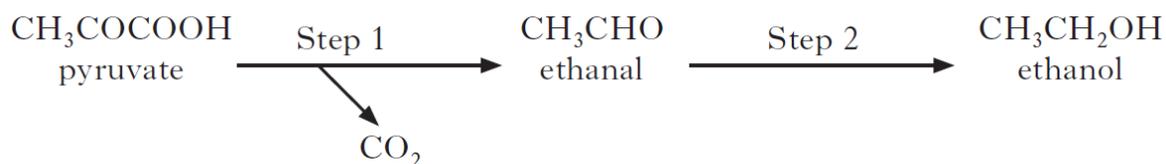
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- (b) Name the type of organic compound formed when phenylethanal is oxidised.

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[Q4ab.R2013]

7. In some countries, ethanol is used as a substitute for petrol. This ethanol is produced by fermentation of glucose, using yeast enzymes. During the fermentation process, glucose is first converted into pyruvate. The pyruvate is then converted to ethanol in a two-step process.



- (a) Step 1 is catalysed by an enzyme. Enzymes are proteins that can act as catalysts because they have a specific shape. Why, when the temperature is raised above a certain value, does the rate of reaction decrease?

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- (b) Why can Step 2 be described as a reduction reaction?

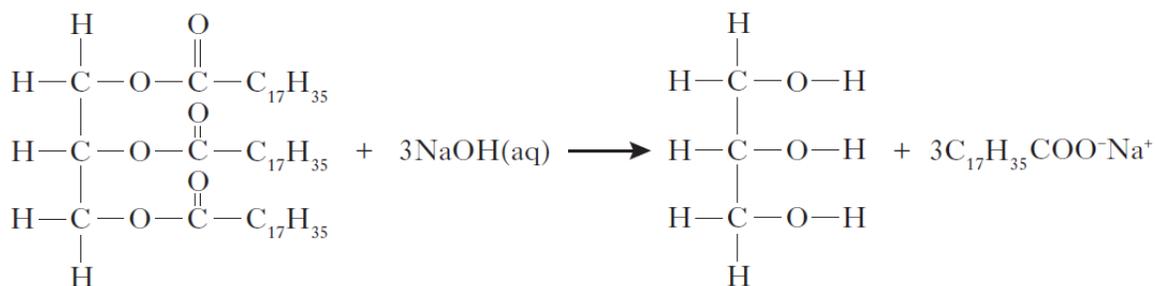
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(2)

[Q2a.R2014]



3. Soaps are produced by the following reaction.



This reaction is an example of

- A condensation
- B esterification
- C hydrolysis
- D oxidation.

[Q18. R2013]

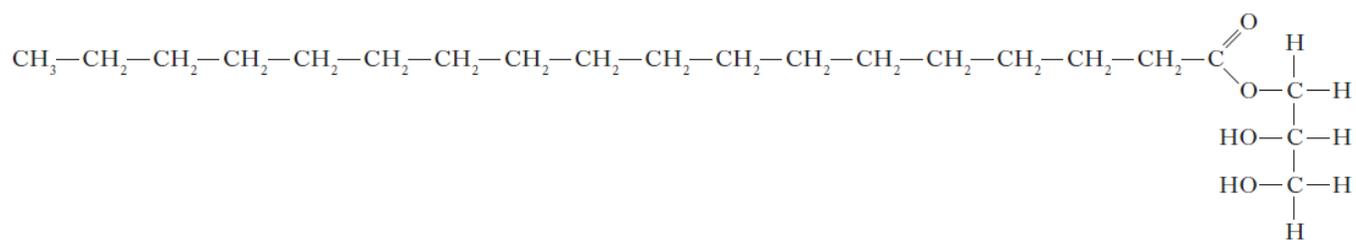
4. Which of the following diagrams and explanations best describes a step in the cleansing action of soap?

	Diagram	Explanation
A		<p>Hydrophobic head dissolves in water.</p> <p>Hydrophilic tail dissolves in oil droplet.</p>
B		<p>Hydrophilic head dissolves in water.</p> <p>Hydrophobic tail dissolves in oil droplet.</p>
C		<p>Hydrophobic head dissolves in oil droplet.</p> <p>Hydrophilic tail dissolves in water.</p>
D		<p>Hydrophilic head dissolves in oil droplet.</p> <p>Hydrophobic tail dissolves in water.</p>

[Q16. R2014]



6. Glycerol monostearate is an emulsifier used in chocolate.



(a) Why is glycerol monostearate added to chocolate?

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(b) Draw a structural formula for glycerol.

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[Q4b.R2013]

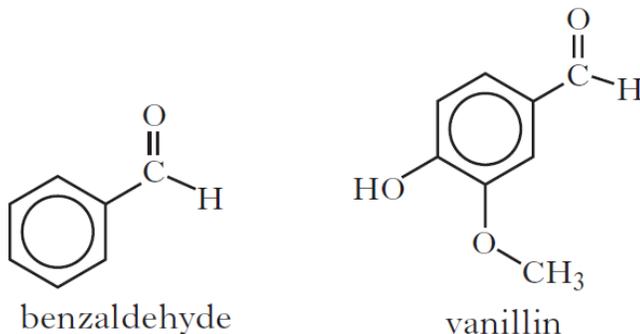
## 5) Fragrances and Skin Care

1. Which of the following could **not** be a possible source of a fatty acid?

- A Soaps
- B Edible oils
- C Emulsifiers
- D Essential oils.

[Q18. RSQP]

2. Benzaldehyde and vanillin are examples of flavour molecules.



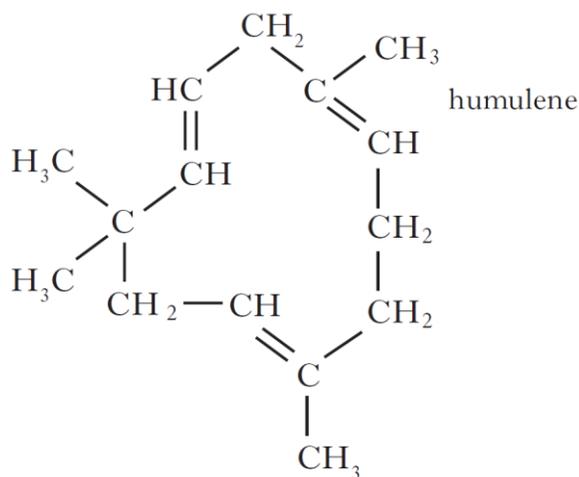
Vanillin is soluble in water and is fairly volatile.

Which line in the table correctly compares benzaldehyde to vanillin?

	<b>Solubility in water</b>	<b>Relative volatility</b>
A	greater than vanillin	greater than vanillin
B	greater than vanillin	less than vanillin
C	less than vanillin	less than vanillin
D	less than vanillin	greater than vanillin

[Q14. R2014]

3. Humulene is a terpene which contributes to the aroma of beer.

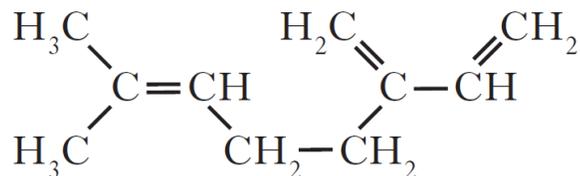


How many isoprene units were used to form a humulene molecule?

- A 2
- B 3
- C 4
- D 5

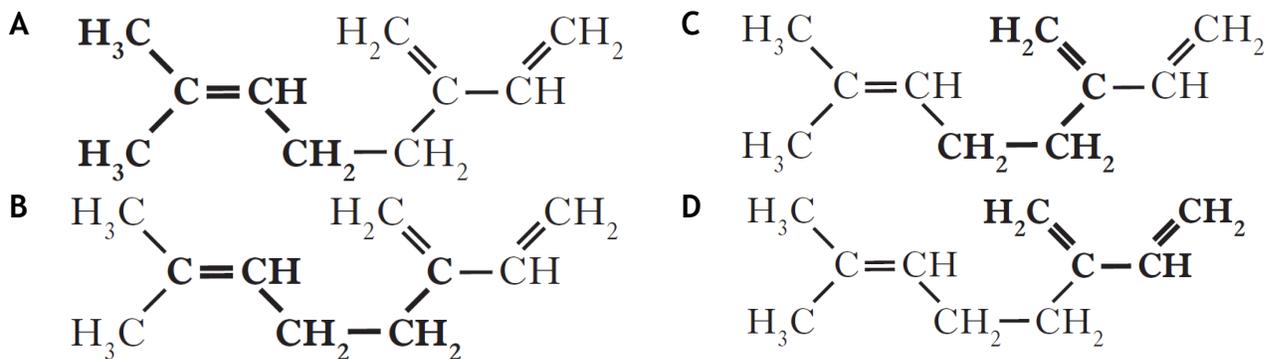
[Q18. R2014]

4. Myrcene is a simple terpene.



Terpenes contain at least one isoprene unit.

Which of the following shows a correctly highlighted isoprene unit?



[Q19. R2012]



6. Fluorine reacts with methane via a free radical chain reaction. Some steps in the chain reaction are shown in the table below.

Reaction step	Name of step
$F_2 \rightarrow 2F\cdot$	
$F\cdot + CH_4 \rightarrow HF + \cdot CH_3$ $\cdot CH_3 + F_2 \rightarrow CH_3F + F\cdot$	propagation
$\cdot CH_3 + F\cdot \rightarrow CH_3F$	termination
	termination

Complete the table by:

- (a) inserting the missing name for the first step;

1

- (b) showing another possible termination reaction in the final row of the table.

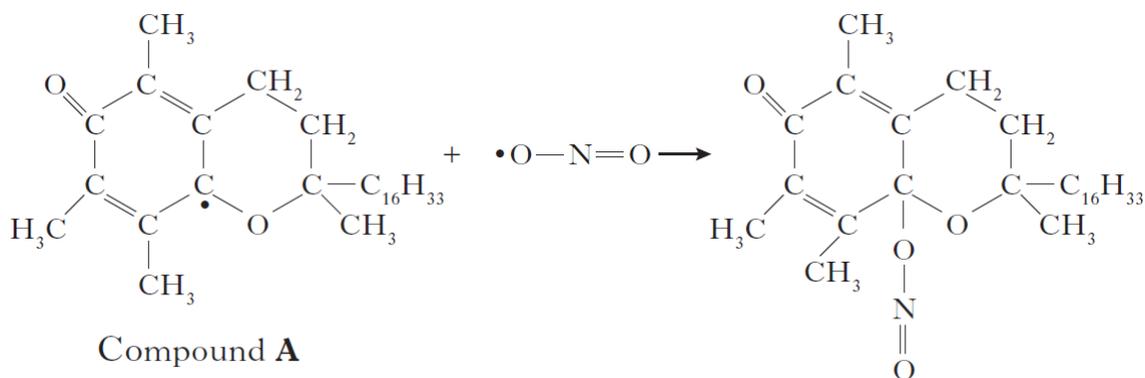
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(2)

[Q13b.R2012]

8. Suncreams contain antioxidants.

The antioxidant, compound A, can prevent damage to skin by reacting with free radicals such as  $NO_2\cdot$ .



Why can compound A be described as a free radical scavenger in the reaction shown above?

1

[Q2a.R2013]